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ABSTRACTS

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Talk abstracts

Examining the Effects of Historic Precipitation Patterns on Current Songbird Abundance

Abernathy, Heather - The University of Georgia; Jeff Hepinstall-Cymerman - The University of Georgia; John Maerz - The University of Georgia

In the last 30 years the southeastern US has undergone precipitation variability changes with an increase in extreme precipitation events and an increased instance of droughts. Understanding the impact of drought on caterpillars and their predators, insectivorous songbirds, can inform local population dynamics and help explain recent declines in wood warbler populations in the southeast. Thus, our objective was to measure breeding songbird occupancy and abundance as well as their food resources across a historic precipitation gradient to quantify songbird responses. To quantify songbird community and habitat quality, songbird and caterpillar surveys were conducted in select watersheds in relation to a 30-year historic precipitation gradient across the Coweeta Basin in Macon County, North Carolina. Caterpillar biomass exhibited a strong response to slope aspect and a marginal response to historically drier conditions. Three insectivore songbirds exhibited significant patterns across the basin. Hooded Warblers (*Setophaga citrina*) exhibited a strong relationship with caterpillars and slope aspect but two other cold-adapted songbird species, Canada Warblers (*Cardellina Canadensis*) and Black-throated Blue Warblers (*Setophaga caerulescens*), exhibited a strong relationship with elevation and slope-aspect but no response to caterpillar biomass. Slope-aspect seems to be the main driver of caterpillar biomass followed secondly by historic precipitation patterns. Thus, if drought becomes more common songbird management should focus on moister slope aspects in historically drier areas of intact forest. The two cold-adapted species' strong correlation with elevation suggests these species distributions in lower latitudes in the eastern United States may be over-estimated.

Coevolution in Action: Defenses Against Brood Parasitism in a New Host of the Eastern Koel

Abernathy, Virginia - Australian National University; Laura Johnson - Australian National University; Naomi Langmore - Australian National University

Measuring the rate at which coevolution takes place between an avian brood parasite and its host is difficult, as parasites rarely switch to completely naïve hosts. In Australia, the brood parasitic Eastern Koel (*Eudynamis scolopaceus*) recently switched to a new host, the Red Wattlebird (*Anthochaera carunculata*), providing a rare opportunity to observe coevolution in action. We compared the evolution of defenses in the new host with those of two traditional hosts at two sites with different durations of parasitism by the koel: Sydney (~38 years) and Canberra (~8 years). Specifically, we tested 1) which hosts have evolved egg rejection, and 2) whether wattlebirds have learned to recognize koels as a nest threat. Model egg experiments showed that the traditional hosts have maintained egg rejection, while the wattlebird has not evolved rejection at either site. In contrast, wattlebird pairs in Sydney responded more aggressively to taxidermic koel mounts than wattlebirds in Canberra. Wattlebirds in Sydney also responded more aggressively to koel mounts than to control mounts (a harmless parrot), while Canberra wattlebirds were equally aggressive to all mounts. This indicates that, while 38 years of parasitism is insufficient time for egg rejection to evolve in wattlebirds, learning to recognize and attack a brood parasite near the nest can occur well within this time frame. This is one

of the few empirical studies on the rate of coevolution in avian brood parasitism, providing important information on how quickly hosts can adapt, which can be used in conservation and speciation.

Differences Between First and Second Broods of Tree Swallows in Tennessee
Aborn, David - University of Tennessee at Chattanooga

Tree Swallows (*Tachycineta bicolor*) can be found breeding from the mid-South region of the United States up to Alaska. Despite being a well studied species, much of what we know comes from populations in the northeastern part of North America; we know relatively little about their biology in other parts of their range. Given their wide range, Tree Swallows make good subjects for studying how environmental variation affects different aspects of their reproduction, such as timing, clutch size, and reproductive success. Another parameter that might differ based on location is double brooding; the laying of a second clutch following the successful fledging of chicks from the first clutch. I measured differences between single-brooded swallows, first broods of double-brooded swallows, and second broods of double-brooded swallows in southeastern Tennessee. About 40% of swallows double-brooded. While there were no differences between first broods and single-brooded nests, second broods tended to lay 1 less egg and fledge 1 less young. First broods and single broods also tended to have higher hatching success, whereas second broods tended to have higher fledging success. Reduced food availability may explain the smaller clutch size of second broods, however, with fewer young to feed, each chick may get more food, resulting in higher fledging success.

Analysis of temporal range change in a neotropical passerine migrant using stable hydrogen isotopes
Abraham, Elizabeth - USGS; Colleen McLean - Youngstown State University; Luke DeGroote - Powdermill Nature Reserve - Carnegie Museum of Natural History

Avian feathers contain an intrinsic hydrogen isotope signature that indicates the latitude where the feather was grown. Temporal changes in range can be discerned when breeding latitudes, determined by analyzing stable hydrogen, are compared between distinct time periods. This technique proves especially useful for neotropical migrants which are vulnerable to habitat loss and climate change throughout various portions of the avian life cycle. During fall migration in 2014, prebasic tail feathers were collected from magnolia warblers to determine current breeding latitudes. Prebasic body feathers were collected from study skins of the same species to determine breeding latitudes from 1895-1985. Feather samples were analyzed at the Stable Isotope Lab at Cornell University and the resulting isotope data was manipulated using spatial analyst operations in GIS to model tolerance limits based on an interpolation of stable hydrogen in precipitation. Comparison models of older feathers and current feathers were created and suggest the area of occupancy has shifted through time, though the reasons for change vary. Between urbanization and land conversion for agriculture, the magnolia warbler may be experiencing varying levels of habitat loss along its southern breeding boundary. Changes seen along northern boundaries are likely northern colonization in response to climate warming. Nevertheless, the application of stable hydrogen to analyze temporal range change was successful and should continue to be used as a method for detecting range change in threatened or endangered neotropical avian migrants. If a species is identified as shifting over time, natural resource managers could adapt management plans accordingly.

Repertoire size and plasticity in Red-eyed Vireo songs

Acheson, Nicholas - McGill University

Red-eyed Vireos (*Vireo olivaceous*) are common and widespread summer residents in eastern, central, and northwestern North America. Male Red-eyed Vireos sing short (0.2-0.8 sec) phrases containing 1 to 6 separate elements, 30-60 times per minute throughout the day during their breeding season. A previous study (DJ Borror, Condor 83, 1981, 217-228) reported that singing males in a variety of locations in the USA had large and distinct phrase repertoires, with an average of 39 phrases per individual. However, little is known about the conservation or plasticity of their repertoires over time. I recorded songs of Red-eyed Vireos in and nearby a 23-hectare urban woodland located on a hilltop 2 ½ km from downtown Montreal, Quebec, Canada. Records of some 5000 phrases sung by 18 individuals over three breeding seasons were analyzed, revealing over 700 phrase types, for an average of 39 phrase types per individual (lowest 18, highest 82). Most phrase types are unique; only a few phrase types are shared among different birds. Unusual phrases similar to calls of Eastern Wood-Pewee, Eastern Phoebe, Great Crested Flycatcher, Olive-sided Flycatcher, Least Flycatcher, Red-winged Blackbird, and Ring-billed Gull were detected in 8 of the 18 individuals analyzed. Mimicry is therefore very frequent in this population. Individual vireos recorded on different days can be identified based on characteristic phrase types sung. I found that Red-eyed Vireos introduce new phrases and discard other phrases over time intervals of from days or weeks up to a year, demonstrating substantial plasticity in their repertoires.

Anthropogenic hazards in urban landscapes reduce juvenile songbird survival after independence from parental care

Adalsteinsson, Solny - University of Delaware; Jeffrey Buler - University of Delaware; Jacob Bowman - University of Delaware; Vincent D'Amico - USDA Forest Service; Zachary Ladin - University of Delaware; W. Gregory Shriver - The University of Delaware

The post-fledging stage for migratory passerines is a poorly understood component of annual productivity that potentially limits population growth. Urbanization may increase mortality risk during the post-fledging stage by altering habitat quality or imposing novel hazards. We studied two migratory passerines with differential population responses to urbanization: Gray Catbird (*Dumetella carolinensis*, synanthropic) and Wood Thrush (*Hylocichla mustelina*, urban-avoider). Our goals were to: 1. Estimate and compare post-fledging survival rates for urban bird populations, and 2. Determine which features of the urban landscape impact mortality risk during the post-fledging stage. From 2012–2014, we tracked 127 fledglings. As a synanthropic species, we expected that fledgling catbirds would survive better than wood thrushes; however, cumulative survival of catbirds over 55 days was approximately half that of wood thrushes: 0.32 (95% CI: 0.22–0.47) and 0.63 (0.52–0.75), respectively. The majority of mortality for both species was due to predation, but after reaching independence from parental care, 6 birds died of "anthropogenic causes" (e.g. building, car strikes). Our results showed that crossing roads significantly increased mortality risk, but that increasing daily movement distance decreased mortality risk. Survival rates during the post-fledging stage, taken in isolation, did not explain differential trajectories of catbird and wood thrush populations in urban environments. Our data raise the question of whether anthropogenic sources of mortality are

compensatory or additive to natural mortality and emphasize the need to monitor fledgling survival beyond the parental-dependence stage in order to understand the impacts of anthropogenic hazards on juvenile birds.

Predicting and describing gradients of forest breeding birds: linking ordination space to environmental gradients
Adams, Bryce – The Ohio State University; Kaley Donovan - The Ohio State University; Stephen Matthews - The Ohio State University

Landscapes are complex and continuous with respect to the occurrence of species and communities that vary across environmental gradients. A better understanding of the interdependence of species to community change over broad areas is essential to developing sound conservation strategies. We examined the feasibility of linking ordination with predictive modeling to map compositional gradients of forest breeding birds across Southeast Ohio. Our objective was to produce a map of compositional change, i.e., a beta diversity map, to forest managers. We decomposed bird count data onto three non-metric multidimensional scaling (NMS) axes to depict compositional gradients in communities, and then linked axis site scores to remote-sensing variables with random forests to predict community composition across the region. The first NMS axis was related to forest structural variables (40% of explained variation), the second NMS axis was related to topography (15% of variation), and the third NMS axis was related to landscape-scale composition and configuration of early-successional woody cover (3% of variation). Lastly, we identified diagnostic species along the community gradients as their habitat-specificity related to discrete units of habitat determined from a multivariate regression tree. These discrete habitats were then mapped onto the landscape to explore relative amounts of species-specific habitat types and show areas with rare or underrepresented combinations of environmental conditions where specialist species may reside. Our maps produced spatially-explicit estimates of community composition across our landscape and identified potential drivers of community change to help inform sound landscape-scale conservation efforts.

Distribution and Abundance of Breeding Marsh Birds of the Gulf of Mexico
Adams, Evan - Biodiversity Research Institute; Mark Woodrey - Mississippi State University; Scott Rush - Mississippi State University; Jared Feura - Mississippi State University; Robert Cooper - University of Georgia

Despite the recent development of a North American standardized protocol for monitoring breeding marsh birds and a national repository for the survey data, tidal marsh bird distribution and abundance along the Gulf of Mexico are still poorly understood. Many projects have employed marsh bird surveys over the last 15 years for a variety of purposes ranging from conservation land inventory to ecological research, but the use of a standardized protocol make it possible to aggregate data to quantify marsh bird densities and distributions across a larger study area. The purpose of this project was to compile marsh bird survey data to determine the: (1) temporal and spatial extent of survey effort, (2) distribution and abundance of marsh birds in the region, and (3) species-habitat relationships and interspecific interactions. We applied a Bayesian modeling framework with an N-mixture model to predict abundance across multiple species. Despite patchy effort with little temporal consistency, we found that the abundance of marsh bird species were associated with fairly specific habitats and salinity levels of nearby watercourses. For example, Clapper Rails (*Rallus crepitans*) were highly associated with highly saline, emergent marsh. Interspecies relationships were complex and species with similar habitat requirements were often found to have negative relationships. These results

could be useful for determining what unsurveyed areas have the largest potential marsh bird populations and what areas are of highest conservation value for these species.

Using genomics to characterize differentiation and hybridization in the Northern Flicker

Aguillon, Stepfanie - Cornell University; Irby Lovette - Cornell University; Richard Harrison - Cornell University

Hybridization in natural systems presents an opportunity to study the ecological and genetic contexts for speciation, as well as to define species boundaries. The hybrid zone between the red-shafted and yellow-shafted subspecies of the Northern Flicker (*Colaptes auratus*) has been historically well characterized by ornithologists, as the subspecies come into contact in a wide region of North America and hybrids can be easily identified using six distinct plumage characteristics. This system presents an interesting and tractable opportunity to study a well-known avian hybrid zone using modern genomic techniques. Here, we use a reduced-representation genomic sequencing approach (ddRADseq) to characterize genomic differentiation between the two subspecies and the closely related Gilded Flicker (*Colaptes chrysoides*). We sequenced 25 red-shafted and 21 yellow-shafted individuals from populations across the geographic range and 4 Gilded Flickers for comparison. We show that even with genomic resolution, genetic differentiation between the three taxa is difficult. Few markers are useful for differentiation, which suggests an important role for frequent ongoing hybridization and/or incomplete lineage sorting in the evolutionary history of these taxa. Overall, the results from this pilot dataset suggest the need for whole genome sequencing of many individuals across the hybrid zone, as this may allow for the identification of small genomic regions that are important in local adaptation and species' phenotypic differences.

Death of a Meadowlark: Are Conservation Lands Helping Grassland Bird Populations?

Ahlering, Marissa - The Nature Conservancy; Douglas Johnson - USGS Northern Prairie Wildlife Research Center

According to Breeding Bird Survey trends, populations of most grassland birds have been in decline for decades. Sadly, this statement has been repeated so often we have habituated to it. The reality is that even private landowners have begun to notice the disappearance of once common birds, like the Western Meadowlark. Given that the majority of the remaining grasslands are in private ownership, this is indicative of a very large problem. The conservation community has direct control only over publicly owned lands, but to be effective managers, we need to understand the context in which public lands function and the contribution they make to grassland bird populations. The goal of this study was to evaluate the status of 19 grassland obligate and grassland associated bird species on public versus private lands across the Prairie Pothole Region of Minnesota and Iowa and to determine how different land management practices (e.g., burning and grazing) influenced abundance. To address these questions, we sampled 210 grassland management units stratified by public/private ownership. We also sampled across a range of landscape variability defined by the amount of grassland or trees in the surrounding landscape. We found that ownership per se did not markedly affect the abundance of most species, but land management practices, which typically differ by ownership, had greater effects on some species. It is useful to consider public conservation lands as providing habitat complementary to that on private lands.

Evaluating Stopover Resource Use by Spring Migrants in Apalachicola Bay Using Stable Isotope Analysis

Aispuro, Armando - Delaware State University; Christopher Heckscher - Delaware State University; Melanie Mancuso - Delaware State University; Devin Mendez - Delaware State University

The value of a stopover site for Nearctic-Neotropical migratory songbirds is related to the quality of resources acquired there. Therefore it is important to identify and describe resource use at stopover habitats to inform migratory songbird conservation. The Northern Waterthrush (*Parkesia noveboracensis*) is an aquatic insectivore and obligate boreal breeder that makes spring stopovers at Gulf Coast barrier islands. We conducted passive mist-netting on St. Vincent Island in Apalachicola Bay, Florida during Spring Migration of 2015 and 2016 to examine how birds use these coastal resources. In order to assess habitat use through diet, we collected samples of feathers, claws, red blood cells, plasma and breath for stable isotope analysis. When birds were recaptured within-season, we collected a subsequent breath sample to examine intra-individual changes in the isotopic signature. Carbon dioxide from breath has a fast diet-tissue turnover rate; therefore, the isotopic signature reflects recent foraging and habitat use during island stopover. Observed changes in the isotopic signature of intra-individual captures suggests diet switching; while no difference between captures may suggest the use of a consistent diet resource during island stopover. Breath isotopic signatures can then be compared to signatures of other tissues providing a relative index of habitat use at various points along a yearly migration gradient. These results provide the first insight into the resource use of Apalachicola Bay barrier islands by migratory songbirds. Our study also highlights the need for increased attention to stopover habitat conservation in addressing migratory connectivity.

Carry-over effects of winter habitat on breeding season phenomena vary annually and among sex and age classes in prairie warblers

Akresh, Michael - University of Massachusetts Amherst; David King - U.S. Forest Service Northern Research Station; Peter Marra - Smithsonian Migratory Bird Center

Previous research has shown that winter habitat quality can directly or indirectly influence breeding phenology and reproductive success for migratory birds. We tested this for different sex and age classes in a population of prairie warblers (*Setophaga discolor*) breeding in Massachusetts, USA in 2009-2013. Using stable isotope ratios of Carbon (δ13C) from birds' claws collected on the breeding grounds, we assessed if winter habitat use carried over to affect birds' arrival dates, body condition upon arrival, pairing success, first-egg date, and apparent reproductive success. We did not find any evidence for direct or indirect effects of winter habitat use on breeding season phenomena for second-year (SY) males or females. In two of three years, our observations of ASY males were consistent with our expectation that birds wintering in drier habitat would arrive on the breeding grounds later. However, we found no evidence for time-mediated constraints of later arrival or nesting on reproductive performance for ASY males, possibly because many of the ASY males arrived even before the first-arriving females. Additionally, high rates of nest predation and the lack of double brooding in our population, even for early-arriving individuals, may have obscured the links between arrival, first-egg date and reproductive performance. Our study adds to a growing body of research that shows the influence of carry-over effects can differ among sex and age classes and can be modulated by other environmental conditions; this information further enriches our understanding of the role of carry-over effects in population limitation for migratory birds.

Mapping lethal dehydration risk in desert birds of the Southwest USA under current and future climates: integrating physiology and microclimate

Albright, Thomas - University of Nevada, Reno; Blair Wolf - University of New Mexico; Denis Mutiibwa - US Department of Agriculture; Andrew McKechnie - Department of Zoology and Entomology, University of Pretoria; Alexander Gerson - University of Massachusetts, Amherst; Devin Jacobs - University of Nevada, Reno

Heat waves affect function and fitness of birdlife in indirect and direct ways, including mass die off events due to hyperthermia and dehydration. Although heat waves are predicted to become more frequent and extreme, the spatial and temporal dynamics of die-off risk are poorly understood. For a largely desert region of the Southwestern USA, we used experimental data, temperatures from vegetated microsite measurements and coarse-scale gridded products, and models to characterize dehydration die-off risk in a desert bird assemblage in current and +4 °C climates. Even in this hot region, conditions capable of producing lethal dehydration within a day among large songbirds are very rare, and only slightly more common among small birds because of higher rates of mass-specific evaporative water loss. However, a 4° C warming scenario produces large increases in the frequency, extent, and intensity of die-offs. Reduced exposure to high temperatures in vegetated microsites mitigates some of the risk but may prove insufficient in the future, particularly for small-bodied songbirds.

Warm ambient temperatures reduce the variation in offspring growth caused by hatching asynchrony

Aldredge, Robert - Archbold Biological Station

Many birds increase the variation in offspring size at hatching by beginning embryonic development (incubation) before all eggs are laid, a behavior that causes eggs to hatch asynchronously. Hatching asynchrony causes substantial variation in offspring growth, which often is quantified as differences in growth rate, or K. In many species, hatching asynchrony increases from the beginning to the end of the breeding season. Current hypotheses suggest this increased hatching asynchrony likely occurs because young produced at the end of the breeding season have a lower reproductive value than young produced at the start of the season. I use random effect estimates from nonlinear mixed effects models to show that much of the variation in growth of house sparrow nestlings can be explained by differences in the timing of peak growth and in final adult size, suggesting that variation in growth may be explained better by factors other than growth rate. I then use this mixed modeling framework to show that the initial variation in size caused by hatching asynchrony increases the variation in offspring growth when ambient temperatures are cold but has little to no effect on variation in offspring growth when ambient temperatures are warm. These results suggest that warm ambient temperatures may buffer late-hatched offspring from the negative effects of increased hatching asynchrony at the end of the breeding season. Thus, this study exemplifies the need to understand how ambient temperatures influence variation in offspring growth seasonally, as well as across different spatial gradients (e.g., latitude and altitude).

Translocations reverse high hatching failure in a small, isolated woodpecker population

Aldredge, Robert - Archbold Biological Station; Emily Angell - Archbold Biological Station; Lauren Gilson - Archbold Biological Station; Gregory Schrott - Archbold Biological Station; Reed Bowman - Archbold Biological Station

Inbreeding depression can have severe demographic consequences for small, isolated populations. Translocating individuals from large to small populations is a tool to augment small populations, which also can increase genetic diversity and rescue populations from inbreeding. Unfortunately, little is known about the long-term consequences of translocations on demography in wild populations. Analysis of 21 years of nesting data from a small, isolated population of endangered red-cockaded woodpeckers (*Picoides borealis*) indicated that parents from the same population, whether from our small, isolated population, or the larger source populations from which we obtained donor birds, produced fewer viable embryos (i.e., higher hatching failure) than pairs comprised of local and translocated birds or their descendants. Over the first decade of monitoring (1994-2004), hatching failure increased at a time when the population declined by almost 40% and immigration into the population nearly ceased. We began translocating birds in 2001 to augment our small population (42 birds over 14 years) and, after a 4-5 year lag, hatching failure began declining in 2006, eventually reaching levels equal to those in the late 1990s. Because hatching failure is the most often cited negative consequence of inbreeding in birds, we conclude that increased genetic diversity resulting from translocations reversed the high hatching failure indicative of inbreeding. We also suggest that even large populations of red-cockaded woodpeckers appear to incur costs of inbreeding, and translocations may be a valuable tool not only for augmenting small populations but also for introducing (outbred) genes into large, but isolated populations.

Partners in Flight as a Catalyst for Ecosystem Conservation

Alexander, John - Klamath Bird Observatory

The history of conservation policy in the United States is rooted in a philosophy of ecosystem conservation and has resulted in many fundamental statutes that are intended to advance a systems approach to conservation. This history sets precedent for the Partners in Flight (PIF) mission to reverse at-risk landbird population declines and keep common birds common. The PIF science-based approach to multi-species landbird conservation is based on the successful waterfowl conservation model. The PIF approach also ties directly into the ecosystem management and adaptive management models, which are core to the current management paradigm that is in place in this country. Unfortunately, the ecosystem conservation vision that influenced the United States' progressive set of conservation policies is not being realized. Conservation management remains focused on game, and on threatened and endangered species. Neither ecosystem management nor adaptive management are being fully implemented. The PIF approach could help move conservation beyond its current narrow implementation and help realize the ecosystem conservation intent of our current management paradigm through the use of PIF's science-based tools. A strategy that uses the PIF approach within today's management paradigm will serve as a means for realizing the ecosystem conservation vision as well as PIF's ambitious mission. Such a strategy should involve unique federal agency–NGO partnerships and use of PIF science-based tools within a management- and policy-relevant approach to science that is implemented as part of the ecosystem management and adaptive management models.

Forest Landbirds as a Multi-species Surrogate for Measuring Ecological Conditions along a Spotted Owl Habitat Suitability Gradient

Alexander, John - Klamath Bird Observatory; Katherine Halstead - Klamath Bird Observatory; Jaime Stephens - Klamath Bird Observatory; Brian Woodbridge - US Fish and Wildlife Service; Matthew Betts - Oregon State University

In the Pacific Northwest, USA, forest restoration programs are employing management principles designed to accelerate the rate at which habitats become suitable for the Northern Spotted Owl. Beyond Spotted Owl monitoring, few efforts are in place that offer quantifiable measurements for evaluating the effectiveness of such restoration to reach desired ecological conditions, especially for wildlife. Given novel pressures presented by Barred Owl range expansion, there is a need to identify additional surrogates for monitoring. We present results that show how a suite of coniferous forest bird species serve as a surrogate for forest conditions associated with Northern Spotted Owl habitat suitability quantified in the species' 2011 recovery plan. Existing bird monitoring data were used to develop landbird distribution models. Predicted bird community composition was then derived from distribution models and evaluated across a 0% to 100% Spotted Owl habitat suitability gradient. Results from non-metric multidimensional scaling ordination and multiple response permutation procedure show a relationship between the relative habitat suitability gradient and bird community composition. Predicted forest bird communities reflect shifts in vegetation structure and composition and associated habitat components relevant to both Spotted Owl habitat use and forest management. Our results suggest that a multi-species surrogate approach may provide a method to quantify changes in forest conditions over the near and long-term, to help managers evaluate whether management goals are being met.

February precipitation in the wintering grounds of the Lesser Whitethroat as a migration cue

Aloni, Irith - Ben-Gurion University of the Negev; Shai Markman - University of Haifa; Yaron Ziv - Ben-Gurion University of the Negev

Numerous studies examined the effect of climate change on timing of spring arrival of migratory birds at European breeding grounds. However, only few examined the effect of climate at African wintering quarters on birds en route. We examined the effect of weather conditions at the wintering grounds of the Lesser Whitethroat, *Sylvia curruca*, on spring arrival in Eilat, Israel, a major stopover site after crossing of the Sahara desert barrier. We used a 30-years record data set with 27,000 observations provided by the IBRCE. Principal component analysis and multivariate regression models were applied in order to examine correlations of median arrival time with 46 climate variables at wintering quarters. In spite of the high variation due to the large area of the wintering grounds, we were successful in constructing a model with a very high statistical fit. The model's explanatory variables included precipitation in February and March, and number of wet days during November-February. Negative coefficient estimates of February and March precipitation suggest that they accelerate departure. Contrary to others' published results, yearly or seasonal precipitation showed no correlation with spring arrival time, nor did temperature. Moreover, winter at the Lesser Whitethroat's wintering quarters is dry season with negligible rainfall quantities. Hence, it is unlikely that the effect of precipitation on habitat productivity is a driving force of migration, as suggested by other studies. Instead, we propose that precipitation in February acts as a cue for the birds, indicating the approach of spring and migration time.

Evaluating Anthropogenic Disturbances to Minimize Effects on Staging Seabirds

Althouse, Melissa - SUNY College of Environmental Science and Forestry; Jonathan Cohen - SUNY College of Environmental Science and Forestry; Sarah Karpanty - Virginia Tech; Kayla Davis - Virginia Tech; Jeffrey Spendelow - USGS Patuxent Wildlife Research Center; Katharine Parson - Mass Audubon; Cristin Luttazi - Mass Audubon

Flight-initiation distance is commonly used by managers to develop set-back distances to reduce anthropogenic disturbances to wildlife. It is also a classic component in understanding the energetics of antipredator behavior. Many factors can influence this method of measuring stress on an individual. Regardless of the mechanism that determines flight initiation distance, for endangered species anthropogenic disturbance is usually considered to be "take". Minimization of disturbance to Roseate terns (*Sterna dougallii*) is therefore a management goal at Cape Cod National Seashore, an important pre-migratory staging area. We have developed a statistical model to determine the probability of staging mixed-species tern flocks responding to disturbances in any of four increasingly energetically-demanding behaviors: (A) no response, (B) respond without flight, (C) flight of less than one minute, and (D) flight of more than one minute. We will be presenting preliminary results demonstrating the contrast in flock responses to natural vs. anthropogenic disturbance sources. Gulls and shorebirds elicited similar responses from tern flocks regardless of proximity, whereas decreasing anthropogenic sources' distance demonstrated a strong correlation with high-energy flock responses. From these data, we will be able to reliably identify distances likely to cause different flock responses, and will therefore be able to make management recommendations to minimize anthropogenic disturbance to staging seabirds.

Just Google it: using Google Images to describe geographical variation in visible traits of birds

Amar, Arjun - Percy FitzPatrick Institute of African Ornithology; Gabriella Leighton - University of Cape Town; Pierre Hugo - University of Cape Town; Alex Roulin - University of Lausanne

Information on the spatial distribution of phenotypic traits can be important for evolutionary and ecological studies. However, traditional approaches, such as fieldwork, can be time-consuming and expensive. Information technologies, such as Internet search engines, could facilitate the collection of these data. We investigated the use of Google Images to extract data on geographical variation in phenotypic traits visible from photographs. We compared the distribution of visual traits obtained from Google Images with four previous studies (1 mammal and 3 bird case studies). We found very good agreement between fieldwork data and Google Images data across all studies. Additionally, we developed a free-to-use web application (MORPHIC) which facilitates the data capture of this method. Our results suggest that this method can work well for visible traits of common and widespread species that are objective, binary, and easy to see irrespective of angle. The Google Images method is cost-effective and rapid and can be used with some confidence when investigating patterns of geographical variation, as well as a range of other applications. In many cases, it could therefore supplement or replace fieldwork.

Linking Winter Habitat, Phenology, and Post-Fledging Survival in a Migratory Songbird

Ames, Elizabeth - The Ohio State University; Christopher Tonra - The Ohio State University

Every year millions of birds migrate between the wintering grounds, in tropical Central and South America, and the breeding grounds, in

temperate North America. Many of these Neotropical migrants complete the various stages of their annual cycle thousands of kilometers apart, and events in one stage can influence events in a subsequent stage. Understanding these carry-over effects is fundamental to understanding changes in migratory populations and their conservation, as many are in enigmatic decline. The objective of this study is to explore carry-over effects between wintering and breeding events, and elucidate an unexamined life-cycle stage, the post-fledging period, in a migratory songbird of conservation concern, the Prothonotary Warbler (*Protonotaria citrea*). In order to achieve this objective we utilized a large network of nest boxes and natural cavities across the 925-acre Hoover Nature Preserve, Columbus, Ohio. We tracked arrival timing to the breeding grounds, monitored breeding phenology and fledging success, and estimated post-fledging survival using radio telemetry. To determine if arrival is winter habitat dependent, and how winter and breeding ultimately affect post-fledging survival, we will analyze stable carbon isotopes from claw clippings collected within 10 days of arrival. I will present preliminary results, focusing on post-fledging survival as a function of phenology with a comparison between natural cavity and nest boxes, from fieldwork currently taking place. I will also discuss how this research will fill important gaps in the Prothonotary Warbler's full annual cycle and guide forested wetland bird conservation across the Americas.

Molecular phylogeny and biogeography of kingfishers (Alcedinidae)
Andersen, Michael - University of New Mexico; Jenna McCullough - University of New Mexico; William Mauck III - American Museum of Natural History; Brian Smith - American Museum of Natural History; Robert Moyle - University of Kansas

Kingfishers are the most speciose family within Coraciiformes and are the only cosmopolitan family in the order. However, global species diversity is unevenly distributed. For example, of the 114 species that comprise Alcedinidae, 19 species occur New Guinea, whereas only six species occur in the entire New World. To investigate the biogeographic history and speciation dynamics of this group, we inferred the first completely sampled, species-level phylogeny of kingfishers. Our dataset comprised up to five Sanger-sequenced gene regions for all species plus genus-level sampling of ultraconserved elements. We recovered a well-supported phylogeny of kingfishers that includes 22 species whose phylogenetic relationships were not previously known. The pygmy-kingfishers (subfamily Alcedininae) sit on a long branch, sister to all other kingfishers. Two clades, Ceyx and Todiramphus, showed patterns consistent with explosive diversification relative to the background speciation rate, which we attribute to their insular distribution. We discuss the origin, biogeographic history, and patterns of global colonization in context to the pantropical Coraciiformes.

Trophic Influence of Ocean Warming on Breeding Success of Nazca Boobies
Anderson, David - Wake Forest University; Emily Tompkins - Wake Forest University

Populations often respond to climate change with a geographic range shift to track their ecological niche. Abiotic aspects of the niche have dominated research on these range shifts, despite calls for broader consideration of the mobile modern-day niche, including biotic components such as trophic effects. We document the trophic biology of a seabird, and model this top predator's breeding biology across a prey base change that is likely to persist under expected ocean warming, showing the expected decline of a fixed island population as its mobile, preferred prey's niche is displaced. Nazca boobies (*Sula granti*) in the Galápagos Islands ate mostly Pacific sardines (*Sardinops sagax*), a densely aggregated, highly nutritious food, from 1983 until 1997.

After 1997, sardines nearly vanished from their diet. Lacking these valuable prey, Nazca boobies switched to flying fish, a lower quality food. Breeding success during the “Flying Fish Phase” was ~50% of that during the “Sardine Phase”, causing negative population growth during the Flying Fish Phase. Nazca boobies require island breeding sites and have virtually no other options for this spatially fixed resource in the Eastern Tropical Pacific. Under climate change, ocean warming around Galápagos is expected to exclude sardines permanently from the predator’s breeding foraging range, creating a “spatial mismatch” and a persistent Flying Fish Phase. If these links between diet and demography apply in the future, the trophic influence of climate change will lead to steady decline in this population.

Landscape-level influences of Gyrfalcon (*Falco rusticolus*) occupancy in western Alaska

Anderson, David L. - The Peregrine Fund; Peter J. Bente - Alaska Department of Fish and Game; Travis L. Booms - Alaska Department of Fish and Game; Leah Dunn - Independent; Christopher J. W. McClure - The Peregrine Fund

Habitat degradation and loss are regarded as leading causes of species decline and extirpation, potentially having significant impacts on species associated with rapid climate changes observed in the Arctic. For many Arctic species we lack basic information about how specific habitats influence occupancy, or how competition for high quality breeding sites and heterogeneity of resources influences spatial variation in occupancy, productivity, and population growth rates. The Gyrfalcon *Falco rusticolus* is the apex avian predator of Arctic tundra and is considered highly vulnerable to global climate change, yet there has been little research on habitat preferences, a necessary precursor to effective conservation planning. To address this information gap, we assessed breeding territory quality of 84 territories observed annually between 2004 – 2013 in western Alaska. We characterized high- and low-occupancy breeding territories as those occupied more or less often than expected by chance, and we evaluated land cover at 1-km and 15-km buffer zones at each territory to identify habitat variables associated with observed occupancy patterns. We tested 15 competing models to rank hypotheses reflecting prey and habitat variables important to nesting Gyrfalcons. Our results demonstrate an important and positive relationship between site occupancy patterns and 15-km buffers of primary prey habitat for Willow Ptarmigan (*Lagopus lagopus*). Selection of breeding areas at large spatial scales (e.g., breeding territory) by Gyrfalcons may reflect predictable differences in nestling survival and nesting success between territories, which in turn are influenced by long-term prey availability.

Using Video Cameras to Evaluate Nest Fate Classification of Least Terns and Piping Plovers on the Missouri River

Andes, Alicia - University of North Dakota; Susan Ellis-Felege - University of North Dakota; Terry Shaffer - USGS Northern Prairie Wildlife Research Center; Mark Sherfy - USGS Northern Prairie Wildlife Research Center; Colin Dovichin - USGS Northern Prairie Wildlife Research Center

For federally listed species, such as piping plovers (*Charadrius melodus*; hereafter “plover”) and least terns (*Sternula antillarum*; hereafter “tern”), correct determination of nest fates and causes of nest failure is crucial to understand population dynamics and improve recovery plans. We used video cameras to evaluate the misclassification rate and identify the contributing factors that may cause current monitoring methods to misclassify plover and tern nest fates. During the 2013 – 2015 breeding seasons, we installed miniaturized surveillance cameras at 62 of 294 tern and 86 of 551 plover nests under observation at the Garrison Reach of the Missouri River in North Dakota. Field and

camera fates were classified by different researchers. Multinomial regressions were used to examine whether current monitoring intervals, life history or temporal factors influenced a correct, incorrect, or partial (probable successful in the field vs successful by camera) nest fate classification. For an 8-day monitoring interval, 27.5% of nests were fully and 45.9% were partially misclassified. The percent of partially (20.3%) and fully (8.0%) misclassified nests decreased with a more intensive 3-day monitoring schedule. Researchers were also less likely to correctly classify nest fates for plovers and as clutch age increased. Furthermore, causes of failure were classified differently by field evidence versus video for 63% of plover and 67% of tern nests. The ability to accurately identify nest failure reasons will facilitate a better understanding of the limiting factors that influence population dynamics for both species as well as inform management decisions to improve nest survival.

Historical analysis of birders' attitudes towards ornithology with implications for Citizen Science

Anthony, Matthew - College of William & Mary

Citizen science is fast becoming a major driver in contemporary ornithology. To be successful, citizen science requires scientific researchers to connect with and mobilize the expertise of amateur birders. This relationship depends upon the willingness of birders to be involved in the ornithological process. While the fast growth of citizen science in recent years would make it appear almost self-evident that birders are interested in ornithology, it is important to understand that the relationships between birders and ornithologists that sustain contemporary citizen science have a recent historical origin. This paper investigates the historical relationships between birders, ornithologists, and bird conservationists through a qualitative rhetorical study of editorials published in Birding, the magazine of the American Birding Association, in the late 1960s and 1970s. Focusing on the content of editorials is intended to help gauge how the rank-and-file birding community expressed its relationship to ornithology. Through this examination, it becomes clear that the emphasis on scientific participation among birders is a recent phenomenon. Birders in the 1960s and 1970s actively sought to distance themselves from ornithology and define birding as solely a recreational or sporting activity. In the late 1970s and early 1980s, birding was gradually redefined to place emphasis on complex field identification and rarity finding, rather than list building. This shift necessitated a greater understanding of bird life history and distributions, and opened the door to a more scientific inclination among birders. Without this shift in the attitudes of birders, the current citizen science boom would not be possible.

Multi-decadal trends in full-life cycle drivers of population growth and size: lessons for the next century

Arcese, Peter - University of British Columbia; Kate Johnson - University of British Columbia; Ryan Germain - University of British Columbia; D. Ryan Norris - University of Guelph; Jane Reid - University of Aberdeen; Lukas Keller - University of Zurich

Developing full life-cycle models for populations that are resident year-round is simpler than for migrants because all life stages can be sampled intensively, often including large numbers of birds and a wide range of environments. Given enough data, we might expect to obtain sufficiently accurate estimates of demographic rates to predict population trends in future with precision. Alternatively, it is possible that ongoing change in climate, land use and the make-up of biological communities causes shifts in the influence of demographic vital rates or their parametric values, such that precise predictions become impossible due to model 'misspecification error.' We used 4 decades of longitudinal data from >10,000

individually-identified song sparrows (*Melospiza melodia*) resident year-round on Mandarte Island, BC, to develop a full life-cycle model of population growth that accounted for most of the observed variation in population growth over time. We show that, historically, winter weather limited growth via its effects on survival, and that nest depredation by Brown-headed cowbirds (*Molothrus ater*) limited growth via its effect on reproductive rate. However, we further show that neither of these once dominant limiting factors can explain long-term population trends. Instead, ecological changes in native species distribution and its consequences for competition within an avian community offers the best explanation for observed trends over time. This support the idea that specifying the correct model will often be more influential than the precision of estimated vital rates when developing full life cycle models to predict species distribution and trend.

Climate, land use and life history drivers of population growth and distribution and their application to conservation prioritization

Arcese, Peter - University of British Columbia; Richard Schuster - University of British Columbia; Elizabeth Kleynhans - University of British Columbia; Amanda Rodewald - Cornell Lab of Ornithology and Cornell University Department of Natural Resources; Scott Wilson - Wildlife Research Division, Environment and Climate Change Canada

Prioritizing conservation action often begins with the identification of target species or communities most at risk of decline in future. We tested whether occupancy maps developed for common birds could be used to identify priority areas in which to conserve critically endangered Douglas fir - Garry oak savannas of the Pacific Northwest of North America, and whether trends in the abundance of those species over time was linked to habitat preference or life history. We used ebird presence-absence data and 27 spatial variables describing land cover, ecosystem type and climate to create occupancy maps for 90 species. We then characterized species by their affinity for naturally-occurring and anthropogenic habitats and combined them to create composite maps, weighted by the reliance of each species on habitats of interest. We then used those data to test whether 1) the preference of species' for particular habitats predicted historic population trends in the region, 2) the suites of species identified as relying on particular habitats shared population trends in common, and 3) the distributions of species assembled into communities could be used to predict the occurrence of rare species that could not be mapped reliably with available data. Our results indicate that climate is much less influential of species distribution than land cover, that guilds of common species can be used as surrogates to prioritize habitat for rare species, but that it is harder predict population trend from species life history or breeding season habitat alone.

Hummingbird Conservation in Mexico: the national Protected Areas System

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Hummingbirds represent an avian family restricted to the Americas that feed mainly on nectar obtained from ornithophilous plants. In North America (Mexico-USA-Canada) 58 species have been reported out of the 330 total hummingbird species, all of them occurring in Mexico. In this work we analyzed the distribution of hummingbirds in relation to the coverage of the natural protected area system in Mexico using a complementarity analysis to assess the minimum set of areas

needed to protect all species. We focused our search mainly to biosphere reserves as these areas have complete bird lists. Six biosphere reserves included 93% of the hummingbird species. Four species were not included in any biosphere reserve or other natural protected area. To preserve those species three important bird areas (AICAS as they are known in Spanish) are needed. With these 9 areas all hummingbird species are included at least in one area. Hummingbird distributions can be classified in six groups that distribute following the major biogeographic regions described for Mexico including groups using i) the main mountain ranges, the tropical dry forests in both ii) Pacific and iii) Gulf of Mexico slopes, iv) the humid tropical forest in southern Mexico, and both v) Yucatan and vi) Baja California peninsulas. Hummingbird conservation need among other things, promoting connectivity between protected areas to preserve healthy populations. For endemic and restricted range species it is very important to promote habitat preservation.

Resolving an urban human-wildlife conflict: an experimental test of using falconry to reduce Egyptian Geese on golf courses

Atkins, Alex - Percy FitzPatrick Institute of African Ornithology; Rob Little - Percy FitzPatrick Institute of African Ornithology; Steve Redpath - University of Aberdeen; **Arjun Amar** - Percy FitzPatrick Institute of African Ornithology

Urbanisation can lead to changes in predator--prey dynamics, and may drastically alter the demographics and behaviour of prey species. As a result some prey species may increase in abundance, becoming a nuisance for humans which may require management. One management option is lethal control, but such approaches are often controversial and tend to be particularly unpopular amongst the general public within urban environments. Within Cape Town, South Africa, Egyptian Geese *Alopochen aegyptiaca* have increased dramatically in abundance over the last few decades, and there is now a human--wildlife conflict centred on Cape Town's golf courses where large numbers of geese congregate and defecate on the courses, causing problems for managers and players. We experimentally tested whether introducing a predator to the system in the form of trained hawks could increase vigilance and thereby decrease the abundance of these nuisance animals. Over the three months of the experiment, numbers of Egyptian Geese declined by 73% at the treatment site, but remained constant at the control sites. Simultaneously, vigilance levels increased by 76% at the treatment site, but showed no such increase at the control sites. Our experiment suggests that falconry can be an effective non--lethal technique to reduce Egyptian goose numbers. These findings suggest that the use of trained raptors may be a useful technique to reduce the number of nuisance birds by replacing lost interactions with predators. This approach may be particularly useful in urban areas where the use of lethal techniques are often undesirable.

Functional importance of spatial heterogeneity and scale in the coexistence of sympatric avian predators

Atuo, Fidel - Oklahoma State University; Timothy O'Connell - Oklahoma State University

Spatial heterogeneity can alter the extent to which coexisting generalist predators explore and compete for resources in the presence of a potential sympatric competitor. The southern Great Plains supports wintering populations of top co-occurring generalist predators that potentially rely on similar food sources. In this study, we assessed potential mechanisms for coexistence by determining the scales at which two of these predators partition habitat at two mixed-grass prairie landscapes. We also investigated the

influence of compositional heterogeneity gradients on the degree of specialization and overlap in habitat selection across multiple spatial scales. We found that both predators demonstrated significant fine scale habitat discrimination in less heterogeneous landscapes, but not in relatively high heterogeneous landscapes. At all spatial scales, the Northern Harrier was more likely to be associated with upland grassland, whereas the Red-tailed Hawk was mostly associated with woody vegetation. At each study site, environmental tolerance (ecological niche breadth) over measured environmental variables was mediated by spatial heterogeneity with the species having a lower tolerance exhibiting spatial segregation. For example, the Red-tailed Hawk demonstrated higher degree of tolerance in the highly heterogeneous Packsaddle landscape but occupied a narrower marginal niche at the less heterogeneous Beaver River. Our study supports the growing body of evidence that local interactions among sympatric competitors may vary in strength across gradients of habitat complexity and heterogeneity. Moreover, our study demonstrates that spatial heterogeneity can modify predators foraging behavior such that a generalist predator may tend towards specialist foraging behavior if heterogeneity is reduced.

Threatened/endangered species and critical habitats on airports: a case study in unintended consequences

Atwell, Nick - Port of Portland

Activities undertaken by the Port of Portland (Port) have inadvertently created and maintained habitat on Port properties (including Portland International Airport [PDX]) that provides essential nesting habitat for the Streaked Horned Lark (*Eremophila alpestris strigata*), recently listed as "threatened" under the Endangered Species Act (ESA). This species presence on airport property potentially provides constraints to the airport's ability to meet current and future air service demand. Airport operations are generally incompatible with conservation of avian species on airport property due to the increased risk to aircraft safety. Wildlife hazard management is currently allowed at PDX under the special 4 (d) rule of the ESA. The Port of Portland's goal is to support conservation of the Streaked Horned Lark or other listed species where it can be accomplished in a manner that is not a conflict with safe airport operations now and in the future, and does not put the species at risk. The Port is currently seeking opportunities to mitigate the loss of essential nesting habitat on airport property by developing a Habitat Conservation Plan to enhance offsite areas for nesting. Presently, the bird is found in relatively discrete locations that exhibit the necessary habitat characteristics as a direct result of human intervention, specifically: controlling vegetation at airports and creating dredged material deposits on the Columbia River navigation channel. This presentation will provide an overview of the impacts future development may have on the Streaked Horn Lark and the actions taking to mitigate these impacts.

Pre-migratory movements and migration routes of Bicknell's Thrush (*Catharus Bicknelli*) revealed by the Motus wildlife tracking system.

Aubry, Yves - Environment and Climate change Canada; André Desrochers - Université Laval; **Junior A. Tremblay** - Environment and Climate change Canada

Bicknell's Thrush (*Catharus Bicknelli*) is a migratory bird whose range is one of the most restricted in northeastern North America, classified as "threatened" under the Species at Risk Act in Canada. The species breeds in balsam fir stands with a very high density of stems in high elevation areas. The pre-migratory period, which extends from

fledgling to migratory departure, is probably critical for adults and juveniles because of its short duration and its key role in accumulating energy for migration. Migration routes and stopovers are unknown for Bicknell's Thrush and this information is needed for conservation given that the risk of mortality during this period could be higher than most, if not all, other periods of the annual cycle. We documented pre-migratory movements and migration routes of male Bicknell's thrush using the Motus wildlife tracking system. We compared them to movements of the sympatric and more abundant Swainson's Thrush (*Catharus ustulatus*). Bicknell's Thrush post-breeding movements were restricted or nonexistent, and most birds remained in their breeding territories until late September, and later than most Swainson's Thrushes. Preliminary data suggest that Bicknell's thrushes migrate closer to the east coast of North America than Swainson's thrushes do.

Challenges in Big Data Ornithology: Grounds for a Technical Working Group?
Auer, Tom - Cornell Lab of Ornithology; Daniel Fink - Cornell University; Nick Bruns - Cornell Lab of Ornithology

The application of Big Data in ornithological research poses substantial technical challenges related to managing data volumes, applying appropriate technical workflows, and finding sufficient computational resources, especially for applications that focus on species distribution modeling, global-scale landscape ecology, and the analysis of eBird and/or RADAR data. However, within ornithological institutions, technical capacity to address challenges presented by Big Data is highly varied. In the context of promoting Big Data analysis within the field, we highlight a case study of successfully reducing computational time for a species distribution model, introduce options for technical solutions, and propose a broader technical working group, that would seek to facilitate information and code sharing, code review, collaboration, and dissemination of technical knowledge within the greater community, so that, collectively, we can improve the efficacy and scalability of existing Big Data analyses that seek to further research and conservation goals.

Implementation of bird's protection law: A step for conservation of migratory birds
Awan, Mahmood - Lahore High Court; Zahid Bahtti - Department of Wildlife & Parks

Punjab Pakistan is representing wide variety of bird's fauna because it is occupying an ideal location among famous biological realms with considerable diverse network of wetland. In present research work data of last ten years regarding migratory bird's distribution, protection law and threats was analyzed. The findings of regular surveys at different wetlands in Pakistan revealed that about 700, 000 and 1, 200, 000 birds landed in diverse habitats of Pakistan annually via Green Route or Indus Flyway. This avifauna consisting of internationally threatened birds' species like White headed Duck (*Oxyura leucocephala*), Houbara Bustard (*Chlamydotis undulata*) and Siberian Crane (*Grus leucogeranus*). Various conservation organizations are working for protection and conservation of migratory birds like IUCN, RAMSAR and WWF-P. A National Conservation Strategy (NCS) was approved by the government of Pakistan in 1992, with biodiversity preservation as a possible necessary element. The Pakistan government is signatory to numerous worldwide initiatives and is particularly doing concerted schemes to save avian diversify. It's concluded for conservation of migratory birds that strict law should be implemented for protection of these guest birds.

Acoustic rhythm in woodpeckers: Is there a geographical variation of mechanical drums and rattle calls in *Picoides*?

Baer, Alex - Hunter College; Nicolas Mathevon - Hunter College

While the majority of birds communicate using vocalizations, some species also produce sounds independent of a vocal organ. One of the most widely known groups of birds to mechanically produce acoustic signals are woodpeckers. Just as vocal signals usually convey species identity, research suggests that the drum sequences of woodpeckers may also convey species-specific information. In spite of this biological importance, our knowledge about how drums code for species identity is rather limited. Additionally, it is well known that there are often geographical differences to vocalizations within a bird species, sometimes referred to as 'dialects'. Although dialects can have significant effects on the evolution of species, little research has been devoted to woodpeckers on this topic. Furthermore, studies on birds' dialects have been restricted to their vocal signals and it is not know if sounds produced by another mechanism, in this case drumming, could also be affected. In this study, I examine the potential relationship between geographic variation and acoustic sequences (both drum and rattle calls) in woodpeckers of the genus Picoides. I hypothesized that there would be some effect of geographic location on both the drum and call sequences. However, both acoustic signals were found to be extremely stable across each species' geographic range, with respect to both latitude and longitude. Playback experiments will be useful to investigate the plasticity of species-specific coding in both drums and rattle calls.

Habitat-specific abundance and survival of Wood Thrushes in agroforestry landscapes in Honduras

Bailey, Brett - Department of Environmental Conservation, University of Massachusetts, Amherst; David King - USDA Forest Service Northern Research Station / University of Massachusetts, Amherst

Using point count (n=300), mist net capture (n=82), and radio telemetry (n=46) data from Wood Thrush across a coffee-growing, agricultural landscape in central Honduras (800 m to 1600 m), we consider how these datasets inform poorly understood aspects of Wood Thrush winter ecology and reveal important considerations for monitoring during the non-breeding season. Julian day and playback were important factors in determining point count efficacy. Point count and banding surveys found that Wood Thrush were virtually absent from drier pineforest, but were found in greater, albeit varying densities across shade coffee plots and humid forest fragments. Telemetry revealed well-documented territorial and wandering movement strategies along with a third strategy, infrequently mentioned in the literature, indicated by high levels of subcutaneous fat, months before migration. Contrary to previous studies, we found no evidence that wanderers experienced higher mortality rates than territorial individuals. Mixed-effects models selected to evaluate the relationship between survival, movement, and local habitat variables found that deep leaf litter, an open understory, and a well-developed subcanopy were associated with increased survival and persistence while older individuals in better condition maintained smaller home-ranges and remained more faithful to their site. The observed patterns of movement and variation in detectability pose challenges to creating monitoring and conservation plans for Wood Thrush. With individual detectability decreasing while drier habitats are vacated, a better understanding of movement, habitat use, and climate interactions may be required

to effectively evaluate habitat quality for the Wood Thrush.

Using Radio Frequency Identification (RFID) Technology To Investigate Gap Crossing Decisions in Chickadees
Bailey, Jacob - University of Northern British Columbia; Stefanie LaZerte - University of Northern British Columbia; Mark Paetkau - Thompson Rivers University; Matthew Reudink - Thompson Rivers University; Ken Otter - University of Northern British Columbia
Increasing development and deforestation are causing habitat fragmentation worldwide. The result is a matrix of forest patches separated by deforested gaps that must be navigated by forest songbirds. Our work uses a novel approach (radio-frequency identification - RFID) to assess the permeability of habitat gaps, and investigate factors influencing avian gap crossing decisions. Using bird feeders outfitted with RFID readers, we tracked the movement patterns of wintering black-capped chickadees banded with passive integrated transponder (PIT) tags. We placed four RFID feeders in a square centered on habitat gaps (two feeders on each side of the gap) at four locations in central BC. While all four feeders were equidistant from one another, movement between feeders within the same forest patch did not require gap crossing, while movement between feeders on opposite sides of the gap did require gap crossing. We collated feeder visits to determine the relative number of movements between feeders that did, or did not, require gap-crossing. Preliminary results support the prediction that gaps act as movement barriers; bird movements between feeders on opposite sides of gaps were substantially reduced compared to feeders on the same sides of gaps, and larger gaps with sparser vegetation appeared to be bigger impediments to movement than smaller gaps. Gaining a better understanding of factors influencing gap-crossing decisions allows for better management to minimize the negative effects of gaps on bird movements.

Do predator guards on nest boxes improve reproductive success of birds?
Bailey, Robyn - Cornell Lab of Ornithology; David Bonter - Cornell Lab of Ornithology

Humans have long provided nest boxes in a widespread effort to augment nesting sites for cavity-nesting birds. However, nest boxes may provide easy access for predators and thereby create ecological traps for nesting birds. Predator exclusion techniques are often deployed at nest boxes to reduce nest predation, but very few studies have tested their performance. Our objective was to test the effectiveness of predator guards in promoting the reproductive success of birds at a large spatial scale (U.S. and Canada). We addressed four main questions: 1) Does the presence of a predator guard improve nest success? 2) Do certain species benefit from the presence of a predator guard more than others? 3) Which predator guard designs are associated with greater reproductive success? 4) Do multiple guards at boxes increase nesting success over boxes with a single type of guard? We used nest fate data from 16,006 nest attempts to determine whether predator guards installed on nest boxes promoted reproductive success. Across all species, the top logistic regression models predicting nest survival suggest a positive influence of guards. At the level of species groupings, reproductive success was greater for tits, wrens, and bluebirds nesting in guarded boxes, while reproductive success was marginally better for aerial insectivores. Although all guard types were correlated with improved nesting success, birds nesting in boxes with cone-type baffles installed were most likely to result in successful reproduction. Our results can help managers of cavity-nesting birds incorporate science-based evidence into decision-making and allocate resources more effectively.

Using integrated population models to understand the demographic mechanisms driving population changes at large spatial scales

Baillie, Stephen - British Trust for Ornithology; Catriona Morrison - University of East Anglia; Robert Robinson - British Trust for Ornithology

Many widespread British bird populations are declining while most rare species are doing well. To investigate the causes of changes in the abundance of widespread species we developed Integrated Population Models for 17 species based on breeding bird surveys, nest records and ring recoveries gathered by volunteers. In general well over 80% of annual variation in population growth rates was accounted for by directly measured demographic parameters. Across species variation in adult survival generally made the largest contribution to variation in population growth rates while productivity (fledglings per nesting attempt) made the least. Results from large-scale Integrated Population Models agree with those from previous studies based on more ad hoc approaches. Ring recovery rates are low for most species and have declined. We therefore investigated how survival estimates from two alternative approaches can be incorporated within Integrated Population Models. One is based on mark-recapture data from Constant Effort mist-netting while the other uses age-ratios from capture data to estimate recruitment. Both approaches have good potential to broaden the range of species for which IPMs are available. To-date our analyses have largely been retrospective, seeking to explain the demographic causes of past population changes. Because we have annual parameter estimates much of this work can be done without a full understanding of demographic mechanisms. In order to identify and evaluate potential conservation strategies we now need to develop prospective analyses based on underlying demographic mechanisms. We report on progress towards achieving this goal.

Investigating behavioral variation in urban and rural populations of eastern bluebirds

Ballentine, Barbara - Western Carolina University; Meghan Graham - University of West Georgia

Urbanization presents animals with unique challenges associated with the effects of human disturbances in the environment such increased noise, light, pollution and proximity to humans. Thus, differential selection pressures in urban and rural environments may lead to morphological, physiological and behavioral adaptations that allow some species to be tolerant of urban landscapes while other species remain vulnerable to extinction. Studies on birds provide insight into the types of behaviors that are favored in urban environments. Some aspects of urban environments such as access to resources, less interspecific competition and lower predation can benefit individuals that are able to tolerate human disturbances. Clumped resources and human disturbances characterize human disturbed landscapes and may favor more aggressive males. In this study, we investigate how aggressive behavior differs in populations of eastern bluebirds, *Sialia sialis*, inhabiting both urban and rural landscapes. We measured differences in male aggression using a conspecific playback paradigm, where approach toward the speaker was used to determine aggressiveness in male eastern bluebirds. We also measured repeatability of aggressive behavior by assaying males multiple times to address selection potential of aggressive behavior. We found that males in urban habitats are more aggressive than males in rural habitats, supporting our hypothesis that more aggressive males are favored in more human disturbed areas. Further, we found that aggressive behavior is repeatable across individuals which may support the potential for selection to favor different behavioral phenotypes in urban and rural habitats.

European Starling nestlings adjust vocalizations in response to noise but do not show a physiological stress response

Barber, Colleen - Saint Mary's University; Alyssa Walthers - Saint Mary's University; Celina Campbell - Saint Mary's University; Andrew Horn - Dalhousie University; Jennifer Foote - Algoma University

Anthropogenic noise can adversely affect health and communication in many taxa. Studies on urban-nesting birds have documented decreased fitness, increased stress levels, and impaired parent-nestling communication. Higher heterophil/lymphocyte (H/L) ratios in birds are associated with increased stress levels. Nestlings may adjust the frequency of their calls to unmask their begging from noise in the environment. Our objective was to determine if urban noise had an effect on: a) nestling stress levels, and b) the frequency of nestling begging calls in European Starlings (*Sturnus vulgaris*). We predicted that nestlings exposed to playback of noise would have higher H/L ratios, but show habituation to it, and would have higher frequency begging calls than those in the control group. Nest boxes were randomly assigned to either an experimental (increased urban noise) or a control (normal ambient noise) treatment. Experimental nests were subjected to artificially increased noise daily for 7 hours from age 5 to 15 days post-hatch. Blood was sampled at days 11 and 15 post-hatch, while nestling vocalizations were recorded daily. Contrary to our prediction, experimental broods had lower H/L ratios than control broods, but did tend to show signs of habituation as their H/L ratios decreased over time. In support of our prediction, experimental broods begged at a higher frequency during noise playback when compared to controls. Urban-thriving European starlings appear to have adapted to consistent noise, exhibiting a low physiological stress response and the ability to adjust their vocalizations in noisy environments.

Influence of forest stand complexity on forest songbird diversity within large tracts of forest in Pennsylvania

Barenblitt, Abigail - Penn State University; Margaret Brittingham - Penn State University; David Miller - Penn State University; Glenn Stauffer - Penn State University

Pennsylvania is characterized by large tracts of forests that provide key habitat for neotropical migrant songbirds. Past management practices, soil acidification, and heavy deer browsing have led to the simplification of forests in Pennsylvania. This research asks: Does the diversity of songbirds increase as a function of the complexity of forest stands within large tracts of forest? A complex stand is one having key forest features associated with forest specialist birds. We hypothesized that the presence of specific forest features would influence the occupancy of specialist species grouped a priori based on their use of compositional and structural features. We hypothesized that points with more of these forest features would support more groups. In 2015, we conducted 192 avian point count surveys within Northcentral Pennsylvania. We surveyed vegetation at the same points for compositional and structural forest features. We analyzed our data using GLM's in R and occupancy models in JAGS using the runjags package in R. We detected 77 passerine or near passerine species and 75.6% of detected individuals were neotropical migrants. The probability of occupancy of specialist groups increased with presence of hemlock (β=0.79; CrI 0.29, 1.3) and ericaceous shrubs (β=1.2; CrI 0.46, 1.8) and abundance of large trees (β=0.031; CI -0.13, 0.18), and woody debris (β=0.28; CI -0.17, 0.73) and decreased with abundance of hayscented fern (β= -0.17; CrI -0.81, 0.55). The number of specialist groups detected at a point showed a positive trend with number of key features (β =0.082; CrI 0.01, 0.16)(Fig. 1).

Biogeography outperforms mating systems in explaining rates of morphological evolution in Icteridae
Barker, Keith - University of Minnesota; Alexis Powell - Emporia State University

Both natural and sexual selection can act as powerful and sometimes contradictory shapers of phenotypic diversity. Ecologically diverse lineages that vary in mating system offer the chance to estimate the relative importance of these selective forces. In this study, we evaluated the impact of ecological opportunity (as measured by inter-continental dispersal) and mating system (coded as monogamous versus polygynous) on rates and patterns of morphological evolution in the blackbirds (family Icteridae). Comparative analyses of morphology identified substantial heterogeneity in evolutionary rates among lineages and among biogeographic regions. Specifically, a model selection approach found strong support for differences in rates of skeletal evolution between North and South America, with South American species evolving approximately 40% faster. By contrast, external measurements suggested a lineage-specific increase in shape within the oropendolas, but no broader correlation of rates with either mating system or biogeography. Comparison of clades of icterids suggests that while evolutionary rates do not differ widely among them, they have differentially accumulated disparity, with meadowlarks and orioles occupying smaller regions of morphospace than the grackles and allies and caciques and oropendolas despite the similar ages of thes lineages. In particular, variation within the ecologically diverse grackles and allies clade encompasses nearly the entire range of variation found in orioles and meadowlarks, and only the caciques and oropendolas have moved into new regions of morphospace. In sum, ecological diversification seems to have had a much stronger impact than mating system on rates of morphological evolution in blackbirds.

Evaluating Behavioral Responses of Lesser Snow Geese to Unmanned Aircraft Surveys
Barnas, Andrew - University of North Dakota; Robert Newman - University of North Dakota; Christopher Felege - University of North Dakota; Michael Corcoran - University of North Dakota; Samuel Hervey - University of North Dakota; Robert Rockwell - American Museum of Natural History; Susan Ellis-Felege - University of North Dakota

Unmanned aircraft vehicles (UAVs) are relatively new technologies gaining popularity among wildlife biologists. As with any new tool in wildlife science, operating protocols must be developed through rigorous impact testing. To date, no studies have been conducted that comprehensively address impacts that UAVs may have on unhabituated individuals in the wild. We evaluated potential sources of disturbances introduced by unmanned surveys by measuring UAV-induced behavioral responses during the nesting phase of lesser snow geese (*Chen caerulescens caerulescens*) in Wapusk National Park, Manitoba, Canada. Using a Trimble UX5 fixed wing aircraft in 2015 we flew over 9 nests being monitored by nest cameras and audio recorders. We compared these to 3 nests without UAV flights. Audio recorders were used to detect changes in background noise levels produced by the aircraft, while video cameras revealed any physical changes in behavior during fly-over events. We found that during flights, proportion of time spent off-nest and with aerial-vigilance behaviors increased from 7% to 15% (P=0.01) and 0.9% to 4.0% (P=0.0007) respectively, though it is unclear if this affected overall reproductive success. Within flights we found no effects of different altitudes on off-nest behavior (P=0.08) but aerial vigilance differed (P=0.007). Within line-of-sight regulations forced operators to be near nesting birds, and may have played a larger role in off-nest behaviors than the UAV fights. Results from this study should be used to inform best practices for unmanned aircraft

surveys, and highlight the need for species-specific impact assessments before using a UAV for wildlife studies.

From Discovery to Surveillance to Intervention: A Bird's Eye View of Modern Avian Extinction

Barrow, Mark - Department of History, Virginia Tech

Birds have played a key role in the discovery of and response to human-caused wildlife extinction. As a charismatic, widely collected, and much studied taxonomic group, they provided early, well-documented cases of species loss. By the mid-19th century, naturalists were chronicling the decline and loss of the dodo, moa, and auk, three endemic island species that fell victim to human predation. In the latter part of 19th and the early 20th centuries, the fall of the passenger pigeon showed that even once superabundant species with expansive geographic ranges could be completely destroyed through habitat destruction and market hunting. Not until the middle decades of the twentieth century did ornithologists begin systematically studying the heath hen, ivory-billed woodpecker, and California condor with the hope of discovering why these avian species were precipitously declining. As threats to those and other birds increased, efforts to research the causes of their decline intensified while attempts to deploy traditional wildlife management techniques–like protective laws and refuges–gave way to more interventionist approaches. As the twentieth century drew to a close, worried scientists and wildlife officials captured every known living California condor, began a lengthy captive breeding program, and developed programs to train the species to survive re-release in the wild. Recent proposals to use modern genomic techniques to revive extinct avian species–like the passenger pigeon–and to help rescue threatened species represent the culmination of an increasingly interventionist response to potential or actual wildlife extinction.

Setting Gulf Coast Habitat Objectives for Migrating Landbirds

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Joint Ventures are self-directed, regional partnerships of public and private organizations and individuals, originally established to carry out the North American Waterfowl Management Plan. Joint Ventures have now accepted the challenge of implementing landbird conservation plans. The Gulf Coast Joint Venture (GCJV) boundary extends from Texas to Alabama and hosts millions of landbirds as they migrate through the Gulf of Mexico (GOM) region in spring and fall. Because all wooded vegetation in this region of the GOM is potential stopover habitat for an array of landbird species, important stopover habitat is not easily identified. We currently have only a crude way to objectively rank stopover sites for their value to migrating landbirds, and we lack the ability to quantify habitat needed to meet target population sizes. The GCJV aims to set habitat objectives based on the premise that food resources during the migratory period influence stopover success (e.g., fuel deposition, survival) and thus may limit population levels for landbird species. Given that birds select stopover sites from geographic to landscape to site-specific scales, it is a challenge to define the appropriate model structure for developing rules to characterize quality of stopover sites across the GCJV region. To address some of these challenges we are developing conceptual models to diagram both landscape- and site-specific influences on stopover habitat selection and use by migrants. These conceptual models may guide the development of spatially explicit

statistical models whose output maps, in combination with established population objectives, could aid GCJV in identifying habitat objectives.

Phylogeography and geographic variation in the Red-bellied Woodpecker (*Melanerpes carolinus*)

Barrowclough, George - American Museum of Natural History; Jeff Groth - American Museum of Natural History; Elizabeth Bramlett - American Museum of Natural History; William Mauck - American Museum of Natural History; Jonas Lai - American Museum of Natural History

We sequenced the mitochondrial ND2 gene of 72 Red-bellied Woodpeckers (*Melanerpes carolinus*) from ten populations distributed throughout their range. We identified 25 haplotypes, one of which was very common and distributed in all populations except southern Florida. In addition, a small clade of haplotypes was restricted to the Florida peninsula where it was present in all populations at high frequency. ND2 nucleotide diversity was lowest at the edges of the geographic range and overall Gst was twenty percent. *M. c. perplexus*, described in 1944 and restricted to southern Florida, is characterized by a pale post-nasal band that divides the red forehead and crown of males into two disjunct patches. We interpret the geographic patterns of plumage and ND2 haplotype distribution to represent the signatures of allopatric differentiation during the Pleistocene. The two zones of intergradation (hybrid zones) differ in their central points, maximum slopes, and widths; this might be the result of selection or differential rates of gene flow for the mitochondrial and nuclear markers. These represent two phylogenetic species.

Elevational movement patterns drive hemoglobin concentration in Himalayan birds: A Tensing and Hillary story

Barve, Sahas - Cornell University; Zachary Cheviron - University of Montana; Vinod Mathur - Wildlife Institute of India; Andre Dhondt - Cornell University

Hypobaric hypoxia or the decreasing partial pressure of oxygen with increasing elevation is a global constraint for organisms at high elevations. Although the relationship between elevation and hypoxia has been established for decades, little is known about how hypoxia might constrain species distribution. Hemoglobin is a crucial respiratory pigment for oxygen transport in vertebrates. We undertook a comparative study to explore variation in hemoglobin concentration and hematocrit (volume of red blood cells in blood) in 15 species of Himalayan birds along a 2500m gradient. We quantified within and among species variation in hemoglobin concentration and the relationship between hemoglobin concentration and hematocrit. In a linear mixed model framework we incorporated several covariates of natural history to understand the drivers of hemoglobin concentration in these birds. We did not find the predicted strong correlation between hemoglobin concentration and hematocrit in all species. Elevational migrants (birds that winter in lowlands and breed in the highlands) showed the predicted positive relationship between hemoglobin concentration and hematocrit, while resident birds (birds that live year round at the same elevation) did not show such a correlation. Resident birds however had a higher mean cellular hemoglobin concentration than elevational migrants. The linear mixed models also demonstrate that elevational migrants and resident birds have a functionally different way of regulating hemoglobin concentration. These results show that natural history plays an important role in how Himalayan birds cope with hypoxia. Our results suggest the importance

of taking a comparative community approach while studying the effects of hypoxia.

Mindful silviculture: creating habitat for greater avian biodiversity
Bassett, Graham - Plymouth State University; **Leonard Reitsma** - Plymouth State University

Interest is increasing among landowners, foresters, and conservationists concerning best practice silviculture. Timber harvested from small patch cuts can create necessary disturbance and openings that may positively affect avian diversity with little to no impact on forest-interior species. Work done on a 46.5ha American Tree Farm with 18 patch cuts (0.1-0.6ha) resulted in numbers of early successional species increasing without detracting from pre-harvest numbers of mature-forest species. Point counts, territory mapping, and nest searching were used to assess changes in community structure and individual success during five consecutive breeding seasons (2011-2015) before and after a March 2012 experimental harvest. Return rates of three target species, Black-throated Blue Warbler (*Setophaga caerulescens*), Ovenbird (*Seiurus aurocapilla*), and Hermit Thrush (*Catharus guttatus*), were at or above those found in comparable studies(Holmes et al. 1996, Hartley 2003). Data collected from point count observations resulted in a significant increase in species diversity ($F=25.9;df=3,116;p < 0.05$). Nest success data for these three species was gathered in 2013, and nest productivity was high post-harvest. Implementing forestry practices that promote recruitment of early successional bird species should ideally be planned at landscape scales, being mindful of the ecological needs of forest-interior species and region-specific concerns. For example, no incidence of nest parasitism has been documented on this site. Stewardship aimed at locally increasing biodiversity, especially among avian species, can reflect broader landscape implications, and smaller, private forest landowners may be agents willing to meet such goals.

What genes are important to immunity and survival in the endangered Attwater's prairie-chicken?
Bateson, Zachary - UWM; Susan Hammerly - Univ. of North Texas; Jeff Johnson - University of North Texas; Michael Morrow - USFWS; Linda Whittingham - University of Wisconsin-Milwaukee; **Peter Dunn** - University of Wisconsin-Milwaukee

The negative effects of inbreeding on fitness are serious concerns for populations of endangered species. Reduced fitness has been associated with lower genome-wide heterozygosity and immune gene diversity in the wild; however, few studies have compared both types of genetic variation in the same study. Thus, it is often unclear whether variation in fitness was due to the general effects of inbreeding, immunity-related genes, or both. Here, we tested whether genome-wide heterozygosity (20 990 SNPs) or diversity at six immune genes was a better predictor of two measures of fitness (immune response and survival) in the endangered Attwater's prairie-chicken (*Tympanuchus cupido attwateri*). We found that post-release survival of captive-bred birds was related to alleles of the innate (toll-like receptors, TLRs) and adaptive (major histocompatibility complex, MHC) immune systems, but not to genome-wide heterozygosity. Likewise, we found that the immune response at the time of release was related to TLR and MHC alleles, and not to genome-wide heterozygosity. Overall, this study provides a critical step in genetic rescue efforts by discovering candidate immune genes that are related to fitness.

Phylogeography of the Rufous Hummingbird (*Selasphorus rufus*): Insights on Migratory Connectivity and a Recent Wintering Range Expansion

Battey, C.J. - University of Washington Dept. Biology; Donna Dittmann - Louisiana State University; Steven Cardiff - Louisiana Museum of Natural Science; John Klicka - Burke Museum of Natural History

Rufous Hummingbirds (*Selasphorus rufus*) fly up to 7,000 miles a year in an annual clockwise loop of western North America. Although the species is abundant and locally common during the breeding season, population-level migratory connectivity remains mostly unknown because of low banding recapture rates and the lack of tracking devices small enough to fit on a hummingbird. We sequenced genomic SNP's from 64 *S. rufus* specimens caught on the breeding grounds and across the main east-west divide in migratory routes in order to test for population-level philopatry and migratory connectivity. In addition, we sequenced 17 specimens of *S. rufus* caught while wintering in Louisiana in order to infer the likely breeding range of individuals now wintering on the US Gulf Coast. We found that the species exhibits clinal variation in allele frequencies across the breeding range (e.g. isolation-by-distance), suggesting that most individuals return to their breeding region in successive years. We tested the utility of several population assignment pipelines to infer the breeding range of individuals caught on migration and find moderate levels of geographic connectivity between breeding ranges and migratory routes. Preliminary results find that southeastern-wintering populations include most of the genetic diversity present across the species' range, suggesting that they are not the product of an isolated founder event. We discuss the implications of our findings in the context of the long-term decline of *S. rufus* populations documented in the Breeding Bird Survey, and address future directions for research in the species.

Using Occupancy Data to Detect Phenological Changes in Avian Populations

Baumgardt, Jeremy - Institute of Renewable Natural Resources, Texas A&M University; Michael Morrison - Department of Wildlife and Fisheries Sciences, Texas A&M University; Leonard Brennan - Caesar Kleberg Wildlife Research Institute, Texas A&M University – Kingsville

The study of phenology often relies on date of first arrival or first egg laying for avian communities. Using annual peak detection probability (p) to monitor phenological change avoids many of the biases that the aforementioned indices are prone to. We analyzed point-count data collected in south Texas at 30 transects from 6 occasions from 20 April to 24 July 2015 in a multi-scale occupancy framework. We fit a model with a 3rd order polynomial for time in p to records from individual species and identified the predicted date of greatest p using Program Mark. We detected 138 total species and fit models to a subset of 25 species representing a range of p and life histories. Our range of sampling was too late to include peak p for some resident species such as Cassin's Sparrow. The earliest peak in p for a breeding migrant was 13 May (Scissor-tailed Flycatcher). Our latest peaking resident was Black-throated Sparrow on 12 July and our latest migrant was Painted Bunting on 28 June. Replicating our methods with a long-term dataset would allow researchers to detect shifts or cycles in peak p and potentially link these changes to ecological processes. Additionally, identifying peak p allows biologists to make informed decisions for timing of future surveys, both for monitoring occupancy and phenology.

High-resolution "genoscapes" of neotropical migrants elucidate population-level distribution and migration patterns
Bay, Rachael - UCLA; Kristen Ruegg - UCLA; Thomas Smith - UCLA

Effective conservation plans are often hindered by a lack of resolution for population boundaries, making it difficult to determine which populations are vulnerable to anthropogenic threats. The decreasing cost of genomic sequencing now allows for high-resolution analysis of population differentiation in any species across any landscape. Using a combination of whole genome assembly, restriction site associated DNA sequencing (RAD-Seq), and targeted genotyping, we have developed a pipeline for building high-resolution maps of genomic structure, which we call "genoscapes". These maps can then be used to delineate boundaries of vulnerable populations, understand movement of migratory species, define biodiversity hotspots, and predict species response to environmental change. In this presentation I will outline the goals of the Bird Genoscape Project, including the current set of taxa for which we are building genoscapes and the ways that the resulting data can be used to inform management of vulnerable populations.

Migration stopover strategies within the Neotropics: filling the black hole in our knowledge of annual cycles
Bayly, Nicholas - SELVA: Investigacion para la conservación en el Neotrópico

It is now well recognized that to conserve migratory birds, we must understand their needs at all stages of their life cycle and design conservation strategies that take into account when populations are most vulnerable and where actions can have the maximum positive impact on population dynamics. While our knowledge of carry-over effects and links between different stages of the life-cycle has been increasing exponentially, one major piece of the puzzle is missing. Migration strategies, despite decades of research and recent technological advances, still remain poorly described and our nascent knowledge of stopover regions, habitat use and quality, and their impact on population dynamics, remain a barrier to full life-cycle conservation planning. This is particularly true in the Neotropics, where the strategies of migratory landbirds have rarely been studied and yet the geography of the region suggests that critical stopover areas must exist. Here we describe how this critical knowledge gap is being filled, showing how by combining results from tracking technologies, stable isotopes and on-the-ground observational and mark-recapture studies we can shed light on one of the least understood aspects of the lives of migratory birds.

The elevational distribution and winter ecology of the Canada Warbler in the Andes of Colombia: the basis for defining conservation priorities
Bayly, Nicholas - SELVA: Investigacion para la conservación en el Neotrópico; Laura Cespedes - SELVA: Investigación para la Conservación en el Neotropico; Keith Hobson - Environment Canada

The Canada Warbler (*Cardellina canadensis*) is a declining Neotropical migratory bird and >50% of its non-breeding range is within the Colombian Andes. Despite being relatively abundant in Andean forests, the species' elevational distribution and non-breeding ecology have yet to be studied, thereby precluding the design of effective conservation actions. During two non-breeding periods (2014-2016), we surveyed five Colombian regions, carrying out passive five minute point counts and one minute playback experiments between 700 m and 3150 m, in three habitats (mature forest; secondary forest; shade coffee). For all birds detected, we recorded perpendicular distance, age and sex where possible, foraging height, and association with mixed

species flocks. We recorded habitat variables at each point. Based on passive point counts (822 points) and playback experiments (500 points), Canada Warblers occupied elevations between 1000 and 2250 m, with a tendency to be more abundant between 1250-1500 m. Density was higher in mature forest relative to shade coffee at the same elevation, and with increasing canopy height. Birds in forest foraged at mid-levels, 5 to 15 metres above the ground. There was limited evidence for a difference in the elevational distribution of males and females. The probability of Canada Warblers occurring in mixed-species flocks increased with elevation. For maximum effectiveness, conservation actions should focus on reforestation projects and the protection of forest fragments at mid-elevations (1000-2250 m). Given high densities and presence of birds from declining populations (connectivity analysis), actions may be more effective in the Eastern Cordillera of Colombia.

Habitat selection by Burrowing Owls in prairie Canada across life stages and scales: What is the right conservation strategy when data are contradictory?
Bayne, Erin - University of Alberta / Department of Biological Sciences; Corey Scobie - Royal Alberta Museum; Alan Marsh - Lotek; Troy Wellicome - University of Alberta

The Burrowing Owl is often used as the poster child for native prairie conservation in Canada. The species has declined over 90% in the past 50 years. These decline have been correlated with loss of native prairie and the cumulative effects of other land-uses. While specific in the types of nests they require, the Burrowing Owl is capable of living in a wide array of environments across their range. We evaluated if the correlative pattern of agricultural land-conversion and human disturbance correlated with Burrowing Owl declines are in fact reflected in their current behavior and demography in different landscapes. We used high-resolution GPS transmitter data and videography at hundreds of nests to determine how, when, and where Burrowing Owls obtain prey at different life stages. We then evaluated the consequences that habitat selection at different orders influences reproductive success and survival. Using different approaches to creating resource selection functions we found several patterns of habitat selection that if applied as conservation tools would contradict past conservation recommendations and suggest that agriculture per se is not the sole driver of observed declines. Understanding the underlying processes that influence prey capture is crucial to understanding how habitat selection should or should not inform Burrowing Owl conservation. We demonstrate that the “resources” measured and the timing of when these resources are obtained need to be explicitly tied to demography if conservation decision making is to be optimized for the Burrowing Owl.

Using eBird to find relationships between priority migratory species and resident birds in western Mexico for conservation project planning
Beardmore, Carol - U. S. Fish and Wildlife Service

Partners in Flight is using the concept of Conservation Business Plans to market full annual cycle conservation for both priority migratory species and resident tropical species. Priority migratory species were selected that define north-south movement within geographic areas and ecosystem types. To link migratory species to tropical resident species I searched eBird to find associations, such as Black-capped Vireo’s association to resident species such as Mexican Woodnymph and Flammulated Flycatcher, which were¬¬ identified in “Saving our Shared Birds” as priority residents. These linkages will provide the basis for planning, project selection, and funding in the Tropical Deciduous Forest geographic area.

Annual Survival and Breeding Dispersal in Scissor-tailed Flycatchers: Associations with Sex and Reproductive Success?

Becker, Adam - Portland State University; Diane Roeder - University of Oklahoma; Mike Husak - Cameron University; Michael Murphy - Portland State University

Breeding dispersal (i.e., movement between breeding locations in successive years) in birds exhibits considerable interspecific variability but is typically sexually biased in that females disperse more frequently and at greater distances than males, especially in the closely related Eastern Kingbird (*Tyrannus tyrannus*). Unsuccessful breeders also tend to follow this pattern. We banded 151 adult male and 119 adult female Scissor-tailed Flycatchers (*Tyrannus forficatus*) between 2008 and 2015 at two sites near Lawton, OK. Return rates in successive years were established through recapture and resightings, while breeding dispersal was measured as the distance between nests in successive years. Return rates to our sites were low (24.4%) and did not differ between the sexes. Detectability was also low, however, and estimates of annual survival based on MARK analyses did not differ between the sexes. Birds that returned were significantly more likely to have successfully raised young in the previous year, but among the returnees, the frequency of dispersal (> 600 m) did not differ between successful and failed breeders, nor between the sexes. Breeding dispersal distance of males (478 ± 81 SE, n = 42) and females (752 ± 257 SE, n = 34) did not differ, nor did that of failed (681 ± 208 SE, n = 18) and successful (657 ± 177 SE, n = 48) breeders. Thus, unlike most birds, only modest evidence suggests that prior nest success influenced dispersal probability, and little to no evidence suggested a sexual difference in dispersal behavior.

Testing the role of interspecific introgression across elevation and geography in the South American siskins.

Beckman, Elizabeth J. - Museum of Southwestern Biology, University of New Mexico; Christopher Witt - University of New Mexico

Interspecific gene flow may be an important mechanism for introducing selectively advantageous alleles into new species, particularly among recently diverged lineages. A likely candidate for advantageous interspecific introgression is the mitochondrial genome since specific haplotypes may facilitate thermogenesis and reduce risk of O2 free radical damage at high elevations. Further, significant discordance between phylogenies constructed with mitochondrial and nuclear genes is documented across bird orders, suggesting a complex history in mitochondrial DNA. We investigated the adaptive potential of mtDNA introgression in a recent, diverse clade of finches, the South American siskins (Spinus). This clade includes three high elevation specialist species as well as one species with an extensive elevational range; these species occur sympatrically in the high Andes. We hypothesized that an unique pattern of mitochondrial haplotype sharing among elevation-restricted and widespread siskin species was the result of mitochondrial introgression. To test this hypothesis, we generated a dataset of 45,000 variable loci using a RADseq approach to (1) construct a phylogenetic tree based on nuclear DNA, and (2) test for nuDNA introgression among sympatric, high elevation species using population genetic and phylogeny based approaches. We found morphological species are genetically distinct; however we discovered congruent evidence across tests for nuclear introgression among restricted high elevation and widespread species. This introgression pattern mirrors mitochondrial haplotype distributions in the Andes, including the acquisition of a high-elevation haplotype in low elevation clade. We conclude that rare

introgression among recently-diverged species is an important component to high altitude adaptation.

History of bird-aircraft collisions and the role of Bird Strike Committee-USA within the International Civil Aviation Organization

Begier, Michael - USDA APHIS Wildlife Services

Soon after the breakthrough of powered flight in 1903, the Wright Brothers created another footnote in aeronautical history. In 1905, the first bird strike was recorded during test flights over cornfields in Ohio. Aviation is rich with stories of how human engineering skills overcame technology shortfalls, often related to safety issues. However, interactions between the sciences of ecology and aviation have not been so clear cut. The first human fatality tied to a bird strike was in 1912 in California when a gull (*Larus sp.*) compromised the aircraft controls resulting in a crash in the surf. Several high profile accidents involving birds and aircraft during the past 50 years have increased our understanding about the complex relationships between wildlife ecology, human behavior and aviation safety. The International Civil Aviation Organization, which governs global standards for aviation, encourages member nations to establish Bird Strike Committees to discuss solutions. Each national committee should include governmental departments such as transport, defense, agriculture, and environment as well as representatives from the major aircraft and airport operators, pilot associations, and airframe and engine manufacturers. Communication among people from these disciplines is key to addressing the issues locally and nationally. Bird Strike Committee USA (BSC-USA) has provided a forum since 1991, through annual conferences and other activities, that advances current science, best practices and provides comment on regulatory issues that affect the interplay between natural resources management and aviation safety. BSC-USA welcomes ornithologists to participate in these activities.

Reproductive costs for female Greater Sage-grouse in Northern Nevada and Southern Oregon

Behnke, Tessa - University of Nevada, Reno; Phillip Street - University of Nevada, Reno; James Sedinger - University of Nevada, Reno

Differential exposure to risks and altered energy budgets associated with raising young could lead to costs of reproduction for female Greater Sage-grouse. We implemented a multistate model to investigate the effects of reproduction on survival. To assess instantaneous and short-term costs in terms of survival, we separated female birds into three states: non-breeding, nesting, and brood-rearing. We also assessed lagged costs by including a covariate for reproductive effort on fall survival. This individual covariate included days spent incubating combined with days the hen tended chicks after hatch. We estimated weekly survival rates from March to February of the following year using 480 radio-marked hens from 2013-2015. We assessed impacts of annual precipitation, hen age, and reproductive effort on survival. Weekly survival did not vary among states, suggesting little instantaneous cost of nesting or brood rearing. We did observe variation among years and seasons. Fall survival was negatively influenced by increased reproductive effort, with the strongest effect during 2015, indicating a delayed cost of reproduction. Annual precipitation positively influenced fall survival in 2013- 2014, but negatively impacted fall survival in 2015. Annual precipitation was 10cm greater in 2015, than in 2013 or 2014, and most of the additional moisture came as spring rain during the breeding season. The interaction between year and precipitation, combined with the interaction between year and reproductive effort suggest that overall costs of reproduction are exacerbated in years with extreme weather events.

Rails in a Working Landscape: Links Between Metapopulation Dynamics, Landowner Decisions, Drought, and Disease Ecology.

Beissinger, Steven - UC Berkeley; Laurie A. Hall - Humboldt State University; Nathan van Schmidt - University of California at Berkeley; Sean Peterson - University of Minnesota; Lynn Huntsinger - University of California at Berkeley; Norman L. Miller - University of California at Berkeley; Tony Kovach - University of California at Santa Cruz; A. Marm Kilpatrick - University of California at Santa Cruz

Incorporating people directly into the system under study from multiple perspectives may offer the best potential to produce meaningful conservation solutions. This approach has been characterized as coupled natural and human systems (CNH) research. It uses a multidisciplinary approach to identify important feedbacks between different components of a study system and models system complexity across organizational scales. Here we illustrate how CNH thinking can be applied to understand factors affecting metapopulation dynamics of Black (BLRA) and Virginia Rails (VIRA) inhabiting small wetlands in a working landscape in the Sierra Nevada foothills. We quantify linkages between rail metapopulation dynamics, landowner decisions, climatic variation, and disease ecology. Landowners have increased the number of foothills wetlands, with over 2/3rds of sites receiving irrigation water. Colonization rates of the smaller BLRA were strongly affected by wetland area and secondarily by irrigation, while extinction rates were driven by isolation and area. Turnover of the larger VIRA was primarily driven by site area. Occupancy rates of both species strongly declined after the arrival of West Nile Virus (WNV) in 2007 and due to drought from 2013-15. WNV-positive mosquito abundance and prevalence among sites varied consistently across years. These factors were integrated through an agent-based model that allows landowner irrigation decisions to affect the number, size and distribution of wetlands on the landscape. Preliminary results suggest that actions within the human system are profoundly impacting the natural system, but resulting changes in the natural system have weak feedbacks on the human system.

Cultural ecosystem services and disservices of birds in urban neighborhoods

Belaire, J. Amy - St. Edward's University; Lynne Westphal - US Forest Service; Christopher Whelan - Illinois Natural HIstory Survey & University of Illinois at Chicago; Emily Minor - University of Illinois at Chicago

As our world becomes increasingly urbanized, cities are often where we come into contact with the natural world— not just in parks and urban nature preserves, but in more familiar places like residential yards. We conducted bird surveys and social surveys in Chicago-area residential landscapes near forest preserves (primarily in middle- and high- income areas) to examine residents' perceptions of the birds that co-inhabit their neighborhoods and the relationship of those perceptions with characteristics of the bird community. We found that residents value many aspects of neighborhood birds, especially those related to aesthetics and birds' place in the ecosystem. Our results indicate that while birds were generally well liked and annoyances were minor, several common and visible urban species, such as the House Sparrow (*Passer domesticus*), European Starling (*Sturnus vulgaris*), and Blue Jay (*Cyanocitta cristata*), may attract attention for their negative qualities, such as their sounds and effects on personal property. The results also indicate that residents' valuations of ecosystem services are linked to their perceptions of bird species richness rather than the actual species richness, and people may perceive only a subset of the birds in their neighborhoods. Although birds provide many important ecosystem services, perhaps

one of their most important roles in cities is as a relatable and likable connecting point between city dwellers and the broader environment.

Testing the effect of increasing predator abundance on prey populations using census data

Bell, Christopher - SongBird Survival

The proposition that increasing abundance of predators may have contributed to long-term declines in bird species' populations at a widespread scale is in theory testable using national census data, but such an approach is beset by methodological difficulties. As with all time-series data, spurious correlations between predator and prey populations may emerge because of covariance of both with a third variable. Regression analysis has therefore been used to compare within-year trends in prey and predator numbers at census sites, but spurious correlations are still likely to arise because of sequential occupation/withdrawal from different habitats during either population expansion or contraction. In the UK, the spatio-temporal pattern of recovery of the Eurasian Sparrowhawk, following pesticide-related populations lows in the mid-20th century, has been documented in great detail by national census data. Comparison of average trends among prey species in relation to the year of recolonisation of sites by Eurasian Sparrowhawk has the potential to reveal the effect of the predator where its appearance coincides with a downturn in prey species' population trends. The possibility of spurious correlation between such downturns and the spread of the predator can be tested by calculating the trend that would occur if prey species nunbers at sample sites were simply mirroring national trends. Results of such analyses for 40 potential prey species indicate a population level effect of predation by the Eurasian Sparrowhawk in 18 species.

An Evaluation on the Effects of Restoration on Nesting and Brood-Rearing Success of Northern Bobwhite in North-Central Texas

Belleny, Danielle - Tarleton State University; Heather Mathewson - Tarleton State University; Jeff Breeden - Tarleton State University; John Tomeček - Department of Wildlife and Fisheries Sciences | Texas A&M AgriLife Extension Service; T. Wayne Schwertner - Tarleton State University; James Giocomo - Oaks and Prairies Joint Venture - American Bird Conservancy

The decades long decline in grassland avian populations is ultimately attributed to changing land use throughout the United States. Due to their economic importance and status as a healthy grassland indicator species, attention focused towards proper habitat management for northern bobwhites (*Colinus virginianus*) benefits other grassland avian species. While several studies focus on the conservation of bobwhites, this study addressed the effectiveness of such conservation practices. The Oaks and Prairies Joint Venture established a landowner incentive program in north-central Texas and conducted approved land management activities (i.e. mechanical and chemical brush removal) within 2 years before the study. Land restoration practices offer opportunities to mitigate the declines in bobwhite populations. Regions across the United States have documented increased grassland bird abundance in response to restoration practices; however, studies regarding the effects of restoration on bobwhite habitat use are lacking. Our study evaluated the effects of various land manipulation practices on reproductive success and microhabitat selection in nesting and brood-rearing bobwhite through comparisons among treated and control sites. Using radio-marked bobwhite we will examine how land manipulation practices influence spatial heterogeneity, microhabitat selection, and nest predators assemblages. Understanding bobwhite productivity may be

the most imperative factor associated with their current population size. Previous literature suggested bobwhite nesting and brood rearing microhabitats vary widely in vegetation characteristics. More complex spatial heterogeneity reduces predator search time thus, it reduces the opportunity to overexploit their prey. Managing land to increase spatial heterogeneity may be an alternative to predator control.

Multiple commonly used measures of bird song complexity are uncorrelated within a single species

Benedict, Lauryn - University of Northern Colorado; Nadje Najar - University of Northern Colorado; Stephanie Pitt - University of Northern Colorado

When studying the evolution of animal communication systems researchers often ask what generates and maintains signal complexity. In doing so, investigators have defined and measured complexity in different ways which may or may not be similarly informative. For this study we examined whether multiple commonly used metrics of bird song complexity varied in tandem within a single species. We measured 1) song repertoire size, 2) song delivery rate, 3) song type switching rate, 4) new song type introduction rate, 5) average song duration, 6) average song frequency bandwidth, and 7) average number of frequency modulations per song for 19,058 songs given by 12 rock wrens (*Salpinctes obsoletus*) from a single population in Colorado. Each individual bird was represented by an average of 1,588 songs and had a repertoire of between 53 and 117 song types. Measurements indicated that none of the complexity metrics positively correlated with any of the others across individuals. The complexity metrics also failed to positively predict two measures of quality: trill performance and consistency within a single song type. Our results suggest that bird songs (and potentially other communication signals) may not be under general selective pressures that favor increases in complexity along multiple linked features of signal form. If multiple measures of song form are not correlated, then researchers need to be careful when selecting traits for analysis. Studies of the evolution of signal form should first verify that the “complexity” under investigation has significance to the study species.

Genetic divergence predicts the degree of physiological divergence in salt marsh Savannah Sparrows

Benham, Phred - University of Montana; Zachary Cheviron - University of Montana

Local adaptation is a major driver of population divergence in birds. Although driven by differential selection, gene flow, fluctuations in population size, and colonization history can constrain adaptation. Inundations of seawater into salt marshes impose severe osmoregulatory challenges for most freshwater adapted birds. However, multiple Savannah Sparrow subspecies have successfully colonized salt marshes along the Pacific coast. Comparing variation in demographic history and divergence in physiologically relevant traits among salt marsh populations provides a powerful framework to assess demographic influences on adaptation. From 11 salt marsh and three interior populations we measured a suite of osmoregulatory traits and sequenced thousands of SNPs for historical demographic inference to address whether: (1) salt marsh populations exhibit demographic differences? And (2) do these differences influence adaptive differentiation in osmoregulatory traits? Genetic analysis revealed two clusters: (1) interior populations from across the distribution including California salt marsh birds; and (2) salt marsh populations from northwest Mexico. Secondly, we found a pattern of decreasing nucleotide diversity from north-to-south along the Pacific coast. Kidney mass and medulla size in salt marsh birds were larger than their interior counterparts and these structural changes were associated with increased urine and

plasma osmolality. However, Mexican salt marsh populations were more divergent from interior populations than California birds. We also found a positive correlation between Fst and the degree of osmoregulatory divergence from interior populations. These results suggest that time since divergence and/or gene flow play a significant role in constraining adaptive divergence in salt marsh savannah sparrows.

The evolutionary dynamics of a key life history trait, and the ecological consequences of climate change in fire-prone forests
Benkman, Craig - University of Wyoming

The retention of seeds in fruits (serotiny) for extended periods is an important life history characteristic of woody plants in fire-prone communities that provides a resource on which some bird species specialize (e.g., crossbills, cockatoos). Unfortunately, the abundance of seeds in serotinous fruits will decrease with increasing fire frequency, because of less time for seeds to accumulate in the canopy. Moreover, these canopy seed banks will become increasingly unreliable with increasing temperatures, because high temperatures cause the sudden release of seeds. The consequences will be devastating, not only for the serotinous plants, which are often foundation species of the community, but also for many bird species. I will discuss the reliance of birds on seeds retained in serotinous fruits, the influence of fire and seed predators on the evolution of serotiny, and the ecological and evolutionary implications of shortened fire intervals and increasing hot days across an increasingly human-dominated landscape.

Sexual segregation in overwintering Golden-winged Warblers (*Vermivora chrysoptera*) at multiple spatial scales.
Bennett, Ruth - Cornell University Department of Natural Resources; Amanda Rodewald - Cornell Lab of Ornithology and Cornell University Department of Natural Resources; Kenneth Rosenberg - Cornell Lab of Ornithology

At the most basic level, successful conservation of Nearctic-Neotropical migratory birds requires a thorough knowledge of non-breeding distribution and critical wintering areas. For the Golden-winged Warbler (*Vermivora chrysoptera*), a sharply declining Neotropical migrant, non-breeding season conservation efforts are complicated by relatively few observations of females and indications that the sexes may segregate by habitat. Until now, low detection probability of females has prevented a robust comparison of the distribution and habitat associations of the sexes. During two non-breeding seasons in 2015 and 2016, we developed and used a protocol to improve detection probability of females by eliciting mobbing behavior with playback. We conducted surveys at 1103 points distributed across five Central America countries, detecting 95 males and 60 females. We furthermore conducted detailed foraging observations of 50 individuals at a site where sex ratio changes along a physical gradient in Honduras. Based on these data, we created sex-based, range-wide distribution models to compare habitat segregation at the landscape level and used behavioral observations to compare microhabitat use between the sexes. Our results show that sexual segregation occurs at the scale of landscape and territory. Females occupy areas that receive less precipitation during the stationary non-breeding season, in more fragmented landscapes, and in territories with lower canopy heights than male occupied areas. By accounting for female distribution, we show that critical wintering areas occur in habitats previously considered unsuitable for the

species, and we propose the expansion of focal areas for conservation to incorporate female dominated landscapes.

Interspecific variation in nest survival is not driven by nest predator identity or nest-site characteristics in shrub-nesting birds

Benson, Thomas - Illinois Natural History Survey, University of Illinois; Scott Chiavacci - Illinois Natural History Survey, University of Illinois

Considerable attention has been focused on factors influencing spatiotemporal variation in avian nest survival. Despite focus on causes of nest failure within species, relatively little consideration has been given to variation in nest survival among species nesting within close proximity. Predation is the leading cause of nest failure for most open-cup nesting passerines, and nests of different species within the same habitats may be susceptible to the same predator species. However, numerous factors, including the timing of nesting within the breeding season, nest height, nest-site habitat, and species-specific behaviors may influence the probability of nest predation. We examined causes of interspecific variation in nest survival in shrub-nesting birds at 12 sites in Illinois from 2011 to 2014. Using data collected from >2,000 nests of 7 different open-cup nesting passerines, including >350 video-monitored nests, we examined the importance of nest height, nesting date, habitat characteristics surrounding nest sites, and nest concealment on nest survival and predator identity. After controlling for these ecological factors, we examined whether adding species identity explained further variation in nest survival or predator identity. After controlling for date and aspects of the nest site, bird species were susceptible to the same suite of nest predators. Nonetheless, species exhibited considerable variation in daily survival rates even after accounting for nest-site characteristics. Given that these species were susceptible to the same nest predators, interspecific differences in nest survival likely reflect differences in predation rates resulting from interspecific behavioral differences.

Nesting Plasticity in a Tidal Marsh Sparrow

Benvenuti, Bri - The University of New Hampshire; Jennifer Walsh - Cornell University; Denyelle Surrell - University of New Hampshire; Kathleen O'Brien - United States Fish and Wildlife Service; Adrienne Kovach - University of New Hampshire

Tidal-marsh birds that nest on the marsh surface are faced with adaptive challenges and a trade-off between flooding and predation pressure. We investigated adaptive responses in nesting behavior of the Saltmarsh Sparrow, an obligate tidal-marsh breeding bird, using 370 nests from four New England marshes from 2011-2015. Using mixed effects models, we evaluated the relationship of structural nest characteristics and nesting success. For females with multiple nesting attempts within the same season, we investigated changes in nest structure and placement as a function of nest success. We also tested the hypothesis that females have fidelity in the placement of their nests by comparing distances among nest locations of individual females across 2-5 breeding seasons. Nest characteristics differed among females by nesting success, with fledged and predated nests built higher in the vegetation and in higher elevation areas of the marsh than those that flooded. Additionally, vegetation composition, nest height, and elevation differed between consecutive nests, consistent with a response to previous experience. Females whose nests were predated in their first nesting attempt moved their second nests farther than females with fledged nests. Furthermore, 80% of females renested between years within the average home range diameter distance (77m), suggesting nest placement fidelity. Our findings suggest that Saltmarsh Sparrows exhibit plasticity in nesting

behavior, which may be important for balancing selective pressures in a dynamic environment. This plasticity, however, may be insufficient in the face of increased flooding predicted with sea-level rise.

Phylogenetic relationships of *myzomelid* honeyeaters reveal contrasting patterns of diversification in Australasia
Benz, Brett - American Museum of Natural History; Robert Moyle - University of Kansas

The *myzomelid* honeyeaters (*Myzomela*, Meliphagidae) comprise 77 named taxa in 30 species, and are ubiquitous across much of the Australasian tropics. Despite their small size, most *myzomelids* exhibit a strong capacity for long-distance dispersal, which has enabled successful colonization of remote islands throughout Wallacea, Micronesia, and western Polynesia. Although several recent studies have brought significant advances in resolving higher-level meliphagid phylogenetic relationships, limited representation within *Myzomela* has precluded detailed biogeographic inference within the group. In this study, we developed a multilocus dataset with comprehensive taxon sampling to examine the diversification history and species-limits of *myzomelid* honeyeaters throughout their distribution. Maximum likelihood and Bayesian inference analyses recovered a well resolved phylogeny indicating that *myzomelid* honeyeaters likely arose in the Bismarck Archipelago during the late Miocene, followed by early waves of diversification in New Guinea, Australia, and eastern Wallacea. Secondary pulses of rapid diversification are evident in the Solomon Islands, Wallacea, Micronesia and western Polynesia, which account for over half of the myzomelid species diversity. The evolutionary history of *Myzomela* is considerably more complex within archipelagos of Wallacea by comparison with Melanesian and Polynesia counterparts, a pattern that is consistent with other Australasian bird groups. Our molecular phylogenetic results also clarified several important aspects of *myzomelid* plumage evolution and taxonomy, revealing paraphyly in four currently recognized species complexes and confirming labile plumage evolution throughout the group.

Comparative developmental biology of the vocal-flight-respiratory axis in a tropical bird community
Berg, Karl - University of Texas-Rio Grande Valley; Astolfo Mata-Betancourt - Centro de Ecología Instituto Venezolano de Investigaciones Científicas

Vocal learning and flapping flight are among the most celebrated and contentious of avian behaviors. Each co-opted ancestral respiratory systems, however given their complex physiologies, each has usually been studied independently, and little is known about how birds coordinate vocal production given the respiratory demands of flapping flight, or how the two behaviors influenced each other over evolutionary time scales. We studied vocal and locomotor ontogeny in representatives of four lineages of the Psittacopasserae: parrots, finches, flycatchers and woodcreepers in a tropical bird community of Venezuela. We filmed inside nest cavities every day during development in 36 broods containing 136 nestlings. Flight trials were conducted during successive stages in nestling development by releasing each nestling from a fixed height onto a soft trampoline to quantify displacement from the center. Flight attempts were captured with high-speed video to quantify wingbeat frequency and any evidence of integration with vocals. Preliminary results indicate that attainment of flapping flight was significantly correlated with fledging age. The three passerines showed only subtle differences in onsets to and rates of flight development compared to the more distantly related parrot. Despite the phylogenetic distance, the two vocal learning taxa (parrot and finch), functionally integrated contact calls with flight precursors, while wing movements and vocal production tended

toward mutually exclusive behaviors in the non-vocal learners (flycatcher and woodcreeper). These results and other studies support the notion that a developmental departure in the vocal-flight-respiratory axis characterized early branching in the largest radiation of vocal learners.

Bird Conservation and Citizen Science in México

Berlanga, Humberto - CONABIO

Twelve years ago AverAves (eBird México) was launched in México as a product of the collaboration between the National Commission for the Knowledge and Use of Biodiversity (CONABIO), the Cornell Lab of Ornithology and the National Audubon Society. AverAves rapidly became the main source of online data about Mexican birds. In a country where birds have deep and diverse cultural roots, there is little interest for bird watching or bird conservation in a population more concerned about primary interests such as education, health or the economy. In this context, CONABIO through the coordination of the North American Bird Conservation Initiative (NABCI), has successfully promoted the use of this tool. We have used three main different strategic approaches: 1. Link the use of AverAves with sustainable productive programs for conservation; 2. Use the internet (avesmx) and the social networks for outreach to engage and inform participants; and 3. Develop the Urban Birds program (PAU) in order to awake the interest of urban citizens for Mexican birds. Today thousands of participants are directly or indirectly involved, nationwide, in these programs, contributing on regular basis to submit data and spreading the joy of watching and identifying species, as well as being part of a new national recreational activity, that scientist, wildlife managers and decision makers are using in a variety of ways to better understand bird biology, distributions and the potential impacts of human activities. We present data, examples and information about how citizen science is contributing to build a stronger society.

Panel: Rising to Future Challenges in North American Migratory Bird Conservation

Berlanga, Humberto - NABCI-Mexico; **Greg Butcher** - U.S. Forest Service, International Programs; **Charles Francis** - Canadian Wildlife Service, Environment and Climate Change Canada; **Ashley Dayer** - Virginia Tech, Department of Fish and Wildlife Conservation & Cornell Lab of Ornithology

Cooperation among the United States, Canada, and Mexico has proved invaluable for conservation, but all three countries are increasingly aware that North American bird conservation must cover the entire Western Hemisphere (and sometimes beyond) to be successful. Discovering an effective path towards full life-cycle conservation throughout the Americas is the number one challenge to our bird conservation future. Thus modern bird conservation work cannot be effective without international cooperation. The North American Bird Conservation Initiative (NABCI) and other initiatives have helped the three countries improve communications, understand different needs and views, and to consolidate a common vision to conserve the avifauna of North America. In the years to come, sustainable landscapes, biological corridors, and resilient natural protected areas, all based on sound science, partnerships and alliances, will light the road to consolidate this international friendship and commitment to conserve all birds in all habitats. Equally important, our realization is growing that conservation success depends more and more on engaging people in conservation action. It is time to expand human dimensions science, as well as engagement of new audiences. True engagement cannot be characterized simply by a “loading dock” approach, whereby we translate our findings into ready-made products to be handed off and hopefully used. Instead we need a new way of doing

conservation science where we truly co-produce knowledge with stakeholders, engage communities in citizen science and civic action, support sustainable livelihoods, and conduct interdisciplinary science because, after all, our problems are social and ecological in nature.

A comparison of lethal and non-lethal sampling of avian gut microbial communities
Berlow, Mae - Tulane University; Emily Norris - Tulane University; Elizabeth Derryberry - Tulane University

Gut microbial communities play an essential role in the biological functions of their host. The gut microbiome mediates nutrient absorption, digests food components host enzymes are unable to, and defends the host against enteric pathogens. Gut microbiota may indirectly affect host behavior through these same mechanisms, as well as through microbial neurotransmitters and signaling peptides. Extensive research on gut microbial communities has been conducted on mammals, including humans and rats, but much less has been done in birds. Furthermore, much of the research on the effect of gut microbiota on host behavior makes use of fecal samples as a proxy for difficult to attain direct intestinal samples. Little is known however about the overlap between the microbial community of gut fauna and feces, which limits interpretability of results based on fecal samples. To address this gap in knowledge, we compare five sample types – proventriculus, small intestines, large intestines, cloacal swab, and feces – across individual zebra finches housed in constant conditions with a constant diet. We will compare diversity and community composition through amplicon-based metagenomic sequencing. Gaining insight into noninvasive sampling techniques has implications for studies of gut microbial diversity and abundance in wild bird populations. Further, reliable non-lethal sampling is necessary for temporal sampling and behavioral studies.

Post-K/Pg Extinction Lilliput Effect May Influence Avian Molecular Clocks
Berv, Jacob - Cornell University; Daniel Field - Yale University

Survivorship following major mass extinctions has been associated with a decrease in body size, a phenomenon called the Lilliput Effect. Since body size may be associated with life history traits (LHTs), which, in turn, influence population genetics, pronounced changes in organismal size throughout Earth History may be associated with concomitant changes in nucleotide substitution rates. Here, we document extreme shifts in genome wide rates of molecular evolution across a recent ~200-taxon genomic dataset, and demonstrate that these shifts are strongly associated with inferred changes in body size when controlling for other LHTs. We show that in the presence of such life history driven rate variation, even relaxed molecular clocks may dramatically over-estimate divergence times. We hypothesize that transient increases in nucleotide substitution rate deep within the extant avian phylogeny may have been associated with selection for reduced body size after the cataclysmic Cretaceous-Paleogene transition, consistent with the paleontological expectation of a ‘Lilliput Effect’ in the wake of a major mass extinction. This phenomenon may help explain divergence time debates across the tree of life, and suggests that life history evolution may be associated with deterministic molecular evolutionary outcomes.

Strength of bird trophic cascades is mediated by forest management intensity
Betts, Matthew - Oregon State University; Thomas Stokely - Oregon State University

Trophic cascades, where effects at one trophic level indirectly impact other levels, can have important implications for the

functioning of terrestrial ecosystems. There have been multiple tests of the hypothesis that forest birds exert 'top-down' effects on insects and subsequent vegetation growth in forest systems. However, the strength of these effects has been variable for reasons that remain cryptic. We hypothesized that bird trophic cascade strength would decline with increasing management intensity (i.e., decreasing plant abundance and diversity). Intensive forest management (IFM) practices use herbicides to reduce competition from non-crop plants, and are used to increase timber yield. To test our hypothesis we implemented a large-scale experiment (N=28) representing a gradient in management intensity in early successional forests of western Oregon. We also experimentally excluded birds for four years using 225 m^2 netted exclosures. We predicted that higher bird abundances in unmanaged stands would result in stronger top-down control of arthropod herbivores than in heavily managed stands. This top-down control would result in reduced tree growth. On average, bird exclosures resulted in 1.49x more herbivorous arthropods than adjacent bird-accessible plots. Further, the top-down effect of birds on arthropods was strongly mediated by forest management intensity; as predicted, intensively managed stands showed weaker and more variable bird predation effects. However, elevated arthropod abundance did not appear to influence tree growth. We hypothesize that the high productivity of Pacific Northwest forests buffers the impact of insect herbivores on plant communities.

Breeding biology of the Sooty Swift (*Cypseloides fumigatus*) and White-collared Swift (*Streptoprocne zonaris*) in southeastern Brazil

Biancalana, Renata - Universidade Federal do ABC

The White-collared Swift (*Streptoprocne zonaris*) and the Sooty Swift (*Cypseloides fumigatus*) are resident breeders in southeastern Brazil. Both species are found in Intervales State Park (ISP) in the southeast of the state of São Paulo. While many data have been collected on the development of nestlings, little is known about the construction of nests, incubation and parental care of both species. The main objective of this study was to detail the reproductive behavior of the Sooty Swift and the White-collared Swift during one breeding season. Nesting sites were sampled from October 2015 to April 2016 at the ISP. Weekly visits were made at the Água Comprida Waterfall and Luminosa Cave. Observations were done with the help of binoculars. Measurements were taken with a wing ruler, caliper, and digital scale. Adult swifts and nestlings were banded and measured. At Luminosa Cave, 25 White-collared Swift nests were found. A total of 40 nestlings were banded. At Água Comprida Waterfall three Sooty Swift nests and one White-collared Swift nest were found. Three Sooty Swift nestlings and four adults were banded. This is the first medium term study on the reproductive biology of both species in Brazil. Data gathered during the 2015/2016 breeding season will help the formulation of conservation plans and allow a better understanding of the population dynamics occurrying in this region, including philopatry, competition and migration.

Oil contaminant impacts on pre-migratory fuelling in two shorebird species

Bianchini, Kristin - University of Saskatchewan; David Newstead - Coastal Bend Bays & Estuaries Program; **Christy Morrissey** - University of Saskatchewan

Many shorebirds are currently failing to sufficiently fuel prior to departure for migration, which may be contributing to population declines in these birds. Proper fuelling is important because it increases a bird's probability of surviving migration and it determines migration speeds, which are correlated with reproductive performance. The polycyclic aromatic hydrocarbons (PAHs) found in oil pollution have the potential to

interfere with avian pre-migratory fuelling physiology. However, a link between PAH exposure and impaired pre-migratory fuelling has yet to be established. Our objective was to determine whether PAH contamination affects pre-migratory fuelling in two shorebird species. We captured over 35 Red Knots (*Calidris canutus*) and over 375 Sanderling (*Calidris alba*) from Chaplin Lake, SK, a relatively uncontaminated site, and from sites along the Gulf of Mexico, which are subject to recurring oil spills. We determined plasma PAH levels using an immunoassay, body condition using mass and fat score measurements, and fuelling status using plasma metabolite levels. We also used Motus radio telemetry array technology to track the arrival, departure, and stopover duration of over 20 Red Knots and over 75 Sanderling. We found that birds in the Gulf of Mexico had longer minimum stopover durations, which were associated with body condition and fuelling status at capture. We are currently testing the hypothesis that higher plasma PAH concentrations are associated with altered plasma metabolite profiles, body conditions, and stopover durations. This work will inform shorebird conservation by providing valuable insight into a potential cause of long distance migratory shorebird declines.

How might zoos best steward the (Avian) Tree of Life?
Biega, Alannah - Simon Fraser University; **Arne Mooers** - Simon Fraser University

Species with fewer close relatives contribute more to the Tree of Life (consider, e.g. the Kagu and the California condor), and so their extinction would cause a disproportionate loss of biodiversity (see Jetz et al. doi:10.1016/j.cub.2014.03.011). Such ""evolutionarily isolated"" species may therefore be worthy of increased attention. As zoos become ever-more involved in conservation and conservation education, zoo Taxon Advisory Groups might consider highlighting such species for both display and assurance breeding purposes. Using global Zoo holdings data and measures of avian evolutionary isolation and conservation status, we consider the patterns of current Zoo holdings, and identify candidate species at national, regional and global scales that we think the Zoo community should consider in this context. More generally, evolutionary isolation may help with prioritization for both in situ and ex situ conservation.
http://dx.doi.org/10.1016/j.cub.2014.03.011

An Integrative Approach to Understanding Hybrid Zone Movement and Introgression in Sphyrapicus Woodpeckers
Billerman, Shawn - University of Wyoming; Matt Carling - University of Wyoming

Evolutionary theory suggests that biodiversity is often created when once-continuous populations are geographically subdivided, diverge, and accumulate differences during periods of isolation. Hybrid zones, where two divergent taxa come into secondary contact and interbreed, can provide powerful insights into the differences that contribute most importantly to reproductive isolation between taxa. Red-naped (*Sphyrapicus nuchalis*) and Red-breasted Sapsuckers (*S. ruber*) meet and hybridize along a narrow contact zone that stretches from northern California to southern British Columbia. We find strong evidence for movement of the hybrid zone in comparisons of phenotypic and genotypic data, with significant differences in allele frequencies and the proportions of parental phenotypes across time. Despite identifying strong patterns of genetic structure between parental populations, there are only weak patterns of genetic divergence, with most alleles shared between parental populations: we find evidence that patterns of genetic structure are likely the result of isolation by distance, and not selection. We did find, however, that climate is strongly linked with movement in the hybrid zone, with sapsuckers tracking their climate niche through time. Red-breasted Sapsuckers, which have expanded eastward, are

predicted to expand in the future, while the range of Red-naped Sapsuckers will retract, resulting in less overlap and less hybridization. Understanding how climate change has influenced movement and the genetic structure of this hybrid zone may help us to better understand how speciation has been shaped by climate in the past, as well as how evolution may respond to climate change in the future.

Can Drones Help Our Birds?
Bird, David - McGill University

Small unmanned vehicle systems (UVS; aka drones) are gaining in popularity among wildlife biologists and managers all over the world for conducting population surveys, tracking radio-tagged animals, sensing and observing animals in sequestered or dangerous places, mapping and monitoring wild habitats, and deterring poachers. This naturally includes avian species. We have experimented with using a fixed-wing UVS to monitor the abundance of nesting common terns (*Sterna hirundo*) in a colony in Kouchibouquac National Park near Richibucto, New Brunswick, to map breeding habitat of threatened least bitterns (*Ixobrychus exilis*) in a military wetland compound near Baie-du-Febvre, Quebec, to detect heat signatures from bobolink (*Dolichonyx oryzivorus*) and Bicknell's thrush (*Catharus bicknelli*) nests, to radio track song sparrows (*Melospiza melodia*) in the Gulf Islands, and to disperse nuisance birds such as starlings from vineyards. Furthermore, we also employed a rotary UVS to record the nest contents of several raptorial bird species nesting in Saskatchewan and Montana, and monitor their respective behavioral responses. Compared to using manned light airplanes or helicopters, flying drones can be cheaper, greener, less obtrusive, and much safer (the number one source of mortality for wildlife biologists is dying in a plane or helicopter crash!). However, UVS technology is still in its infancy. Limitations exist in the form of regulations, costs, and in the technology itself, e.g. weather constraints, terrain, piloting skills, etc. This presentation summarizes the above research and discusses the positive and negative sides of using drones for avian research and management.

Diet of Great Black-backed (*Larus Marinus*) and Herring (*Larus Argentatus*) Gulls, Tuckernuck and Muskeget Islands, MA
Black, Allison - Central Connecticut State University; Richard Veit - College of Staten Island, City University of New York

Great Black-backed and Herring Gulls both colonized Massachusetts during the early 20th century, as their North American population dramatically increased and expanded southwards. Herring Gulls have declined by at least 50% after a peak before 1980, and Great Black-backed Gulls have decreased proportionately less since a peak in the 1990s. Part of the precipitous decline of gulls, perhaps most of it, reflects changes in garbage dumping procedures and decline of New England fisheries. WIth virtually no data on gull diets collected in Massachusetts, it is unknown how they are impacted by changes of fish stocks, nor how they impact fish. We studied Great Black-backed and Herring Gull diet on Tuckernuck and Muskeget Islands during the breeding season of 2015. We collected voluntary chick regurgitations as well as basic demographic data including clutch initiation date and size, hatch dates, and chick weights. We found a high frequency and proportion of squid (*Loligo pealei*) in the diet of both species. Great Black-backed diet was composed predominately of squid and fishes, while Herring diet had other sources, most notably blueberries. Great Black-backed Gulls had high fledgling success, while Herrings were less successful, especially on Muskeget Island. These findings will be used to elucidate the cause for the decline of these breeding species in Massachusetts.

Role of sensory ecology and behavioral theory in enhancing avian detection and response to aircraft approach

Blackwell, Bradley - USDA/APHIS/WS National Wildlife Research Center; Travis DeVault - USDA/APHIS/WS National Wildlife Research Center; Esteban Fernandez-Juricic - Department of Biological Sciences, Purdue University; Steven Lima - Indiana State University, Department of Biology; Thomas Seamans - USDA/APHIS/WS National Wildlife Research Center

Annually in the USA, well over 80 million bird fatalities occur as a result of automobile collisions and over 10,000 as a result of bird-aircraft collisions. In addition to animal mortality, animal-vehicle collisions pose a substantial safety concern and financial burden to the public, particularly those involving aircraft. Our purpose for this presentation is twofold. First, we will discuss how sensory ecology and behavioral theory can be applied to the development of methods that will enhance avian detection and response to approaching objects. More specifically, we will focus on the role of avian vision in the context of antipredator behavior theory, and how the sensory and behavioral frameworks provide a foundation for understanding bird response to approaching aircraft. Second, we will review progress to-date toward development of aircraft lighting intended to enhance avian detection and response to approaching aircraft.

Habitat Ecology of Pileated Woodpeckers (*Dryocopus pileatus*) in a Managed Forest in Northern California

Blake, Dawn - Humboldt State Universtiy; Matthew Johnson - Humboldt State University; Mark Higley - Hoopa Tribal Forestry

Pileated woodpeckers (*Dryocopus pileatus*) are associated with characteristics of older forest stages, such as larger diameter trees and the presence of snags used for roosting, nesting and foraging. However, pileated woodpeckers are also known to use managed forests. The Hoopa Valley Reservation (HVR) is approximately 37,000 ha of mostly forested area with an array of seral stages from old growth to recently cut stands. The Hoopa Tribe manages timber, and makes provisions for the persistence of woodpeckers. However, no formal study has assessed pileated woodpecker habitat on the HVR, and habitat has not been well described in this region. We caught and outfitted 11 pileated woodpeckers with 10g transmitter backpacks between April 2009 and May 2013. We examined habitat selection with Resource Utilization Functions, which give a weighted value of use for every GIS cell. We created a fixed kernel estimator with the plug-in method as a smoothing parameter, and then applied multiple regression to fit a model to the habitat covariates. We found that birds selected late seral attributes within their home ranges. Home range size averaged 213 ha, (138-324), which is smaller than most home range sizes previously reported. This study will help adedress the need to inform the Hoopa Tribe's current practices with knowledge of habitat for pileated woodpeckers.

Long-term changes in bird populations in lowland forest of eastern Ecuador

Blake, John - University of Florida, Wildlife Ecology and Conservation; Bette Loiselle - University of Florida, Center for Latin American Studies & Wildlife Ecol. & COnserv.

Lowland forests of eastern Ecuador are among the most diverse in the world and largely unaffected by human activities. We have sampled birds at Tiputini Biodiversity Station annually since 2001 using a combination of mist nets and observations on two 100-ha plots. The initial goal of the study was to document patterns of diversity and to determine how abundance and distribution varied among species, between plots, and over time. Bird numbers fluctuated on both plots during the first 8 years but did not show a consistent pattern of change. Since about

2008-2009, birds on both plots have declined in abundance; capture rates in the last years were ~40% less than at the start of the study and observation rates were ~50% less. Thus, by continuing the study over more years, using complementary sampling techniques and replicate plots, we were able to document changes in bird numbers that would not have been apparent with short-term studies. By using both mist nets and observations, we were able to demonstrate that both understory and canopy species declined in abundance, eliminating the possibility that sampling method had an impact. Many of the years from 2008 onward also were associated with stronger La Nina events which are associated with increased rainfall. The mechanism for declines is not known but likely reflects a combination of reduced reproductive success coupled with reduced survival associated with changing climate. The study has been possible by the presence of a well-established research station in a large, protected area.

Plumage pattern dimorphism in a shorebird exhibiting sex-role reversal (*Actitis macularius*)

Blizard, Misha - University of Chicago; Stephen Pruett-Jones - University of Chicago

Both sexes exhibit socially selected traits, but relatively few studies address the role of female ornaments despite their potential importance in competitive female-female interactions and male mate choice. We investigated the melanized plumage pattern of spotted sandpipers (*Actitis macularius*), a shorebird species exhibiting sex-role reversal and a polyandrous mating system. Although the sexes overlap in the spottiness metrics, females had fewer, but larger and more irregularly shaped spots that covered a greater percentage of their plumage than did males. Furthermore, females with larger spots had lower mite loads, and females with greater percent spot cover and more irregular spots were heavier and had higher hematocrit levels. In contrast, males with larger spots were caught earlier in the breeding season and in earlier years. In addition, spot pattern varied across years. Overall, these results demonstrate that although the differences between the sexes are subtle, spottiness in spotted sandpipers is a measurably sexually dimorphic trait and that melanized ornaments can be indicators of female condition.

Paying the physiological cost – how oxidative stress affects reproduction in a migratory species

Bodey, Thomas - University of Exeter; Ian Cleasby - University of Exeter; Freydis Vigfusdottir - University of Exeter/ Icelandic Institute of Natural History; Graham McElwaine - Irish Brent Goose Research Group; Stuart Bearhop - Exeter University

Migratory life histories place huge physiological demands on individuals. Avian migration is chiefly fueled through the mobilisation of lipid stores, with antioxidants utilized to prevent the damaging consequences of lipid peroxidation. Directly linking this oxidative stress with fitness outcomes is complex however, and we know little about how resource allocation to manage physiological tradeoffs varies among individuals or across seasons. Arctic migrants are particularly interesting as their short reproductive windows provide limited opportunities for buffering delays. For example, increasing antioxidant expenditure to prevent oxidative damage may result in a decrease in investment in reproduction, particularly in females where antioxidants used to prevent tissue damage cannot be transferred to eggs. We measured antioxidant levels and oxidative damage in brent geese *Branta bernicla hrota* both cross-sectionally and longitudinally at the wintering and staging grounds. By combining this information with estimates of fat stores (i.e. reproductive potential), we were able to establish the link between antioxidant levels, oxidative damage and body condition. In addition, we were able to link variation in these physiological parameters with stable isotopic measures of

diet. We investigate whether individuals can deploy a 'buy now pay later' strategy and 'raid' their antioxidant protective system during migration and breeding, replenishing it during staging and winter; or whether oxidative debts cannot be deferred. These results shed light on how short-term impacts and responses to oxidative stress in the first stage of one of the longest wildfowl migrations can also carry-over to affect major components of individual fitness.

Social influences on variation of female mating preferences in the American Goldfinch (*Spinus tristis*)

Bolen, Donella - The Ohio State University; J. Andrew Roberts - The Ohio State University at Newark; Ian Hamilton - The Ohio State University

Social factors, such as the mate choice decisions of others, may influence a female's preference for a particular male. Mate choice copying occurs when a male is perceived as more attractive simply because he was observed being chosen by another female. To identify the extent to which female mating preferences are influenced by the mate choice decisions of others, we presented female American Goldfinches with a choice between two potential males in a series of three preference trials. After observing her non-preferred male with a female goldfinch, male goldfinch, or female House Finch, the female was tested again to see if her preference for the previously non-preferred male had changed. We found that the younger females increased time spent with the previously non-preferred male after observing him with another bird regardless of whether they ultimately changed their preference. Alternatively, only the older females that switched their preference increased time spent with the previously non-preferred male. The social nature of goldfinches may explain why most females increased time spent with the previously non-preferred male after observing him with another bird. However, we also found that, for the older females, the influence of the social environment on changing mate preferences is limited to observations involving conspecific females, who can potentially provide the most useful information on a potential mate. We have demonstrated that not only does the social environment influence female preferences, but that the expression of this influence varies with the female's age.

Swainson's Thrushes show little response to winds when negotiating the Gulf of Mexico

Bolus, Rachel - USGS Northern Rocky Mountain Science Center; **Robert Diehl** - US Geological Survey; Jill Deppe - Eastern Illinois University; Michael Ward - University of Illinois at Urbana-Champaign; Frank Moore - University of Southern Mississippi; Gil Bohrer - Ohio State University; Lynn Schofield - Yosemite National Park; Theodore Zenzal - University of Sothern Mississippi; Antonio Celis Murillo - Illinois Natural History Survey; Jaclyn Smolinsky - University of Delaware

Migrating birds should benefit from flying with wind support, as it can minimize the energetic costs of flight and increase migration speed. However, to what extent an individual benefits from optimizing wind support depends on its flight efficiency, variation in available winds, and the costs of seeking most favorable winds. To examine how Swainson's thrushes responded to winds when negotiating the Gulf of Mexico, we combined long-term banding data and automated radio-telemetry data with modeled wind fields to examine stopover behavior and generate individual based models of trans-gulf flight. Thrushes stopped over more frequently in years with less supportive winds. Even though the nights they chose to stop over and depart over the Gulf were more supportive than expected, they often chose nights that were unsupportive, and only avoided the least favorable nights (wind profits < -5 m/s). Moreover, birds did not appear to select altitudes or routes with the

most supportive winds when crossing the Gulf, perhaps because they can tolerate large variation in winds, or because, in this system, finding and using the most supportive winds has more energetic costs (climbing, maneuvering in increased turbulence) than benefits (fewer travel miles, lower airspeeds). The finding that Swainson's thrushes with sufficient fat stores are able to cross the Gulf successfully even in unsupportive winds challenges the notion that the Gulf should be considered an ecological barrier for migratory birds, and identifies a need to redefine the term to reflect true, context-dependent impediments to movement.

Female mountain bluebirds paired to more colourful males produce male-biased broods

Bonderud, Erica - University of Northern British Columbia; Nancy Flood - Thompson Rivers University; Jonathan Van Hamme - Thompson Rivers University; Cameron Boyda - Thompson Rivers University; Matthew Reudink - Thompson Rivers University

Sex allocation theory states that females should bias the sex ratio of their offspring in response to differences in the reproductive value of sons versus daughters. When males have higher variance in reproductive success, females capable of producing high-quality offspring may benefit from producing more sons than daughters, while a female only capable of producing low-quality offspring may benefit from producing more daughters than sons. Consistent with these predictions, females of many species appear to bias offspring sex ratios in response to mate attractiveness and condition. Male mountain bluebirds (*Sialia currucoides*) display full-body UV-blue structural plumage colouration, which is associated with attractiveness, condition, and reproductive success. Here, we asked whether female mountain bluebirds produce sex-biased broods in response to the colouration of their mates' UV-blue tail and rump plumage. Over four breeding seasons, we found females paired with colourful males produced increasingly male-biased broods. Surprisingly, however, we also found females with duller plumage and those mated to first-year males produced male-biased broods. In addition, we found females paired with more colourful males provisioned their offspring more frequently. However, there was no evidence that either males or females adjusted provisioning rates in response to brood sex ratios. Together, these results provide support for sex allocation in mountain bluebirds and suggest female reproductive decisions may be influenced by the attractiveness of her mate. However, this system is clearly complex and more work is needed to understand the roles of male age and female colouration in the signalling system of mountain bluebirds.

Unifying the Voice for Migratory Bird Conservation Across the Western Hemisphere through Festivals

Bonfield, Susan - Environment for the Americas

Successful conservation of birds that travel across political boundaries requires collaborations among scientists and researchers, politicians, agencies and organizations, and people of all ages. With the growing ease of communicating from Canada to Argentina and the Caribbean, hemispheric education programs that connect classrooms, communities, gardens, parks and more are resulting in initiatives that develop environmentally literate citizens who may contribute to solving threats to migratory birds, preventing new ones, and maintaining sustainable bird populations for the enjoyment of generations to come. International Migratory Bird Day (IMBD) connects people of all ages across the Western Hemisphere to bird conservation and unifies our voices through a single conservation message each year. This presentation will highlight the growth and success of IMBD and share organizer and participant data on the benefits of the program, the characteristics of attendees,

ways to reach diverse audiences, and areas for improvement. You will also learn some of the tips for hosting a successful bird-focused festival or program. Be sure to look for the 5 lightning tips that will make your IMBD shine!

Transcriptomic response to oil contamination in Louisiana Seaside Sparrows

Bonisoli Alquati, Andrea - Louisiana State University; Philip Stouffer - Louisiana State University; Christine Bergeon-Burns - Indiana University; Stefan Woltmann - Austin Peay State University; Wei Xu - Louisiana State University; Sabrina Taylor - Louisiana State University

Oil from the 2010 Deepwater Horizon (DWH) oil spill infiltrated the terrestrial food web in the marshes of the northern Gulf of Mexico. In 2011, Seaside Sparrows (*Ammodramus maritimus*) from oiled sites had higher expression of cytochrome P450 (CYP1A), a biomarker of exposure to polycyclic aromatic hydrocarbons (PAHs), compared to birds from 'unoiled' sites. CYP1A expression went down in 2012, but was high again in both oiled and 'unoiled' sites in 2013, suggesting that birds were responding to remobilization of oil from the sediments, possibly due to storms. However, the wider genetic response of birds to oil is largely unknown. Characterizing the transcriptomic response of birds exposed to oil will help us understand the regulation of CYP1A pathway in physiology and metabolism, and develop more efficient biomarkers to evaluate oil exposure and its effects. To this end, we analyzed genome-wide transcriptomic profiles in Seaside Sparrow liver samples using microarray techniques. We also compared gene expression patterns in birds that exhibited high CYP1A levels in 2011 and 2013, to investigate whether the response to oil changed with time since the disaster. Our study not only described the transcriptomic response of birds to toxicant exposure, but also identified genes that could be used as biomarkers of exposure to DWH oil or to future oil spills. Our results also contribute to understanding the persistence of DWH oil in the affected ecosystems.

Conservation decisions for multiple species with multiple uncertainties

Bonnot, Thomas - University of Missouri; Frank Thompson - Forest Service Northern Research Station; Joshua Millspaugh - University of Missouri; Todd Jones-Farrand - Gulf Coastal Plains & Ozarks Landscape Conservation Cooperative

Regional conservation partnerships are important in the effort to conserve biodiversity in the face of landscape and climate change. But, regional conservation planning is hampered by uncertainty in the future impacts of climate change and complexity surrounding conservation decisions. Assessing the impacts of climate change on wildlife populations is complicated by multiple sources of uncertainty, including the range of projected climate changes, diversity of habitat responses, and dependence on population processes and interactions between demographic and landscape dynamics. Planning conservation to address landscape and climate change has also been impeded by the complexity of the decisions planners must make (e.g., public or private lands). Recent development of dynamic-landscape metapopulation models and the growing use of structured decision making provide regional planners with an opportunity to overcome these limitations and provides a structured way to compare the effectiveness of alternative conservation scenarios on multiple species under various climate change possibilities while being confident that the important ecological and population processes are captured in each outcome. We layout our approach to integrate dynamic landscape population viability models and structure decision making to choose among conservation scenarios that best meet desired endpoints for focal wildlife species in the Ozark Highlands region under a range of climate change scenarios. Based on our

results, we will show how strategic and ecosystem-based conservation approaches can be an effective approach for multiple species even when their habitat needs differ. We will also demonstrate the advantage of framing decisions with risk.

Integrated population modeling as a basis to inform waterfowl harvest regulations
Boomer, Scott - U.S. Fish and Wildlife Service; Patrick Devers - United States Fish and Wildlife Service; Guthrie Zimmerman - US Fish and Wildlife Service

The United States Fish and Wildlife Service coordinates an Adaptive Harvest Management (AHM) Program to inform annual waterfowl harvest regulations at the Flyway scale. The adaptive management process requires population models to predict population responses to exploitation while accounting for multiple forms of uncertainty and environmental variation. Under AHM protocols, population models are used in an optimization procedure to determine optimal harvest regulatory decisions relative to harvest management objectives. The first AHM protocols developed for mid-continent mallards (*Anas platyrhynchus*, 1995) and eastern mallards (2000) used different parametrizations of a population model to represent structural uncertainty about the factors that govern their population dynamics. These models were developed with survival and recruitment parameters resulting from piecemeal, independent analyses. In contrast, recently implemented AHM decision frameworks for American black duck (*A. rubripes*), western mallard, and scaup (*Aythya, affinis, A. marila*) are based on population parameters and process variance estimates from integrated estimation frameworks that evaluate multiple data sources. As these population parameters are updated each year based on information from monitoring programs, parametric uncertainty is reduced and future regulatory decisions are based on the most recent information. We describe how these estimation methods and results are used in current decision making protocols and discuss how these tools may be used in the future to develop revised population models for other mallard AHM frameworks.

Fitness effects of early rearing conditions and growth differ between urban and wildland habitats in Florida Scrub-Jays
Bowman, Reed - Archbold Biological Station; Ronald Mumme - Allegheny College; Shane Pruitt - Archbold Biological Station; Annette Sauter - University of Zurich; John Fitzpatrick - Cornell Lab of Ornithology

The early rearing environment can profoundly affect survival and future reproduction of vertebrates. In cooperative breeders, where natal social conditions interact with environmental variation, the fitness consequences of early-life conditions are likely to be especially strong and may vary when environmental conditions differ from the species' selective environment, such as when urbanization has occurred. We examined these how patterns and early growth influences survival and recruitment to breeding using data from concurrent studies of Florida Scrub-Jays (*Aphelocoma coerulescens*) in wildland and suburban habitats from 1992-2010. Florida Scrub-Jays are habitat specialist and, in wildland birds, area of oak scrub within a breeding territory positively affected both nestling and juvenile body mass. Nestling mass also was a strong positive predictor of juvenile mass and survival from fledging to independence, and both juvenile mass and area of oak scrub were positively related to the probability of becoming a breeder. In suburbs, jays have tiny territories with little scrub, but unlimited access to high-quality human-provided foods. Nestlings are heavier at hatching than those in wildlands, but lighter at day 11 post-hatching, thus have significantly slower growth rates. However, strong selection for rapid growth existed in the suburbs but not the wildlands. Suburban nestling mass predicts juvenile survival, but not juvenile

mass and neither have significant long-term effects on subsequent fitness. Human-provided foods may reduce growth and survival of nestlings, but release older birds from the environmental constraints that lead to silver spoon effects.

Live fast and die young? – Does resting metabolic rate explain variation in adult survival probability within and across latitudes?

Boyce, Andy - Montana Cooperative Wildlife Research Unit, University of Montana; Blair Wolf - Biology Department, University of New Mexico; Thomas Martin - USGS - University of Montana

Tropical birds are typically longer lived than temperate counterparts. However, the reasons for this striking difference remain largely unexplained. The slow “pace of life” typical of tropical birds is thought to be linked to reduced metabolic rates resulting in low levels of oxidative damage. Indeed, recent work has found lower metabolic rates in tropical species, fitting the pattern predicted by the pace of life hypothesis. However, latitudinal patterns in metabolic rate do not explicitly link metabolism to adult survival probability. While tropical species are longer-lived than temperate counterparts, extensive variation exists within latitudes. This variation provides the opportunity to determine the influence of metabolic rate on adult survival independent of factors correlated with latitude. We measured resting metabolic rates (RMR) of passerine birds at tropical and temperate sites where long-term (7+ years) banding/re-sighting studies have generated robust adult survival estimates. We find that metabolic rate explains variation in adult survival within but not among latitudes. Within sites, long-lived species have lower metabolic rates than predicted by mass and phylogenetic relationships alone. However, latitudinal differences in adult survival probability remain unexplained by metabolic rate. Our results support the pace of life hypothesis in that, within latitudes, species with low metabolic rates had high adult survival probability. However, they also suggest that other factors correlated with latitude (ie; reproductive effort, seasonality, temperature & development time) may be linked to latitudinal differences in adult survival probability.

The current and future effects of climatic variation and change on tropical frugivores

Boyle, Alice - Kansas State University

Global climate change is influencing a multitude of organismal traits and behaviors including avian migration, reproduction, and survival. While considerable literature explores temperature effects in high-latitude systems, relatively little is known regarding the responses of tropical endotherms to altered climates, where precipitation is changing more rapidly than is temperature. I report on results of studies of the avifauna from the Caribbean slope of Costa Rica. These insights are based on results from three sources of long-term data; a foundation of knowledge contributed over three decades conducted by other researchers, a decade of intense community- and population-level research, and a long-term citizen science effort. I summarize the answers to the primary questions that spurred my research in the system focused on the causes of altitudinal migration, and describe how those answers have provided more general insights relevant to interpreting how climatic variation influences the evolutionary ecology of tropical birds. I report on preliminary results of a new modeling effort designed to project changes in behavior and population size of a focal species, the White-ruffed Manakin (*Corapipo altera*), under altered precipitation regimes. While barely “long-term”, research in this system exemplifies how often the most important conclusions and data are not necessarily those one initially sets out to address. Intimate knowledge of the natural history of focal species and communities is essential to interpreting inter-annual variation

and long-term trends. Major challenges to obtaining both in-depth and long-term data include funding, and uncertain access to both privately- and publicly-protected reserves.

Grasshopper Sparrows on the move: patterns and consequences of within-season breeding dispersal in a declining grassland songbird
Boyle, Alice - Kansas State University; **Emily Williams** - Kansas State University

Dispersal is a behavior common to virtually all taxa with important consequences for gene flow, demography, and conservation. Mobile animals such as birds frequently engage in breeding dispersal, but the factors shaping this behavior are not well understood. In mid-continental grasslands, preliminary evidence suggested that Grasshopper Sparrows (*Ammodramus savannarum*) engaged in breeding dispersal within a single breeding season. We hypothesized that dispersal decisions are shaped by spatial and/or temporal variation in nest predation, nest parasitism, and food availability. We studied Grasshopper Sparrows on 18 experimentally-managed watersheds at the Konza Prairie Biological Station during 2013–2015. To determine if nest predation or nest parasitism affected dispersal, we monitored the fate of 223 nests. We estimated food intake rates using plasma metabolites, and prey availability using sweep sampling. Dispersal decisions were related to past nest predation, but not parasitism. Dispersal likely yields fitness benefits, as sparrows that dispersed increased their chances of nest survival by 23% relative to site-faithful individuals. However, food availability did not affect settlement decisions. This study provides the first evidence of within-season breeding dispersal in Grasshopper Sparrows, and represents one of few tests of alternative hypotheses explaining dispersal decisions of songbirds. Our results are consistent with a growing literature on the role of predation shaping dispersal, but suggest, somewhat surprisingly, that food is not important in post-dispersal habitat selection. High dispersal capacity coupled with adaptability to temporal and spatial change may be typical of grassland songbirds, implying that demographic studies and management decisions must consider their mobility for conservation.

Climatic drivers of tropical avian demography in very wet environments: a case history from a population of Central American White-ruffed Manakins (*Corapipo altera*)
Boyle, Alice - Kansas State University; Brett Sandercock - Kansas State University

Tropical birds exemplify the importance of biotic interactions in shaping life history and demography. Small tropical birds are long-lived relative to their temperate-zone relatives which is often attributed to high adult survival mediated by benign climatic conditions. In arid to humid tropical forests, inter-annual variation in rainfall can increases vital rates. However, in wetter forests, positive deviations from mean rainfall may adversely affect fitness via multiple mechanisms including nest failure, reduced plant productivity and food, or reductions in adult foraging time. This last mechanism has been implicated in altitudinal migrations of birds on the Caribbean slope of Costa Rica, making the prediction that adult annual survival should be lower in years with particularly harsh rainy seasons. We tested this prediction using mark-recapture data from a population of White-ruffed Manakins collected between 2004-2013. We combined capture data with annual and seasonal metrics of rainfall collected over the same period from Rara Avis reserve in middle elevation wet-pluvial forest. We implemented Cormack-Jolly-Seber models separately for sexes in program MARK. Apparent annual survival was ~0.50 which is considerably lower for adult male manakins of other species, and for this species living in drier areas. Apparent survival varied among years, and although precipitation covariates did not appear in top-

ranking models, adult male apparent survival varied from over 90% in drier years to ~45% in the wettest years. These results are consistent with several less-direct lines of evidence implicating severe rain as an important source of mortality for small endotherms with high metabolic rates.

Techniques used in bird hazard management programs at airports: passive, active, administrative
Brammell, Sarah - Environmental Resource Solutions, Inc.

A wide range of techniques and tools are used to manage birds and bird attractants on and near airports to reduce the risk of bird strikes to aircraft. The foundation of a successful bird hazard management program is based on understanding the biology/life-cycle needs of the birds that pose a risk to aviation in a specific airport setting, daily and seasonal movements of the birds, and aviation operations. Airports and wildlife hazard management professionals use three main categories to describe bird management techniques 1) passive (e.g., habitat management, exclusion), 2) active (e.g., harassment, lethal control), and 3) administrative. Management strategies employed by wildlife biologists depend on several factors, including, but not limited to, the level of immediate risk to aviation safety, permits required to harass or remove hazardous species, the ability to reduce or remove attractants, the species' response to scare tactics, and the effectiveness of exclusion devices. This presentation provides an overview of wildlife management techniques typically used on airports. Discussion will include long-term versus short-term management strategies related to habitat modification, non-lethal techniques (trapping, pyrotechnics, bioacoustics, lasers, predator-based visual repellents, and chemical repellents), and lethal control techniques. Wildlife hazard management professionals prioritize non-lethal, long-term solutions for reducing risks of bird strikes at airports, but it is important for wildlife biologists, permitting agencies, and other stakeholders to understand the application of lethal control methods and their value in a successful bird hazard management program. The presentation will highlight the latest technology and innovations in bird hazard management at airports.

Priority conservation areas taking into account present forest cover and future Climate Change in central Mexico
Bravo-Cadena, Jessica - Universidad Autónoma del Estado de Hidalgo, CIPAMEX; Raúl Ortiz-Pulido - Universidad Autónoma del Estado de Hidalgo, CIPAMEX; Miguel Ángel Martínez-Morales - ECOSUR

Climate change and change of land use are recognized as major direct causes of avian biodiversity loss. Climate change affects species in different ways. Climate change had caused shifts in the geographic ranges of many species and thus is of especial interest for conservation of threatened birds. This work was done in the state of Hidalgo, which occupies 1% of the area of Mexico and have near of 45% species of Mexican birds registered. We investigate the effects of climate change on 56 threatened species, taking into account different future emission scenarios and current cover forest. Occurrence data was obtained from field trips, literature and on line sources. We found that near of 50% of the species are projected to lose more than half of their current geographic range across different scenarios of climate change and current forest cover. We identified areas of replacement of species and priority conservation areas. Such knowledge can be used to plan management focused on adaptation and mitigation of birds to climate change.

What do 35 years of sampling tell us about the population biology of tropical birds?
Brawn, Jeff - University of Illinois, Urbana-Champaign; Thomas Benson - Illinois Natural History Survey, University of Illinois

Tropical birds are notably diverse but more may be known about their evolutionary histories than the ecology of extant populations. Basic questions persist about the magnitude and causes of variation in local abundances, the importance of density-dependent regulation and interspecific competition, and the influence of abiotic factors on quantities such as population growth rates. We report on a 35-year mark-recapture study of understory species conducted in central Panama. Analyses to date reveal considerable variation among species - even within foraging guilds - in the magnitude and patterns of change in annual recruitment, adult survival, and population growth rates. Populations of certain species are relatively constant over time (as is often assumed for tropical species) whereas others are quite dynamic. Abiotic factors such as the intensity and duration of seasonal drought appear to affect population growth rates of several species and this has important implications for predicting the effects of climate change on tropical wildlife. Integrating results of long-term studies from different regions is needed to develop even basic understanding about the “hows and whys” of dynamics in tropical bird populations.

Cerulean Warbler: Forester Perspective
Breshock, Barbara - WV Division of Forestry

About 15 years ago the forestry community in West Virginia was concerned that the Cerulean warbler would be listed as a threatened species by the USFWS. WV contains a source population of this species that is still abundant today. That scare several years ago initiated the forestry community to get involved and help learn more about this bird and what can be done to help maintain its habitat through forest management. We have worked with biologists as they have learned more about the habitat needs of this bird, and identified key habitat features that a forester can help maintain and further develop while preparing and implementing a forest management plan. This presentation will discuss these habitat features, how to provide for them while implementing active forest management, and what barriers we have encountered in integrating forest management with management for a priority songbird .

Macro-scale analysis of Purple Martin roosting populations using NEXRAD
Bridge, Eli - Oklahoma Biological Survey; Kyle Broad foot - University of Oklahoma; Phil Chilson - University of Oklahoma; Andrea Contina - Oklahoma Biological Survey - University of Oklahoma; Todd Fagin - Oklahoma Biological Survey; Katherine Goodenough - University of Oklahoma; Kyle Horton - University of Oklahoma; Gabriel Melhado - University of Oklahoma; William Oakley - University of Oklahoma - Department of Biology; Pletschet Sandra - University of Oklahoma; Kayleigh Stumpf - University of Oklahoma

Opportunities to monitor animal populations across the entirety of their range are rare. However, the Purple Martin provides such an opportunity thanks to their singular roosting behavior. During the late summer and early fall Purple Martins form large roosting aggregations (often in traditional locations), and these roosts are regularly detected by NEXRAD weather radars as the birds depart at sunrise to forage. As a result, we have a continental-scale monitoring system for the vast majority of the Purple Martin population. We exploited this system to investigate patterns of roost site selection in relation to available land cover and land use categories across the roosting range for the species. We have also developed workflows to examine traditional roosts across years (i.e. presence/absence and roost size) to test

for macro-scale effects of recent droughts in the south-central US on Purple Martin productivity. We found that roosts sites occur on a wide variety of land cover types and tend to correspond to the dominant regional land cover type, although in the western part of the range there seems to be a strong proclivity toward urban roosting sites. Our analyses of the effects of drought are ongoing but so far we see no indication that detection of a roost in a particular year corresponds to drought conditions around the roost site during the preceding summer.

The scales of Amazon conservation: Lessons from macaw movements in Southeastern Peru

Brightsmith, Donald - Texas A&M University; Janice Boyd - Schubot Center at Texas A&M; Gabriela Vigo - Dept Wildlife and Fisheries Sciences Texas A&M University; Elizabeth Hobson - National Institute for Mathematical and Biological Synthesis

Problems of scaling permeate conservation. Large vertebrates which show little movement may require relatively small areas of high resource abundance. Alternatively, species may persist in areas of lower resource abundance by traveling widely throughout the landscape. The implications of these contrasting life history strategies are important for landscape-level conservation efforts. In this study we use point counts (10 seasons), ARGOS satellite tracking (5 seasons), GPS tracking (1 season), and forest phenology plots (4 seasons) to determine the movement patterns of Scarlet Macaws (*Ara macao*) and their drivers in Peru. Point counts show high macaw densities from the prebreeding season through fledging, with both macaw abundance and food supplies dropping post fledging. Argos telemetry shows that 1) most but not all birds leave the area post breeding, 2) non-breeding ranges averaged 1384 ± 1183 km2 (N = 9 birds), and 3) birds ranged up to 150 km from the nest. Phenology data show the macaws exploit a brief food peak for breeding, with young fledging as food supplies approach their annual nadir. Our data suggest that 1) dropping food supplies cause many to leave the nesting area post breeding, 2) over half of the birds leave the 1 million ha protected area complex, 3) breeding habitats require high food densities, and 4) if climate change shifts or reduces food availability peaks it could have major repercussions for macaw movements and breeding success in this region.

New Technology and Their Application to Conservation

Brigida, Danielle - US Fish and Wildlife Service

By incorporating the use of social media and new technology, we can grow engagement, listen for feedback, and identify next steps in our campaign. We will take a look at how we are using social media to educate and motivate people around important issues. In addition, we will share tactics for finding and engaging your audience.

Large-scale, remote observations of roosting Purple Martin populations and their emergence behavior

Broadfoot, Kyle - University of Oklahoma; Jeffrey Kelly - University of Oklahoma; Phil Chilson - University of Oklahoma

During the summer months, Purple Martins (*Progne subis*) form dense roosting colonies across the eastern U.S. As they leave these sites on diurnal foraging trips in the lower atmosphere, their exodus is routinely captured by NEXRAD weather radar facilities across the country. Data collected by these facilities are publicly available through the National Weather Service and represents a free, large-scale archive of ecological and behavioral information for a multitude of airborne organisms. By translating radar reflectivity into a biological density product, η, raw estimates of roost populations can be derived. In addition, information concerning

the height, timing, and extent of martin emergences can also be gleaned. These data are useful for refining estimates made of martin roost populations. Here, I present some ways of doing so, as well as a range-wide comparison of martin spatiotemporal emergence and population dynamics. This is done by using archived weather radar data to compare vertical density of martins aloft and estimated populations at roost sites to examine regional patterns in height and extent of foraging behavior. Special attention is given to the effects and interactions of landscape context, atmospheric dynamics and population trends. The methods presented here have the potential to improve population estimates and illuminate some behavioral patterns at large spatial and temporal scales with broad applicability to other colonially roosting vertebrates.

Day herons do not mitigate glare by adjusting body orientation while foraging.
Brown, Holly - University of Connecticut; Margaret Rubega - University of Connecticut; Heidi Dierssen - University of Connecticut

As visual predators, day herons face several challenges while hunting across the air-water interface. One of these challenges is the visual phenomenon known as glare which can be caused by high intensity sun glint off of a water surface. We might expect that herons should orient away from the sun while foraging, in order to reduce glare within their strike zones. However, if they orient facing opposite to the sun, they will create a shadow over their prey, and thus risk provoking prey to flee due to shadow response. Thus, we examined the hypothesis that body orientations of foraging herons should represent a tradeoff between reducing sun glint and self-shadow in their strike zones. Our results indicate that Great Blue Herons and Great Egrets (*Ardea alba* and *Ardea herodias*) orient randomly with respect to sun position. These findings suggest that herons are not compensating for glare behaviorally, and that other heron behaviors that are thought to be compensatory for glare may need to be reconsidered.

Automated radio telemetry reveals expanded scale of movement across multiple species and life-history stages.
Brown, J. Morgan - Acadia University; Dominic Cormier - Acadia University; Zoe Crysler - Bird Studies Canada; Philip Taylor - Acadia University

Automated telemetry has revealed that birds are moving over much broader spatial scales than previously recognized. This expanded scale of movement has been shown across multiple life-history stages, including dispersal, fall migration and stopover. For example, in NE North America we have now compared fall migratory routes between adults and hatch-year birds for three species from local breeding populations: Ipswich Sparrow and Yellow-rumped Warbler (short-distance migrants) and Blackpoll Warbler (a long-distance migrant). Hatch-year Blackpoll Warblers made broad-scale exploratory movements and mostly did not cross large bodies of water, whereas adults, and both ages of the other species made more directional movements to the south and frequently crossed such ‘barriers’, and showed little evidence of exploration. Migrant hatch-year Ipswich Sparrows selected flight directions that minimized water crossing, compared to adults who were more likely to fly across open water, thus minimizing total migration distance. For migrant Blackpoll Warblers we have shown that adults and individuals from more westerly populations have more tortuous paths oriented in non-migratory directions. The full extent of such movements, how they vary across a broader suite of species, and their purpose remain to be discovered. Automated telemetry has raised important new questions about orientation and navigation, memory, social behavior and learning, and migration energetic and physiology and provides core tools to help answer those questions.

Blackpoll warblers (*Setophagia striata*) make regional-scale, non-migratory movements during fall migration

Brown, J. Morgan - Acadia University; Philip Taylor - Acadia University

During migration, birds are hypothesized to use different strategies to reach their destination –minimizing either total time migrating or energetic output. Here, we examine the scale and types of movements made by blackpoll warblers at a migratory stopover during fall. Specifically, we explore how age, distance from the natal location and time of year relate to the scale of movement at 'stopover', the tortuosity of pathways, and the total amount moved. Adults are hypothesized to employ time-minimizing strategies whereas hatch-years are hypothesized to employ energy minimizing strategies. We radio-tagged individuals at two stopover sites in Nova Scotia, Canada and tracked subsequent movements at a scale of 100s of kilometers using the Motus automated telemetry array. Adults and individuals from more westerly populations (identified from isotope signatures) had more tortuous paths oriented in non-migratory directions than did hatch-years and those from more easterly populations. These paths also revealed a previously unknown level of regional-scale movement with a median length of 227 km. Such movements suggest that the energetic cost of flight may be a less important currency during migration than previously thought. Because the movements increase in scale with increasing distance from the natal location, they may relate to re-calibration of navigational compasses. The results demonstrate our limited understanding of regional-scale migration movements, and highlight the importance linking theoretical and laboratory studies with natural field studies.

Captive environment enhances reproductive performance in captive whooping crane (*Grus americana*) pairs

Brown, Megan - University of Maryland; Sarah Converse - USGS-Patuxent Wildlife Research Center; Carol Keefer - University of Maryland; Nucharin Songsasen - Smithsonian Conservation Biology Institute

Whooping cranes naturally breed in wetland habitats. However, captive cranes at Patuxent Wildlife Research Center are housed in dry outdoor pens, which we believe may compromise reproduction. We hypothesized housing crane pairs in an enclosure that mimics their natural environment would enhance reproduction. In the present study, eight crane pairs were housed in traditional dry pens in Year 1, and then moved to either new dry pens (control, n = 4) or ponded pens (wetland, n = 4) for Years 2 and 3. Fecal estrogen metabolites and numbers of egg laid were assessed and compared among groups and years using linear mixed effect models with individual serving as the random effect. There was no significant difference in estrogen metabolites among females of each group in Year 1. When compared within each enclosure group, there was no difference in estrogen metabolite concentration among study years in the control females. However, we observed an increase in estrogen production excreted by wetland females in each consecutive year after being moved to the new pen, with Year 3 being significantly higher than Year 1, (Year1: 286.06; Year 2: 345.62; Year 3: 477.63, $p < 0.001$). The number of eggs laid increased in two of the four pairs housed in the wetland pens, while control pairs continued to produce eggs at similar low levels. These findings demonstrate the beneficial effects of natural environment on reproductive performance of captive whooping cranes.

Seasonal changes in habitat utilization of Swainson's Warblers in response to moisture and prey abundance

Brunner, Alicia - The Ohio State University; Christopher Tonra - The Ohio State University

Migratory passerines that overwinter in the Caribbean will be experiencing a predicted drying trend that will produce drier conditions, known to have adverse effects on birds. To understand how declining songbird populations will be affected by these climatic trends, I am focusing on a species that specializes on drier tropical habitats because they will likely be experiencing the most extreme drying conditions. Swainson's Warblers (SWWA) are an elusive species of concern that occupy tropical dry forests during the nonbreeding season and forage heavily on leaf litter arthropods that rely on moist soil environments. Utilizing long-term study plots at Font Hill Nature Preserve in Jamaica, 20 SWWA were equipped with radio transmitters and tracked from January through April; following deployment, home ranges were calculated throughout the season. Habitat characteristics (soil moisture, leaf litter depth, etc.) were measured and leaf litter arthropod samples were collected at random points within each home range. Each individual's home range size and seasonal shift will be compared to the differences in moisture and arthropod abundance and composition. I hypothesize that SWWA home ranges will shift in response to fluctuations in prey abundance as a result of seasonal changes in moisture and leaf litter depth. By examining if individuals can adjust their movements to track seasonal shifts in moisture and prey abundance, we can determine their abilities to withstand climate-induced reductions in moisture. Based on my results, critical wintering habitat can be prioritized as areas for protection to ensure these organisms can endure these environmental changes.

Home Range Use by Male Ocellated Turkeys in Disturbed and Intact Forest Habitats

Buchholz, Richard - University of Mississippi; Thomas Martin - University of Mississippi

The Ocellated Turkey (Meleagris ocellata) is a threatened Yucatan endemic whose natural history is virtually unstudied. Habitat destruction, habitat fragmentation and indiscriminate hunting have led to the extirpation of this bird in much of its relatively small geographic range. We studied the breeding season movements of male Ocellated Turkeys in and near the Rio Bravo Conservation and Management Area in NW Belize, where they remain abundant due to several decades of protection from hunting. Our objective was to compare the home range sizes of males that occupy disturbed areas with those that live in largely intact forest, in order to better understand how to manage ocellated turkey populations. We used VHF radiotelemetry to track 18 males in deep forest, areas of intermediate disturbance, and in heavily disturbed, pastured areas. Not surprisingly forest males had the largest home ranges (12.6 km2). Males that used areas of medium disturbance, such as shaded coffee groves, had intermediate home range sizes (9.1 km2). Males that rely on the concentrated resources in and near cattle pastures where waste grain is abundant, had the smallest home range sizes (7.75 km2). To begin to understand the fitness consequences of living in these habitat types, we report male mortality rates, fecal parasite counts, and preliminary data on nesting success for hens.

Importance of Ethiopian shade coffee farms for forest bird conservation

Buechley, Evan - University of Utah; Çağan Şekercioğlu - University of Utah; Anagaw Atickem - Oslo University; Gelaye Gebremichael - Jimma University; James Ndungu - Front Trail Safaris; Bruktawit Mahamued - Manchester Metropolitan University; Tifases Beyene - Arba Minch Crocodile Farm; Tariku Mekonnen - Jimma University; Luc Lens - Ghent University

Coffee is the most important tropical commodity and is grown in high-priority areas for biological conservation. There is abundant literature on the conservation value of coffee farms internationally, but there has been little research on this topic in Africa. Ethiopia is a diverse and little-studied country with high levels of avian endemism, pressing conservation challenges, and where *Coffea arabica* originated. We sampled bird communities in shade coffee farms and moist evergreen Afromontane forest in Ethiopia utilizing standard mist netting procedures at seven sites over three years to evaluate bird species richness, diversity and community structure. Although species diversity did not differ between shade coffee and forest, shade coffee farms had over double the species richness of forest sites and all but one of the nine Palearctic migratory species were captured only in shade coffee. There was a greater relative abundance of forest specialists and understory insectivores in forest, demonstrating that little-disturbed forest is critical for sustaining these at-risk groups of birds. Nonetheless, all species recorded in primary forest control sites were also recorded in shade coffee, indicating that Ethiopian shade coffee is perhaps the most “bird-friendly” coffee in the world. This is an important finding for efforts to conserve forest birds in Africa, and for shade coffee farmers that may benefit from avian pest regulation and biodiversity-friendly coffee certifications.

Changing perspectives on the role of forest management in North American bird conservation

Buehler, David - University of Tennessee

In the early 1900s, an era of forest preservation evolved in response to decades of abusive and myopic practices, including unregulated clearing of forests, mining, burning, and introduction of exotic insect pests and diseases. The legacy of these activities forever changed the nature of our forests and established a protectionist mindset among the general public and conservation biologists. Taken as a whole, the lasting forest perturbations and protectionist attitude, have created a contemporary conundrum in that repairing the damage from past abuse often requires science-based management above and beyond simple protection. In addition, emerging science reveals that the full breeding cycle needs of many forests birds cannot be met through simply maintaining mature forest conditions on the landscape. Creating appropriate, diverse forest ages and structural conditions to support breeding birds requires the use of multiple forest management techniques, including timber harvesting, prescribed burning, and aggressively controlling deleterious exotic insects, tree diseases, invasive plants, and ungulates. In this paper, I will review how perspectives are changing in contemporary conservation biology relative to the proactive use of forest management in developing and implementing effective bird conservation strategies.

A macrosystems examination of stopover distributions of migrating landbirds using a network of weather surveillance radars
Buler, Jeffrey - University of Delaware; Matthew Boone - University of Delaware; Deanna Dawson - USGS Patuxent Wildlife Research Center; James McLaren - University of Delaware; Kimberly Rivera - University of Delaware; Timothy Schreckengost - University of Delaware; Jaclyn Smolinsky - University of Delaware

Weather surveillance radars within the United States comprise a unique remote sensing network that has been comprehensively and continuously sampling the aggregate densities of individual birds aloft at relatively fine spatial and temporal resolution since the mid-1990's. We used this radar network to sample birds at the sudden onset of nocturnal migratory flights to estimate relative bird stopover densities at the ground for several years across the eastern United States. This macroscale perspective of the collective behavior of individuals and species revealed novel patterns of daily variability in the timing of onset of nocturnal flight related to latitude and Julian day. Furthermore, we found the aggregate distributional patterns of landbird migrants during stopover are shaped by a hierarchy of factors, such as proximity to coastlines and landscape composition, that operate at various spatial scales. New analyses support the idea that migrants exhibit broad-scale attraction towards brightly-lit urban areas, yet avoid areas that have undergone urbanization or deforestation at a local scale. Radar observations also reveal how Hurricane Sandy affected the stopover distributions of migrants in coastal areas up to several hundred kilometers away from the center of the storm and caused broad-scale disruption to the typical flux of nocturnal migration traffic before and after the storm. The macroscale responses of birds to severe weather and anthropogenic landscape changes can help our understanding of human impacts and climate change on our environment.

Where and for how long do migrating landbirds stopover along the northern Gulf of Mexico? A radar perspective
Buler, Jeffrey - University of Delaware; Matthew Boone - University of Delaware; Jill LaFleur - University of Southern Mississippi; Frank Moore - University of Southern Mississippi; Timothy Schreckengost - University of Delaware; Jaclyn Smolinsky - University of Delaware

Our recent and ongoing studies integrating data from weather surveillance radars, ground surveys, telemetry, and mist-netting reveal that distributional patterns of landbird migrants during stopover along the northern coast of the Gulf of Mexico (GOM) are shaped by a hierarchy of processes operating at various spatial scales. Broad-scale bird stopover distributions observed from six weather surveillance radars across the GOM during four springs (2009-2012) were related to longitude, proximity to the coast, and the amount of hardwood forest cover in the landscape. Longitudinal stopover patterns are consistent with published arrival patterns of trans-Gulf migrants; highest relative densities occur in Louisiana and lowest in Alabama. Longitudinal patterns varied annually in association with prevailing winds over the GOM. Unexpectedly, the panhandle of Florida often supported the greatest migrant densities, possibly due to a mix of trans-Gulf migrants taking an eastern route and/or trans-Caribbean migrants overshooting the peninsula of Florida. Fine-scale migrant densities and stopover duration are related to food availability. Relative stopover duration estimated from ground surveys of migrant use days and radar measures of total migrants among sites within Mississippi revealed that sites closest to the coast with poor food resources appear to function as quick rest stops. Migrants likely quickly refuel within forested areas where food is abundant and stopover the longest at sites away from coasts with moderate food or forest cover. Coastal concentrations of migrants across the GOM exemplify constraints on migrants when

negotiating the GOM and highlight the conservation importance of coastal stopover sites.

Nest takeover by egg burial in a box nesting population of Prothonotary Warbler (*Protonotaria citrea*)
Bulluck, Lesley - Virginia Commonwealth University

Nest takeover by egg burial can be difficult to observe and therefore go unnoticed by researchers. Even in box-nesting studies, egg burial can be mistaken for predation events. Egg burial is often associated with inter-specific brood parasitism, but can also occur intra-specifically, especially in cavity nesting species when cavities are limited. We assess egg burial in a box nesting population of Prothonotary Warblers (*Protonotaria citrea*, PROW) along the James River in Virginia, US. Conspecific brood parasitism has recently been documented in ~26% of broods in this population. From 2012-2016 we observed > 35 instances of intra-specific egg burial (~6.5% of monitored broods/year), and three cases of interspecific egg burial involving PROW taking over Carolina Chickadee (*Poecile carolinensis*) nests. In nine instances, we knew the identity of the buried female and in most cases knew the identity of the female responsible for the burial. Buried females tended to be younger (mean = 2.4 years breeding) than burying females (mean = 3.1 years breeding), but not always. In many cases, the buried and burying female had nested in the focal box or a neighboring box the previous year, or even in the focal box with an earlier brood the same year. While this suggests that nest boxes are a limited resources, it was not uncommon to have unoccupied boxes adjacent to burial events. Nest box fidelity and female competition for boxes appear to be strong in this species, potentially to a detriment.

Forest stewardship for stewardship species of the Atlantic Flyway
Burger, Michael - Audubon New York; Jim Shallow - Audubon Vermont; Curtis Smalling - Audubon, North Carolina

Audubon's Healthy Forest program seeks to establish a protected and properly managed network of forests in the Atlantic Flyway that supports viable populations of forest-dependent priority birds throughout their life cycles. This network includes large, intact forested landscapes critical to the reproductive success of birds during the breeding season, essential stopover sites, and high-priority "wintering" sites both within and outside of the United States. Priority breeding areas are large, forested landscapes (i.e. forest blocks) systematically identified according to block size, forest intactness, and diversity and abundance of Partners In Flight stewardship species in Bird Conservation Regions 13, 14, 27, 28, 29, 30, and 31. For major forest types of the U.S. portion of the flyway, Audubon has synthesized the literature on nesting and post-fledging habitat requirements of stewardship species in order to articulate forest conditions at both landscape and stand scales that are necessary to support the suites of species. Primary characteristics include balance of forest age classes at the landscape scale and vertical structure of vegetation at the stand scale. Audubon staff and partners across the flyway work within the forest blocks to promote management of both public and private forests in order to achieve these desired conditions. Work includes educating forest owners and managers through workshops and webinars, conducting site visits, providing technical assistance, and connecting private landowners with state and federal incentive and cost-share programs. Threats to forest blocks, e.g., overabundant deer and development, are addressed through complementary policy efforts.

Integrating multiple dimensions of biodiversity and considerations of climate change for parrot conservation

Burgio, Kevin - University of Connecticut; Katie Davis - University of Bath; Laura Cisneros - University of Connecticut; Steven Presley - University of Connecticut; Michael Willig - University of Connecticut; Lindsay Dreiss - University of Connecticut; Brian Klingbeil - University of Connecticut

Until recently, taxonomic diversity (TD) has been the primary approach used to identify areas of high conservation value. However, TD hotspots do not always represent functional diversity (FD) or phylogenetic diversity (PD) hotspots. Hotspots of FD or PD may better represent areas with conserved ecosystem function or reduced vulnerability, as well as communities with evolutionary potential of to adapt to future change, which may more fully inform decisions about which areas to protect. Parrots, the most threatened order of birds, often serve as conservation “ambassadors” and play vital roles in ecosystem functioning. Given current risks to parrots, identifying under-protected areas resistant to climate change but harbor high levels of all dimensions of biodiversity may critically inform conservation actions. Using the distribution of all extant parrots, we quantified TD, PD, and FD for 2500 km2 grid cells across the globe, and developed a comprehensive metric, the Integrated Biodiversity Index (IBI), which incorporates these three dimensions. Thereafter, we examined the extent to which IBI hotspots are (1) currently protected by reserves based on the IUCN World Database of Protected Areas, and (2) sensitive to climate change. TD, PD, and FD were correlated, but not highly, suggesting TD may not be a suitable proxy for other dimensions of parrot biodiversity. We identified areas with high IBI that are currently under-protected but resistant to climate change, making these areas of high importance for consideration for parrot conservation. The IBI framework is flexible and easy to use, allowing application to any taxon or spatial extent.

Bank Swallow (*Riparia riparia*) health and productivity: could aggregate pits be key in species recovery?

Burke, Tianna - Trent University; Erica Nol - Trent University; Michael Cadman - Environment Canada , Canadian Wildlife Service

Bank Swallows (*Riparia riparia*) are designated as Threatened in Canada, in part, due to loss of natural breeding habitats along lakeshores and rivers. Excavation of gravel and sand from aggregate pits has increased availability of nesting faces away from lakes and rivers, and these surrogate habitats may be important to stabilize Bank Swallow populations. The goal of this project was to determine whether Bank Swallows successfully breed and replace themselves in aggregate pits. Data for this project were collected on the north shore of Lake Ontario and in 11 aggregate pits from southern Ontario within 100 km of the lakeshore sites. Breeding adults from aggregate pits were heavier than those from natural banks, while juvenile masses were not significantly different between habitats. Although adults in pits were heavier, mass of adults in pits decreased significantly over time. While clutch size was the same in both habitats, the number of fledglings from successfully hatched nests was higher in aggregate sites than from lakeshore sites. Hatching success was not different in either habitat types, suggesting that differences in fledgling success could be attributed to lower depredation pressure observed in aggregate sites. Parasite load on adult and juvenile Bank Swallows was significantly lower in aggregate pits. Aggregate pits appear to provide equivalent or higher quality habitat than natural banks for Bank Swallows, making them adequate and potentially important sites for conservation. Exploring the breeding success of Bank Swallows in aggregate sites provides information on how these areas may be key in species recovery.

Translocation priorities for endangered shorebird altered by floral physiology

Burle, Marie-Helene - Simon Fraser University; Alex Wegmann - The Nature Conservancy; David Lank - Simon Fraser University

Translocations are becoming increasingly common as a conservation tool. Yet, for threatened species, 66% of them fail. Here we show how preliminary research revealed habitat limitations of a proposed site and will inform better future site selection. The Tuamotu Sandpiper (hereafter 'Titi'), endemic to Eastern Polynesia, has seen its range eaten away by spreading introductions of predatory mammals. Its conservation however is rendered challenging by the difficulty to implement regulation on its last refugia. Translocation to controlled grounds is thus necessary to secure the species' status. Palmyra Atoll, under the protection of the USF&WS and The Nature Conservancy, seemed an ideal site: their presence minimizes, better than anywhere else, the possibility of mammal (re-)colonization. We therefore conducted a preliminary site visit to assess translocation prospects.In the Tuamotu, a quarter of foraging events observed consisted of nectar feeding from the flowers of the common shrub *Scaevola taccada*. Flowering *S. taccada* are also common at Palmyra. In the Tuamotu however, flowers produced mean nectar amounts of 3.47 (SE 0.83) μL. In contrast, *S. taccada* flowers on Palmyra produced trace amounts of nectar (mean of 0.12 (SE 0.07) μL). *S. taccada* appears to have coevolved with Titi in the Tuamotu, but not at Palmyra, where the bird was probably never present. It is unknown whether Titi could survive in the absence of nectar, but it is now clear that Palmyra lacks foraging opportunities present in the Tuamotu and that flower type should be taken into account when selecting translocation sites for Titi.

Sex, age and populations: morphological variation in the endangered Tuamotu Sandpiper

Burle, Marie-Helene - Simon Fraser University; David Lank - Simon Fraser University

The Tuamotu Sandpiper (*Prosobonia parvirostris*), endemic to Eastern Polynesia, is the last representative of an unstudied genus of sedentary shorebirds adapted to life on Pacific tropical islands. The first documented European observations date back to 1778 or 1839, depending on taxonomy. Birds were then observed and specimens collected throughout the Tuamotu Archipelago during the 20th and 21st centuries, with census data becoming increasingly available as the number of individuals became increasingly low due to introduced mammals. Yet, live morphometric data for the species has been limited to 59 individuals, with only 3 males and 3 females weighted, and no information on chicks or juveniles. Two morphs were described with no information on proportions. Here we present a thorough description of the species based on 271 adults, 13 chicks and 10 juveniles genetically sexed, weighted and measured on 4 populations throughout the bird's range, plus 179 recaptures over a period of 4 years. This information allowed us to detect: 1/ a sexual dimorphism consistent with shorebird biology, 2/ intra-individual variation which allows some assessment of age based on leg pigmentation, and 3/ size and morph frequency variation throughout the species range. Morphological variation among populations will be compared with microsatellite-based genetic variation. In addition to filling in a long overdue gap in shorebird biology, this information is critical for the conservation of the Tuamotu Sandpiper: variation across the range suggests potential local adaptations and should be taken into account when establishing a translocation plan for this endangered species.

Elevational community structure on three Bornean mountains

Burner, Ryan - Louisiana State University Museum of Natural Science; Alison Styring - The Evergreen State College; Frederick Sheldon - Louisiana State University

Understanding the mechanisms behind species distribution and abundance patterns is one of the central goals of ecology. Ecological gradients on mountains are particularly productive sites for studying these patterns and their underlying causes because these gradients are ubiquitous, tractable in size (e.g., in comparison to latitudinal gradients), and may exhibit rapid species change over relatively short distances. To determine patterns of avian species richness and community turnover along elevational gradients in Borneo, we conducted point counts on three mountains – Mt. Mulu (2400 m) in eastern Sarawak, Mt. Topap Oso (1450 m) in East Kalimantan, and Mt. Pueh (1460 m) in western Sarawak. Our goals were to quantify species patterns across gradients and among mountains, characterize community turnover, and determine the extent to which vegetation structure corresponds to these patterns. Occupancy modeling was completed using RMark, and community richness and similarity measures were estimated in EstimateS. On Mt. Mulu, the largest mountain with the most extensive intact forest gradient (50 m to 2400 m), species richness peaked at 600 m after a lower plateau, then declined steadily with elevation. Community similarity declined most steeply across a fairly distinct divide at 900 m, corresponding with a sharp change in habitat revealed by ordination. The other two mountains revealed richness peaks at similar elevations as Mt. Mulu, but significant differences in both vegetative structure and community composition at these elevations. Our results contribute to the global elevational gradient species richness data set and to Bornean avian community ecology.

Results Of A 20-Year California Condor Release Effort In Big Sur, Ca

Burnett, Joe - Ventana Wildlife Society

Twenty years ago Ventana Wildlife Society joined US Fish and Wildlife Service's California Condor Recovery Program to help reestablish condors in central California; Pinnacles National Park joined local efforts in 2003. In 2006, in our 9th year of releases, we documented the first nest in central California and the first in a coastal redwood. We found that nests in central California were having success, but lower than that of the historic population. Our research documented eggshell thinning and low hatch success associated with DDE and identified California Sea Lions as the predominant source of DDE. As part of our nest management, we exchanged failed wild-laid eggs with viable captive-laid eggs to increase nest success. Because we found that some condors are successfully reproducing young in the presence of DDE and that we expect DDE to diminish with time, we consider lead poisoning, from the ingestion of spent lead ammunition in game carcasses, to be the biggest threat to establishing a self-sustaining population. We manage the lead threat by treating birds with elevated blood lead, providing lead-free carcasses to condors, and conducting public outreach. From 2012-2015, we distributed over $100,000 in free non-lead ammunition to central California hunters/ranchers. A survey of hunters indicated that our free ammunition program increased their willingness to use non-lead ammunition. With a lead ammunition ban going statewide in 2019 and a condor population in California exceeding 150+ birds with 15+ breeding pairs, hope for a self-sustaining population could be within reach.

The Life On Birds: Evolution of Feather Lice on Songbirds
Bush, Sarah - University of Utah; Daniel Gustafsson - University of Utah; Kevin Johnson - Illinois Natural History Survey

Songbirds are parasitized by one of the largest and most diverse groups of feather lice in the insect order Phthiraptera. Lice are permanent, obligate ectoparasites that spend their entire lives on the body of their hosts. This close association between lice and their hosts means that an understanding of macroevolutionary history of these lice can provide unique, and independent insights into the evolutionary history of their hosts. We reconstructed a phylogeny of feather lice based on 333 louse taxa sampled from 250 bird species belonging to 66 bird families. Patterns that emerged from this phylogenetic reconstruction illuminate our understanding of the historical biogeography of the hosts, and highlight how movement of lice among hosts has influenced the evolution of the lice themselves.

Causes and consequences of variation in molt dynamics: implications for avian conservation
Butler, Luke - The College of New Jersey; David DesRochers - Dalton State College

It is widely recognized that interactions between life history stages can have important consequences for the fitness of bird populations, requiring avian biologists to take a full-annual-cycle perspective in order to conserve birds. Recently and historically, molt has received less attention than breeding and migration. Viewed as a stage within the annual life cycle, understanding molt requires perspectives from three different life history stages: 1) conditions or events before molt that may alter subsequent molt dynamics via carry-over effects, 2) conditions or events during molt that may affect molt dynamics directly, such as effects of molting habitat on molt dynamics, and 3) results of molt that affect life history stages that occur after molt is complete, such as the costs and benefits of possessing feathers of a given quality. This presentation will highlight what we know about these three areas and identify some of the knowledge needed to add molt more fully to the full-annual-cycle perspective on avian conservation.

Biliverdin levels are more closely related to nutritional variables than either immune challenges or oxidative damage
Butler, Michael - Lafayette College; Jessica Baylor - Lafayette College

While immune responses help hosts combat pathogens, there are also costs. One component of the immune response is the production of reactive oxygen species, which are useful for destroying pathogens, but also result in oxidative damage to the host's cells. To minimize this collateral damage, organisms may increase antioxidant availability. One potential antioxidant is biliverdin, the pigment most commonly associated with blue-green eggshell coloration. Here, we investigated two questions: 1) to what extent do different types of immune challenges result in oxidative damage, and 2) does biliverdin have a physiological role as an antioxidant? We found that two different immune challenges (administration of either lipopolysaccharide or phytohemagglutinin) result in similar increases in oxidative damage relative to controls over a 24-hour period. However, there was no treatment effect on body mass, change in body mass, circulating triglyceride levels, or biliverdin levels in circulation, the liver, or the spleen. Unexpectedly, we uncovered multiple correlations between biliverdin levels and circulating triglyceride levels, including an inverse relationship between biliverdin concentration in the liver and triglyceride levels in circulation. Also, regardless of treatment, birds that lost weight during the 24-hour experiment had greater levels of biliverdin in the liver and in circulation than those that gained weight. Thus, we found no evidence that biliverdin

functions as an antioxidant, casting doubt on this putative explanation for eggshell coloration signaling hypotheses. However, biliverdin concentration was associated with both circulating triglyceride levels and change in body mass, suggesting that this molecule may have unexplored and important physiological roles.

Are IBAs a good tool for bird conservation in Mexico?

Caballero-Cruz, Pablo - Autonomous University of Hidalgo State; Raúl Ortiz-Pulido - Autonomous University of Hidalgo State

The Mexican Important Bird and Biodiversity Areas (IBAs) constitute a response from Mexican ornithologists to avian diversity lost. However, actually there isn't systematic monitoring for actions, studies and conservation status in Mexican IBAs. We provide a methodology to assess bird's conservation into IBAs, focusing on globally endangered species, including perceptions of people. Our objective was determining the relationship between IBAs placement, bird's conservation and people attitudes. The study sites included five Mexican IBAs with cloud forest zones with similar ecological histories, all distributed in Central Mexico. We used field sampling and empirical evidence to determine the presence of endangered species to relate them with the expected species and calculate diversity indexes. Also, we made interviews to register the attitudes of people on forest and bird's conservation as well as the attributes conferring forest and bird's importance and account the conservation activities. Finally, we estimated importance value indexes for species of interest. The presence *of Hylorchilus sumichrasti*, *Dendroica chrysoparia*, *Dendrortix barbatus* and *Contopus cooperi* was confirmed in the study places. We found no clear relation between presence of globally endangered birds, people attitudes and the establishment of IBAs. Birdsong, beauty, crops damage and chicks hunt give importance to birds for local inhabitants, as intangible resources. People are supporting bird's conservation at all sites but these sites have not the best conditions to maintain endangered species populations. Our results suggest that conservation strategies must be encompassed with empowerment for local communities, taking advantage of their willing.

Most nocturnal migrant birds of the world are exposed to artificial lights during migration

Cabrera-Cruz, Sergio A. - University of Delaware; Jaclyn Smolinsky - University of Delaware; Jeffrey Buler - University of Delaware

Artificial lights are known to disorient nocturnally migrating birds at small scales. At a larger scale, the nighttime glow of city lights can be perceived by nocturnally migrating birds aloft from up to 50 kilometers away, altering the natural dark landscapes that they evolved with. However, the extent of light pollution along migratory passage routes has not been measured comprehensively. We integrated the Birds of the World geodatabase of all bird species ranges in the world compiled by BirdLife International with satellite imagery of the intensity of artificial light brightness (LB) during the night from NOAA to estimate the mean LB within the passage areas of all nocturnal migrants. LB intensity is an index that ranges from 0 (dark) to 63 (bright). Based on the literature, we identified 388 bird species that migrate at night belonging to 44 different families from all the continents except Antarctica. Scolopacidae, Anatidae and Parulidae contributed the greatest number of nocturnal migrant species (51, 46 and 42 species, respectively), with the mean intensity of artificial lights (LB) within their passage areas of 4.9, 6.2, and 6.7 respectively. The Black-bellied Whistling Duck was the only species with a minimum LB > 0 (range= 9 – 63) indicating that all of its passage area is subject to some extent of artificial illumination. Nevertheless, the passage areas

of only 7 species had a mean LB = 0, suggesting that the vast majority of nocturnal migrants are exposed to artificial lights along their migration routes.

The Lives of Crows
Caffrey, Carolee - N/A

American Crows (*Corvus brachyrhynchos* brachyrhychos) in Stillwater, OK, led complex social lives. Individual crows do not become sexually mature until at least their third year, and many crows in Stillwater did not pair and attempt to breed until 4-5 years old. Until then, individuals of both sexes made highly variable dispersal/residency decisions, enabled (encouraged?) by territory-owning breeding pairs. During nest building and incubation, cooperative breeding groups consisted of pairs and genetic offspring, social offspring, step offspring, and half-siblings who had delayed dispersal, siblings, offspring of various relationships with breeders who had dispersed and returned to natal territories, and unrelated immigrants. At hatching, 29% of pre-hatch auxiliaries dispersed out of groups, including all females unrelated to female breeders. Members of post-hatch groups varied widely in their contributions to nesting feeding. Many of the pre-hatch auxiliaries who dispersed returned later in the year. Friendships, tool use, a sense of humor, and pair reunions will also be discussed.

Condors, cranes, and computers: using next-generation tools to enhance zoo contributions to conservation
Callicrate, Taylor - Species Conservation Toolkit Initiative/Chicago Zoological Society; Robert Lacy - Chicago Zoological Society; Jonathan Ballou - Smithsonian Center for Conservation and Evolutionary Genetics; Katherine Ralls - Smithsonian Center for Conservation and Evolutionary Genetics; Oliver Ryder - San Diego Zoo; Webb Miller - Penn State; Kathy Traylor-Holzer - IUCN Conservation Breeding Specialist Group

Zoos are integrating their conservation activities with in situ conservation needs through strategies such as the One Plan Approach. The software tools used for these programs are provided by the Species Conservation Toolkit Initiative, a partnership to ensure that new innovations and tools needed for species risk assessment, evaluating conservation actions, and managing populations are developed, available, and used effectively. We use examples from two iconic North American species (California condor *Gymnogyps californianus*; whooping crane *Grus americana*) to illustrate how advances in conservation science are facilitating integrated conservation planning. Biologists began collecting California condor eggs and individuals for captive breeding during the 1980s. By 1987, all remaining wild condors were captured; the total population was 27 individuals. In 2015, for the first time since beginning reintroductions in 1992, wild condor fledglings outnumbered total wild deaths. Whole-genome sequencing of multiple condors has prompted re-pairings to preserve genetic diversity, made possible by the software PMx. This is one of the first examples of genomic data being used in population management. Only about 20 whooping cranes remained in the wild as of 1941. A captive breeding program was started in 1975 to provide cranes for reintroduciton. Recent efforts have focused on maintaining reintroduced migratory and non-migratory populations. However, reproduction of reintroduced birds has persisted at unsustainable levels. The whooping crane recovery team are using population viability analysis models in the Vortex software program to evaluate potential outcomes of different management scenarios on crane populations.

De-extinction, legal dualisms, and reframing conservation policy
Camacho, Alejandro - UC Irvine School of Law

De-extinction has been the subject of a recent surge of analysis in popular, scientific, and legal literature. Yet de-extinction raises more fundamental questions about the relationship between humans and nature and about the more and less useful ways that the law serves to navigate that relationship. Unfortunately, the conservation laws likely to govern the revival and introduction of de-extinct species largely remain premised on an understanding of nature as static and easily divisible from human activity. In these contexts, the law habitually privileges and even actively promotes what it identifies as natural and native over the unnatural and exotic. Through the example of de-extinction, this article illustrates the limitations of the law's reliance on these crude dualisms. Currently, de-extinct species will often be obstructed as non-native and introduced (even if they might promote ecological function in a particular area) and may be allowed or promoted in locations they used to exist (even if likely to cause ecological damage). De-extinction illustrates how policymakers need to reformulate natural resources law to be less dependent on these strict dualities. Instead, the article argues in favor of cautious risk assessment that acknowledges the dynamism of nature and humanity's indivisibility from it.

Divergent phenotypes despite (mostly) homogeneous genomes: insights from a continental avian radiation
Campagna, Leonardo - Cornell University; Márcio Repenning - Pontifícia Universidade Católica do Rio Grande do Sul; Luís Fábio Silveira - Museu de Zoologia da Universidade de São Paulo; Carla Suertegaray Fontana - Pontifícia Universidade Católica do Rio Grande do Sul; Pablo Tubaro - División Ornitología, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"; Irby Lovette - Cornell University

Recent radiations can offer insight into the genetic architecture of the phenotypes that are important in the early stages of speciation. Incipient species have a weakly differentiated genomic background, facilitating the search for highly diverged outlier loci. These loci are candidate targets of selection and may resist crossing species barriers in the face of gene flow. Here we use whole-genome sequencing to explore patterns of genomic divergence among four species of southern capuchino seedeaters, a group of recently radiated sympatric passerine birds in the genus *Sporophila*. Capuchino seedeaters can be identified by male plumage and song, yet to date species-diagnostic genetic markers are not available and their phylogenetic affinities remain unresolved. We discovered a small number of unlinked, highly differentiated regions among these species, collectively encompassing < 0.3% of the genome. These outlier regions harbor ~900 genes involved in various functions, yet over a dozen loci are known to be important regulators of the melanogenesis pathway (e.g., ASIP, SCL45A2), and may generate the coloration differences observed among species. We find few genetic variants that are unique to a species (i.e., fixed genetic differences), most of which are located in non-coding areas of the genome. Some of these markers are found close to genes, in regions that are conserved across all birds, and may control gene expression. We extend our analysis to explore these differentiated areas across all the species in the group, and discuss the implications of our findings in the context of the evolution of the capuchino radiation.

Avian Community Response to Mechanical Fuel Treatments in the Sierra Nevada, USA

Campos, Brent - Point Blue Conservation Science; Ryan Burnett - Point Blue Conservation Science

Managers of fire-prone forests are increasingly concerned with reducing vulnerability to stand-replacing fire. Fuels reduction treatments that mechanically remove small and medium-sized trees are commonly used to reduce the threat of extensive high severity fire. We investigated the short term response (2–6 years after treatment) of the avian community to three projects that implemented shaded fuel breaks in the northern Sierra Nevada, USA. We sampled the avian community using point counts at 122 treated locations and 314 control locations. We used a before-after control-impact framework and hierarchical distance sampling models to test for an effect of treatment, across and among project areas, on the 30 most prevalent species while controlling for the probability of detection. The effect of treatment on bird abundance varied among species and among the three projects. Species did not respond congruently to treatments across the three projects and overall effects for most species were modest. Species associated with mature dense forest canopies showed the strongest negative responses, while species associated with edge and open forest showed the most positive responses to treatment. We also measured five vegetation characteristics that reflect bird habitat in these forests. Treatments significantly reduced snag density, overstory and understory tree cover, shrub cover, and herbaceous cover. Despite changes in habitat structure, our results suggest that shaded fuel breaks have relatively modest impacts on bird abundance. The potential of these treatments to benefit the full spectrum of disturbance-dependent species, especially those associated with moderate and high severity fire, appears limited.

Fall migration and migratory connectivity of Canada Warbler moving through northern Colombia

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Canada Warbler (*Cardellina canadensis*) is a declining Neotropical migrant. We studied the species fall migration through northern Colombia with the aim of describing: 1) Breeding origins and connectivity patterns; 2) use of migratory pathways; 3) Phenology; 4) Differences between ages and sexes; 5) body condition; and 6) evidence for stopover. We captured birds in the Darien and the Sierra Nevada of Santa Marta in constant effort mist-net stations (2011-2015) and collected feathers samples to determine breeding origins using stable hydrogen isotope (δ2Hf) analyses. The Darien concentrated individuals from across their breeding range. However, δ2Hf values revealed that the majority (80%) were likely to have originated from the northeast of its breeding range. All but one of 161 captures were from the Darien, indicating a Central American migration route. Migration through the Darien occurred between the 20 September and early November. The proportion of HY birds (91%) in the Darién was higher than AHY birds (9%), and females (67%) were more abundant than males (33%). Most (89%) individuals arrived with low fuel reserves and estimated flight ranges revealed that 46% of the individuals captured in the Darién likely needed to refuel to continue migrating. Despite our results suggesting that many individuals should stopover, no individuals were recaptured in five years. Further study is required to determine exactly how long Canada Warblers stay in the region and the importance of other (montane) habitats in the Darién.

The mysterious arrival of H5N2 highly pathogenic avian influenza in the Mississippi flyway
Cardona, Carol - University of Minnesota; **Marie Culhane -** University of Minnesota; Xi Guo - University of Minnesota

Minnesota is the number one producer of turkeys in the US and with 10,000 lakes, a major breeding ground for waterfowl. The combination of a susceptible domestic poultry host and lot of waterfowl has created a rich history of influenza infections in turkey flocks. But, the detection of highly pathogenic avian influenza (HPAI) in late February 2015 was both unprecedented and unusual. Between 1977 and 2007, the majority of avian influenza (AI) outbreaks in Minnesota turkeys occurred in September and October, which follows the peak incidence of waterfowl AI virus prevalence in July and August. But, since 2007, Minnesota has had a series of influenza virus introductions in turkeys from wild birds in the Spring. The most recent Spring introduction was an Eurasian/North American H5N2 HPAI virus, which went on to cause the largest foreign animal disease outbreak in US history. The most recent relative of this H5N2 virus was detected in Washington state in a wild bird and despite efforts to detect H5N2 HPAI virus in wild birds during the outbreak in domesticated birds, detections were limited. There were 21 detections in Mississippi flyway birds, 12 of which came from a single cohort of Canada geese in Michigan and only two of which came from Minnesota. How the virus moved across the continent and what avian species carried it remain mysteries.

Discordance of autosomal, sex-linked and mitochondrial genes
Carling, Matt - University of Wyoming

The dominance theory of Haldane's rule, which is based on the Bateson-Dobzhansky-Muller (BDM) incompatibility model, has had a great deal of influence on our understanding of introgression patterns of different classes of genetic markers across hybrid zones. In birds, for example, according to Haldane's rule, we should expect mitochondrial and z-linked loci to show decreased rates of introgression compared with autosomal alleles. Indeed, there are multiple studies supporting this hypotheses, including ones published on Passerina buntings. Here, focusing on the closely-related species *Passerina amoena* and *Passerina cyanea*, we take a slightly different approach and investigate patterns of divergence of different classes of genetic markers (e.g., autosomal, mitochondrial and sex-linked) using multiple datasets - one generated using a modified RAD-seq approach and two generated using a tissue specific (testes and pectoral muscle) RNA-seq approach. Because BDM incompatibilities are thought to be a major player in causing fitness reductions in hybrid individuals, elevated between-species divergence patterns in interacting genes, particularly those involved in mitonuclear complexes, might be expected. Here we will explore that expectation, as well as general patterns of genetic divergence between *P. amoena* and *P. cyanea*, to better understand the mechanisms important in maintaining reproductive isolation between closely-related species.

How the West was one, or was it? Multi-species conservation under the sage-grouse umbrella
Carlisle, Jason - Wyoming Cooperative Fish & Wildlife Research Unit, Dept of Zoology & Physiology, University of Wyoming; Anna Chalfoun - USGS Wyoming Cooperative Fish & Wildlife Research Unit, University of Wyoming; Douglas Keinath - Wyoming Natural Diversity Database; Kurt Smith - University of Wyoming; Jeffrey Beck - University of Wyoming; Melanie Murphy - University of Wyoming; Shannon Albeke - University of Wyoming

The umbrella species concept is a conservation shortcut wherein multiple

species are protected under the umbrella of a reserve created for one. While appealing in theory, empirical tests of the concept are scarce. Greater Sage-Grouse are a priority species across Western North America. Many hope sage-grouse serve as an umbrella species in the conservation of dozens of at-risk wildlife species in the sagebrush ecosystem. We applied a multifaceted approach (state-level spatial modeling, local field observations, and controlled field experiments) in Wyoming, USA to address the following: How much protection does a reserve established for sage-grouse offer 52 at-risk species? Do finer-scale measures of sage-grouse abundance, habitat preference, and habitat quality mirror those of at-risk species? How do habitat treatments that enhance sage-grouse habitat affect non-target species? We found that the reserve protected 17.3% on-average of at-risk species' habitat; however, protection varied substantially across species. The local abundance of sagebrush-obligate songbirds was positively correlated with that of sage-grouse. However, preferred and high-quality nesting habitats of sage-grouse didn't correspond with those of songbirds. Habitat treatments implemented for sage-grouse had mixed effects on other species. Overall, sage-grouse serve as a good umbrella species for many, but not all, at-risk wildlife species at the broad scale; but the utility of sage-grouse as an umbrella species is limited at finer spatial scales. These findings highlight species missed by the sage-grouse umbrella and illustrate the need to consider spatial scale in surrogate-species conservation.

Migratory Connectivity of Long-billed Curlews Across their Range

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Long-billed Curlew (*Numenius americanus*) populations have declined in many portions of their breeding and wintering ranges, including in some historical strongholds, and curlews are recognized as a species of concern by many federal, state, and provincial agencies. Though we can identify many breeding and wintering season threats, it's also critical to know where curlews spend the rest of their annual cycle - including understanding the connectivity of wintering, stopover, and breeding grounds and potential threats throughout the year. Multiple partners are collaborating to describe the migratory connectivity patterns of Long-billed Curlews using satellite telemetry. Following initial work by Page et al. (2013) who tracked curlews breeding in Montana, Oregon, and Nevada, we are currently following curlews captured in western breeding grounds (Idaho, Montana, Wyoming, n=23) and southern wintering areas (Georgia, Texas, n=11) and have plans to expand sampling areas to include previously unsampled breeding and wintering areas. We will present movement details, compare results to prior work, consider threats to curlew populations, and discuss future objectives.

How does dietary linoleic acid affect metabolic rates in European Starlings (*Sturnus vulgaris*)?

Carter, Wales – University of Rhode Island; Scott McWilliams - University of Rhode Island

Flight places enormous energetic demands on birds (e.g. 60-85% of VO2max at minimum power), creating a strong pressure for birds to maximize efficiency across levels of biological organization. At the molecular level, variation in amount of the fatty acid linoleic acid (18:2n6) sourced from a bird's diet has been hypothesized to affect the rate and efficiency of fuel supply, leading to variation in whole-animal performance during aerobic activity. We tested this hypothesis in European

Starlings (*Sturnus vulgaris*, N=76) fed one of two semi-synthetic diets differing only in their relative content of 18:2n6 and 16:0 (palmitic acid) for 1-3 months, after which we measured basal metabolic rate (BMR) and peak metabolic rate (PMR). We found a significant change in BMR over time between the two diet groups (DateDiet: P = 0.001), with BMR decreasing over time in birds fed 18:2n6 enriched diets, and increasing in birds fed 18:2n6 poor diets. A similar trend was present in PMR (DateDiet: P = 0.08). This the negative effect of dietary 18:2n6 on BMR over time is consistent with expected increases in the efficiency of fatty acid transport. However, the insignificant and negative effect of dietary 18:2n6 on PMR is inconsistent with expected increases in overall fuel supply, suggesting that the rate limiting step for PMR differs from that of BMR, or is unaffected by this type of dietary fatty acid quality. Consequently, the mechanisms proposed to explain previous results and their focus on 18:2n6 should be reevaluated in light of this critical test.

Weather radar data correlate to hail-induced mortality in grassland birds

Carver, Amber - Department of Integrative Biology, University of Colorado Denver; Jeremy Ross - Oklahoma Biological Survey; David Augustine - USDA Agricultural Research Service; Susan Skagen - U.S. Geological Survey; Diana Tomback - Department of Integrative Biology, University of Colorado Denver; Michael Wunder - Department of Integrative Biology, University of Colorado Denver

Hail is a direct cause of avian mortality on the Great Plains of North America. How might global climate change increase the frequency of hail events and adversely influence avian population trends? Quantifying impacts of hail on mortality rates or population demographics is challenging. Hail events are difficult to predict, and they often occur in locations where birds are not under scientific observation. Estimates of bird mortality through remote sensing would be useful for population monitoring, but observations of bird mortality are usually too imprecise to connect directly with spatial information on storm intensity. Here, we demonstrate a strong connection between Doppler radar-estimated metrics of storm intensity and the fate of grassland bird nests (n = 204) during an extreme hail storm that intercepted our study area on 22 June 2014. We compared the distributions of values between failed and surviving nests for three remotely sensed variables: base reflectivity (BR), maximum estimated size of hail (MESH), and azimuthal wind shear (AWS). Failed nests were consistently associated with higher values of BR, MESH, and AWS than were nests that survived. We conclude that weather radar products can be used to remotely predict hail-induced nest mortality among ground-nesting grassland birds. Such data will become an increasingly important to model hail threats to biological communities under global climate change regimes.

Phylogenetic analysis of the *Degeeriella* complex (Insecta: Phthiraptera): The problem of defining genera of lice based on the classification of their hosts.

Catanach, Therese - The Academy of Natural Sciences of Drexel University; Veronica Pereyra - INSUE - Instituto Superior de Entomologia; Michel Valim - Museu de Zoologia da USP; Kevin Johnson - Illinois Natural History Survey; Jason Weckstein - Academy of Natural Sciences of Drexel University, Ornithology Department and Department of Biodiversity, Earth, and Environmental Science

Lice genera have historically been defined based on taxonomic groupings of their hosts. While some of these are natural groups, molecular phylogenies have shown that many of these genera are not monophyletic. Using 1 mitochondrial and 3 nuclear genes we inferred a phylogeny for 115 taxa (from all genera) within the Degeeriella complex to investigate the relationships among taxa in

this group. This complex contains 16 louse genera parasitizing a wide range of birds including raptors, woodpeckers, gamebirds, and toucans. The resulting phylogeny showed that many currently recognized genera are not monophyletic. In some instances these newly identified lineages more accurately reflect higher level bird classification, for example Degeeriella itself was found to actually comprise two distantly related lineages, one infesting Falconiformes whereas the other is found on Accipitriformes, agreeing with the recent findings that these two groups of predatory birds are not closely related. Conversely, Picicola chewing lice parasitizing woodpeckers, which have traditionally all been placed in this single genus, form multiple geographically limited lineages. However, woodpecker host phylogenies have confirmed that these hosts are monophyletic. There are also instances where lice from unrelated hosts are members of a well-supported monophyletic clade indicating a history of intraordinal host-switching. For example, lice from rollers, a group of Old World coraciiform are embedded within Degeeriella from hawks (Accipitriformes). Members of the Degeeriella complex are known to disperse via phoresis (hitchhiking) on hippoboscid flies, which could explain the apparently plethora of intraordinal an intrafamilial host-switches found in this group of parasites.

Carryover Effects of Reproductive Performance and Density Dependence Influence Breeding Propensity in a Short-lived Species

Catlin, Dan - Virginia Tech; Chelsea Weithman - Virginia Tech; Daniel Gibson - Virginia Polytechnic Institute and State University; Kelsi Hunt - Virginia Tech; Meryl Friedrich - Virginia Tech; Jim Fraser - Virginia Tech; Sarah Karpanty - Virginia Tech

Breeding propensity is perhaps the least understood demographic process influencing annual fecundity. Most research on breeding propensity has focused on long-lived organisms where environmental conditions, population density, and other factors affect individual breeding propensity. The extent to which breeding propensity in shorter-lived organisms is regulated by similar constraints is less clear. Additionally, individuals that opt not to breed are more difficult to detect, making estimation of breeding propensity difficult and potenitially biasing other demographic estimates. We studied the effects of sex, age, reproductive success, and habitat on the survival and breeding propensity of piping plovers (*Charadrius melodus*) on the Missouri River. We used a robust design Barker model to estimate survival and breeding propensity. Survival decreased as birds aged, particularly for males, and was lowest during the breeding season. Males were less likely to skip breeding (1–15%) than females (2–24%), and both were less likely to return to breed following years of high reproductive success. If birds did return following high reproductive success, they were of lower condition and produced lighter clutches than years after lower reproductive success. Younger birds and females left the breeding area before older birds and males, but all birds stayed longer when nest survival was low. Although breeding propensity was relatively low during historic flooding (85–90%), it was lowest following habitat creation (77–85%). Apparrently, piping plovers use a variety of environmental and demographic cues to inform reproduction. Despite a positive demographic response following habitat creation, relatively low breeding propensity could outweigh these benefits.

The role of nocturnal song in extra-pair mating of diurnal birds

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The aim of our study was to address the functional role of nocturnal song in the Field Sparrow (*Spizella pusilla*), particularly in the context of acquiring extra-pair mates. Field Sparrow is a diurnal species that occasionally conduct extraterritorial forays and sing at night. While males and females conduct forays to seek extra-pair mates, females usually enter the territories of the extra-pair males that ultimately sired their offspring. The mechanism used by females to locate potential extra-pair sires, however, is still unknown. We used autonomous acoustic recording units (ARUs) and an automated detection and classification system to examine the associations of nocturnal singing behavior of mated field sparrows with social factors (fertility stage, presence of neighbor song and presence of intruder song). Additionally, we used an automated radio telemetry system (ARTS), ARUs, and automated playback systems to conduct a nocturnal playback experiment and explore how mated male and female field sparrows responded to nocturnal single songs at night and across prefertile, fertile, and postfertile stages. Our study showed that nocturnal song in the field sparrow may play a role in extra-pair mate attraction (intersexual function), specifically the announcement of the presence or availability of extra-pair males to females, either through territorial males vocalizing to foraying or neighboring females or through intruder males vocalizing to females on her territory. Our study, particularly when combined with other data on foray behavior, provides a clearer, more comprehensive understanding of the role of nocturnal song as an extra-pair mating behavior.

Spatially explicit integrated population models for understanding the factors limiting Canada Warbler populations in the Southern Appalachian Mountains

Chandler, Richard - University of Georgia; Robert Cooper - University of Georgia; Jeff Hepinstall-Cymerman - The University of Georgia; Sam Merker - University of Georgia; Heather Abernathy - The University of Georgia; Ryan Chitwood - Warnell School of Forestry and Natural Resources, University of Georgia

Species distributions are shifting in response to rapid environmental change, yet little is known about the demographic processes involved. Without this information it is impossible to determine if populations will track their climate optima via dispersal or if low-latitude, trailing-edge populations will become extinct while populations at higher latitudes advance. Although range-wide studies of demographic processes are difficult to implement, studies of the factors limiting species distributions at range margins may provide insights. We designed a study to understand the degree to which climate variables influence demographic rates and limit the distributions of species at their southern range limits in western North Carolina. Focusing here on Canada Warbler, we present results from a spatially explicit integrated population model fitted to three years of mark-recapture, mark-resight, and point count data collected over a strong climate gradient. Results indicate that recruitment was density-dependent and highest in cool, wet forests with rhododendron understories found at the highest elevations in our study area. Survival, however, was not influenced by density or climate, and was most likely determined by non-breeding season events. Dispersal of adults was minimal, with most territories shifting less than 50m between seasons.

Taken together, our results indicate that Canada Warbler populations are likely to shift upward in elevation, but not northward, in response to ongoing climate change. However, more information is needed on habitat-specific vital rates and natal dispersal before viability can be adequately predicted for trailing-edge populations in the Southern Appalachian Mountains.

Body condition in Snowy Owls wintering on the Canadian prairies is greater in females and older individuals and leads to sex-biased mortality

Chang, Alexander - University of Saskatchewan; Karen Wiebe - University of Saskatchewan

Birds that winter in cold northern climates face harsh conditions including reduced food availability and increased energy demands. In raptors, the ability to forage and maintain body condition may be related to age (hunting experience) or the ability to defend good quality territories (dominance). We examined the effect of age and sex on body condition and various sources of mortality in wintering Snowy Owls (*Bubo scandiacus*) on the Canadian prairies. Because of reversed sexual size dimorphism, we predicted that female owls, the dominant sex, would be in better condition than males, and that adults would be in better condition than juveniles. Consistent with these predictions, data from 537 live owls trapped over 18 field seasons showed that adults were heavier than juveniles for a given body size and carried more fat reserves. We found that 56% of male owls lacked body fat whereas only 31% females lacked fat and females but not males tended to put on fat during the winter months. A comparison of the sex ratio of starving owls turned in to rehabilitation centers (37% female) and the sex ratio of living owls observed in the wild (55% female) showed a male-bias in starving and diseased owls. Although most of the wild-trapped birds were above the starvation threshold, proximate mechanisms by which sex-biased competitive dominance manifests in differences in body condition and survival warrant further study. Possibilities include greater energy expenditure through nomadism by males, and/or a wider suite of available prey for larger, dominant females.

Anthropogenic effects on Central Mexican semiarid scrubland birds; from the molecular to the community level: a six-year study

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Semiarid habitats of central and northern Mexico support diverse plant and animal communities. Ecological processes and the influence of anthropogenic impacts on organisms inhabiting these environments are comparatively underrepresented in the scientific literature. Habitat degradation through tree extraction and overgrazing by domestic animals, and pollution generated by mining activities, which increase bioavailability of toxic metals in ecosystems, are among the most widespread impacts in Central Mexican semiarid scrublands. The purpose of this study was to evaluate the effects of these impacts on birds. The response variables studied included genetic diversity, parasitism by haemoparasites (Haemosporidia), habitat occupancy patterns, population apparent survival, and community composition. For the last six years, birds were studied in semiarid scrublands that vary in habitat degradation and exposure to mining. Bird censuses were conducted, birds were also trapped with mist nets and blood samples for genetic analysis and

haemosporidian parasite identification were obtained, all trapped individuals were banded. Effects of anthropogenic impacts on genetic structure were not strong. Therefore, geographic distance may be more important. Contrastingly, most, but not all bird species, showed higher prevalence (proportion of birds infected), parasitemia (number of parasitized cells per parasitized individual), and apparent mortality, in impacted habitats. Habitat occupancy patterns, however, did not follow this trend. Therefore, factors influencing habitat choice should be investigated. Finally bird species richness and diversity were higher in highly degraded sites (i.e., small villages), and intermediate in the most conserved scrublands, suggesting that habitat degradation promote high levels of species turnover.

Infecting mainstream conservation with genomic solutions

Chase, Tom - The Nature Conservancy, MA

With climate change, population growth and the accelerated conversion of native habitats to urban and agricultural uses, more species will be threatened with population fragmentation, genetic isolation and extinction. Today's genomic solutions, rather than a last-ditch effort at the fringe of conservation, represent the beginnings of an increasingly necessary and viable practice. Indeed, technologies to benefit avian species, such as restoring genetic diversity, de-extinction and gene drives, are already proliferating. In addition, the prospect of "revival and rescue" appears to be broadening the base of conservation supporters, raising more funds from new sources, advancing the case for habitat conservation, and in some cases deepening personal and community commitment to conservation. Why, then, are genomic solutions not being more readily embraced by conservation organizations? I describe how many conservation organizations employ a highly disciplined approach to choosing priorities and selecting strategies which, though highly effective, can be resistant to non-traditional approaches and paradigm shifts. I propose the creation of a conceptual framework that facilitates the incorporation of genomic solutions into mainstream conservation strategies while also retaining biotech's capacity to generate innovative approaches, social support and funding.

The effects of seasonal changes, migratory versus resident status, and island characteristics on the spatial structure of bird communities

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While it is recognized that many communities undergo large seasonal changes, the consequences for spatial structure of communities are poorly known. We used beta diversity partitioning, nestedness and null community methodsies to test for differences in landbird communities among seasons and between resident vs. seasonal assemblages. Beta diversity of Winter residents beta diversity was high and mainly driven by richness differences, whereas that of summer residents was low and dominated by species turnover. Winter visitors showed similar nestedness patterns compared with randomly-drawn assemblages, and were less clearly related to island characteristics than winter or summer resident species. The results suggest a selective-extinction process for winter residents, probably due to winter food shortage. Conversely, summer residents appeared more dependent on turnover in local island factors, such asi.e. habitat conditions, which mediate competition. Winter visitors appeared randomly distributed across islands. We conclude that residents maintain strong spatial structure seasonally, whereas winter visitors show considerably less structure.

Genomic consequences of population decline in the endangered Florida Scrub-Jay

Chen, Nancy - University of California, Davis; Elissa Cosgrove - Cornell University; Reed Bowman - Archbold Biological Station; John Fitzpatrick - Cornell Lab of Ornithology; Andrew Clark - Cornell University

Understanding the population genetic consequences of shrinking population size is important for conserving the many species worldwide facing severe decline. Thorough empirical studies on the impacts of population reduction at a genome-wide scale in the wild are scarce because they demand huge field and laboratory investments. Previous studies have demonstrated the importance of gene flow in introducing genetic variation to small populations, but few have monitored the effects of reduced gene flow over multiple generations. Here we assess temporal variation in gene flow, inbreeding, and fitness using longitudinal genomic, demographic, and phenotypic data from a population of federally Threatened Florida Scrub-Jays (*Aphelocoma coerulescens*). We exhaustively sampled and genotyped the study population over the past two decades, providing one of the most detailed longitudinal investigations of genetics in a wild population to date. We show that immigrants were less heterozygous than residents but still introduced genetic variation into our study population. Regional population declines reduced immigration into the study population from 1995-2013, resulting in increased levels of inbreeding and reduced fitness via inbreeding depression, even as the population remained demographically stable. Our results suggest that small peripheral populations play a vital role in preserving genetic diversity of larger and seemingly stable populations, underscoring the importance of maintaining population connectivity in conservation of fragmented species.

A UCE-based genus-level phylogeny of suboscine birds

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Suboscine birds form one of two major groups of passerines and consist of roughly 1300 species, or about one-eighth of extant birds. Suboscines are a predominantly New World group and account for more than 30% of the world's richest avifauna, that of the Neotropics. Some 50 species of suboscines are also found in the Old World, where they form a phenotypically striking part of the avifauna. Using a next-generation approach, we sequenced 2500 nuclear loci, including exons and ultraconserved elements and their flanking sequence (UCEs), for >98% of suboscine species and >99% of suboscine genera. For this talk, phylogenetic analyses were conducted on a subset of nearly 600 suboscine individuals, including representatives of all genera in the dataset and including more than one species for genera of questionable monophyly. Our results supported previous conclusions regarding monophyly of all suboscines, Old World suboscines (including *Sapayoa aenigma*), and New World suboscines. Monophyly of most families and subfamilies, including many only recently recognized as clades, was also supported, although relationships among groups differed in some cases. Our phylogeny also tallied well with recent Sanger-based species-level phylogenies (e.g., that of the Furnariiidae) in the furnarioid suboscines, but many genera in

the tyrannoid suboscines, species-level phylogenies of which have not generally been published, were found to be para- or polyphyletic, even given our limited sampling. This indicates the degree to which species-level phylogenies will likely rewrite our understanding of the lower-level systematics of birds generally.

Investigating the effects of urban features on bird window collisions
Chin, Sean - York University; Bridget Stutchbury - York University

Migrant bird species that stop over in urban locations are threatened by a number of anthropogenic causes of mortality including bird collisions into reflective glass windows. To add to the larger body of knowledge that has systematically surveyed single house dwellings and high-rise buildings, this study addresses a gap in knowledge for low rise buildings in a campus setting. We evaluated the annual avian mortality rate on the York University Keele campus as well as determined the effects of landscaping and building characteristics that can predict mortality rate. We predicted that (1) the frequency of collisions will increase with higher amounts of vegetation near buildings and closer proximity of vegetation to buildings and (2) the risk of collision should increase with increased window area, all else being equal. Surveyors detected 100% of carcasses during search efficiency tests and that predator removal was estimated at 11.4%. A negative binomial GLM model demonstrated that both proportional vegetation area and window area were significant predictors of collision frequency. Interaction effects were found with increasing amounts of vegetation and window area on frequency of collision. Distance to vegetation on the other hand was found to not be a significant predictor. We can conclude that buildings with higher amounts of vegetation and with greater window area pose greater threats to birds during migratory seasons. In order to reduce the number of collisions, mitigation measures such as ultraviolet window film could be applied to high risk buildings with higher number of collisions.

Sex differences in androgen activation of complex courtship in a tropical bird
Chiver, Ioana - University of California Los Angeles; Barney Schlinger - University of California Los Angeles

Sexual dimorphism is common and evolutionarily labile in birds. Gonadal hormones may exert considerable influence on the development and later expression of sexual traits, however studies to date have examined few behaviors, mostly singing and copulatory behaviors. We studied the extent to which androgen treatment of female golden--collared manakins (*Manacus vitellinus*) activates the elaborate, acrobatic courtship display characteristic of males. Non--breeding females and juvenile males, were given implants containing testosterone or blank as control and observed for 3 weeks in a large aviary in the middle of Panamanian rainforest. Males performed the full suite of courtship behaviors and display rate increased significantly with T. Only T-treated females performed male-typical behaviors, and only a subset of the repertoire, namely perched wing-snaps, rollsnaps, and jumps. Our results show that T can partially activate some of the complex elements of male courtship behavior in females but also that some neuromuscular systems encoding male courtship behaviors appear to have undergone sex-specific differentiation and have lower sensitivity or are unable to be activated by T in adult females. Wing-snaps and rollsnaps are complex elements and previous work indicates that muscle characteristics are similar between the sexes and show adaptation for powerful and rapid movements characteristic of acrobatic displays. This suggests that the peripheral neuromuscular system is decoupled in female golden-collared manakins through low levels of circulating T or lower sensitivity to T. On the other hand, females did not perform jump-

snap displays and this is likely due to developmental events producing sexually-dimorphic phenotypes.

Predicting persistence of the highly pathogenic avian influenza virus in the post-breeding ground of Swan Geese (*Anser cygnoides*) through analysis of satellite telemetry data and agent-based epidemiological model

Choi, Chang-Yong - University of Oklahoma, Department of Microbiology and Plant Biology, Center for Spatial Analysis; John Takekawa - National Audubon Society; Diann Prosser - US Geological Survey, Patuxent Wildlife Research Center; Xiangming Xiao - University of Oklahoma, Department of Microbiology and Plant Biology, Center for Spatial Analysis

Persistence of highly pathogenic avian influenza (HPAI) viruses in waterbirds have been studied primarily in wintering grounds where the poultry industry often co-exists. However, few studies have investigated the key ecological features of wild waterbirds in relation to infectious disease transmission within their breeding grounds which have few to no poultry. The Swan Goose (*Anser cygnoides*) is a threatened waterbird in East Asia migrating between naive breeding areas and the epicenter of HPAI outbreaks in China. Molting Swan Geese form large flocks during the post-breeding period which may increase the risk of HPAI transmission. In order to assess the HPAI transmission risk in the post-breeding period, telemetry data were collected from 37 geese and were simulated through an agent-based susceptible-exposed-infectious-recovered (SEIR) model. The simulations of the model with parameter values from the analyses of the telemetry data suggested that HPAI viruses introduced into poultry-free post-breeding grounds might not persist until the fall migration largely due to limited movements imposing localized impacts only. The model also indicated that ecological variables (population size, number of infected birds, availability of molting wetlands) as well as pathological ones (incubation period, infectious period, infectivity, mortality) affect the persistence of the HPAI viruses. Our modeling results highlight the importance of ecological features of wild birds determining the risk of HPAI transmission and persistence, and also suggest that the wetland loss in the breeding and post-breeding ranges, which were in part driven by climate change, may further increase wild bird congregation and the HPAI transmission risk.

Planning and Application of Conditions of Approval for Projects Affecting Migratory Birds

Chopp, Johnny - BLM

The Bureau of Land Management (BLM) New Mexico, Pecos District boundary is located within the Permian Basin oil, natural gas, and potash producing area. To accompany the vast mineral deposits and associated infrastructure is an equal amount of avian abundance and diversity. Hence, the challenges and responsibilities for the BLM to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds through enhanced collaboration with all involved stake holders. The BLM uses both broad-based Resource Management Plans and focused activity planning such as Habitat Management Plans and establishing Areas of Critical Environmental Concern. Additionally, project implementation level survey requirements to determine species presence, conditions-of approval consisting of temporal and spatial buffers, and mitigation measures are established during the National Environmental Policy Act (NEPA) process to ensure on-the-ground conservation and management. Compliance with conditions of approval and mitigation measures is critical for the protection of migratory birds. Project design and implementation ensure impacts to migratory birds are short-term. The mission of the BLM is to sustain the health, diversity,

and productivity of the public lands for the use and enjoyment of present and future generations. In turn, planning and application of conditions of approval are established and utilized to avoid, minimalize and mitigate the anthropogenic issues affecting bird conservation.

Occurrence and Habitat Selection of Upland Sandpiper (*Bartramia longicauda*) in Southern Ontario, Canada
Chronowic, Daniel - Trent University; Erica Nol - Trent University

Upland Sandpiper (*Bartramia longicauda*) are declining across Canada. The Breeding Bird Survey indicates an annual index of -3.12 in Ontario. Open habitat is necessary for UPSA. UPSA occur at 50% incidence when open habitat is approximately 200ha. This prompts the question: what habitat features are important for UPSA in a fragmented landscape? We sampled 130 grassland patches in 2014 with 31 being occupied (23.8%). UPSA occurred in 53/390 (13.56%) surveys. Detection probability was 0.514. In 2015, 20 grassland patches, which were occurrence sites in 2014, were sampled indicating occupancy in 16/20 (80%) sites and in 45/160 (28.13%) of the surveys. Detection probability was 0.339. This study is examining occupancy and detection using covariates of detection, date and time of day, as well as covariates of occupancy, patch size and dominant habitat type using the unmarked package in R. Occurrence data, from five different local populations, was collected in 2013, 2014, and 2015. Proportion of grassland patches used were 60/226 (25.6%), 40/203 (19.7%), and 64/232 (27.6%) respectively. A resource selection function will model the relationship between used and available habitat with dominant habitat type as the independent variable. Agricultural change, specifically change in crop proportions and farmer activity has been hypothesized as a potential mechanism of decline. Using historical census data, agricultural change is being examined for relationships with UPSA occurrence. This study will enhance the understanding of UPSA occurrence and habitat use in a continually changing agricultural landscape.

Full Life Cycle Conservation through Education
Chu, James - United States Forest Service - International Programs

“Linking Communities in Migratory Shorebird Conservation along the Pacific Flyway” The Copper River International Migratory Bird Initiative (CRIMBI) was founded by Ducks Unlimited (United States and Canada) and several units of the United States Forest Service in 2001. The founders of the initiative recognized that they needed to do more to protect the 5 million shorebirds who used the Copper River Delta as a stopover site during the spring migration. Conservation measures used on the Copper River Delta weren’t enough to ensure the return of large shorebird populations. Organizers of the initiative began reaching out north and south of the United States. Today, CRIMBI consists of partners in United States, Canada, Mexico, Panama, Colombia, Ecuador and Peru who are committed to protecting shorebirds and their habitat in their respective countries. This presentation will address how partners utilizing are using education, science, capacity building, and linkages between sites to increase awareness of the of migratory birds and their habitat.

Patterns and mechanisms of population diversification in Bornean montane birds
Chua, Vivien - Louisiana State University; Brian Smith - American Museum of Natural History; Robert Moyle - University of Kansas; Thomas Martin - USGS - University of Montana; Frederick Sheldon - Louisiana State University

Elucidating patterns and processes that cause diversification of populations is among the most interesting areas of research in

evolutionary biology. Changes in an organism's biogeographic and ecological context during its evolutionary history increases the complexity of the processes underlying the divergence of its populations and, consequently, the work required to sort them out. Borneo is perhaps the most important source of biodiversity in SE Asia, and its mountains played a key role in this process. Bornean mountains hold more endemic avian species (39) than the entirety of any other Sundaic island. To gain insight into the evolutionary history and process of population diversification on Borneo, we studied the comparative phylogeography of 11 montane species in light of their historical, ecological, and morphological characteristics. Among significant patterns, we discovered that more vagile species had less population structure, whereas long-lived (presumably less dispersive) species had greater population structure. In those species with clear population structure, divergence time estimates showed that populations diversified during the early to mid-Pleistocene. Phylogeographic patterns and divergence timing suggested: (1) at least two montane refuges existed in Borneo during the cooler, drier early Pleistocene, and one of these was in the northeastern part of the island; (2) the structure and timing of diversification in montane populations resembles that of lowland populations; and (3) isolated mountains that are not part of the central Bornean range have distinct populations, even though these remote mountains were connected to the central mountain chain and gene flow was expected during the LGM.

Nest site choices and consequences revealed by cross-fostering experiments in tree swallows

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Whether nest choices are related to early exposure (EE), genetic or family effects (FE), or chance events (CE) has not been fully resolved in birds. To test among these hypotheses, partial cross-fostering experiments were performed between plywood and aspen nest boxes used by tree swallows (*Tachycineta bicolor*), 2008-2015. Nestlings (2-3 days old, n = 377 aspen to plywood, 379 plywood to aspen) were swapped between 63 box type pairs, matched for hatch date and clutch size, and banded at 12 days old; nestlings (n = 798 aspen, 1833 plywood) at un-manipulated nests were also banded. For nestlings recaptured as breeding adults (n = 119), modal age at recruitment was 1 year old for swallows from aspen boxes (n = 51) and 2 years old for plywood boxes (n = 68). Choice of box of first nesting was unrelated to nest box of hatching or rearing (G-tests, Ps > 0.30), contrary to predictions of the EE and FE hypotheses, suggesting that nest site choice was related more to availability, i.e., CE. An unexpected result was that, regardless of nest box of hatching, swallows fledging from aspen boxes were more likely (odds ratio = 1.55, Wald 95% CI = 1.05-2.29) to recruit than were nestlings raised in plywood boxes. Control and cross-fostered nestlings raised in aspen boxes had lower feather-corticosterone values than did chicks raised in plywood boxes, possibly signaling more favorable nest conditions or higher quality parents associated with aspen boxes.

The Burning Question: Do all mosaics cater equally well for birds?

Clarke, Michael - La Trobe University; Jemima Connell - La Trobe University

Inappropriate fire regimes are recognised as a key threatening process globally, but particularly in Australia. Fire management often aims to maintain a "mosaic" of patches of differing fire history (pyrodiversity); assuming this will cater for the greatest variety of species. We tested this assumption across a 104,000 km2 area of the Murray

Mallee region of southern Australia. We compared avian diversity in 28 'whole' landscapes, representing different fire-driven mosaics. Using a novel technique to age and map vegetation we demonstrated that fire influences mallee vegetation for over a century, particularly key habitat resources (e.g. tree hollows). We found little evidence that bird diversity was related to the diversity of fire age classes in a landscape. Similarly, there was little evidence of the importance of pyrodiversity for individual species. Instead, a key driver was the spatial extent of ecologically important fire age classes; in particular, the spatial extent of long-unburnt mallee vegetation. We used models of species distributions to evaluate the consequences for threatened bird species of alternative management scenarios for fire for the next twenty years. We evaluated the likely effect of planned burning programs that burnt 1%, 3% or 5% of public land annually. The outcomes of this work have provided an assessment of the relative risk of extinction for these species. This research has transformed understanding of how fire affects these threatened species in the region and has been embraced by fire managers and contributed to significant change in fire management policy.

Using randomly-located point counts to enhance bird atlases: A case study in Rhode Island

Clarkson, Charles - URI/RI DEM; Peter Paton - Univ of Rhode Island; Jay Osenkowski - RI Department of Environmental Management

In the 1980s and 1990s, bird atlas projects in the US typically used volunteers to estimate the presence of breeding birds within large blocks (e.g., 25 km2). More recently, some second-round state atlas projects also have conducted statewide roadside point-counts to estimate the densities of most breeding birds. However, using only roadside point-counts can lead to biased density estimates. The Rhode Island Bird Atlas 2.0 (www.ribirdatlas.com) is a five-year (2015-2019) effort that is utilizing a two-tiered design to map the distribution and abundance of breeding birds. For tier-one, we are using volunteers to map breeding birds in large blocks. For tier-two, we have randomly positioned point-count stations throughout Rhode Island (n = 8,250), regardless of distance from roads, among 15 different habitat types. Habitat will be sampled in proportion to its prevalence within Rhode Island. We are conducting point-counts only with professional technicians (n = 1,014 in 2015). Observers will conduct time –removal counts as a robust technique to develop spatially-explicit estimates of the densities of more widespread species. In addition to randomized placement of point-count stations, the density of stations in our design is much greater than previous state atlas projects (e.g., 10X higher than the state of PA), which will allow us to develop detailed maps for many species. The RIBA2.0 represents the first statewide bird atlas to alleviate habitat biases by conducting randomized point-counts and not relying solely on roadside counts.

The Western Hemisphere Shorebird Reserve Network: using science to support shorebird conservation across the hemisphere

Clay, Rob - Western Hemisphere Shorebird Reserve Network; Meredith Gutowski Morehouse - Western Hemisphere Shorebird Reserve Network; Diego Luna Quevedo - Western Hemisphere Shorebird Reserve Network; Lisa Schibley - Western Hemisphere Shorebird Reserve Network; Laura Chamberlin - Western Hemisphere Shorebird Reserve Network

The Western Hemisphere Shorebird Reserve Network (WHSRN) is a grass-roots, voluntary network of public and private partners working to protect the most important breeding, stopover, and wintering habitats for shorebirds throughout the Americas. Thirty years after its launch, WHSRN encompasses 95 sites in 15 countries, helping to protect

more than 33 million acres of shorebird habitat. Sites enter the network through a combination of importance for shorebird populations and landowner commitment to shorebird-friendly site management. WHSRN works to: 1. Build a strong system of international sites used by shorebirds throughout their ranges; 2. Develop science and management tools that expand the scope and pace of habitat conservation at each site within the Network; 3. Establish local, regional and international recognition for sites, raising new public awareness and generating conservation funding opportunities; and, 4. Serve as an international resource, convener and strategist for issues related to shorebird and habitat conservation. WHSRN's approach is underpinned by the best science available. This includes addressing important questions such as: the size and trends of shorebird populations; biogeographic populations and the migration pathways they use; the ecological functions required by shorebird populations and the system of landscape elements needed to maintain them; how habitats and sites can be managed to maximize their value for shorebirds; and, how the needs of shorebirds can be integrated into the plans of other sectors. The presentation will share examples of how the latest research is helping to answer these questions.

Does allopreening control avian ectoparasites?

Clayton, Dale - University of Utah; Scott Villa - University of Utah; Graham Goodman - University of Utah

For birds, the first line of defense against ectoparasites is preening. The effectiveness of self-preening for ectoparasite control is well known. In contrast, the ectoparasite control function of allopreening - in which one birds preens another - has not been rigorously tested. We infested groups of captive pigeons (Columba livia) with identical numbers of parasitic lice, then compared rates of allopreening to the abundance of lice on the birds over time. We documented a clear negative relationship between rates of allopreening and the number of lice on birds. In contrast, we found no relationship between rates of self-preening and the number of lice on birds. Our data suggest that allopreening may be a more important means of ectoparasite defense than self-preening when birds live in groups. Our results have important implications for the evolution of social behaviour.

Climatic conditions produce contrasting influences on demographic traits in a long distance Arctic migrant

Cleasby, Ian - University of Exeter; Thomas Bodey - University of Exeter; Freydis Vigfusdottir - University of Exeter; Jenni MacDonald - University of Exeter; Stuart Bearhop - Exeter University

The manner in which patterns of variation and interactions among demographic rates contribute to population growth rate (λ) are key to predicting how animal populations will respond to changing climatic conditions. Using a unique long-term data set we employed integrated population models (IPM) to demonstrate that the environmental conditions experienced during a short, but critical period, play a central role in the demography of a long-distance migrant, the light-bellied Brent goose (*Branta bernicla hrota*). Female survival was positively associated with June North Atlantic Oscillation (NAO) values, whereas male survival was not. In contrast, productivity was negatively associated with June NAO. While λ was positively correlated with annual productivity it was most sensitive to changes in adult survival. Crucially, different demographic rates responded in opposing directions to climatic variation, emphasizing the need for integrated analysis of multiple demographic traits when predicting population dynamics.

Dynamic Modelling of BBS Data: Effects on Inference

Clement, Matthew - Arizona Game and Fish Department; **James Hines** - USGS, Patuxent Wildlife Research Center; James Nichols - USGS, Patuxent Wildlife Research Center; Jaime Collazo - USGS, N.C. Cooperative Fish and Wildlife Research Unit; Adam Terando - USGS, Southeast Climate Science Center; David Ziolkowski - USGS Patuxent Wildlife Research Center; Keith Pardieck - USGS Patuxent Wildlife Research Center

There is widespread interest in the true relationship between habitat and bird distributions. Frequently, research questions and models are formulated in static terms: what is the relationship between habitat covariates and bird distributions? However, we suggest a dynamic approach: what is the relationship between changes in habitat covariates and changes in bird distributions? The first question focuses on patterns, while the second focuses on mechanisms. We conducted two dynamic analyses of BBS data. First, we used correlated-detection occupancy models to compare static and dynamic analyses relating climate to the distribution of breeding Louisiana Waterthrush. Static models indicated that the distribution of birds was limited by extreme average temperature and diurnal temperature ranges. Dynamic models indicated that colonization was limited by extreme precipitation and diurnal temperature ranges, while extinction was promoted by extreme average temperature. Second, we used dynamic correlated-detection occupancy models to compare the relative importance of changes in land cover and climate to changes in the distribution of breeding Eastern Wood Pewee. We fit nested models that hypothesized that changes in colonization and extinction were or were not related to annual changes in climate and land cover and compared these to a fully time-specified model. We found that although range change was related to average land cover and climate, our metrics of land cover and climate change were not important drivers of range change. In the two analyses considered, dynamic models substantially affected inferences about the relationship between habitat and birds, and may be more appropriate than static questions/models.

Digital Aerial Surveys: Employing Ecological First Principles to Monitor Offshore Bird Populations

Clough, Stuart - APEM Ltd; Mark Rehfisch - APEM Ltd; Stephanie McGovern - APEM Ltd; **Christian Newman** - APEM Inc.

Digital aerial survey technology has become the standard for offshore bird surveys in Europe. Historically, bird survey techniques were transect boat based and aircraft based visual observer methods. They relied on a statistical correction to account for missed birds by observers. In addition, this method influenced the birds under observation, with some species being repelled by low flying aircraft and survey vessels, and other species being attracted to vessels. Digital techniques, however, offered benefits over observer based methods. Higher altitudes meant that there was no attraction or repulsion and was safer than low flying aircraft. The collection of a permanent digital record overcame the need for observers to quickly estimate bird numbers and make species identifications, and allowed for QA/QC of the data. However, transect based survey designs only delivered some of the potential benefits of digital methods. It soon became apparent that for any given pixel resolution the ability to identify birds to species level was better for sharp still imagery than for the more motion blurred video streams. Moreover, still images could be deployed in a variety of configurations, using the image as you would a quadrat in other biological surveys. This meant that for any given coverage grid based surveys have more statistical power, and lead to increased power to detect change over time than any of the other methods of data collection. Our paper will discuss the state of the art

approaches and technology of offshore avian surveys.

Are penguins really all that philopatric?
Clucas, Gemma - University of Southampton and University of Oxford; Jane Younger - University of Oxford; Tom Hart - University of Oxford; Karen Miller - Australian Institute of Marine Science

Recent advances in next generation sequencing technology have opened the floodgates for generating genomic data from non-model organisms. We have used RADseq (restriction site-associated DNA sequencing) to generate an unprecedented dataset consisting of thousands of genome-wide single nucleotide polymorphisms (SNPs) from over 350 Emperor, King, Gentoo, Chinstrap, and Adélie penguins sampled from across their ranges in Antarctica and the sub-Antarctic. By comparing multiple species and by using thousands of molecular markers, we are able to detect population structure at the finest of scales and identify the mechanisms driving patterns of population differentiation, or lack thereof. We find that for all species except the Gentoo penguin, population structure is extremely weak, even over thousands of kilometres. This indicates that individuals are dispersing regularly between colonies, challenging the notion of high levels of natal philopatry in most species. The Gentoo penguin, however, exhibits high levels of population structure and we can detect differentiation between colonies that are separated by just tens of kilometres. Deep phylogenetic splits in Gentoo penguins may also warrant taxonomic revision. We use these large SNP datasets to infer relative migration rates between populations of all five species, and hence detect extrinsic and intrinsic barriers to gene flow. The results from this study show that population structure can differ dramatically between closely related and/or sympatric species, and an understanding of species-specific population structure is necessary for appropriate monitoring.

Using a hierarchical integrated population model to help guide conservation actions: an example of greater sage-grouse in the Bi-State Distinct Population Segment of California and Nevada
Coates, Peter - U.S. Geological Survey-Western Ecological Research Center; Brian Halstead - U.S. Geological Survey, Western Ecological Research Center; Erik Blomberg - University of Maine; Brianne Brussee - U.S. Geological Survey; Kristy Howe - U.S. Geological Survey, Western Ecological Research Center; Lief Wiechman - U.S. Fish & Wildlife Service; Joel Tebbenkamp - University of Idaho; Kerry Reese - University of Idaho; Scott Gardner - California Department of Fish and Wildlife; Michael Casazza - U.S. Geological Survey-Western Ecological Research Center

A geographically-isolated and genetically distinct population of greater sage-grouse (*Centrocercus urophasianus*) exists at the southwestern portion of the species range and may be at risk largely as a result of habitat loss and fragmentation. We developed a hierarchical integrated population model (IPM) to help inform the species assessment under the Endangered Species Act and to help inform local level management decisions. Specifically, we used a Bayesian framework to model population growth (λ) as a function of survey and demographic data that spans over a decade in the form of: (1) lek counts with observation error; (2) adult and yearling survival; and (3) recruitment (a composite function of nest attempt, clutch size, egg hatchability, nest survival, chick survival, and juvenile survival). Relative importance of each population vital rate to λ was evaluated using sensitivity, elasticity, and a retrospective analysis. We provide an approach to develop a model that incorporates information from multiple sites and years using random effects (e.g., subpopulation) and evaluated results from different random effect structures. Although we identified substantial spatiotemporal variation within λ and multiple subpopulation

vital rates, across the Bi-State as a whole we did not detect a consistent trend of increase or decrease. However, one subpopulation is currently at risk of extinction. Preliminary findings indicate that patterns of climatic variation (i.e., temperature and precipitation) explain variation in λ and specific vital rates, especially those factors associated with the spring and summer months. This information is preliminary and is subject to revision.

Wildfire, Wildlife, and the Wild West—Fire, Climate, and Invasive Grass Impact an Indicator Species by Reshaping Sagebrush Ecosystems

Coates, Peter - U.S. Geological Survey-Western Ecological Research Center; Mark Ricca - U.S. Geological Survey-Western Ecological Research Center; Brian Prochazka - U.S. Geological Survey-Western Ecological Research Center; Mathew Brooks - U.S. Geological Survey, Western Ecological Research Center; Kevin Doherty - U.S. Fish and Wildlife Service; Travis Kroger - U.S. Geological Survey, Western Ecological Research Center; Erik Blomberg - University of Maine; Michael Casazza - U.S. Geological Survey-Western Ecological Research Center

Iconic sagebrush ecosystems of the American West are threatened by larger and more frequent wildfires that can kill sagebrush and facilitate invasion by annual grasses, thereby creating a cycle that continually alters sagebrush ecosystem recovery after disturbance. Thwarting this accelerated wildfire-grass cycle is at the forefront of current national conservation efforts, yet its impacts on wildlife populations inhabiting these ecosystems have not been quantified rigorously. Within a Bayesian-framework, we modeled 30 years of wildfire and climatic effects on population growth of a sagebrush indicator species, the greater sage-grouse, across the Great Basin of western North America. Importantly, our modeling also accounted for variation in sagebrush recovery time after fire as determined by underlying soil properties that influence ecosystem resilience to disturbance and resistance to invasion. Our results demonstrate that the cumulative loss of sagebrush of wildfire has contributed strongly to declining populations of sage-grouse over the last 30 years at large spatial scales. Moreover, long-lasting effects from wildfire nullified pulses of sage-grouse population growth that typically follow years of relatively high precipitation. If wildfire trends continue unabated, model projections indicate sage-grouse populations will be reduced to 43% of their current numbers over the next 3 decades. Our results provide a timely example of how altered fire regimes are disrupting recovery of sagebrush ecosystems and leading to substantial declines of a widespread indicator species. Accordingly, we present scenario-based stochastic projections to inform conservation actions that may help offset the adverse effects of wildfire on sage-grouse and other wildlife populations.

Migratory connectivity of spring migrants on the northern coast of the Gulf of Mexico

Cohen, Emily - Smithsonian Migratory Bird Centet; Clark Rushing - Smithsonian Institute Migratory Bird Center; Frank Moore - University of Southern Mississippi; Peter Marra - Smithsonian Migratory Bird Center

North America’s migratory birds congregate twice a year in important resting and refueling areas along the coast of the Gulf of Mexico. Understanding how conditions birds encounter during migration influence demography requires information about how populations are connected throughout the annual cycle. We used stable isotopes in the tissues of birds captured during spring migration at three sites on the northern coast of the Gulf of Mexico, in Texas, Louisiana, and Florida, to understand migration biology in the context of breeding destination and winter environment. We found American Redstart breeding populations exhibited strong spatial connectivity during migration

through the gulf coast while Ovenbird and Wood Thrush breeding populations did not. American Redstart and Ovenbird populations also exhibited strong temporal connectivity during migration, with southern breeding populations passing earlier than northern breeding populations. Wood Thrush breeding populations did not have a temporal pattern during migration. American Redstart males passed earlier than females and older birds of all three species passed earlier than younger birds. American Redstarts from presumably wetter winter environments arrived earlier than those from dryer environments. For Ovenbirds and Wood Thrush, the influence of winter conditions depended on the stopover site. It is possible that increases in risk and changes in resources are inflating the cost of migrating through the coast of the Gulf of Mexico. Measuring the impacts of changes in gulf coast ecosystems on North America's migratory bird populations requires information about connectivity to temperate breeding destinations and carryover from tropical winter environments.

Assembly patterns of mixed-species avian flocks in the Andes

Colorado Z., Gabriel - Universidad Nacional de Colombia; Amanda Rodewald - Cornell Lab of Ornithology and Cornell University Department of Natural Resources

The relative contribution of deterministic and stochastic processes in the assembly of biotic communities is a central issue of controversy in community ecology. However, several studies have shown patterns of species segregation that are consistent with the hypothesis that deterministic factors such as competition and niche-partitioning structure species assemblages in animal communities. Community assembly provides a theoretical framework for understanding these processes, but it has been seldom applied to social aggregations within communities. In this research, we assessed patterns of non-randomness in Andean mixed-species flocks using three assembly models: (i) co-occurrence patterns; (ii) guild proportionality; and (iii) constant body-size ratios using data from 221 species of resident and Neotropical migrant birds participating in 311 mixed-species flocks at 13 regions distributed in Venezuela, Colombia, Ecuador and Peru. Significant assembly patterns for mixed-species flocks based on co-occurrence models and guild proportionality models suggest that competitive interactions play an important role in structuring this social system in the Andes. Distribution of species among foraging guilds (i.e. insectivore, frugivore, omnivore, nectivore) was generally similar among flocks, though with some regional variation. In contrast, we found little evidence that structuring of mixed-species flocks in the Andes was mediated by body size. Rather, we found greater than expected variance of body-size ratios within flocks, indicating that birds did not segregate morphologically. Overall, our findings suggest that deterministic factors associated to competitive interactions are important contributors to mixed-species flock assemblages across the Andes.

Amigos Alados: Students of the Americas Protecting Migratory Birds

Contreras-Martinez, Sarahy - University of Guadalajara

The Amigos Alados vision is to involve an increasing number of schools in the western United States and Mexico so that we create a widespread conviction that migratory songbirds and their ecosystems can be saved by education and collaborative effort. We hope to inspire our children to seek higher education in the environmental sciences and to continue working to sensitize their larger communities to today's pressing environmental issues of habitat loss, toxic contamination, global warming, and rapid extinction of species so that together we can find solutions to these problems. Besides helping to sensitize kids to the plight of migratory birds and their habitat, Amigos Alados offers an opportunity for a friendship

and penpal program between the schools. This project is an important way to bring children on both sides of the border together and to enrich their appreciation of the longstanding, close relationship between the environments and cultures of Mexico and California.

Integrated Population Modeling to Assess Demographic Variation and Contributions to Population Growth for Endangered Whooping Cranes

Converse, Sarah - USGS Patuxent Wildlife Research Center; Scott Wilson - Wildlife Research Division, Environment and Climate Change Canada; Karine Gil-Weir - Department of Biology, Lower Division, Texas A&M University; Robert Clark - Wildlife Research Division, Environment and Climate Change Canada; Greg Robertson - Wildlife Research Division, Environment and Climate Change Canada; Mark Bidwell - Canadian Wildlife Service, Environment and Climate Change Canada

Management efforts for endangered species are enhanced by knowledge of the causes and extent of demographic variation, but this information is often lacking even when abundance is well known. We developed an integrated population model to study the dynamics of the only remnant population of endangered whooping cranes (*Grus americana*) in North America, 1977-2013. Despite much conservation attention for this species, there has been little study on temporal variability in demography and how that variation contributes to population dynamics. Demographic rates were most variable for fledge rate and survival of the youngest age classes while adult survival was less variable. Population growth was influenced mainly by variation in fledge rate, breeding propensity and survival of hatch year and second year cranes while survival of older age classes had less influence. Fledge rates were correlated to the boreal snowshoe hare (*Lepus americanus*) - Canada lynx (*Lynx canadensis*) cycle and were lowest 2 years after increases in lynx population growth. In terms of management, mean annual fledge rates were similar between years with and without egg collection for captive rearing (0.523 vs 0.518), suggesting no influence of this practice on population-level productivity. Our findings add to the growing body of results showing that while population growth may be most sensitive to changes in adult survival in long-lived vertebrates, variation in breeding parameters often drives annual fluctuations in abundance. Maintaining adult whooping crane survival at currently high rates and increasing breeding output where possible may be effective management strategies for achieving conservation goals.

Integrated population modeling for species with complex life histories: application to Atlantic Yellow-nosed albatross

Converse, Sarah J - USGS Patuxent Wildlife Research Center; Cat Horswill - British Trust for Ornithology; Richard J Cuthbert - Royal Society for the Protection of Birds; Steffen Oppel - Royal Society for the Protection of Birds; Alexander L Bond - Royal Society for the Protection of Birds; John Cooper - Department of Botany and Zoology, Stellenbosch University; Peter G Ryan - Percy FitzPatrick Institute of African Ornithology, University of Cape Town

Integrated population models (IPM) represent a major advance in our potential to understand population dynamics. However, species with complex life histories pose special challenges. We developed an IPM for Atlantic Yellow-nosed Albatross (*Thalassarche chlororhynchos*) on Gough Island based on a 34-year dataset. The base of the IPM is a multi-event mark-recapture model which accounts for multiple observable and partially-unobservable latent states. The multi-event model is combined with nesting colony counts to form the IPM. We describe the challenges that existed in developing this model, including pre-breeding and skipped breeding periods where birds are

unobservable, and breeding colony immigration. We correlated posterior distributions for the parameters of interest to population growth rates. Variation in growth rate was most strongly correlated with immature survival, suggesting that factors at sea could be driving population trend. Further IPM methods development, and more applications, are needed for species with complex life histories.

Specialism in tidal marsh sparrows differs across niche axes: Implications for niche evolution in a changing landscape
Conway, Meaghan - The University of Maine; Brian Olsen - The University of Maine; Adrienne Kovach - University of New Hampshire

Specialization can play an important role in the abundance and distribution of species, and is a predictor of a population's adaptive response to fluctuating environments. The niche breadth of specialists is often assumed to be narrow, as a result of evolutionary trade-offs between increased competitive ability over a narrow range of conditions and the ability to persist in multiple habitats. However, niche breadth can be defined along multiple dimensions, or niche axes, and most species are likely generalist on some axes and more specialized on others. Yet, the degree to which niche breadth is correlated among niche axes has received little attention, especially in a quantitative way. We measured traits in a suite of Emberizid sparrows that have colonized tidal marsh habitats at different evolutionary time scales and show variation in the degree of specialization for tidal marsh habitats. We measured traits associated with the social (inter- and intra-specific competition), abiotic, and biotic environment experienced by birds across a salinity (upriver) gradient and morphological and physiological traits that likely reflect longer term selection and a species' capacity to persist along the environmental gradient. We quantified niche breadth using the coefficient of variation for each trait of each species, and we found no correlation among niche breadth (i.e., a narrow niche in one trait does not correspond with a narrow niche across the other traits). Our results demonstrate that the definition of specialization may be trait specific. Considering multiple niche axes may be important for predicting species' responses to global change.

Does physiological condition drive behavioral decisions of passerines on an offshore stopover site?
Cooper-Mullin, Clara - University of Rhode Island; Scott McWilliams - University of Rhode Island

The ability of a bird to effectively rebuild fuel stores on a stopover site may influence behavioral decisions that effect overall timing and success of migration. Further, during migration, birds have an elevated metabolic rate and are forced to cope with a surge in reactive species. Consuming fruits on stopover provide birds an energy dense source of nutrients, as well as dietary antioxidants to combat reactive species. As a bird's physiological condition may influence how long it remains on stopover and the direction it departs, we examined how fat stores and dietary antioxidants can influence stopover behavior by manipulating the physiological condition of Myrtle Warblers (*Setophaga coronate coronata*) as they reached an offshore stopover site. We captured Myrtle Warblers in similar physiological condition (n = 32, and divided them into four treatment groups: 1) ad-libitum food and antioxidants, 2) ad-libitum food and no antioxidants, 3) maintenance food and antioxidants, or 4) maintenance food and no antioxidants. We tracked the warblers using nanotags (Avian NanoTag model NTQB-1, 0.26 g, Lotek Wireless) and determined stopover duration, and the direction of departure from stopover. Diet regime affected the change in mass, and fat score in ad libitum warblers during captivity (ANOVA, $P < 0.001$). Dietary treatment did not affect the

stopover duration (GLMM, p = 0. 576) or the direction of the migratory flight (GLMM, p = 0.532). In Myrtle Warblers, the decision to depart and the length of stopover are more likely affected by atmospheric conditions than physiological conditions.

Generation of gene edited birds in one generation using sperm transfection assisted gene editing (STAGE).
Cooper, Caitlin - CSIRO Australian Animal Health Lab; Mark Tizard - CSIRO Australian Animal Health Lab; Tim Doran - CSIRO Australian Animal Health Lab

Generating transgenic and gene edited mammals involves in vitro manipulation of oocytes or single cell embryos. However, due to the comparative inaccessibility of avian oocytes and single cell embryos, many novel protocols have been developed for the production of transgenic and gene edited birds. While efficient, these protocols involve two generations to generate fully transgenic or gene edited birds. Additionally, most of this work has focused on chickens, with many protocols involving the culture of primordial germ cells. While there is established methodology for long term culture of chicken primordial germ cells, no such methodology exists for many other bird species. Finding a way to produce germline transgenic or gene edited birds in one generation would save significant amounts of time and resources. Furthermore, developing a protocol that can be adapted to a wide variety of avian species would be very beneficial for the field and open up new areas of research. We have developed a method using sperm to deliver gene editing tools called sperm transfection assisted gene editing, or STAGE. We have successfully used this method to generate GFP knockout embryos and chickens, as well as to generate embryos with mutations in the doublesex and mab-3 related transcription factor 1 (DMRT1) gene. The average efficiency of the method is 14% with multiple factors such as CRISPR guild efficiency and mRNA stability likely impacting the outcome. Given its straightforward methodology STAGE could simplify the generation of gene edited birds and be applied to many different bird species.

Managing birdwatchers as a citizen science resource for avian research and conservation
Cooper, Caren - North Carolina State University / North Carolina Museum of Natural Sciences; Lincoln Larson - Clemson University, Department of Parks, Recreation, and Tourism Management; Nate Shipley - Clemson University; Ashley Dayer - Virginia Tech, Department of Fish and Wildlife Conservation & Cornell Lab of Ornithology; Kathy Dale - National Audubon Society; Geoff LeBaron - National Audubon Society; John Takekawa - National Audubon Society

Birdwatchers have a long history of contributing to avian research and conservation, particularly through aggregating observations over space and time. Citizen science has two pathways to conservation: the new knowledge it produces and the informed actions of empowered participants. To explore the social capacity of citizen science with respect to conservation outcomes, we surveyed participants in Audubon's 116th Christmas Bird Count (CBC). Based on over 3,000 responses, we found that all respondents participate in at least one other bird citizen science project. Just over half (53%) of respondents did the CBC as their first citizen science project, 30% of whom went on to also participate in non-bird projects. Over one-third (33%) of respondents participated in a different citizen science project before doing the CBC, almost half (47%) of those starting with a non-bird projects. Although only a once/year citizen science project, still about 15-20% of participants report that the CBC influenced their donation of conservation funds, voting for habitat conservation, and creation of wildlife habitat at home. We found that respondents who participate in bird and non-bird citizen science (multi-topic) had more

years of experience in the CBC, and were more likely than those who participate in only bird citizen science (bird-only) to undertake a variety of conservation behaviors, such as vote for conservation policies, create wildlife habitat at home, donate money to conservation organizations, and recruit birdwatchers to the CBC. These insights suggest that birdwatchers with diverse experiences in citizen science are valuable resources for broad research and conservation.

Light-level geolocation reveals wintering distribution, migration routes, and primary stopover locations of an endangered long-distance migratory songbird
Cooper, Nathan - Smithsonian Migratory Bird Center; Michael Hallworth - Smithsonian Migratory Bird Center; Peter Marra - Smithsonian Migratory Bird Center

The importance of understanding the geographic distribution of the full annual cycle of migratory birds has been increasingly highlighted over the past several decades. However, the difficulty of tracking small birds between breeding and wintering areas has hindered progress in this area. We deployed archival light-level geolocators across the breeding range in Michigan. We recovered devices from 27 males and analyzed light-level data within a Bayesian framework. We found that most males wintered in the central Bahamas and exhibited a loop migration pattern. In both fall and spring, departure date was the strongest predictor of arrival date, though in spring, stopover duration and migration distance were also important. Though stopover strategies varied, males spent the majority of their spring migration at stopover sites, several of which were located just before or after large ecological barriers. As climate change and anthropogenic habitat loss threaten winter habitat, the central Bahamian islands should be targeted for conservation, as two-thirds of the population wintered there. By documenting a tight link between spring departure and arrival dates, we provide a plausible mechanism for previously documented carry-over effects of winter rainfall on reproductive success in this species. The migratory periods remain the least understood periods for all birds, but by describing Kirtland's Warbler migration routes and timing, and identifying locations of stopover sites, we have begun the process of better understanding the dynamics of their full annual cycle. Moreover, we have provided managers with valuable information on which to base future conservation and research priorities.

Application of structured decision making in development of an avian monitoring network for the Gulf of Mexico
Cooper, Robert - University of Georgia; Evan Adams - Biodiversity Research Institute; Peter Frederick - University of Florida; Jeff Gleason - US Fish and Wildlife Service; James Lyons - USGS Patuxent Wildlife Research Center; John Tirpak - USFWS; Randy Wilson - U.S. Fish and Wildlife Service; Mark Woodrey - Mississippi State University

Despite the importance of the Gulf of Mexico to North American avifauna, no comprehensive, Gulf-wide, bird monitoring program exists for any avian taxonomic group. This deficiency was highlighted during and after the Deepwater Horizon oil spill, when little was learned about the effects of the spill on bird populations. To address the diverse monitoring challenges and complexities across species, habitats, and the region, the Gulf of Mexico Avian Monitoring Network (GoMAMN) was formed. Comprised of a diversity of conservation partners including state and federal agencies, NGOs, and academic institutions, GoMAMN's broad goal is to define a vision and process for developing the role of bird monitoring in achieving integrated, efficient, and effective Gulf of Mexico management and recovery of impacted avian species. Utilizing a Structured Decision Making process, the team developed a set of fundamental objectives

along with an explicit objectives hierarchy that reflects the goals, objectives, values, and information needs for an integrated Gulf avian monitoring strategy. Fundamental objectives reflect the need for scientific rigor, relevancy, and integration with other monitoring efforts. Relevant emphases of monitoring efforts focus on maximizing ability to (1) assess status and trends, (2) reduce uncertainty associated with management, and (3) understand ecological processes and their respective impacts on avian populations. Collectively, this framework provides a means to establish baselines for assessing future perturbations, evaluate restoration activities, and fill critical information gaps related to how ecological processes drive bird populations, as well as a means to establish priorities among many options for monitoring.

Individual variation in chick development at fledging: physiology, morphology, and flight ability

Cornell, Allison - Simon Fraser University; Kate Gibson - Simon Fraser University; Tony Williams - Simon Fraser University

The post-fledging stage is marked by high levels of mortality (40-80% mortality), making the developmental “milestone” from nestling to fledgling a critical life history transition. The majority of mortality is caused by high predation rates, suggesting that escape flight ability may be important in determining survival. Some studies have shown positive relationships between nestling mass and survival (22 species), but no relationship has been demonstrated in other systems (12 species). Although recent studies have related physiological components of chick quality (e.g. hematocrit) and fledging survival (Bowers et al. 2014) no studies have confirmed the mechanism linking chick development to post-fledging survival via physiological determinants of flight ability. We present a large dataset (n= 366) of individual variation in a range of traits at fledging that might determine post-fledging survival in European starlings (*Sturnus vulgaris*) just prior to, and at the fledging (day 17 and day 21, post-hatch). We measured physiology (hematocrit, hemoglobin, reticulocyte counts, oxidative stress), morphology (feather length, wing area, tarsus, mass), and flight ability (takeoff angle, velocity, energy produced). We focus on comparison of quality of chicks from first versus second brood, because second brood offspring have lower recruitment. Preliminary analysis shows a) physiological and morphological maturity related to ecological context of year quality and brood, b) increase in all physiological and some morphological traits 4 days prior to fledging, c) average decrease in mass just prior to fledging, the only trait moving away from adult values, d) relationship between physiology underlying aerobic capacity and takeoff flight ability.

A Pleistocene disturbance event explains patterns of diversity in tidal marsh birds

Correll, Maureen - Bird Conservancy of the Rockies; Whitney Wiest - USFWS; Thomas Hodgman - The Saltmarsh Habitat and Avian Research Program; Brian McGill - The University of Maine; Chris Elphick - The University of Connecticut; W. Gregory Shriver - The University of Delaware; Joseph Kelley - The University of Maine; Meaghan Conway - The University of Maine; Christopher Field - The University of Connecticut; Brian Olsen - The University of Maine

There is growing evidence to support that paleo-timescale events are important determinants in the present-day distribution of organisms on our planet. Climate patterns are perhaps the most easily measured drivers occurring at this timescale, and are known to drive both ecological and evolutionary mechanisms operating over millennia that create patterns persisting into the modern era. We measured both functional and species diversity in tidal marsh bird communities to explore the relationship between these indices and potential drivers of biodiversity patterns that operate across orders of timescale magnitude. These drivers

include 1) a recent, intense hurricane event driving a large-scale perturbation of this ecosystem (2 ya), 2) gradual modification of marshes through installation of human infrastructure (~150 ya), and 3) marsh formation and development after the Last Glacial Maximum (LGM, ~20,000 ya). We found that functional diversity (measured through habitat specialization) and species diversity were best explained by incremental marsh establishment, and hypothesize this pattern was driven by ice sheet retreat across North America after the LGM. We hypothesize that formation of marsh millennia earlier in the southern part of our survey area allowed for earlier evolution of specialization to tidal marsh by bird species than those occupying much younger, northern marshes, an occurrence which then shapes both functional and species diversity patterns observed in our study. This is the first record of this scale demonstrating vertebrate functional diversity patterns driven by paleo-climate, and highlights the importance of historical contingency in biodiversity research to further explore mechanisms operating across geological timescales.

Geographic and Morphological variation within the *Icterus chrysater* complex (Yellow-backed Oriole)
Cortes, Nandadevi - Smithsonian Institution, NZP; Rachel Sturge - Cornell University; Kevin Omland - University of Maryland Baltimore County

Geographic barriers between populations of a species can result in divergence of genes, morphology, or behaviors that can lead to speciation. The Yellow-backed Oriole (*Icterus chrysater*) is distributed from Southern Mexico to Colombia but with a major range disjunction of 600 km in Costa Rica where this species is absent. We examined molecular and morphological data for differences between northern and southern populations. We sequenced seven genes in total: the mitochondrial control region and six nuclear introns. Genetic data show strong north–south population structure, but with evidence of gene flow. The evidence of gene flow between populations is surprising due to the large geographic break between populations. We found more than 1 migrant/population/generation from either side of Costa Rica. In addition, the estimated time since divergence between the two populations is of about 15,000 years. We also measured six morphological characters from specimens collected along the species' distribution and found shallow north–south divergence. Finally, this species exhibits certain characteristics that suggests that it is in the earliest stages of intraspecific differentiation including shallow genetic and morphometric differences with no evidence of reproductive isolation.

Flocks of the Flatirons: Understanding how rock climbing influences presence and behavior of avian species
Covy, Nora - University of Northern Colorado; Lauryn Benedict - University of Northern Colorado

This study examined how rock climbing activity influences the distribution and behavior of avian species as well as the structure of avian communities at cliff formations. Employing a paired design, we surveyed birds at 16 high (>500 climbers per year) and 16 low (< 100 climbers per year) climbing use formations in Boulder Open Space and Mountain Parks (OSMP), Colorado. Paired comparisons and model-fitting approaches were used to identify impacts of both human recreational activity and natural habitat features as spatial drivers of birds. Avian species richness and diversity were higher at low climbing use formations, although this pattern was driven by birds that were in the survey area, but not on the cliff itself. Interestingly, avian cliff use was higher at high climbing use sites. Violet-green swallows, *Tachycineta thalassina*, and white-throated swifts, *Aeronautes saxatalis*, actively used areas where climbing was prevalent and were observed more often at high use sites.

Canyon wrens, *Catherpes mexicanus*, were the only species negatively impacted by climbing, as this species spent less time actively foraging and singing at sites of high rock climbing activity. Ultimately, cliff aspect was found to be the strongest predictor of both avian diversity and cliff use, while climbing use rating and number of climbing routes on the cliff moderately influenced avian diversity. Results suggest that cliff specialist birds are only minimally impacted by rock climbing activity, and that recreational access may not pose a significant threat to (non-raptor) avian cliff communities.
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Nestling cross-fostering as a tool for manipulating population sex ratios in a cooperatively breeding passerine
Cox, James - Tall Timbers Research Station and Land Conservancy; Jessica Cusick - Florida State University; Emily DuVal - Florida State University

Variation in the number of sexually mature males and females found in a population is predicted to influence behavior, ecology, and life history. Experimental manipulations of population sex ratios have been used to assess these predictions for some taxa, but sex-ratio manipulations of wild birds are rare and generally focus on manipulating individual territories rather than larger population units. We assessed nestling cross-fostering as a tool for manipulating population sex ratios in the Brown-headed Nuthatch (*Sitta pusilla*), a species where male-biased sex ratios may influence cooperative breeding behavior. Nestlings within large (>150 ha) experimental plots were sexed using DNA and then cross-fostered in 2012 (n = 15 nests) and 2013 (n = 18 nests) to generate a preponderance (>85%) of nests that fledged males or females exclusively. The manipulations effectively altered sex ratios in the plots in subsequent breeding seasons and led to changes in cooperative behavior. The number of cooperative breeding groups increased two-fold where the male bias increased. The number of helpers present in those breeding groups also doubled and led to novel group compositions. A female helper and female floater were observed in the female-biased plot. Cross-fostering had no effect on parent provisioning and nestling survival. Nestling cross-fostering may be an effective way to manipulate population sex ratios in birds with similar nesting habits.

The search for pragmatic professional optimism in avian conservation
Cox, W. Andrew - Florida Fish and Wildlife Commission

Full consideration of the magnitude of conservation challenges that exist at both local and global scales can rightly leave a thoughtful conservation biologist overwhelmed and bereft of hope. Nevertheless, many of us need some semblance of positivity in our professional lives to operate effectively. In addition, support from the general public is reliant in part upon positive messaging that conveys our conservation successes. But given the magnitude of the conservation challenges we face, from where does a conservation scientist draw to maintain a sense of positivity and optimism that is neither naïve nor misguided? Here, I review recent conservation successes and failures that have occurred in Florida to demonstrate how one can develop an empirically based and pragmatic professional optimism in the face of increasing threats to wildlife from climate change, invasive species, human population growth, anthropogenic disasters, and land-use change.

Red Siskin Initiative: Recovering a highly endangered and iconic bird through captive breeding, genomics and agroforestry
Coyle, Brian - Smithsonian Institution; Mike Braun - Smithsonian National Museum of Natural History; Miguel Arvelo - Provita; Warren Lynch - Smithsonian Conservation Biology Institute; Paul Marinari - Smithsonian Conservation Biology Institute; Erica Royer - Smithsonian Conservation Biology Institute

The red siskin (*Sporagra cucullata*) is an iconic and highly endangered bird of northern South America that is threatened mainly by wildlife trafficking for the pet trade. Peak demand in the early 20th century was due to aviculturalists attempting to produce red canaries through hybridization with red siskins. Illicit trapping and trade continues today but is not well understood. The Red Siskin Initiative (RSI) is an international partnership of public and private institutions, communities and individuals that was formed to help understand, protect and restore self sustaining populations of this species across its historic range through threat reduction, field and genomic research, captive breeding and reintroduction to shade coffee farms certified as Bird Friendly by the Smithsonian Migratory Bird Center. This talk will summarize the comprehensive effort, with a focus on Smithsonian research and development of a captive breeding program that will be implemented at zoos in Venezuela for reintroduction and education.

Global avian biogeography: a test of two worldviews
Cracraft, Joel - Department of Ornithology, American Museum of Natural History; Santiago Claramunt - American Museum of Natural History

For the last 45 years there has been a clash of worldviews over the biogeographic history of modern birds. One the one hand, multiple avian paleontologists have proposed that modern birds arose primarily in the Northern Hemisphere and then spread to the southern continents, or are relictual to those areas following climate deterioration in the mid-Miocene. A second worldview, inferred from phylogenetic studies, proposed that many clades, including a large number near the base of Neornithes, suggest that birds arose on the continental fragments of Gondwana. This often-intense debate has been perpetuated because of reasons well understood in the history of science: entrenched belief systems over evidence as well as over methods. In this case it has involved the primacy of fossil evidence in biogeographic analysis and the relevance of quantitative analytical methods in historical biology (phylogenetics, biogeography). To resolve this problem we constructed a global timetree and phylogenetic analysis of 202

avian families of birds using a large suite of fossil taxa for time-calibration. Our analysis shows that Neornithes arose and diversified on Gondwana, primarily in South America and West Antarctica around the K-Pg boundary, and became cosmopolitan by ~55-50 Ma (Claramunt and Cracraft Sci. Adv. 2015;1:e1501005). This result is robust to phylogenetic uncertainty at the base of birds as well as to methods of analysis. We contend the 45 year-old debate is solved.

Characterizing spatial and temporal variation in sexual selection in black-throated blue warblers using a sexual network approach

Cramer, Emily - Smithsonian Migratory Bird Center and Cornell Lab of Ornithology; Sara Kaiser - Smithsonian Center for Conservation and Evolutionary Genetics; Mike Webster - Cornell University; T Sillett - Smithsonian Migratory Bird Center; T Ryder - Smithsonian Migratory Bird Center

Variation in selective pressures over time and space has long been recognized, but how the social environment contributes to, or potentially mediates, that variation has not been thoroughly investigated. We applied a recently-developed social network analytical approach to examine social selection on male body size in black-throated blue warblers (*Setophaga caerulescens*), a sexually size-dimorphic passerine. We used 10 years of paternity data on total reproductive success and included data from three study plots that differ in habitat quality and bird density. Specifically, we tested whether selection on an individual's body size differs depending on the average body size of the individual's sexual competitors, and whether selection varied among study plots or among years, with body size estimated as a combination of standard morphometric measurements (wing, tail, tarsus, and body mass). We found little evidence for variation in selection on male body size over time, but substantial spatial variation in the strength of selection on body size among the three study plots. The social environment played a surprisingly small role in mediating selection on body size within plots, although previous research has shown that density-dependent effects regulate this population. These findings suggest that characteristics other than body size may be more important targets of social selection in this species, and spatially heterogeneous environmental conditions, such as predation and food availability, may drive selective processes and social interactions.

Birds help agriculture… and vice versa? Lessons learnt from macadamia production areas in eastern Australia

Crisol-Martinez, Eduardo - Central Queensland University; Laura Moreno-Moyano - University of Melbourne; Kevin Wormington - Central Queensland University; Philip Brown - Central Queensland University; Dragana Stanley - Central Queensland University

With an increasing human population, there are projected global declines of biodiversity produced by agricultural intensification. Adoption of conservation strategies in agro-ecosystems is critical for maintaining avian biodiversity. We studied the interactions between birds, arthropods, and pest management practices, using the macadamia industry in eastern Australia as an example. Up to 65 bird species (including seven declining regionally) were recorded actively foraging in macadamia orchards, and the activity of those species with an insectivorous diet was consistently associated with arthropod-related variables. A dietary study using next-generation sequencing showed that bird communities inhabiting riparian zones near orchards preyed upon five insect pests of macadamia, including a major one (*Nezara viridula*), which was present in 23% of all the faecal samples. These pest-reduction services highlight the benefits that avian conservation could bring to macadamia farmers. Nevertheless, organophosphate insecticides are commonly sprayed in macadamia orchards. Using acoustic

surveys, it was found that the activity of most avian species was similar before and immediately after trichlorfon applications, demonstrating their exposure to this insecticide. A controlled experiment showed that ingestion of a single low dose of trichlorfon caused significant shifts in the gut microbiome of an avian model within 24 hours. These results indicate that acute and chronic health impacts could occur in wild birds, if similar reactions occurred under field conditions. Overall, these findings have implications for the conservation of birds foraging in agricultural areas where organophosphates are sprayed, and advocate to reduce their use or to switch to less-disruptive pest management practices.

Productivity of the forest bird community at Hakalau Forest National Wildlife Refuge, Hawai‘i

Cummins, George - Northern Arizona University; Steve Kendall - Hakalau Forest National Wildlife Refuge, U.S. Fish and Wildlife Service; Eben Paxton - Pacific Islands Ecosystem Research Center, U.S. Geological Survey

Hawai‘i has some of the most endangered avian species in the world, facing numerous threats from habitat loss, disease, climate change, and introduced species. Long-term surveys are conducted in many locations across the Hawaiian Islands, but they can only tell us about past and current population sizes, not what may be driving trends. Demographic studies examining productivity, survival, and movement of individuals across the landscape are necessary to assess what factors drive population fluctuations. In 2013 we began a productivity study at Hakalau Forest NWR on Hawai‘i Island in conjunction with banding and radio telemetry studies to determine key population parameters for all forest bird species, and enable modeling of population trends over time. The results from the first two years of the productivity study, along with preliminary findings based on nest success and reasons for failure from the most recent two field seasons, are presented here. The daily survival rate (DSR) of nests had an inverse relationship with the amount of rainfall, and was lower in the much rainier 2014 compared to 2013 for every species with sufficient sample size (ranging from 2 to 4 times lower in 2014). The large difference in weather and DSR between years illustrates the need for long term demographic studies that can capture the vital rates of this avian community. Overall, these preliminary results suggest that anthropogenic climate change that leads to more intense weather events during the breeding season could negatively impact conservation and recovery efforts for native Hawaiian birds.

Fitness costs of behavioral thermoregulation and threshold temperatures revealed by behavioral data sets

Cunningham, Susan - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Katherine du Plessis - Percy FitzPartick Institute of African Ornithology; Tanja van de Ven - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Rowan Martin - World Parrot Trust; Phil Hockey - Percy FitzPatrick Institute of African Ornithology, University of Cape Town

For endotherms like birds, the physiological costs of keeping cool are high, especially as air temperatures approach body temperature. Physiological cooling mechanisms can involve risky use of ‘adaptive hyperthermia’ and rapidly increasing expenditure of water with concomitant risks of dehydration and changes in blood chemistry. In the face of such challenges, birds often use behavioral thermoregulation: reducing activity in order to reduce metabolic heat production, and choosing cool, sheltered microsites within the landscape (e.g. within vegetation, rock crevices or underground) to minimize environmental heat load. However, these behavioral changes may carry important lost-opportunity costs that can cumulatively result in loss of fitness. Detailed behavioral studies

can reveal the nature and severity of lost-opportunity costs related to behavioral thermoregulation. We review several recent studies of birds in the Kalahari desert, including southern pied babblers (*Turdoides bicolor*), southern fiscals (*Lanius collaris*), and southern yellow-billed hornbills (*Tockus leucomelas*). In each species we found that temperature thresholds exist above which the fitness costs incurred through changes in behavior increase rapidly in severity. Thresholds are species-specific, but often fall within the mid-30°C range of air temperatures. We discuss the potential for these thresholds to be used in spatial and temporal modelling of climate change vulnerability, with the added benefit that the costs of exceeding these thresholds in terms of fitness and hence risks to population persistence are known.

Behavioral responses to anthropogenic noise in two species of grassland songbirds in the Canadian mixed-grass prairie

Curry, Claire - University of Manitoba; Bridget Antze - University of Manitoba; Miyako Warrington - St.George's University; Paulson Des Brisay - University of Manitoba; Patricia Rosa - University of Manitoba; Nicola Koper - Natural Resources Institute, University of Manitoba

Anthropogenic noise, such as that caused by energy development, can cause some species to avoid habitats, whereas others alter amplitude, frequency, or structure of vocalizations to avoid masking by noise. Species that cannot alter vocalizations may be at greater risk from noise pollution. Baird's Sparrow (*Ammodramus bairdii*) is a declining grassland songbird with a relatively invariant song repertoire. We hypothesized that species with variable songs, such as the more common Savannah sparrow (*Passerculus sandwichensis*), may adjust songs more easily. We recorded songs from 29 each of Baird's and Savannah sparrows before, during, and after high-fidelity playbacks of oil well drilling noise. Contrary to our predictions, both species altered approximately equal numbers and types of song parameters and song parameter repeatability had no effect on whether parameters changed in response to noise. We additionally tested whether Savannah sparrows respond differentially to noise-adjusted songs in noisy vs. quiet environments. We played songs from quiet (control) and noisy (noise-adjusted songs) environments to color-banded males at quiet sites and noisy infrastructure sites. We found that males responded appropriately to both noise-adjusted songs at quiet sites and to noise-adjusted songs at noisy sites, but altered their responses to the control songs at noisy sites. This suggests that species that cannot adjust their songs and do not avoid noise may face difficulties in signaling. Understanding effects of anthropogenic noise on at-risk and common species will help us develop appropriate habitat management strategies for conservation in areas with increasing energy development.

Utility of social network analysis for investigating behavior in Carolina Chickadee winter flocks

Curry, Robert - Villanova University; Christopher Roche - Villanova University; Christine Eldredge - Villanova University

Most North American chickadees are permanent residents that spend nonbreeding seasons in flocks. Flock composition and dominance relationships influence survival, dispersal, and pairing; however, this generalization is based almost entirely on studies of Black-capped Chickadees. To explore the utility of social network analysis for understanding relationships within Carolina Chickadee flocks, we used radio frequency identification (RFID) methods at two southeastern Pennsylvania sites—Nolde Forest (NF) and Great Marsh (GM)—in fall and winter, 2012-2013. At NF, we monitored visitation throughout a 4 x 4 grid of feeders (200 m apart) and detected ~115,000 visits

by 46 resident chickadees. At GM, we recorded ~162,000 visits by 86 tagged residents at 17 feeders distributed among three sub-sites. We analyzed participation of tagged individuals within temporal clusters of visit at each feeder, and constructed social networks from resulting association matrices. Analysis of within-network "community" structure revealed four flocks among NF residents; these flocks interacted frequently, however, as indicated by network edges connecting members of different flocks through overlapping use of individual feeders. Greater spatiotemporal structure emerged at GM, largely because the three feeder sets were separated by ≥ 300 m; few individuals visited feeders in more than one sub-site. Our view of flock composition and structure remains incomplete because we did not PIT-tag all residents, but our social network analyses suggest that Carolina Chickadee flocks are less discrete than those of Black-capped Chickadees, but results depend on site design. Ongoing work aims to link social network patterns with direct measures of social dominance.

Migratory strategy is related to aspects of dietary flexibility in a partially migratory passerine

Dale, Catherine - Queen's University; Kurt Kyser - Queen's University; Samantha Franks - British Trust for Ornithology; Joe Nocera - Ontario Ministry of Natural Resources & Forestry; Laurene Ratcliffe - Queen's University

Seasonal variation in food availability is thought to be a main driver of animal migration. The trophic polymorphism hypothesis proposes that differences in diet may lead to divergent migratory strategies among individuals in the same population, known as partial migration. In this study, we investigated whether the trophic polymorphism hypothesis explains mixed migratory strategies in a partially migratory population of western bluebirds (*Sialia mexicana*) breeding in southern British Columbia, Canada. We compared carbon and nitrogen isotope signatures in both feathers (grown in late summer/fall) and claws (grown in winter) of migrant and resident individuals, allowing us to examine the relationship between migratory strategy and diet both before and after fall migration. We then tested responses of breeding individuals to novel and familiar foods to investigate whether dietary flexibility varied with migratory strategy. Carbon and nitrogen isotope signatures differed between migrants and residents in the winter (i.e., in claws), but not prior to fall migration (i.e., in feathers), implying that differences in diet are unlikely to be driving migratory strategy in this population. However, responses during the food choice trial resulted from an interaction between migratory strategy and sex: male migrants were more likely to take food than residents, but took longer to eat novel food items. For females, the relationship was reversed. Thus, our results suggest aspects of dietary flexibility may be related to migratory strategy, but that the factors shaping migratory strategy may differ with sex in western bluebirds.

Heat limits behavioral performance

Danner, Raymond - UNCW; Casey Coomes - Tulane University; Elizabeth Derryberry - Tulane University

We tested if thermal stress reduces the speed and accuracy with which birds perform cognitive tasks. We trained male zebra finches (*Taeniopygia guttata*) on cognitive tasks and then measured several aspects of speed and accuracy of task performance at room temperature (22°C) and high temperatures (40°C and 43°C). At high temperatures, birds performed thermoregulatory behaviors that indicated thermal stress: panting and postural changes included standing tall and spreading wings to increase heat dissipation. As predicted, birds completed the task more slowly when showing signs of thermal stress (linear model, $p=0.005$). Compared to room temperature,

the time to finish the task was slightly longer per individual at 40°C, and up to four times longer at 43°C. The slower completion times at higher temperatures were attributed to two factors. First, birds took longer between steps of the cognitive task ($p=0.017$) because they paused to perform thermoregulatory behaviors. Second, birds chewed the food rewards more slowly at higher temperatures ($p < 0.001$). High temperatures did not reduce the accuracy of the cognitive task ($p=0.836$), but birds missed food rewards, suggesting cognitive errors. These results provide novel evidence that high temperatures reduce behavioral output by limiting both cognitive and motor performance. This experiment also provided evidence that thermal stress affects cognition and motor performance at different temperatures: heat dissipation behaviors began at lower temperatures than cognitive errors and slower movements.

Males with larger bills sing at higher rates in a hot and dry environment
Danner, Raymond - University of North Carolina Wilmington; **David Luther** - George Mason University

Temperature and water availability affect the survival, reproductive success, and behavior of all animals, thus traits that influence thermoregulation and water balance should be under strong selection. Avian bills can dissipate excess body heat through convection. We hypothesized that in hot, dry locations, bill size is selected for its value in thermoregulation: males with larger bills shed excess heat more efficiently, allowing greater activity levels during thermally challenging periods of the breeding season. We predicted that thermoregulatory challenges require *Melospiza melodia* atlantica, which breeds in hot, dry sand dunes, to trade off between behaviors associated with breeding (song output) and thermoregulation, and males with larger bills maintain higher song rates in hot weather. We captured, measured, and marked individual birds and then observed singing behavior, microclimate, and microhabitat use to assess thermoregulatory challenges. Ambient weather indicated thermally challenging conditions, and birds displayed thermoregulatory behaviors, including reduced song rates at higher temperatures. Birds with larger bills sang at higher rates than birds with smaller bills, and males with the largest bills in the population sang almost twice as many songs per minute than birds with the smallest bills. These results are consistent with the hypothesis that climate influences selection on the bill as a thermoregulatory organ.

An interactive decision support tool to predict the demographic consequences of exclosure use in U.S. Atlantic Coast Piping Plovers
Darrah, Abigail - SUNY-ESF; Jonathan Cohen - SUNY-ESF

Nest exclosures are used to increase nest success of the threatened U.S. Atlantic Coast Piping Plover (*Charadrius melodus*) population, but they also increase nest abandonment rates, which has been linked to adult mortality; thus exclosure use may not always benefit the population. The objective of our project is to create a decision support tool that predicts the population-level effects of exclosure use. We analyzed Piping Plover nest fate data collected in 2015 from 46 sites using a Bayesian multinomial logistic exposure model to estimate the effects of exclosure use on probabilities of nest depredation and abandonment, with site modeled as a random effect. The estimated site variances and exclosure effects were used to calculate hatching and adult mortality probabilities under scenarios of 0% and 100% exclosure use and eight combinations of site-specific predation and abandonment rates. The hatching and mortality probabilities were incorporated into a two-stage stochastic projection model to estimate long-term population growth rates for each combination of management and site effects. Exclosure use at sites with high abandonment rates

resulted in declining populations regardless of site predation risk, while exclosure use increased growth rates at sites with average abandonment rates and high predation. We have developed a decision support tool that allows users to enter site characteristics and to upload nest fate data. The tool performs a Bayesian multinomial nest fate analysis to estimate site-specific intercepts and exclosure effects, which are fed into the population projection model to predict the consequences of using vs. not using exclosures.

Foraging niche structure and coexistence in a highly diverse community of Amazonian antbirds (Thamnophilidae: Aves)

David, Santiago - University of British Columbia; Jill Jankowski - University of British Colombia

The high species richness of antbirds (Thamnophilidae) in Amazonian lowlands, where as many as 40 species may coexist at local scales, represents a major challenge to ecologists for explaining patterns of coexistence and niche evolution. I studied foraging ecology of a local community of antbirds in a 2-Km2 area in SE Peru to examine how co-occurring species differ in their use of foraging resources, and whether these differences result in niche partitioning at the community level. I also examine whether resource use similarity is related to phylogenetic similarity. Forty-four antbirds were detected in the plot in a four-year period, with 30 species categorized as a local assemblage of common resident breeders. Multivariate analysis of foraging parameters showed that segregation at two height layers in two forest type was more important than foraging substrates and maneuvers in explaining the differences in foraging behavior. However, a null model analysis revealed that at the community level, antbirds exhibited high foraging niche overlap, with average observed overlap significantly larger than expected by chance, indicating that antbirds prefer, rather than avoid, resources used by other species. No general relationship exists between phylogenetic similarity and niche overlap. Closely related species consistently exhibit high values of niche overlap, but some distantly related species also exhibit high niche similarity. Taken together, these results suggest that foraging niche similarity is the predominant pattern among co-occurring antbirds, and that positive interactions might explain the stable coexistence of species that use similar resource and habitats at a local scale.

Compromised song performance: an effect of both natural and anthropogenic noise

Davidson, Benjamin - California Polytechnic State University; Clinton D. Francis - Cal Poly San Luis Obispo

The importance of the acoustic environment is becoming more apparent as studies show that both natural and anthropogenic noise impact vocal behaviors in songbirds. However, little is known about whether these changes compromise the vocalizations. We were able to quantify the relative effects of both natural and anthropogenic noise on song performance using quantile regression analyses, which provided performance frontiers based on song bandwidth and trill rate. We recorded Chipping Sparrows in areas with and without anthropogenic noise and White-crowned Sparrows along a gradient of ocean surf noise. Analyzing deviations of individuals from the performance frontier, we found that the songs of both species were significantly further below the performance frontier in noisier environments. These results demonstrate that natural and anthropogenic noise can have a significant impact on song performance. Because song performance strongly influences the outcome of male-male contests and mate selection by females, the acoustic environment of songbirds should be considered when selecting natural refuges. Prime habitat may not be as expansive as

previously thought, considering the substantial natural noise due to surf along the extensive coastlines surrounding the U.S. It's crucial that we consider both natural and anthropogenic noise and the significant impacts both have on ecological communities, not only as we develop and expand our range of impact, but also when establishing new wildlife refuges and parks.

Influence of vegetative characteristics on predation and predator assemblage of bird nests.
Davis, Helen - Texas A&M University - College Station

Predation is the primary cause of nesting failure in birds. Thus, understanding this process is paramount to conserving birds and mitigating population declines. My goal is to investigate predator/nest relationships and how these relationships are influenced by nest site specific vegetative characteristics. Between March and August 2015, I collected nest survival data for 17 species of birds on the 60,000 ha San Antonio Viejo ranch of the East Foundation in south Texas. During this period, I visually monitored 137 nests to estimate nest survival and deployed 59 infrared digital video recorders to identify nest predators. Shrub cover was included in the top models for two nesting functional groups, suggesting increasing shrub cover could have negative effects on nest survival. Snakes were the primary predator of camera monitored nests (47%, n = 17). Nest height was included in the top model for snakes, indicating increasing nest height could increase nest depredation by snakes. As woody vegetation continues to encroach upon semi-arid savannas in south Texas, results of my study will help predict how vegetation management such as brush control could potentially influence predator dynamics and breeding bird nest survival in this region.

Hatch Year Roseate Tern (*Sterna dougallii*) Behavioral Responses to Anthropogenic Disturbances and Natural Events
Davis, Kayla - Virginia Tech; Sarah Karpanty - Virginia Tech; Jeffrey Spendelow - USGS Patuxent Wildlife Research Center; Jonathan Cohen - SUNY-ESF; Melissa Althouse - SUNY College of Environmental Science and Forestry; Katharine Parson - Mass Audubon; Cristin Luttazi - Mass Audubon

Thousands of migratory birds prepare for long-distance flights in the weeks preceding migration by building fuel reserves at forage-rich pre-migratory staging grounds. Birds are often concentrated at staging areas, leaving large numbers of birds exposed to the same environmental threats and disturbances. A large proportion of the Northwest Atlantic population of Roseate Terns (*Sterna dougallii*; ROST(s)) stages at Cape Cod, Massachusetts, making this an ideal focal species for studying the effects of disturbance on staging birds. We present data from two fall pre-migratory seasons at Cape Cod National Seashore to quantify time-activity budgets of hatch year (HY) ROSTs and to determine the effects of human activities and natural disturbances on HY ROST behavior. We used focal sampling to determine whether human activities and other possible disturbance events affect HY ROST behaviors, specifically active versus resting and maintenance behaviors. We used mixed-effects logistic regression to analyze the effects of survey site, time, day, pedestrian disturbance (minutes pedestrians were present during survey), and total disturbance (minutes any non-tern entity was present during survey), on individual HY ROST activity. All variables included in our model were significant predictors of HY ROST activity. Hatch Year ROST activity increased with time, day, pedestrian disturbance, and total disturbance. Survey site was also an important predictor, as each site had a different effect on HY ROST activity level. Our results demonstrate that human disturbance

increases HY ROST activity, but natural factors, including natural disturbance events, time, and date, also are positively correlated with HY ROST activity.

Integration of weather, vegetation and topography to understand grassland bird abundance on Colorado's shortgrass steppe

Davis, Kristin - Department of Environmental Science and Sustainability, Natural Resource Ecology Laboratory, Colorado State University; Cameron Aldridge - Department of Ecosystem Science and Sustainability, Natural Resource Ecology Laboratory, Colorado State University; David Augustine - USDA Agricultural Research Service; Susan Skagen - U.S. Geological Survey

Grassland birds are of major conservation concern in North America and have declined more precipitously than any other guild of birds since the 1970s. While numerous studies have examined vegetation or weather effects independently on grassland bird abundance, few have jointly examined these impacts. We developed generalized linear models accounting for detectability from point count data (2013-2015) to evaluate the influence of habitat heterogeneity and weather on breeding grassland bird abundance on the Central Plains Experimental Range in northeastern Colorado's shortgrass steppe. We assessed hierarchical effects of topographic, vegetative and weather (spatial and temporal variability in precipitation and temperature) variability on the abundance of horned larks, lark buntings and McCown's longspurs. Both vegetation and weather affected songbird abundance. For instance, horned lark abundance was negatively affected by visual obstruction cover ($\beta = -0.097$, $p = < 0.0001$) and scale-dependent responses to topographic wetness (TWI; an index quantifying soil moisture based on topography) were also evident. Horned lark abundance was negatively associated with TWI at a large spatial extent (250-m window; $\beta = -0.090$, $p = 0.002$), but positively associated with abundance at the patch scale (50-m window; $\beta = 0.035$, $p = 0.007$). Initial analyses indicate both local and regional weather patterns directly affect abundance of breeding birds and these responses vary across three grassland bird species with different habitat requirements. With interannual weather variation predicted to increase under climate change, our research can help elucidate how future climate change may impact animal populations and inform conservation and management actions.

Size Variation with Altitude in the Rufous-Collared Sparrow

Davis, Kyle - Ohio Wesleyan University; Edward Burtt - Ohio Wesleyan University

Heat is generated by the body volume and lost across its surface. Therefore larger homeotherms with their proportionately larger volume and smaller surface will withstand cold better than small homeotherms. Bergmann's Rule, which states that as temperature decreases body size increases, is a common expression of this relationship. Bergmann's Rule also relates body size to latitude. Environmental temperature also decreases with altitude. I tested the possible relationship between body size and altitude in Rufous-collared Sparrows (*Zonotrichia capensis*), which are abundant; range through the tropics and from sea level to the snow line in the Andes. Due to the range of temperatures, we expect a similar change in body size with altitude as described for latitude by Bergmann's Rule. To estimate the change in size, I measured the tarsometatarsus of 198 specimens from the Peruvian Andes in the collections of Louisiana State University, The University of Michigan, and Cornell University. The change is slight, but if the specimens are grouped into elevational increments of 700 m from sea level to 4,000+ m, there is a gradual increase in size of the tarsometatarsus specimens from sea level to the snow line. Based on the coefficient correlation, the average tibiotarsal

length increases in size. This change was minimal (.3) but suggests there is change in size with altitude following Bergmann's Rule which states as environmental temperature decreases, body size increases.

Beyond knowledge: Understanding what might influence people's bird-friendly coffee purchasing behaviors

Dayer, Ashley - Virginia Tech, Department of Fish and Wildlife Conservation & Cornell Lab of Ornithology

A widely held belief in the bird conservation community is that "if consumers only knew that drinking conventional coffee fosters clear cutting for sun coffee plantations, they would buy bird friendly coffee". Or "if consumers only knew that bird friendly coffee benefits birds and people, they would buy it." We see bird-friendly product marketing and conservation organization communications reflecting these beliefs about human behavior. Yet, it's not so simple. In the case of coffee consumption, along with many other human behaviors related to the environment, a gap exists between knowledge and action. Knowing the facts about an issue is not enough to change most people's behavior. I will present a framework from environmental education for understanding bird-friendly coffee purchasing behavior including knowledge, attitudes, and skills, showing the three tiers of change hypothesized to be necessary for behavior change. To create successful strategies for bird conservation, it will be necessary to incorporate what is known about how people behave and new social science research to advance our understanding specifically related to food and beverage consumption behavior.

The Surveys Say Birdwatchers are Conservationists

Dayer, Ashley - Virginia Tech, Department of Fish and Wildlife Conservation & Cornell Lab of Ornithology; Tina Phillips - Cornell Lab of Ornithology; Brian Sullivan - Cornell Lab of Ornithology; Lincoln Larson - Clemson University, Department of Parks, Recreation, and Tourism Management; Caren Cooper - North Carolina State University / North Carolina Museum of Natural Sciences

Recent survey research is shedding light on an often-asked question: are birdwatchers conservationists? Survey research in New York found birdwatchers were five times more likely than non-recreationists to engage in conservation behaviors, such as donating to support local conservation efforts, enhancing wildlife habitat on public lands, advocating for wildlife recreation, and participating in local environmental groups. In contrast, engagement in environmental lifestyle behaviors such as recycling, energy conservation, and green purchasing was roughly comparable among all types of wildlife recreationists and non-recreationists. An international survey of eBird data users showed that 80% of individuals who downloaded and used the data had also submitted at least one eBird checklist. These citizen scientist birdwatchers reported conservation outcomes with the data across a spectrum from research and monitoring to conservation planning to on-the-ground actions such as site and habitat management, habitat protection, law and policy, and species management. Another recent study of citizen scientist birdwatchers in the Great Backyard Bird Count highlighted that new and returning participants have high levels of knowledge, efficacy, and intention to help protect birds. Their motivations are also largely driven by worry about what might happen to birds if more is not done on their behalf. Together, these studies highlight the powerful role that birdwatchers can play in supporting broader conservation outcomes.

Causes and consequences of nestling development variation in an alpine songbird population

de Zwaan, Devin - University of British Columbia; Alaine Camfield - Environment and Climate Change Canada / Migratory Bird Conservation and Management; Elizabeth MacDonald - Environment and Climate Change Canada; Kathy Martin - University of British Columbia

Nestling development is an important life-stage for altricial songbirds because conditions during growth can strongly influence adult fitness. Development of critical size traits during this stage has positive effects on first-winter survival and annual fecundity. Time available for development is constrained by weather and predation risk. Poor weather and predation risk (reduced provisioning rates) can disrupt growth and prolong time within the nest by reducing provisioning rates to the offspring. Longer nestling periods may mediate the effects of variable resources, but shorter nestling periods reduce the chance of nest depredation. Whether nests exhibit a 'fledge early' or 'fledge late' strategy is likely linked to maternal condition and the ability to buffer nestlings against external constraints. Variation in condition-specific optima may be more pronounced in extreme environments such as the alpine. In a 7 year data set of alpine breeding horned larks, nestling development was prolonged when precipitation was greatest, but good condition females were able to maintain a 'fledge early' strategy during harsh conditions (i.e., early in the year). Nestling condition was negatively associated with predation risk, precipitation, and long-term storm patterns, while first-winter survival increased with nestling size and decreased with greater predation risk. The combined effects of weather, predation risk, and maternal condition may explain much of the inter- and intra-specific variation in nestling development. Understanding the drivers of developmental variation within a species may indicate the capacity to respond to a changing environment and provide more accurate projections of population trends.

The genomic architecture of rapid adaptive divergence in swamp sparrows

Deane-Coe, Petra - Cornell University; Russell Greenberg - Smithsonian Migratory Bird Center; Irby Lovette - Cornell University; Richard Harrison - Cornell University

To understand the molecular targets of selection during adaptive divergence, we apply reduced representation genome sequencing to inland and coastal subspecies of the swamp sparrow (*Melospiza georgiana*). The coastal subspecies possesses a suite of heritable adaptive traits, including a larger bill that aids in heat dissipation and prey capture. We find that genome-wide differentiation between the subspecies is very low, consistent with a postglacial origin of the coastal subspecies (mean FST 0.02). Haplotypes at a small subset of loci were strongly differentiated (max FST 0.80). Among high-FST loci, estimates of ΦST (an analog weighted by mutational distance) were highly variable. Mapping to the *Geospiza fortis* assembly, we investigated all BLAST hits for loci in the top 5% of FST and found three compelling candidate genes within cis-regulatory range. Loci mapping to all three of these candidates were among the lowest in terms of ΦST, suggesting that selective sweeps have driven divergence in these regions. Two loci mapped near BMP4 (a bone morphogenetic protein) and NOGGIN-2-LIKE (a BMP inhibitor), independently implicating the same BMP-signaling pathway that controls bill size and shape in chickens and Darwin's finches. A third locus mapped near TARDBP, a gene that influences salt transport and reabsorption. Our findings suggest that comparison of ΦST and FST may represent a simple but novel identification tool for candidate functional loci in cases of recent adaptive divergence.

The relationship between refueling performance, migratory flight calls, weather, and competition at an inland stopover site

DeGroote, Luke - Powdermill Nature Reserve - Carnegie Museum of Natural History; Amy Tegeler - South Carolina Department of Natural Resources

We collected blood samples and measured lipid metabolite levels from seven species if migrant songbirds throughout the spring and fall migrations of 2013 and 2014 at Powdermill Avian Research Center (PARC), an inland banding station located in western Pennsylvania. Three species, were subsequently transported to a soundproof recording studio where conspecific flight calls were played and flight call response rates were recorded. Finally; data on age, sex, mass, and wing length were recorded prior to each bird's release. Capture rates from the entire banding operation were used as a surrogate for competition. Refueling performance of all species increased as each migratory season progressed and increased more rapidly in the spring. We found no evidence that competition reduced refueling performance. Instead, refueling performance was higher when more birds were captured after major migratory flights in the spring. The decision to respond to migratory flight call playback was unrelated to either size-adjusted body mass or lipid metabolite levels. However, we found that of the individuals who did respond to flight call playbacks, flight call response rate increased with improved refueling performance in the spring. Our study begins to disentangle the relationship between weather, physiology, and behavior thereby improving our ability to monitor and conserve migrant landbirds en-route.

Full Life Cycle Conservation through Education: Making Connections for Migratory Bird Conservation Across the Western Hemisphere

Deinlein, Mary - Smithsonian Institution-Migratory Bird Center

Through their annual journeys Neotropical migratory birds connect distant places and, by extension, the people who live there. Based on the principle that migratory bird conservation depends on the goodwill and cooperation of people in both breeding and non-breeding ranges, the Smithsonian Migratory Bird Center has been partnering elementary school classes in the US and Latin America since 1993 through "Bridging the Americas/Unidos por las Aves". This cross-cultural conservation education program is designed to inspire a desire to protect birds and the habitats they depend on throughout the year, and stimulate an interest in learning about other countries and their cultures. Students in the partnered classes learn about the migratory birds that connect their communities and about each other through the preparation and exchange of art work, letters and other creative materials. Participating teachers receive materials and support that enable them to use migratory birds as an integrating theme for teaching required standards in English language arts, science, geography, social studies, visual arts, and Spanish. Managing an education program that spans different countries poses many challenges. This presentation will address the questions: Do the benefits outweigh the effort involved in meeting these challenges? What do students learn that's of value as evidenced by pre/post survey results, teacher feedback, parent testimonials, and an analysis of student products? Is there any evidence of changes in attitudes and behaviors that are beneficial to bird conservation?

Highly Pathogenic Avian Influenza Challenge Studies in Waterfowl

DeLiberto, Thomas - NWRC/WS/APHIS/USDA; Erica Spackman - US National Poultry Research Center; Mary Pantin-Jackwood - US National Poultr Research Center; David Swayne - SEPRL/USNPRC/ARS/USDA; Diann Prosser - USGS Patuxent Wildlife Research Center

Waterfowl are the natural hosts of avian influenza (AI) virus. The majority of AI viruses are classified as low pathogenicity (LP) based on their virulence in chickens, which are the reference species for pathotype testing and can be any of the 16 hemagglutinin subtypes (H1-16). Circulation of H5 or H7 LPAI viruses in gallinaceous birds can select for mutations which result in the highly pathogenic (HP) phenotype. Infection of waterfowl with HPAI virus occurs as spill-over from gallinaceous poultry and one virus lineage has been repeatedly found in wild waterfowl since 2006 which has resulted in intercontinental spread of the virus. Since wild waterfowl typically do not carry HPAI viruses data on the susceptibility among species and virulence is lacking. An exception is the A/goose/Guangdong/1996 (Gs/GD/96) H5 HPAI virus lineage of viruses of which several variants have become endemic in domestic poultry and waterfowl in Asia. Most experimental studies have been conducted with viruses of the Gs/GD/1996 lineage in Mallard or Pekin ducks, but studies with Muscovy ducks, geese, and diving ducks have been conducted with a small subset of virus isolates. The clinical outcome of exposure varies among species and virus strain, which is suggested by field data. The most common presentation is sub-clinical infection or mild, self-resolving disease (i.e. fever and anorexia). However, some isolates can cause more severe disease, often neurological signs, and mortality in some waterfowl species.

Highly Pathogenic Avian Influenza Surveillance in Wild Birds Across the United States

DeLiberto, Thomas J - NWRC/WS/APHIS/USDA; Jonathan Sleeman - USGS National Wildife Health Center; Patricia Bright - USGS Environmental Health, Contaminant Biology Program; Ronald Anglin - Oregon Department of Fish & Wildlife, National Flyway Council; Samantha Gibbs - USFWS / National Refuge System / Natural Resources Program Center / Wildlife Health Office; Darrel Styles - USDA / APHIS / VS Animal Health Emergency Management; Susan Trock - CDC / NCIRD / Influenza Division; Dale Garner - Iowa Department of Natural Resources; Thomas Gidlewski - USDA / APHIS / WS National Wildlife Research Center, National Wildife Disease Program

A unique A(H5Nx) clade 2.3.4.4 highly pathogenic avian influenza virus (HPAIV) was detected in North America in late 2014. Motivated by both the alarming spread of new H5 reassortant viruses in Asia and Europe as well as by the detection of HPAIV in both domestic poultry in Canada and in wild and captive birds in Washington State, initial HPAIV surveillance was conducted among in wild birds in the Pacific Flyway of the United States. This effort was later expanded to include the Central and Mississippi Flyways. Positive HPAI H5 findings from wild waterfowl samples suggested that while some of these species exhibit no detectable morbidity or mortality, clinical disease was documented for other wild bird species similarly infected. Also, losses in U.S. domestic poultry were unprecedented. In July 2015, state and federal agencies initiated a national surveillance effort to provide information to guide management actions to address some of the issues associated with HPAIVs in birds. This includes risks to commercial poultry, backyard poultry, game bird farms, wild birds, wild bird rehabilitation facilities, falconry birds, and captive bird collections in zoos/aviaries. Specific objectives of the plan

are to: 1) determine the distribution of influenza viruses of interest in the U.S.; 2) detect spread of influenzas of interest to new areas of concern; and 3) provide a flexible surveillance framework that can be modified to monitor wild waterfowl populations for avian influenza, detect reassortant avian influenza viruses, and estimate apparent prevalence of important influenzas once detected in an area of concern.

Aircraft Turbofan Engine Standards for Bird Strikes: Progress and Challenges
Demers, Chris - Pratt & Whitney

Certification standards for bird ingestions into large commercial and business jet engines have evolved with advances in technical knowledge gained through empirical and analytical processes. Steady, research-based improvements in certification standards for bird ingestions have been implemented in step with substantiated threats to jet engines from bird strikes. A brief historical review of bird ingestion regulations is presented to document the evolution of these certification standards. The typical process by which Pratt & Whitney has historically demonstrated compliance with certification requirements is presented. The more recent improvements in certification standards is presented to highlight the global inter-agency, collaborative effort that is expended to assist the regulators in addressing known and emerging threats to aviation safety due to bird strikes.

Male and female signalling during territorial interactions in a Neotropical songbird, the Rufous-capped Warbler (*Basileuterus rufifrons*)
Demko, Alana - University of Windsor; Daniel Mennill - University of Windsor

In many tropical birds, both sexes use conspicuous vocal and visual signals, and pairs defend territories year-round. Three primary hypotheses for the function of these “joint signals” are: shared territory defense, intrasexual competition for mates, and mutual mate attraction. Although many studies examine these hypotheses in the context of vocal duets, non-duetting bird species remain little-studied. Furthermore, few studies test for seasonal variation in signal function by comparing responses across seasons. Our objective was to test whether male and female Rufous-capped Warblers (*Basileuterus rufifrons*) exhibit seasonal variation in their use of vocal and visual signals in the context of territory and mate defense. We conducted a playback experiment in the non-breeding and breeding seasons to territorial pairs in our colour-banded population in Costa Rica. Pairs received three conspecific treatments (male, female, and male-and-female) and a heterospecific control. Both sexes responded to playback intrusions by flying near the speakers and vocalizing frequently. Males responded significantly more to male and male-and-female treatments in the non-breeding season, but they responded equally to all three treatments in the breeding season. Females showed a significantly stronger response to female and male-and-female treatments in the non-breeding season, but showed low responses to all three treatments in the breeding season. The strong responses to paired intrusions by both sexes, and the absence of a clear sex-specific response bias, support the shared territory defense hypothesis. This study experimentally tests hypotheses for season- and sex-specific signal function in a territorial resident tropical songbird.

Avian Influenza Virus in the Aquatic Environment: Biosurveillance Using Potential Biotic and Abiotic Reservoirs
Densmore, Christine - U.S. Geological Survey; Diann Prosser - US Geological Survey, Patuxent Wildlife Research Center; Deborah Iwanowicz - US Geological Survey; Chris Ottinger - U.S. Geological Survey; Luke Iwanowicz - U.S. Geological Survey; Larry Hindman - Maryland Department of Natural Resources, Wildlife and Heritage Service; Shawn McLaughlin - National Oceanic and Atmospheric Administration; Cindy Driscoll - Maryland Department of Natural Resources; Matt Whitbeck - US Fish and Wildlife Service; Amanda Bessler - U.S. Fish and Wildlife Service

Biosurveillance for avian influenza viruses (AIV) among wild and domestic bird populations helps to identify potential risks for transmission and epizootic disease. The environmental distribution and longevity of AIV is quite relevant to biosurveillance efforts. Avian influenza viruses are known to persist outside the host in the aquatic environment, both in water and sediment, with longevity depending upon various environmental condition factors. There are also potential biotic reservoirs of AIV in aquatic environments. Laboratory experiments have shown that AIV may be taken up from the water column and retained by filter feeding invertebrates, including bivalve molluscs. Research in waterfowl habitat of the Delmarva Peninsula (Maryland, USA) is examining the identification of AIV from environmental reservoirs as compared to recovery of AIV from waterfowl in the same region. Approximately 1000 samples consisting of avian oropharyngeal/cloacal swabs from dabbling duck species, pond sediment collected from high-density waterfowl habitat, or sentinel oyster tissue were collected in 2013-2014. Extracted RNA was converted to cDNA and screened for the presence of AIV matrix gene via quantitative reverse transcriptase PCR (qRT PCR). Presumptive positive samples underwent repeat testing with qRT-PCR for confirmation. Avian influenza virus matrix gene was detected in approximately 11.5% of sediment samples, a higher rate compared to bird-source swabs. One oyster tissue homogenate of the approximately 300 tissue samples collected also tested positive. Results suggest that sampling of environmental reservoirs, particularly pond sediment, in high waterfowl density habitat may potentially be useful in biosurveillance for AIV in this region.

Exploring broad-scale songbird migration patterns in Cuba and the Yucatan Peninsula to inform international conservation priorities
Deppe, Jill - Eastern Illinois University; Antonio Celis Murillo - Illinois Natural History Survey; Alina Pérez - Centro de Investigaciones y Servicios Ambientales ECOVIDA; Hiram Gonzalez - Instituto de Ecología y Sistemática, Ministerio de Ciencia de Investigaciones Tecnología y Medio Ambiente; Michael Ward - University of Illinois at Urbana-Champaign; Lauren Solomon - Eastern Illinois University; Alejandro Llanes Sosa - Instituto de Ecología y Sistemática, Ministerio de Ciencia de Investigaciones Tecnología y Medio Ambiente

Mexico's Yucatan Peninsula and Cuba offer the first available stopover sites where songbirds can rest, refuel, or escape unfavorable weather following passage across the Gulf of Mexico in the fall. While large numbers of songbirds migrate through the region, the scarcity of standardized, constant effort survey data has hindered our understanding of broad-scale spatial patterns in species' abundances, age ratios, and energetic condition in the southern Gulf. Documentation of species- and age-specific migration routes and the identification of areas used by birds in poor physical condition are necessary for developing effective conservation strategies. In fall 2015 we initiated a collaborative, international effort to simultaneously survey migratory birds on

Contoy Island, northeast of Cancun, Mexico and the Guanahacabibes Peninsula (GP) in southwestern Cuba. Together with comparable data previously collected in the Ria Lagartos Biosphere Reserve (RLBR) along the northern Yucatan Peninsula coast, we explored spatial patterns in bird abundance, age ratios and body condition. Overall, we found that capture rates were higher in RLBR and GP than Contoy. Some species' capture rates increased toward the east while others decreased. Birds caught on Contoy were significantly leaner and younger than those in RLBR and GP. Based on findings from other studies, Contoy is a low-quality site that provides emergency resting opportunities for en route songbirds, which can explain some of the results found in our study. We discuss how these spatial patterns can inform coordinated regional and international conservation efforts to promote the successful migration of songbirds through the southern Gulf Basin.

Estimating the functional role and quality of stopover sites around the Gulf of Mexico to inform conservation priorities for Neotropical migratory songbirds

Deppe, Jill - Eastern Illinois University; Antonio Celis Murillo - Illinois Natural History Survey; Michael Ward - University of Illinois at Urbana-Champaign; Lauren Solomon - Eastern Illinois University; Lynn Schofield - Yosemite National Park; Robert Diehl - USGS Northern Rocky Mountain Science Center; Theodore Zenzal - University of Sothern Mississippi; Rachel Bolus - USGS Northern Rocky Mountain Science Center; Frank Moore - University of Southern Mississippi

Stopover sites where birds can refuel, rest and/or find shelter from unfavorable weather or predation are essential for successful migration, especially when faced with negotiating geographic features, like the Gulf of Mexico. Prioritization of stopover sites for conservation and management, essential for protecting migratory species, needs to consider site function and quality in combination with spatial patterns in abundance. Factors such as ecological context (e.g., proximity to barriers), birds' physical condition and weather interact to determine the functional role of stopover sites. On the other hand, factors related to resource availability (e.g., food, shelter) influence site quality, or how well a migrant's needs are met by a site serving a particular function. Here, we discuss two case studies examining the function and quality of stopover sites for songbirds before and after crossing the Gulf of Mexico in the fall: Fort Morgan, Alabama and the northeastern Yucatan Peninsula. We used automated radio-telemetry to estimate stopover duration, hourly activity, and departure time and direction. By combining telemetry results with data on fat reserves, mass gains, temporal patterns in capture rates and atmospheric conditions, we gained insight into the role each site plays in promoting successful migration. While some sites appear to be of low quality (Fort Morgan, Contoy Island), their ability to satisfy critical needs during migration underscores their conservation value (e.g., emergency resting opportunities on Contoy). We discuss our findings and provide guidance for empirically evaluating the functional role and quality of stopover sites for conservation prioritization.

Singing in the city: Investigating the mechanisms of how birds avoid masking in urban environments.

Derryberry, Elizabeth - Tulane University; Raymond Danner - University of North Carolina Wilmington; Julie Danner - Tulane University; Graham Derryberry - Louisiana State University Museum of Natural Science; Jennifer Phillips - Tulane University; Katherine Gentry - George Mason University; David Luther - George Mason University

Cities are evolutionarily recent environments that impose novel selection pressures on organisms. Recent research in acoustic communication in urban contexts has found that birds change their vocalizations in the

presence of human-generated noise. Description of this potential adaptation has raised a fundamental question: how are birds changing their song to avoid masking in the urban environment? We explored the relative roles of cultural selection, whereby birds preferentially learn higher frequency songs in noise, and immediate flexibility, whereby birds adjust their song frequencies to noise in real time, as well as the potential synergy between these two mechanisms, in a behavioral model species, white-crowned sparrows (*Zonotrichia leucophrys*). We first assessed whether noise levels predicted variation in song structure in territorial males in San Francisco, CA. Next, using hand-reared birds, we tested whether males preferentially select to learn songs less masked by city-like noise. We then used noise playback experiments in the field and in the lab to test whether males adjusted their song via immediate flexibility to changes in their noise environment. We found support for both cultural selection and immediate flexibility and discuss the evolutionary implications of these findings for how birds cope with acoustic communication in urban environments.

The effects of oil development on demographic structure and stress physiology of a threatened mixed-grass prairie songbird: the chestnut-collared longspur (*Calcarius ornatus*)

Des Brisay, Paulson - University of Manitoba; Marty Leonard - Dalhousie University; Nicola Koper - Natural Resources Institute, University of Manitoba

The Canadian mixed grass prairie region is currently undergoing rapid oil development. This anthropogenic disturbance may have ecological impacts that cannot be detected by assessing species abundance and distribution. We examined how the presence of oil wells and the associated linear disturbances influenced the age distribution and physiological condition of chestnut-collared longspurs (*Calcarius ornatus*). I captured male and female longspurs at six active oil lease sites, and four control sites lacking any oil infrastructure, within 60 km of Brooks, Alberta, Canada. I took two blood samples, to represent basal (taken in under 3 minutes after capture) and acute (taken 12 minutes after capture) levels of corticosterone during a capture event, which were quantified from the plasma using a radioimmunoassay. There was no relationship between the body conditions of captured individuals and proximity to oil wells and roads. Similarly, young birds (second year) were no more likely to nest near oil wells or roads than older birds (after second year). The magnitude of the stress response (the difference between acute and basal corticosterone) and acute corticosterone was negatively correlated with the distance to the nearest road, but not the nearest oil well. Basal levels of corticosterone were not correlated with distance to roads or oil wells. My results suggest that the associated linear disturbances surrounding oil infrastructure may be more impactful than the oil wells themselves. Reducing the amount of roads constructed during oil development may help reduce the impact of these disturbances on grassland bird communities.

Linking demography and foraging behaviors in a long-lived seabird, the black-browed albatross

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There is growing evidence that climate change affects seabirds' vital rates and population dynamics. These correlations are based on the assumption that climate variability has profound consequences on seabirds foraging habitat and prey availability. However, few studies have directly related seabirds foraging behaviors to vital rates (e.g. survival and reproduction) and none to our knowledge has integrated the effect of

foraging behaviors into the entire life cycle, mainly because of a lack of datasets including both foraging and demographic information during the wintering and breeding seasons. Using tracking data collected between 2006 and 2013 on 110 Black-Browed Albatrosses (*Thalassarche melanophris*) of known life-history at Kerguelen Island, we investigated (1) the intimate link between foraging behaviors, individual quality and demographic rates and (2) the respective roles of the breeding and winter seasons on the albatrosses' demography. We also explored if vital rates responded to change in foraging behaviors between years (i.e. inter-annual variation at the population level). Our results show that foraging behaviors highly depend on individual characteristics (age, sex and breeding status during the previous breeding season) suggesting that some individuals forage more efficiently than others. We also found that environmental variability has an important effect on albatrosses' foraging behavior. Such variability in foraging behaviors affects demographic parameters and in turn the dynamic and persistence of the population.

Mountain Birdwatch: assessing changes in abundance of high-elevation songbirds using citizen science data in the Northeastern US

Dettmers, Randy - U.S. Fish and Wildlife Service; John Lloyd - Vermont Center for Ecostudies; Julie Hart - Julie Hart Consulting; Judith Scarl - Association of Fish and Wildlife Agencies; Daniel Lambert - High Branch Conservation Services; Peter Solymos - Alberta Biodiversity Monitoring Institute, Alberta Innovates Technology Futures and University of Alberta / Department of Biological Science

Montane spruce-fir forests in northeastern United States and southeastern Canada support a unique suite of breeding birds, including the vulnerable Bicknell's Thrush. However, until the last 15 years, the birds breeding in this ecosystem were not monitored due to inaccessibility. Mountain Birdwatch is a citizen science program designed to assess how climate, competition, and habitat factors influence the abundance of a set of focal bird species over time. From 2001-2010, approximately 120 routes along hiking trails were surveyed each June across the mountains in the northeastern US. To analyze these data, we identified covariates influencing detection probability, independent of abundance. We then corrected for detection probability and used reverse step-wise model selection with generalized linear models to determine the ecological covariates influencing abundance. We present the climate, competition, and habitat variables influencing the detection and abundance of each of five focal species for 2001-2010. Over this time period, we found the abundance of Bicknell's Thrush, Swainson's Thrush, White-throated Sparrow, and Winter Wren increased, while Blackpoll Warbler showed no change. Unexpectedly, Bicknell's Thrush abundance was positively related to the presence of Swainson's Thrush and negatively related to patch size. In 2010, we revised the Mountain Birdwatch program by replacing the ad-hoc sample design with a randomized, spatially balanced approach. We also refined the survey protocols to better allow for modeling abundance and detectability. Preliminary analyses within the US suggest no trend in abundance for the focal species between 2010 and 2015.

The role of societal values in shaping conservation-related attitudes and behaviors

Dietsch, Alia - Ohio State University; Michael Manfredo - Colorado State University; Tara Teel - Colorado State University

Values are enduring, core beliefs that shape a wide range of attitudes and behaviors across various situations. Research suggests that the values held by Americans have shifted due to societal-level advances (e.g., urbanization, increased wealth and

education). In the context of wildlife conservation, a change in these societal values would ultimately lead to new public priorities regarding the treatment and management of wildlife such as birds. Our body of research suggests that the perceived rise of conservation-relevant attitudes and behaviors, including birdwatching, is consistent with a societal shift away from domination values focused on meeting basic human needs toward mutualism values focused on the perceived needs of others, such as wildlife. For example, using data from several studies conducted throughout the western U.S., we found that mutualism was strongly and positively correlated with support for actions such as habitat conservation even while restricting human interests (e.g., economic development, access to protected areas). We found mutualism to be positively associated with wildlife observation, birdwatching, and environmental education, and negatively associated with hunting and fishing. Mutualism also appears to lead to declines in trust of traditional wildlife management authorities, changing the context of wildlife-related decision-making. Finally, mutualism was predominately found in states exhibiting higher levels of income, education and urbanization, suggesting that socioeconomic advances at the societal level lead to value shift. Our work underscores the importance of understanding what shapes values, as well as how values influence thought and behavior in the context of bird conservation.

Testing the relative effects of partial incubation and within-nest egg movements on hatching asynchrony

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Hatching asynchrony has traditionally viewed as a consequence of starting full incubation before clutch completion, so that last-laid eggs started their development later than their nest-mates. However, at least two additional processes could condition the degree of hatching asynchrony. First, females could warm the eggs, sometimes near normal incubation temperatures, during some periods of time along the egg-laying period (so-called "partial incubation"), thus promoting differential development of embryos even if full incubation starts on or after clutch completion. Second, the specific relative position of eggs within the nest could cause them to receive more or less warmth (central eggs receiving less heat than peripheral ones); if some eggs are in central positions more often they could develop faster. We tested the relative effect of these two processes by (1) experimentally marking and removing eggs from 19 great tit *Parus major* nests as they were laid (replacing them with fake eggs), and returning them when incubation began (so all of them started development at the same time), and (2) monitoring twice a day the relative position of each egg within the nest along the incubation period, estimating an index of "centrality". Experimental nests had lower hatching asynchrony than controls (0.81±0.14 vs 1.65±0.15 days), so partial incubation is an important source of hatching asynchrony. On the other hand, hatching asynchrony was not affected by the relative movement of eggs within the clutch, suggesting that the asynchrony not explained by partial incubation has other causes than within-clutch egg movements.

The role of colony position on Least Tern nest survival in Mississippi
Dinsmore, Stephen - Iowa State University

In colonial nesting birds, there is evidence suggesting that nest losses are greatest for nests on the colony periphery while nests in the middle of a colony are more successful. The Least Tern (*Sternula antillarum*) is a colonial nesting bird of coastal regions and interior rivers. I studied Least Terns in coastal Mississippi during the 2004 and 2005 nesting seasons to investigate the role of colony position and other factors on their nest survival. I monitored 454 nests in 2004 and 462 nests in 2005 to determine nest fate. Terns nested earlier and had slightly larger clutch sizes in 2005 when compared to 2004. Nest survival of Least Terns was influenced by the distance from each nest to the colony centroid, year, a quadratic pattern within years, colony, and nest age. There was a linear relationship between nest survival and distance from the colony centroid such that nests along the periphery of a colony had lower survival than nests near the center of the colony. Nest survival was lower in 2004 compared to 2005, and within years survival increased slowly until about 20 May, after which it declined through the end of the nesting season in early August. There were also strong differences in nest survival between colonies, and nest survival declined slowly as nests aged. These findings expand our understanding of nest risk in a colonial nesting bird and have important conservation implications for colony management.

Maternal antibodies to influenza A viruses in Mallards
Dirsmith, Katherine - Colorado State University; **Susan Shriner** - National Wildlife Research Center

Waterfowl are endemic reservoirs of avian influenza viruses (AIVs). Because infection may cause only mild pathology, AIVs can be transported asymptomatically over large areas and affect populations of wild birds and sometimes the viruses are transmitted to poultry where they can cause great economic harm. Maternal antibodies to AIVs have been shown to be important in chick survival early in life, as well as in population level-disease dynamics. Multiple factors, including hen circulating AIVs antibody concentration, have been found to be correlated with the concentration of circulating antibodies in chicks. In this study, we examined the transfer of maternal AIVs antibodies in captive Mallard (*Anas platyrhynchos*) chicks reared in a large outdoor flight pen. Before chicks hatched, we monitored nest activity and determined hen-nest associations. After chicks hatched, we collected blood samples from chicks at regular intervals and tested the serum for antibodies to AIVs using the IDEXX Multi-S ELISA which detects antibodies to influenza A viruses. Our results indicate that maternal antibodies are detectable for approximately a week post hatch. Chicks from four of 23 (17%) nests remained positive for at least 14 days after hatching. These data are important for developing epidemiological models that account for host resistance to AIVS immediately post hatch.

Herbivores fuelling for long-distance migration: prisoners or masters of their food supply?
Dokter, Adriaan - Cornell lab of ornithology, Cornell University; Wimke Fokkema - University of Groningen; Willem Bouten - Computational Geo-Ecology, Institute for biodiversity and ecosystem dynamics, University of Amsterdam; Bart Ebbinge - Alterra, Wageningen University; Gerard Müskens - Alterra, Wageningen University; Han Olff - Conservation Ecology, University of Groningen; Bart Nolet - Netherlands Institute of Ecology (NIOO-KNAW); Henk van der Jeugd - Centre for Avian Migration and Demography, Netherlands Institute of Ecology (NIOO-KNAW)

Brant Geese are specialist grazers of marine environments. In addition to traditional intertidal niches, Brant increasingly make use

of agricultural land. To understand these habitat shifts, and given that the intertidal ecosystems used by Brant are in world-wide decline, it is crucial to understand the habitat selection and energetics of Brant throughout their annual cycle. We studied two groups of Brant staging in neighboring agricultural and saltmarsh habitats and equipped them with individual trackers. By combining high-resolution GPS-tracking, acceleration-based behavioural classification, thermoregulation modelling, and measurements of food digestibility and intake rates, we reconstructed their energy budgeting in detail. Individual fuelling trajectories were used to identify factors that explain differences in fuelling rates between sites, and long-term individual resightings were used to infer the consequences of departure fuel loads for reproductive success. We find that Brant staging on agricultural grasslands experience long time surpluses for harvesting resources, providing evidence that both the fuelling onset and daily energy assimilation are controlled and limited mostly internally. Saltmarsh birds required longer foraging in a more competitive environment, delaying their fuelling. Fitness correlates with departure condition nonetheless persisted in both habitats. Our results show that carry-over effects of condition may be very long-lived and not easily negated by stopovers with easy access to high quality food, like fertilized pastures. We suggest general vitality and digestive capacity are critical drivers of inter-individual variation in departure reserves, which may overrule effects of competitive ability and access to food.

The National Wildlife Strike Database: a scientific foundation for basic and applied ornithology related to birds and aviation safety

Dolbeer, Richard - U.S. Department of Agriculture

Over 165,000 strikes involving about 520 species of birds in North America have been entered into the Federal Aviation Administration's (FAA) National Wildlife Strike Database (NWSD), 1990-2015. This public database provides a scientific foundation for 1) FAA regulatory policies and guidance to manage the risks of bird strikes within the aviation industry, 2) design improvements by engine and aircraft manufacturers to minimize damage and risk by bird strikes, and 3) species-specific wildlife risk mitigation plans developed by airports and air carriers to enhance aviation safety. In addition, the NWSD contains a wealth of information that can be of use in many fields of basic and applied ornithological research. This presentation provides 3 examples of hypotheses tested with data from the NWSD: 1) Are the mean heights above ground level at which white-plumaged birds (e.g., great egrets [*Ardea alba*] and wood storks [*Mycteria americana*]) fly positively correlated with the percentage of black (melanin) coloration in primary flight feathers?, 2) are the seasonal patterns in strikes for Canada geese (*Branta canadensis*) and mallards (*Anas platyrhynchos*) reflected in differences in the phenology of feather molt related to nesting success and renesting?, and 3) do aircraft navigation lights (red on left wing and green on right wing) result in a positive bias in bird strikes to left side of aircraft because birds have a greater robustness of avian visual capability at middle wavelengths (green) compared to longer wavelengths (red)? In all 3 cases, the hypotheses were supported by data in the NWSD.

Songbird conservation on the landscape scale in southeast Ohio's public forestland using habitat suitability index models

Donovan, Kaley - The Ohio State University; Stephen Matthews - The Ohio State University; Bryce Adams - The Ohio State University

Sound conservation planning is essential for the maintenance of biodiversity and ecosystem function. We aim to identify

landscape-scale management recommendations to maintain avian diversity in the Appalachian Foothills Region of Southeast Ohio. We identified several focal species representative of different stages of forest succession and of conservation concern: Cerulean Warbler (*Setophaga cerulean*), Prairie Warbler (*Setophaga discolor*), Eastern Towhee (*Pipilo erythrophthalmus*), Wood Thrush (*Hylocichla mustelina*), and Kentucky Warbler (*Geothlypis formosa*). We use established Habitat Suitability Index Models (HSI) and validate those models with 304 point counts conducted from 2012-2016. Where species level results diverge from established models, we develop statistical models to integrate into established HSIs. These new models are based on occurrence data as well as detailed vegetation data collected at point count stations. Landscape scale variables utilized are from spatial databases including National Land Cover Database and Ohio Division of Forestry harvest data. In an analysis with nine candidate models, the most supported models using Akaike Information Criterion Corrected were those with either vegetation or landscape scale variables, which include canopy cover, small stem density, patch area, and percent forest within 1 kilometer (n=59). For example, Prairie Warbler presence had a positive association with stem density and a negative association with canopy cover, and negative associations with both patch area and percent forest within 1 kilometer. These results demonstrate a framework by which we can evaluate and improve variable selection in our region-specific HSIs.

Breeding on an artificial island: reproductive success of terns in Israel
Dor, Roi - Tel Aviv University; Inbal Goldshtein - Tel Aviv University

In the last three decades, the two tern species breeding in Israel, the little tern (*Sterna albifrons*) and the common tern (*Sterna hirundo*), have suffered from loss of breeding sites and reduction in breeding population size. Consequently, breeding populations of these species are concentrated on a small artificial island, rendering the populations as vulnerable. Despite some conservation efforts, less is known regarding the reproductive success and survival of these populations, critical information for the conservation of these breeding colonies. In order to examine the factors that affect reproductive success and survival of these birds, we captured and marked terns with individual rings, monitored their breeding biology (observations from a hide and an on-site camera), and tested the contribution of shelters for their survival. Terns breeding season lasts for three months, with two main peaks of breeding cycles. During the first cycle, all little terns nested in one site (~250 nests). However, in the second cycle, some moved to a nearby alternative artificial site, with higher reproductive success compared to the original location. The presence of shelters on the island decreased aggression, directed mainly toward chicks that aggregate for shade during heat hours. These findings demonstrate the importance of developing alternative breeding sites for the terns in order to maximize their breeding efforts and decrease the breeding density on the island. In addition, suitable management of the artificial site, making it similar to the natural habitat, is required for tern conservation.

Loss of understory insectivorous birds functional traits in fragmented forest landscapes.
dos Anjos, Luiz - State University of Londrina; Gabriela Menezes Bochio - State University of Londrina; Bia de Arruda Almeida - State University of Maringá

Understory insectivorous birds have been considered one of the most sensitive groups of birds to forest fragmentation. In this study, we compared species richness and functional diversity in two bird groups (G1 and G2) throughout a continuous block of forest and a fragmented forest landscape, both in the

Atlantic rainforest, southern Brazil. We investigated if G1 (antbirds-ovenbirds, primarily understory insectivorous birds) and G2 (tyrant flycatchers-tityras, with larger diet spectrum and occupancy of forest strata) have different patterns of occurrence throughout the continuous forest. In the continuous forest the functional dispersion (FDis) was higher and less variable in 24 recorded species of G1 (0.29±0.008SD) than in 25 recorded species of G2 (0.24±0.02SD). In the fragmented landscape, we evaluated G1 and G2 in a gradient of fragment size, connectivity, vegetation quality, and forest cover. In addition, we investigated which traits are lost in that gradient. We recorded 23 G1 species and 27 G2 species in the fragmented landscape and found that G2 species did not respond to the measured variables, while G1s species richness and functional dispersion increased with forest connectivity (p2), the foraging traits of G1 species related to capture directed to a target (0.46), branches substrate (0.43), dead leaves substrate (0.24), and aerial maneuver (0.24) were those lost with decreasing connectivity ($p < 0.05$). We suggest that different patterns in continuous forest makes individuals occurrence of G1 more predictable in the remaining forest fragments, which could explain the differences in the response of those groups to forest fragmentation.

Seasonal rainfall influences inter-and intra-seasonal territorial dynamics of a migratory bird.

Dossman, Bryant - Cornell University; Colin Studds - University of Maryland, Baltimore County; Peter Marra - Smithsonian Migratory Bird Center; Amanda Rodewald - Cornell University

The role of territoriality and space use in regulating animal populations is arguably one of the most important concepts in population ecology. For migratory birds, territoriality during the non-breeding season is primarily driven by competition over food. However, studies have overlooked how territorial behavior may exhibit temporal variation that is likely to have important implications on population dynamics. Given the importance of rainfall on insect (food) abundance, we hypothesize that variation in territorial behavior will be influenced by extreme rainfall events where prolonged drought or excessive rainfall will diminish territorial behavior. To test this hypothesis, we will utilize the long-term model system of American Redstarts *Setophaga ruticilla* wintering in Southwest Jamaica. Using spot mapping and banding efforts territorial behavior will be defined by—1) detection probabilities of individuals from constant effort banding, 2) spatial overlap between territories, and 3) the prevalence of off-territorial movements. Rainfall has been previously shown to influence redstart ecology and will be used in this analysis to determine its effect on modifying the strength of territoriality. Annual density will be accounted for in our analysis because population density will influence competitive pressure. This study will be the first to investigate the extent of intra-seasonal variation in territorial behavior brought upon by variation in seasonal rainfall. With decreasing seasonal rainfall predicted for the Caribbean, future efforts will seek to build upon the potential implications that variation in territorial behavior will have on population dynamics of migrants wintering in the Caribbean in light of global climate change.

Assessing Plasticity in the Migratory Behavior of a Songbird Wintering in the Caribbean Using the Motus Wildlife Tracking System.

Dossman, Bryant - Cornell University; Colin Studds - University of Maryland, Baltimore County; Peter Marra - Smithsonian Migratory Bird Center; Amanda Rodewald - Cornell University

Variation in timing of arrival on the breeding grounds for many migratory songbirdsis a primary driver of among-and within-population variation in reproductive success.

Although arrival timing is known to be influenced by carry-over effects associated with non-breeding habitat quality, no studies have demonstrated how arrival schedules are maintained throughout spring migration. In particular, plasticity in migratory behavior may mediate the strength of these carry-over effects. However, to investigate this, we require longitudinal tracking data on individuals during spring migration but also between years to assess annual survival. By linking a long-term demographic study of American redstarts (25+ years) on the non-breeding grounds in Jamaica with large-scale automated radio telemetry array spanning across Florida and the Southeast US, we seek to investigate whether individuals can compensate for delays in migratory timing due to winter habitat quality and evaluate the consequences of that behavior on annual survival. We first demonstrate that the Motus Wildlife Tracking System allows for the tracking of < 8 g migrants from their Caribbean wintering grounds through their spring migration through Florida and the Southeast US. We show that Florida likely serves as a vital stopover corridor for migrants wintering in the Caribbean and South America. Here we provide preliminary results of a study that will ultimately provide unique insights into a potential mechanism by which non-breeding carry-over effects operate through migration and ultimately influence population dynamics of migratory organisms.

How does a two-day bird education event affect the long-term knowledge, attitudes, and behaviors of high school students? Evidence from 13 Jamaican high schools.
Douglas, Leo - BirdsCaribbean; Luke Powell - Smithsonian Migratory Bird Center; Lisa Sorenson - BirdsCaribbean; Loraine Cook - Dept of Education, University of the West Indies, Mona, Jamaica; Susan Bonfield - Environment for the Americas; Peter Marra - Smithsonian Migratory Bird Center

The significance of knowledge acquisition, attitude and behavior changes resulting from nature conservation education programs has been extensively debated in the academic literature. Using an experimental design including 13 Jamaican high schools, we randomly assigned seven of these schools to an experimental group, and the remaining six to a control group. Our central objective was to determine whether and to what extent a short-term bird-science experience could produce significant positive outcomes observable over multiple years. Our experimental group received a program that involved one classroom-based workshop and one field-based birding and a research mist-netting station experience. We used a mixed methods design that included quantitative and qualitative pre and post experience interviewing. We then re-assessed all participants after 12 months to determine knowledge retention, attitudes and behavioral changes. Our findings reveal that the knowledge and attitudes about the value and importance of wild birds improved significantly within our experimental group. However pro-conservation behaviors changed much less significantly. We discuss these results within the context of dominant educational theories that link knowledge and learning experiences to observable or behavioral intention changes. We also discuss how the differences in the backgrounds and education standards of the students/schools involved differed, and how these differences affected the responses to the education program. We advocate that understanding such nuances are important in both designing and delivering future conservation education programs.

The science and art of identifying bird remains: an essential component of bird-aircraft hazard mitigation efforts and a potential data source for ornithologists
Dove, Carla - Smithsonian Institution

The Smithsonian Institution’s Feather Identification Laboratory processes over 9,000 bird strike cases per year through

interagency agreements with the U.S. Air Force, U.S. Navy and U.S. Federal Aviation Administration. Knowing the exact species of birds that cause damage to aircraft is fundamental to developing ecologically based management plans on airfields, improving designs of aircraft engines and airframe components, and in building predictive models to mitigate the risk of bird strikes. This presentation reviews the molecular and morphological techniques used to identify bird strike remains and summarizes the species of birds that are most often identified from these cases. Over the past 10 years, data recorded on bird strike reports has become more accurate and trustworthy and species-level identifications are now more obtainable with improved molecular techniques. In addition, feather identification skills have been used in dietary analyses of prey remains and applied to anthropological studies. Given these applications and improvements in identification methods, potential collaborations with professional ornithologists will be discussed.

Can single nucleotide polymorphisms reveal population structure across divergent habitats in Prairie Falcons (*Falco mexicanus*)?

Doyle, Jacqueline - Towson University; Douglas Bell - East Bay Regional Park District; Peter Bloom - Bloom Biological Inc.; Todd Katzner - U.S. Geological Survey; J. Andrew DeWoody - Purdue University

The prairie falcon (*Falco mexicanus*) inhabits diverse habitats in western North America – from desert and shrub-stepp to grassland and oak-savannah-chaparral. It is currently unclear to what extent gene flow occurs amongst prairie falcons breeding in these diverse landscapes. Given the increasing development pressure of large scale projects (e.g. wind and solar) on these habitats, it is important for conservation efforts to determine if Californian prairie falcons represent an interbreeding population or genetically distinct units. To this end, we took a genomics approach to investigating population structure in the prairie falcons sampled across California. We sequenced the genome of the prairie falcon using a combination of Illumina paired-end, mate-paired and LR-synth reads. The preliminary genome assembly included 2181 scaffolds greater than 10 Kb and the longest scaffold was 17.39 Mb. Coverage of the genome was ~30X. We annotated 16,320 genes implicated in prairie falcon muscle and cranial development, immunity, sperm viability, vision and many other biological functions. We additionally mined ~600,000 high-quality SNPs from the genome, ultimately choosing 192 gene-associated markers to be included in a Fluidigm SNPtype assay. We subsequently genotyped prairie falcons from across California to describe the genetic variability present in regional subpopulations and identify patterns associated with diverse habitats. Our data should prove informative for conservationists charged with identifying evolutionary significant units of prairie falcons for population management and for testing hypotheses related to divergent movement or migratory patterns.

Estimating biases in nesting phenology predictions

Drolet, Bruno - Cadaian Wildlife Service - ECCC; François Rousseu - Canadian Wildlife Service

Simulations were used to assess biases in using backcalculation algorithms when predicting nesting phenology. An “early” bias was expected when estimating the earliest first egg dates and a “late” bias when estimating the latest nest departure dates. Inversely, a “late” bias was expected when using only nest observations to estimate the beginning of the nesting season. Four scenarios and different weighting methods and/or use of different data were studied. All scenarios were biased with a varying level of magnitude, except for the one using an appropriate weighting method. Because biases depend on several factors, systematic

correction is difficult, especially since the "real" distribution of first egg dates for each species remains unknown, and the pattern of backcalculation uncertainty likely varies between species. Models were developed to predict the nesting phenology of 311 species nesting in Canada. A new R package called rNest has been developed to enable the automated treatment of 202,407 nest records. The use of backcalculation algorithms indicated a small bias in predictions for most species, which was negligible compared to the uncertainty in the nesting phenology predictions. The bias was more systematic in late breeding neotropical migrants, for which predicted first egg dates were always earlier using backcalculated data. However, the difference was generally short and was not more than 5 days, and was less important in the case of nest departure dates. The use of a backcalculation procedure provides better nesting estimates than the use of nest observation only.

Estimating golden-cheeked warbler immigration using integrated population models: implications for the spatial scale of conservation

Duarte, Adam - Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University; Floyd Weckerly - Texas State University; Michael Schaub - Swiss Ornithological Institute; **Jeff Hatfield** - USGS Patuxent Wildlife Research Center

Understanding the factors that drive population dynamics is fundamental to species conservation and management. Since the golden-cheeked warbler *Setophaga chrysoparia* was first listed as endangered, much effort has taken place to monitor warbler abundance, occupancy, reproduction and survival. Yet, despite being directly related to local population dynamics, movement rates have not been estimated for the species. We used an integrated population model to investigate the relationship between immigration rate, fledging rate, survival probabilities and population growth rate for warblers in central Texas, USA. Furthermore, using a deterministic projection model, we examined the response required by vital rates to maintain a viable population across varying levels of immigration. Warbler abundance fluctuated with an overall positive trend across years. In the absence of immigration, the abundance would have decreased. However, the population could remain viable without immigration if both adult and juvenile survival increased by almost half or if juvenile survival more than doubled. We also investigated the response required by fledging rates across a range of immigration in order to maintain a viable population. Overall, we found that immigration was required to maintain warbler target populations, indicating that warbler conservation and management programs need to be implemented at larger spatial scales than current efforts to be effective. This study also demonstrates that by using limited data within integrated population models, biologists are able to monitor multiple key demographic parameters simultaneously to gauge the efficacy of strategies designed to maximize warbler viability in a changing landscape

Differential altitudinal migration and elevational range size are associated with differences in thermal tolerance in Tarsiger bush-robins

DuBay, Shane - University of Chicago; Yongjie Wu - Sichuan University; Zachary Cheviron - University of Montana; Yanhua Qu - Institute of Zoology, Beijing, Chinese Academy of Science; Graham Scott - McMaster University; Trevor Price - University of Chicago; Fumin Lei - Institute of Zoology, Beijing, Chinese Academy of Science; John Bates - The Field Museum

Altitudinal migration in birds is well documented, but the physiological mechanisms associated with this behavior are poorly understood. Three Himalayan bush-robin species breed in sympatry above

3000 m elevation but segregate elevationally in winter. We discovered differences in arrival date to breeding elevations within and among species. *Tarsiger indicus*, which winters the highest, arrived to breeding elevations first, followed by *T. rufilatus* and then *T. chrysaeus*, which winters the lowest. We observed protandry within each species; adult males arrived first, then subadult males, and then females. Birds that arrive early must cope with freezing temperatures and snow cover at upper elevations. Species and age/sex classes that arrive earlier exhibit increases in anaerobic capacity and flight muscle size, which confer increases in cold tolerance. Increased anaerobic capacity represents a previously undescribed mechanism by which endotherms cope with the physiological stress of cold, hypoxic environments. Species and age/sex classes that are less cold tolerant minimize cold stress by arriving later in the season. Theory suggests that males should benefit from arriving early, but this requires resource investment in traits that increase cold tolerance. Females should benefit from investing resources in reproduction rather than thermogenic traits. This differential selection between sexes likely maintains protandry and the observed physiological differences. Among species, increased cold tolerance is associated with smaller annual elevational range, allowing *T. indicus* to winter closer to breeding elevations. Our results highlight adaptive phenotypes that have evolved in association with differential altitudinal migration strategies and elevational range size in temperate montane species.

Alone we can do so little; together we can do so much: Birders, conservationists, hunters, and a new paradigm for wetland and waterfowl conservation
Duberstein, Jennifer - Sonoran Joint Venture; Patricia Edwards - Canadian Wildlife Service

Since 1986, the North American Waterfowl Management Plan (NAWMP) has provided a blueprint for waterfowl and wetland conservation in North America. Prior to 2012, much of this effort focused on habitat and waterfowl biology. The 2012 Plan Revision for the first time incorporated the importance of an engaged community of users and supporters for continued conservation success. The resulting NAWMP Human Dimensions Working Group and Public Engagement Team recognized that engaging people in conservation action for waterfowl and wetlands requires a deeper understanding of values, beliefs, and attitudes that drive human behavior, and a strategy for using this knowledge to improve conservation efforts. In order to do this, we are implementing a survey of birders in Canada and the U.S. to better understand behavior, as well as values, beliefs, and attitudes. The birding, wildlife viewing, recreation, and conservation communities are key but untapped constituencies for reaching the goals and objectives of the NAWMP. To be successful moving forward, we need to find ways to leverage the tremendous interest, capacity, and passion of these groups to support waterfowl and wetlands conservation. In addition, there is a need to find common ground between hunters, birders, and conservationists. These groups share many of the same values, but may not adequately or effectively work together in support of their common goals. The results of this survey are an important step in moving toward a new paradigm for waterfowl and wetlands conservation in North America.

Detecting climate change impacts on birds and their habitats in northern Mexico and the southwest United States
Duberstein, Jennifer - Sonoran Joint Venture; Sam Veloz - Point Blue Conservation Science; Dennis Jongsomjit - Point Blue Conservation Science; Leo Salas - Point Blue Conservation Science; Geoff Geupel - Point Blue Conservation Science; Carol Beardmore - U. S. Fish and Wildlife Service

Appropriate natural resource management responses to projected future changes in

climate rely on the ability to detect and attribute the effects of changes as they occur. It is unknown to what degree climate change will impact species and habitats in northern Mexico, making it difficult to plan for bird conservation efforts. PLuMA (Planning for Landscape Management and Adaptation / Planeación para el Manejo y Adaptación de Paisajes) is an online, bilingual decision support tool that helps users identify where, what, and how to monitor in order to evaluate climate change impacts on birds and their habitats. It allows land managers to identify priority species and regions for monitoring, which can guide collaborative projects among institutions across borders. PLuMA aggregates current and future projections of suitable bird habitats for 67 taxa. The integration of multiple models into a single tool allows users to evaluate the projected impacts of five different future climate scenarios, organized by habitat type, to help managers understand and prioritize bird monitoring and habitat restoration and protection activities within a larger spatial and temporal context. This not only improves decision-making at local scales, but also provides a single source to better addresses full life cycle needs of birds and inform management actions at the regional scale and into the future. The long-term goal of PLuMA is to help managers in northern Mexico incorporate the projected impacts of climate change into their land management and monitoring decisions.

Direct and indirect influences of climate on bird species abundance along elevation gradients in the northern Appalachians

Duclos, Timothy - University of Massachusetts Amherst/Dept. of Environmental Conservation/USGS DOI Northeast Climate Science Center Fellow; William DeLuca - Northeast Climate Science Center, University of Massachusetts; David King - USDA Forest Service Northern Research Station / University of Massachusetts, Amherst

The stratification of bird species along elevation is widely reported, with high elevation bird communities typically characterized by distinctive species occurring in small and isolated populations; as such, these species are of considerable interest to ecologists and conservationists. Evidence that bird species are shifting upwards in elevation fuels speculation that species are tracking their climactic niches in response to climate change, however there is evidence plant communities are concurrently shifting in elevation. Uncertainty regarding the pathways and degrees to which climate influences bird distributions represents a key impediment to understanding the ecology of these montane species. In an attempt to resolve this important question, we directly measured bird abundance, habitat and temperature at 150 survey points during 2014 and 2015 located along 15 elevational transects in the Presidential Mountains of New Hampshire. Precipition data were derived from a downscaled regional dataset. We used N-mixture models to correct for imperfect detection of species and structural equation models to tease apart the direct and indirect effects of climate upon these birds. Analysis of 22 species revealed both direct influences of climate on bird abundance as well as indirect effects mediated through the influence of climate on vegetation, with the pathway and strength of association varying between species. These findings underscore the importance of incorporating robust models of vegetation shifts into models of bird responses to climate change, as well as potential shortcomings of climate envelope models that fail to incorporate changes in habitat; information critical to the long-term conservation of these species.

Age-specific survival of Adélie penguins in relation to colony size, reproductive status, and environmental variation

Dugger, Katie - OR Coop Fish and Wild Research Unit/Oregon State University; David Ainley - H.T. Harvey and Associates; Grant Ballard - Point Blue Conservation Science; Phil Lyver - Landcare Research; Kerry Barton - Landcare Research

Similar to other seabirds, the Adélie penguin (*Pygoscelis adeliae*) exhibits high survival, delayed maturation & high breeding philopatry, although we previously confirmed that survival & breeding philopatry can vary in response to environmental variation. However, age-related variation in key demographic parameters is still poorly understood for this species. Using data collected on individuals banded as chicks, and multi-state capture-recapture models, we estimated age-related variation in survival, age-at-1st reproduction and breeding propensity over 18 years from a 3-colony metapopulation in the Ross Sea, Antarctica. A preliminary analysis with 13 years of data suggested that survival varied in relation to breeding status (non-breeder>pre-breeder>breeder), age (lowest survival observed the first 2 years), colony size (lower survival at smallest colony), and by year. Recruitment rate into the breeding population increased through age 8, with no differences observed between colonies, and penguins do not breed every year after recruitment into the breeding population. However, this initial analysis did not yet reach the upper limit of the Adélie penguin lifespan, or include the effects of annual environmental variation, so the addition of 5 more years of data may help us disentangle the confounding effects of age, reproductive state and temporal variation. We need to determine the underlying mechanisms that maintain the large degree of size discrepancy (orders of magnitude differences) among these 3 colonies and the role of annual environmental variation in maintaining this system in order to understand the population dynamics of this meta-population.

Speed and stopover duration in Arctic breeding shorebirds: contrasting spring and autumn patterns

Duijns, Sjoerd - National Wildlife Research Centre, Carleton University; Diana Hamilton - Mount Allison University; David Mizrahi - New Jersey Audubon; Larry Niles - LJ Niles Associates LLC; Amanda Dey - Endangered and Nongame Species, New Jersey Division of Fish and Wildlife; Yves Aubry - Environment and Climate change Canada; Erica Nol - Trent University; Yves Turcotte - Cégep de La Pocatière; Ann McKellar - Environment and Climate Change Canada; Christy Morrissey - University of Saskatchewan; David Newstead - Coastal Bend Bays & Estuaries Program; Lindsay Tudor - Maine Inland Fisheries and Wildlife; Rebecca Holberton - University of Maine; Jennie Rausch - Environment and Climate Change Canada; Christian Friis - Environment and Climate Change Canada; Stephanie Koch - United States Fish and Wildlife Service; Julie Paquet - Environment and Climate Change Canada; Sarah Neima - Mount Allison University; Allie Anderson - Trent University; Paul Smith - Environment and Climate Change Canada

Every year millions of shorebirds migrate from Arctic breeding grounds to temperate or tropical non-breeding areas. While broad patterns of movement have been documented, relatively little is known about movements at the individual level because of the difficulties of tracking small-bodied birds across the continent. Theory predicts that long-distance migrants are more time-limited en route to the breeding grounds, leading to a prediction of faster migratory passage in spring than in autumn. By using a coordinated, automated radio telemetry system, the Motus Wildlife Telemetry System, we were able to track the movements of long-distance migrant shorebirds on a continent-wide scale. From 2012 to 2015 we recorded

movements of 1,518 individuals of 12 shorebird species differing in age and sex throughout multiple seasons. Contrary to theoretical predictions, individuals made slower progress during spring migration compared to autumn migration. Differences between the two seasons appear to be largely induced by a longer duration at stopover sites during spring. Birds' arrival at their northern breeding grounds may be constrained by weather and snow conditions, or the timing and rate of their migration more influenced by environmental factors such as food availability on the staging sites and wind conditions suitable for migration. Our data also shed light on connectivity among breeding and staging sites, as well as individual-level variation in use of stopover and staging sites. Because many shorebird species are declining, this understanding has substantial conservation relevance.

Is there functional significance among different song types in Song sparrows (*Melospiza melodia*)?
Duke, Cameron - Western Carolina University; Barbara Ballentine - Western Carolina University

Bird song is a complex, sexually selected signal. In song sparrows, previous research has shown that full repertoire song indicates male quality. However, there has been little research devoted to understanding the functional significance of the various songs in a song sparrow's repertoire. In this study, we have explored the functional significance of a trilled syllable type shown to have a quantifiable performance level due to a clear physiological performance barrier. To assay this, we performed playback experiments with 23 song sparrows on the campus of Western Carolina University in North Carolina. Each individual heard three song types on consecutive days: a trilled song, a non-trilled song, and a foreign song used as a control. Playback consisted of two minutes of song followed by a four minute recovery period. Using average distance to the speaker as a measure of response, we found that the local songs were perceived differently than the foreign songs and that during playback trilled and non trilled songs approached significance. This spring, we conducted an experiment to further explore the relationship between trilled and non trilled song sparrow songs. We used six minutes of playback, which included a song-type change (maintaining trilled and non trilled status) with no recovery period. If we are able to determine the functional significance of song sparrow songs within repertoires, our research will enable us to ask more nuanced questions about the evolution of bird song as a complex signal.

Surveying Waterbirds with Unmanned Aircraft Systems (UAS): Case Studies from California and Nevada
Dulava, Sharon - Humboldt State University; William Bean - Humboldt State University; **Orien Richmond** - U.S. Fish and Wildlife Service

Unmanned aircraft systems (UAS) offer an efficient and repeatable means of surveying wildlife, especially waterbirds. In a series of case studies from California and Nevada, we examined the effect of image resolution (a product of UAS flight altitude and camera focal length) on an analyst's ability to identify waterbirds to species or species group and examined the effect of UAS flight altitude on bird flushing behavior. We found that a minimum pixel resolution of approximately 5mm was needed be able to identify most duck-sized waterbirds from imagery. Sensors needed to be carefully calibrated in order to obtain images of sufficient quality to identify waterbirds over open water. Our results suggest that gas-powered UAS may result in increased rates of flushing at low flight altitudes (< 90ft) for some waterbirds. After confirming that imagery collected with UAS can be used to identify waterbirds to species, we compared ground counts of an American white pelican colony to automated counts from UAS imagery and developed a nearest-

neighbor method for estimating the number of active pelican nests using multi-temporal imagery. Ground counts underestimated colony size by about 30% compared to counts from UAS imagery. With careful design of surveys and processing workflow, UAS show great promise for monitoring waterbirds and potentially for providing estimates of reproductive success.

Long-term quantification of the strength of sexual and natural selection on complex cooperative behavior in the lance-tailed manakin

DuVal, Emily - Florida State University; Brett Sandercock - Kansas State University

Flashy lekking species are used as models for explaining sexual selection, but the long lives and extended reproductive strategies of Neotropical birds make it difficult to accurately quantify the strength of selection on individual behavior. Extensive overlap of generations generates important heterogeneity in adults' age and experience. Here we leverage detailed information on individual behavior, survival, and genetic reproductive success across 17 years to understand the lifetime fitness consequences of complex cooperative behavior in the lance-tailed manakin (*Chiroxiphia lanceolata*). In this species, subordinate beta males serve as non-breeding helpers for up to six years, and gain no immediate direct or indirect benefits while betas. Instead, long-delayed direct benefits seem to select for cooperation in this system. Interestingly, nearly half of males are never betas before becoming alpha, and prior beta experience does not affect siring success once males reach alpha status. We separately quantify the influences of survival, status transitions, and reproductive success on subordinates' cooperative behavior. These forces combine to create disruptive selection on pre-breeding cooperation, and allow assessment of the relative influence of components of natural selection (status-specific estimates of survival) and sexual selection (acquisition of a breeding territory and success in attracting mates) in generating the complex fitness surface of cooperation in this system.

Common Currencies in Ecology, Space and Time of Continental Landbirds in Decline

Easton, Wendy - Environment Canada and Climate Change, Canadian Wildilfe Service

Partners in Flight scores continental and regional factors of distribution, threat, population size and trend across the full life cycle of bird species to assess their vulnerability and pinpoint potential unifying factors driving changes in population size and range. Currently, more than one-third of the over 450 species of landbirds in the U.S. and Canada have declined by over 15% since 1970 and over 40 have lost half of their population. Many of these are common species. We compare the unifying factors in the ecological needs, geography, and season of both at risk Watch List landbirds with more common species and demonstrate how continental trends of more abundant birds can act as an early warning system to widespread changes in environmental health across the landscape. In regions and habitats like grasslands, where specialists have been declining over the past decade, more common species are declining now indicating that our current conservation work is inadequate. Some habitats like forests are showing opposite trends where more common, flexible species are increasing, but species with more specialized needs are not. Finally, almost two-thirds of our landbirds are migratory. We present examples of where breeding geographies overlap with the non-breeding areas of at risk or declining birds and show how geographies are seasonally limited throughout some western landscapes.

Predator (*Corvus brachyrhynchos*) Electrical Shock Aversion System for Endangered California Least Terns (*Sternula antillarum* browni)

Eberts, Erich - Loyola Marymount University; Peter Auger - Loyola Marymount University; Eric Strauss - Loyola Marymount University

Anthropogenic factors often affect the ecology, behavior, and dispersion of various species in urban ecosystems. In Los Angeles, California, beach grooming has eliminated nearly all of the suitable nesting area for the endangered Southern California least tern *Sternula antillarum* browni. When terns return each summer to reproduce, they are restricted to the same few protected areas. This facilitates american crows *Corvus brachyrhynchos* to easily prey upon eggs and nestlings, as is the case at the Venice beach enclosure where there has been virtually no reproductive output for the last decade. Because traditional management strategies have failed, in 2014 we designed and installed egg shocking systems to condition crows to stop preying upon tern eggs. Motion-activated video cameras were used to record crow shocking events. During the first three years of the study 103 crows have been color banded. After initiation of egg shocking in 2014 79 chicks fledged which was the largest fledging group since 2008. No terns fledged during 2015 but we feel this was attributed to local people feeding crows peanuts adjacent to the site. Due to extensive peanut caching in the ungroomed nesting site crows were observed persistently searching the nesting site which neutralized the negative conditioning of the shocking system. However, this issue has been remediated through discussion with local residents and the shocking system design has been substantially improved and expanded in an effort to reestablish 2014 reproductive output.

Testing models of energetic cost and tradeoffs associated with malaria infection in Dark-eyed Juncos

Eddy, Doug - University of Wyoming; Maria Stager - University of Montana; Zachary Cheviron - University of Montana; Matt Carling - University of Wyoming

In passerine birds, there are large energetic costs associated with maintaining a high internal body temperature. Similarly, mounting an immune response is energetically costly. Here, we test metabolic cost hypotheses using avian malaria-infected Dark-eyed Juncos (*Junco hyemalis*) against non-infected individuals to assess the tradeoffs associated with aerobic performance and immune response. We captured juncos in northwestern Wyoming and diagnosed their infection state. Each bird was measured with flow-through respirometry to measure metabolic output (resting metabolic rate [RMR]; and cold-induced summit metabolic rate [SMR]). We also measured two blood parameters, hematocrit and hemoglobin concentration. Birds infected with hematazoa had elevated SMR ($t = -2.7165$, $p=0.02$). There were significant differences in both hemoglobin and hematocrit between the elevational treatments, with low elevation birds (7000 ft. asl) having significantly higher values for both hematocrit.t ($t=3.3994$, $p=0.004$) and hemoglobin concentration ($t=2.3133$, $p=0.03$) than high elevation birds (8600 ft. asl). We are testing two alternate hypotheses: the additive cost hypothesis, and the negative-relation hypothesis. The additive cost hypothesis posits that the costs of mounting an immune response and those of thermogenesis are additive. This model predicts an increase in RMR, SMR, and immune stress. The negative-relation hypothesis predicts increased RMR in infected individuals but also predicts an inability to increase SMR beyond what an uninfected individual could achieve. By testing these hypotheses, our study investigates the still murky relationship

between the costs of aerobic performance and immune response in passerines.

Evaluation of acute phase protein changes and blood loss values as indicators of parasite related effects in nestling European Starlings

Efstathion, Caroline - University of Florida; **William Kern** - University of Florida; Carolyn Cray - University of Miami; Tim Broschat - University of Florida

Hematophagous arthropods are known to negatively impact nestling birds, causing decreases in health parameters, nestling survival, and fledging success. Reducing parasite loads could increase the health and fledging rate of nestlings birds. The objective of this study was to use an insecticide to reduce loads of the blood-sucking mite, *Ornithonyssus bursa*, on nestling European Starlings. Two forms of permethrin, a dust and a microencapsulated spray, were evaluated for their effectivness at reducing mite loads within the nest. At day 15, a blood sample was taken from each nestling to determine their hematocrit and immature red blood cell level. In order to evaluate nestlings' inflammatory response and stress level induced by feeding mites, we additionally measured their acute phase proteins and corticosterone level. Each nestling was ranked for mite load when the blood sample was taken. Nestlings with high mite loads had the highest mortality. Immature red blood cells were negatively correlated with hematocrit. Acute phase protiens albumin and alpha 1 values decreased as mite load increased and pre-albumin and beta values increased as mite load increased. Corticosterone levels did not correlate with mite load or treatment. Overall, high mite loads caused significant mortality in nestlings and immature red blood cells were more sensitive to parasite induced blood loss than hematocrit. Evaluation of acute phase protein changes can help assess a nestling's inflammatory response to feeding parasites. Therefore, this should be included, in addition to blood loos parameters, in order to better elucidate the impact of parasites on birds.

Wintering American Crows Produce "Hot Moments" of Nitrogen in the Urban Ecosystem

Eisenkop, Ben - Binghamton University; Weixing Zhu - Binghamton University; **Anne Clark** - Binghamton University

Migration and overwintering habits of birds are well studied, but seldom for their ecosystem level effects. This study focuses on the unique interplay between the winter roosting behavior of American Crows (*Corvus brachyrhynchos*), nitrogen (N) inputs from crow feces, and patterns of nitrogen (N) biogeochemistry in urban ecosystems. American Crows in Canada move south, joining non-migrating crows in mid-latitudes to forage and roost at night, Since the 1970's, winter roosts, sometimes exceeding 100K crows, are increasingly urban. Thus crows defecating in high density roosts in urban forest patches may create "hot spots" of pulsed ("hot moments") N, alter the pattern of N cycling, and affect N losses via denitrification and leaching. From Dec 2014 to present, we radio-tracked marked crows to monitor roost site use, and combined soil sampling and gas chromatography to measure amount and chemical transformation of roost-associated N in central New York State. We studied eight non-roost sites and three roosts: a large roost (>40,000 crows) in Auburn, NY and two smaller ones in Ithaca (4000 crows) and Cortland, NY (up to 8500 crows). Crow feces contributed N up to 400 times that falling on non-roost sites in winter. By summer, pools of soil NH_4-N were converted by nitrifying bacteria to NO_3-N, but roost sites still had more nitrogen. NO_3-N then decreased, being released as N_2 and N_2O, the latter a strong greenhouse gas.

Corticosterone treatment influences nestling behavior and sibling competition in Florida scrub-jays

Elderbrock, Emily - University of Memphis; Thomas Small - Archbold Biological Station; Stephan Schoech - University of Memphis

Altricial young are dependent on adults for food and protection as they develop. During this period, nestlings display nutritional need by begging to elicit feeding from parents. Begging at high levels can be energetically expensive and attract predators; thus, an individual must balance its nutritional needs with these potential costs. Further, a parent is often limited in the amount of food it can provide to its offspring, thus creating potential parent-offspring and sibling-sibling competition. Many factors may contribute to begging behavior, and corticosterone (CORT), a metabolic hormone, is hypothesized to play a role in regulating a nestling's behavior. We investigated the hypothesis that increased exposure to CORT influences nestling behavior in an altricial bird, the Florida scrub-jay (*Aphelocoma coerulescens*). During nestling development, we treated one nestling per treatment nest with a twice-daily dose of exogenous CORT via an injected wax-worm. A second individual within the treatment nest received an oil-injected wax-worm. Additional non-manipulated jay nests were monitored to serve as controls. We monitored individual nestling and parental behavior at all nests with the use of high-definition video cameras pre-, during, and post-treatment. There was no difference in begging rate between CORT fed and vehicle fed nestlings within a treatment nest. However, all nestlings within the nests containing a CORT-treated individual begged more than those in control nests, regardless of individual treatment. This result, repeatable across multiple years, suggests that CORT treatment of an individual alters its behavior, as well as that of its siblings' behavior.

A five-year crowdsourced census of nestling provisioning via livestreaming cameras at a wild Red-tailed Hawk nest: new insights on annual prey variation and parental investment.

Eldermire, Charles - Cornell Lab of Ornithology

Most studies of nestling provisioning in wild species give only a partial glimpse into the diversity of prey and the investment of each adult throughout the process because it is difficult to accurately record what is brought to the nest and to sample this unpredictable event comprehensively. We overcame these limitations by using 24/7 livestreaming cameras placed near a wild Red-tailed Hawk nest in Ithaca, NY, from 2012-2016 and crowdsourcing the prey deliveries. Each year this nest fledged three young from the same two adults while nesting in the same area. Over 1100 items were brought to the nest across those five years and catalogued by volunteer observers via cloud-based spreadsheets. The total mass of prey brought to the nest was remarkably consistent across years, despite the differences in prey species and climate variation. On average, the male hawk brought nearly five times the mass of prey brought by the female during the time between first hatch and first fledge, favored smaller items, and caught the highest diversity of prey. Prey diversity varied substantially across years, with a variety of small mammals accounting for 50-75% of prey items and small birds the remaining amount. The variation in diet did not seem to affect fledging dates, which were consistently between 43-48 days post-hatch. We will discuss the implications and challenges of using fine-scale data to enrich the understanding of sample-based natural history as well as the use of livestreaming cameras and volunteer communities for gathering such data.

American Woodcock (*Scolopax minor*) Movement Ecology and Habitat Selection in Louisiana, USA

Elizondo, Elisa - Louisiana State University; Bret Collier - Louisiana State University

American Woodcock (*Scolopax minor*) have shown declines across the species range. Reduction in the availability of early successional habitats within both breeding and wintering ranges is considered the primary driver of population declines. Over the last 50 years, considerable effort has focused on evaluating selection and use of different habitat types. Within this vein, we conducted research in Louisiana to assess survival, movement ecology, and habitat selection and use of wintering woodcock between November 2015 and February 2016. As woodcock are known to select specific habitats based on time of day, we utilized backpack style GPS transmitters programmed to record time-specific spatial data during both diurnal and nocturnal periods. We recovered data on 9 woodcock and generated Minimum Convex Polygons (MCPs) for each period (43 diurnal, 49 nocturnal) to estimate day-specific ranges, which we then sampled to identify and evaluate vegetation structure. We found that American Woodcock regularly utilized mixed pine within 1.5 km of nightly foraging habitat. Mean area MCP size was 0.110 ha for diurnal habitats and 0.239 ha for nocturnal habitats. Mean distance between diurnal and nocturnal habitats was 1.03 km, and fidelity to particular diurnal habitats was 33%. Use of GPS telemetry allowed for an undisturbed evaluation of fine scale woodcock movement and habitat selection, which will lead to better informed management decisions.

Evaluating the Grasshopper Sparrow as an indicator species for upland prairie birds

Elliott, Lisa - University of Minnesota; Douglas Johnson - USGS Northern Prairie Wildlife Research Center

The Grasshopper Sparrow (*Ammodramus savannarum*) has been identified as a potential indicator species within tallgrass prairie habitat by state and federal agencies due to its status as a species of conservation concern and obligate use of increasingly rare dry upland prairie. To examine the suitability of this species and other grassland birds as indicators for upland prairie bird populations, we conducted bird surveys on 71 grassland habitat patches in southwestern Minnesota in 2013 and 2014. The species of interest included five upland-associated prairie birds in addition to Grasshopper Sparrow: Savannah Sparrow (*Passerculus sandwichensis*), Henslow's Sparrow (*Ammodramus henslowii*), Dickcissel (*Spiza americana*), Bobolink (Dolichonyx oryzivorus), and Western Meadowlark (Sturnella neglecta), as well as one mesic-associated prairie species (Sedge Wren; *Cistothorus platensis*) and one generalist species (Brown-headed Cowbird; *Molothrus ater*). We used correlation coefficients to measure linear association of density between species and compared overall grassland bird density and individual species' densities between grassland sites with and without Grasshopper Sparrows. Of the individual species, Grasshopper Sparrow density significantly predicted the greatest number of upland grassland species' densities. Overall grassland bird density and density of the five upland-associated species were significantly higher at sites with Grasshopper Sparrows, whereas Sedge Wren density was significantly lower and Brown-headed Cowbird densities did not differ. Our results suggest that the Grasshopper Sparrow is a potential indicator species for upland prairie birds within this region.

Temporal variation in avian haemosporidian parasite prevalence in relation to host breadth

Ellis, Vincenzo - Federal University of Minas Gerais; Robert Ricklefs - University of Missouri - St. Louis

The host breadth of a parasite species is the number or diversity of its host species. Some parasites (specialists) infect primarily a single host species, while others (generalists) infect a broad range of host species. Temporal variation in the availability of naïve host individuals of a particular species may lead to more dramatic fluctuations in the population sizes of specialist relative to generalist parasites, because specialists may not be able to compensate by infecting individuals of other host species. We surveyed an assemblage of forest and second-growth birds and their haemosporidian blood parasites (*Plasmodium spp.* and *Haemoproteus spp*.) over a 12- year period in the Ozark Mountains of southern Missouri, and we investigated temporal variation in parasite prevalence (proportion of infected hosts) in relation to parasite host breadth. Using molecular methods, we identified 11 common parasite lineages, four of which specialized on two common hosts (*Vireo olivaceus* and *Icteria virens*) and seven of which were found infecting a variety of host species. Seven of the parasite lineages (4 specialists and 3 generalists) exhibited significant variation from year-to- year. The standard deviation of prevalence across years (a measure of temporal variability in local parasite population size) was higher among specialist parasite lineages than among generalists, as we predicted. This increased temporal variation in prevalence may represent an evolutionary cost to specialization since transmission and parasite genetic diversity may decrease when prevalence is low.

Can Hummingbirds Increase Compensatory Nectar Consumption during Extreme Energetic Demand?

Elting, Rosalee - George Fox University; Donald Powers - George Fox University

Hummingbirds might be limited in their ability to increase nectar consumption because most water consumed is absorbed and processed through their kidneys, which could restrict feeding rate. Such a restriction could limit energy intake during periods of extreme energetic demand. We measured maximum feeding rate in four hummingbird species by sequentially feeding them nectars with decreasing sucrose concentration (10-2%). Feeding rate in broad-billed(3.2g) and magnificent (7.5g) hummingbirds peaked at 4% (0.55 and 0.53 gsg-1h-1, respectively) whereas black-chinned (3.0g) and blue-throated hummingbirds (8.0g) peaked at 6% (0.77 and 0.55 gsg-1h-1, respectively). Maximum water consumption occurred at 4% for broad-bills and magnificents (0.53 and 0.51 mLg-1h-1, respectively), and at 6% for black-chins and blue-throats (0.72 and 0.51 mLg-1h-1, respectively). Maximum energy consumption occurred at 8% for all species (0.50-0.79 kJg-1h-1). Differences in water and energy consumption were not related to body mass. All species except black-chins maintained mass throughout the experiment, which could indicate higher energy demand, lower assimilation efficiency, or lower intestinal water absorption in this species. Our data suggest all four species have capacity to upregulate compensatory feeding under current conditions. Even so, anticipated temperature increase due to climate change could create conditions where maximum foraging rate becomes limiting. Integrating obtained maximum feeding rate into predictive models could improve our ability to anticipate climate change impact on energy availability and sequential distribution shifts.

Achieving Conservation through the AZA-Saving Animals From Extinction Program

Elvin, Sandra - Association of Zoos and Aquariums; Debborah Luke - Association of Zoos and Aquariums

Zoos and aquariums accredited by the Association of Zoos and Aquariums (AZA) play vitally important roles in animal conservation, including actions that focus on public education and engagement, scientific research, animal intro- and reintroductions, and in-situ field conservation. Each year, AZA members contribute over $155 million directly to field conservation efforts. However, despite these efforts, as well as those of numerous other conservation organizations, the extinction crisis continues and a new approach to animal conservation is needed. AZA SAFE: Saving Animals From Extinction is a new initiative that combines the power of zoo and aquarium visitors with the resources and collective expertise of AZA members and partners to save animals from extinction. 10 Signature SAFE Species were initially identified including two avian species: the African penguin and the whooping crane. SAFE uses a collaborative process to prioritize conservation needs by incorporating the wide-ranging expertise of AZA members in wild animal management, care, research and conservation, education, outreach and public engagement to leverage the power of our 180 million annual visitors in actions that will recognize and advance the impacts of conservation efforts. Species-specific SAFE Conservation Action Plans (CAPs) are developed and implemented through this collaborative process. Each 3-year CAP includes specific conservation projects that have detailed goals, actions, timelines, and budgets. This presentation will provide an overview of SAFE and the progress made to date with the two avian species.

Structural mechanisms of plumage ornament production between sexes and across sister species of tropical passerine birds

Enbody, Erik - Tulane University; Samantha Lantz - Tulane University; Jordan Karubian - Tulane University

Visual ornaments have evolved in a wide range of taxa to convey information about quality and condition. Ornamentation can be found in both sexes in birds, and comparative work shows that sexual dichromatism can arise due changes to in both males and females colors. However, many questions remain about the underlying mechanisms of ornament evolution and how these may act to promote or constrain evolutionary pattern and tempo. We contrast the anatomical basis for variation in a plumage-based signal in three lineages of *Malurus* fairywrens (family Maluridae), including both a genetically fixed and flexible variation in plumage traits. We focus on melanin-based color in two subspecies of *Malurus alboscapulatus* (White-shouldered Fairywren) and *Malurus melanocephalus* (Red-backed Fairywren) that exhibit considerable variation in the degree of sexual dimorphism. We explore the nanostructure basis for two extreme subspecies of White-shouldered Fairywren with low and high degree of dichromatism and compare them to dichromatic sister species, the Red-backed Fairywren. We assess the over-arching hypothesis that similar phenotypes obtain similar color production through parallel nanostructure mechanisms, regardless of sex, species, or whether the trait is genetically fixed or plastic. We demonstrate that a transition to ornamentation in females has occurred following a similar, but incomplete, structural pathway to males. We also demonstrate that temporally variable male ornaments are produced in a structurally more complex transition. These results are consistent with research that suggests male and female fairywrens face differing selective pressures,

which are reflected in the structural development of the ornament.

Of moths and moon: interannual variation in vital rates a nocturnal aerial insectivore
English, Philina - Simon Fraser University; Joe Nocera - Ontario Ministry of Natural Resources & Forestry; David Green - Simon Fraser University

The foraging style and long annual migrations of aerially insectivorous birds may make them particularly sensitive to changes in seasonal phenology and weather extremes. Nocturnal aerial insectivores, like the whip-poor-will *Antrostomus vociferous*, face the additional challenge of only foraging during twilight periods, or when adequate moonlight is available. We assessed daily nest survival and annual productivity in relation to weather, seasonal changes in the abundance of night-flying insects, and moon phase. Nest survival through incubation was 40% across all years. Nestling survival to 15 days of age dropped from 91% in 2011 to 42% in 2012 and rose moderately to 67% in 2013. Daily nestling survival was lowest in the middle of the breeding season, and higher on rainy days or when moth abundance was high. Moonlight was only retained in a top model when combined with moth abundance. Minimum adult male annual survival was 63% (46% in 2012 and 89% in 2013). When compared between years, we find hatch dates track earlier peak insect abundance in 2012, but food availability averaged much lower and was largely asynchronous with periods of peak moonlight. These factors may explain the lower nest survival rates, but were partially overcome by more nesting attempts (fledglings/pair: 1.56 in 2011, 1.22 in 2012).When combined with a lifespan exceeding 15yrs, our data suggest that while there is the potential for phenological changes to interact with both weather and moonlight to influence productivity, long-term population viability may be more threatened by factors influencing adult survival.

Blood parasites and body fat reveal subtle effects of anthropogenic disturbance on an early successional species
Enslow, Chelsea - University of Manitoba; Rachel Vallender - Canadian Wildlife Service, Environment and Climate Change Canada; Nicola Koper - Natural Resources Institute, University of Manitoba

Golden-winged warblers (*Vermivora chrysoptera*) are a threatened, disturbance-dependent species, and will use edges of old anthropogenic disturbances such as pit mines and pasture as breeding habitat. Usable habitat is not necessarily optimal, however, and it is unclear if using this anthropogenically disturbed habitat impacts the health of golden-winged warblers. We investigated this by comparing two metrics of bird health, body condition and blood parasite infections, to land cover in Manitoba. We took blood samples and body metrics from 75 golden-winged warblers across Manitoba, and screened blood samples for presence of parasites. We compared body fat and parasite presence to land cover characteristics around each bird. Golden-winged warblers that were surrounded by large amounts of rangeland had significantly less body fat, and significantly more infections of the parasite genus Haemoproteus. Rangeland was positively correlated with average topographic wetness, which supports the hypothesis that cattle grazing creates suitable habitat for the Haemoproteus vector, Culicoides. Interestingly, the trend for lower body fat was not driven by parasite infection, suggesting that rangeland may have several distinct effects on this bird species. Additionally, birds that were surrounded by high surface areas of road had significantly lower fat scores. Rangeland and roads may reduce bird body fat by reducing the quality of food available, affecting feeding behaviour, or increasing other stressors. Overall, these findings suggest that some anthropogenic disturbance may reduce habitat quality for golden-winged warblers.

Spatio-temporal variation in mechanisms driving regional-scale population dynamics of a model grassland bird: Bobolink (*Dolichonyx oryzivorous*)
Ethier, Danielle - University of Guelph; Nicola Koper - Natural Resources Institute, University of Manitoba; Thomas Nudds - University of Guelph

Correlative relationships between changing farming practices and grassland bird population trends are often used to inform landscape-level conservation approaches. However, incorrect inferences about threats to population persistence could occur if (1) aggregating data at these scales homogenizes regional variability in trend estimates, or (2) there is temporal variability in spatial correlations with environmental predictors. Thus, knowledge of the mechanisms that drive spatio-temporal patterns in avian population dynamics are needed to inform scale-variant policy development. Using a spatially explicit hierarchical Bayesian model, we estimate Bobolink (*Dolichonyx oryzivorous*) population trends to geographic areas amenable to conservation planning (i.e., agricultural census regions, n=35) in Ontario, Canada. We then determined whether, and by which mechanism(s), changes in habitat quantity and quality contributed to regional declines over the entire study period (1986-2011) and over five sub-periods. Over the entire study period, only one region displayed strong evidence of population decline, and four regions displayed strong evidence for population increases (95% credibility intervals did not overlap zero). Important predictors of spatial patterns in trends over the entire study period were human population growth and fragmentation. By sub-period, the predictors shifted temporally, and included habitat amount and latitude. Results demonstrate that analyses performed at broad geographic extents and over long time spans have the potential to homogenize both regional population trend estimates and temporal spatial correlations. Our modeling framework therefore provides a means to account for non-linearity or non-stationarity of spatial correlations, and provides additional insight into the processes that drive regional patterns in avian population dynamics.

Changing hábitat for non-breeding shorebirds along the Pacific coast of the Americas: a GIS approach
Eusse-Gonzalez, Diana - Asociacion Calidris; Matthew Reiter - Point Blue Conservation Science; **Richard Johnston** - Asociacion Calidris; Eduardo Palacios - Centro de Investigación Científica y de Educación Superior de Ensenada; Marcela Cuervo - Universidad del Valle-Asociación Calidris; Monica Garcia - Universidad del Valle-Asociación Calidris; Yeslith Hurtado - Universidad del Valle-Asociación Calidris; Jessica Velasco - Universidad del Valle-Asociación Calidris

Habitat loss in non-breeding areas is one of the hypothesized causes of declines in shorebird populations. Despite its importance for guiding conservation strategies its impact on shorebirds in the Western Hemisphere has not been well quantified. We present the first assessment of habitat loss and its overlap with shorebirds concentration areas for the Pacific Coast of the Americas. We developed a coastal ecosystems map from Mexico to Chile by adjusting national ecosystem map to a standard classification. To confirm and update this, we compared with current satellite images (2010-2015). We conducted the same analysis with satellite images from 1980-1985 to develop a habitat map for that time period. We then calculated the area and location of changes in ecosystem polygons between these two time periods. On this map of estimated hábitat change, we overlayed the predicted distribution of eight species of shorebirds. These models were constructed by combining physical and biotic variables with abundance records to identify concentration areas for each species. Model-predicted shorebird concentration areas were

corroborated with field data. We estimated declines in intertidal mudflat of up to 13% and declines in mangrove áreas. Some of the main concentration areas of shorebird species overlapped with habitats with high rate of change. Our analysis identifies areas where habitat restoration and prevention of future losses is required and highlights the importance of exploring the link between habitat loss and declines of shorebirds in the Western Hemisphere.

Three-dimensional free-flight kinematics and network analyses of massed Chimney Swifts entering a chimney roost at dusk
Evangelista, Dennis - United States Naval Academy; Dylan Ray - University of North Carolina at Chapel Hill; Satish Raja - University of North Carolina at Chapel Hill; Tyson Hedrick - University of North Carolina at Chapel Hill

Chimney Swifts (*Chaetura pelagica*) are highly maneuverable social birds notable for roosting overnight in chimneys in groups of hundreds or thousands of birds. At dusk in late summer, birds gather in large numbers from surrounding areas near a few suitable roost sites. They then enter a single, small-aperture chimney within a very short time, with the whole flock employing an orderly, but dynamic, circling pattern, even as winds shift and light levels decrease. Such repeatable, reliable behavior in a convenient urban area with fixed landmarks provides an excellent opportunity to use multi-camera videography to measure three-dimensional kinematics of natural flight behavior, in the field and under challenging lighting conditions. We present results from automatic tracking of every bird in the flock and discuss metrics for analyzing the tracks and modeling components of the behaviors as well as examining changes in the flock over a season and within a single evening.

Dispersal in the urban matrix: Assessing the influence of landscape connectivity on the settlement patterns of breeding songbirds
Evans, Brian - Smithsonian Migratory Bird Center; A. Marm Kilpatrick - University of California at Santa Cruz; Peter Marra - Smithsonian Migratory Bird Center

The ability of organisms to disperse across urbanized landscapes, a process critical for the persistence of populations, is predicted to be constrained by habitat fragmentation. Previous research has shown that the distribution of forest patches is a determinant of dispersal patterns among forest-obligate bird species. However, the effects of landscape connectivity on the dispersal of species that occupy the human-dominated matrix has yet to be examined. Here, we use capture-recapture data of birds banded over a 10 year period to assess the dispersal of four species of songbirds in the Washington, D.C. area. To assess patterns of settlement, birds banded in previous seasons were sampled at 48 locations within a 1.5 km radius of each of six banding stations. We used habitat suitability models developed from point count data to construct connectivity surfaces representing potential travels costs associated with moving between banding and sampling locations. To evaluate the influence of landscape connectivity on resight locations, we compared models in which the spatial distribution of marked individuals is a function of connectivity with null models in which settlement patterns are not influenced by intervening land cover. There was considerable model support that habitat connectivity influenced settlement patterns for two of the four focal species, the Northern Cardinal (*Cardinalis cardinalis*) and Gray Catbird (*Dumetella carolinensis*). Our study provides a unique look at the influence of landscape connectivity on bird dispersal in urban environments and expands our understanding of the role of the anthropogenic land use matrix on bird populations.

The Rusty Blackbird Blitz: Using six years of citizen science data to predict the wintering and stopover habitat for a formerly common species

Evans, Brian - Smithsonian Migratory Bird Center; Luke Powell - Smithsonian Migratory Bird Center

Once common, the Rusty Blackbird (*Euphagus carolinus*; RUBL) has experienced a 90 percent decline since 1960—one of the steepest declines of any monitored bird. Habitat loss has been implicated as a key contributor to the decline, however our ability to assess the effects of habitat change on RUBL is limited by uncertainties in the distribution of non-breeding RUBL populations. To address this, the RUBL Working Group and eBird established two citizen science efforts: Winter Hotspot Blitz (2009-2011) and the Spring Migration Blitz (2013-2016). Using these data in conjunction with 15 bioclimatic variables, we developed habitat suitability models to assess the variation in RUBL distributions by flock size and within environmental space. Average minimum temperatures were most predictive of Rusty Blackbird presence across flock sizes (mean = 1ºC). The probability of observing RUBL increased with the proportional composition of floodplain forest and declined with the proportion of shrub and upland forest habitats. Large and small flocks of RUBL occupied different portions of environmental niche space, with floodplain forest increasingly critical as flock size increased. Moreover, the model predicted less suitable habitat for the largest flocks, suggesting large RUBL flocks occupy a narrower niche space relative to small flocks. This project has aided our understanding of the distribution of RUBL populations, allowing us target suitable habitats and critical RUBL hotspots where research and conservation efforts might be most effective.

The influence of individual characteristics on group dynamics in wild black-capped chickadees

Evans, Julian - University of Ottawa; Teri Jones - University of Ottawa; Julie Morand-Ferron - University of Ottawa

The use of social network analysis techniques has offered enormous insight into the group dynamics of animal populations. Understanding the structure of these groups has become increasingly important, as an individual's position within a network can affect many aspects of their behaviour and life-history, and how they influence the behaviour of others. While many studies of social processes now utilise network statistics, few also consider the effect that individual traits such as personality or dominance hierarchies might have on group structure. We examined social networks of wild black-capped chickadees (*Poecile atricapillus*), which form stable non-kin flocks with linear dominance hierarchies during non-breeding seasons. By equipping individuals with passive integrated transponders (PIT) we were able to generate replicated networks for each of 8 study sites using feeding stations equipped with radio-frequency identification (RFID) antenna to determine associations. Using these networks and datasets of dominance and exploratory tendencies, we investigated the effect of an individual's traits on their network positions and how this influences information transfer throughout the network. Network size and individuals' positions in a network was found to be repeatable during the study period, suggesting consistent individual differences in sociability within a group. Interactions between personality types and dominance level were found to significantly affect an individual's position within a network and an individual's dominance affected how they utilised information about novel feeding locations. Our results provide improved insight into how personality and social dominance interact to influence social

behaviour and information use in social species.

Developing a Global Mercury Monitoring Plan for Birds: Contributions to the Minamata Convention on Mercury
Evers, David - Biodiversity Research Institute

On 10 October, 2013, the Minimata Convention on Mercury was signed by 128 countries as a legally binding international agreement designed to specifically address global mercury pollution. The objective of the Convention is “to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.” The evaluation of the effectiveness of the Convention will partly depend on the use of mercury monitoring data for biota, including birds. As part of this need, the United Nations Environment Programme’s Global Mercury Partnership (UNEP-GMP) has been tasked with developing metrics for countries to use in order to meet the stipulations of the Minimata Convention. A descriptive matrix of avian taxa, tissue types, and geographic areas is being created by the UNEP-GMP that is based on criteria such as initial objectives (e.g., spatial vs. temporal trends), interaction with human health (e.g., food species of concern), and conservation priorities (e.g., IUCN listed species of concern). Because of the documented adverse effects of methylmercury availability on many species of avian piscivores and invertivores around the world, there is a parallel concern for identifying species at greatest risk to mercury pollution.

Long-term dynamics of a Puerto Rican bird community
Faaborg, John - University of Missouri; **Judith Toms** - Canadian Wildlife Service; Wayne Arendt - USDA Forest Service

We have been monitoring bird populations in the Guanica Biosphere Reserve, southwest Puerto Rico, since January 1972. Monitoring uses constant effort mist netting; a single line of 16 nets was operated annually from 1973 to the present, except in 1977 and 1979. We added six new lines in 1989, for a total of 7 lines, then added an 8th in 1990 and a 9th in 1991. During the period 1973 through 2000, captures were variable but generally high, ranging from 75 to 140 captures per net line per year. Winter resident captures peaked in 2001 at over 19 birds per line, dropped to 10 per line in 2002, and have declined subsequently to as few as 3.8 birds per line and no more than 8 per line. Except for one exceptional year, resident birds have also shown consistent declines in this century, declining to as few as 30 birds per net line. Rainfall patterns have become more erratic, diverging from historical patterns, but have shown no consistent changes over time. Here, we attempt to explain these declines by determining whether survival and recruitment rates have changed in recent years or depend on the amount of rainfall. However, additional factors underlie the changes seen, because most species (12 of 16) showed changes in survival rates over time that were not due to changes in the amount of rainfall, and three species exhibited changes in recruitment rates over time that were not due to changes in the amount of rainfall.

California Condor Microbiome
Fair, Jeanne - Los Alamos National Laboratory; Benjamin McMahon - Los Alamos National Laboratory; Jonathan Longmire - Los Alamos National Laboratory; Momchilo Vuyisich - Los Alamos National Laboratory; Marti Jenkins - Peregrine Fund; Rick Watson - Peregrine Fune

We present data evaluating the suitability of genomic sequencing of California condor microbiomes from cloacal swabs and fecal samples for use as indicators of both condor and ecosystem health. We present analysis of the gut microbiome of captive California condors (*Gymnogyps californianus*), to establish the value of a whole new class of

information-rich signatures of terrestrial ecosystem health. As a first step in developing signatures of condor and ecosystem health, we characterize seventeen microbiomes of thirteen captive California condors by shotgun metagenomic sequencing. Ten fecal samples and twenty cloacal swabs were successfully sequenced. The birds lived in captivity, and ate a controlled diet. We identified eleven species of bacteria from these samples; all previously associated with gut microbiomes, with some closely related to human pathogens, some being probiotics, and some associated with toxic and acidic environments. An environmental organism, *Delftia acidovorans*, was the dominant organism identified in most of the adult cloacal samples. We also evaluated the functional complement of genes with SEED rollup categories to characterize the ecological niches occupied by the bacteria, the 963 SEED subsystems to identify specific responses in metabolism, virulence, and resistance to chemicals, and Pfam to identify specific genes over-represented in genomic DNA or expressed as mRNA. The Sequedex software package enables rapid analysis of data sets to in a few hours on a laptop computer. This work opens the possibility of using microbiome profiles and disease surveillance of other sentinel species to provide urgently needed specific, leading, signatures of ecosystem health.

Making Connections: Birds, Farms, and People
Fallon, Katie - Avian Conservation Center of Appalachia

John Muir famously wrote, “When we try to pick out anything by itself, we find it hitched to everything else in the universe.” The relationships among birds, farms, and people are an excellent illustration of this. The health of our birds is linked not just to ecosystem health but also to psychological wellbeing. We know birds are important for many practical reasons; they distribute seeds, pollinate, control insects, control rodents, and scavenge. Birds are important for inspirational and psychological reasons, as well; birding and bird watching help build community, provide an opportunity for mentorship, engage people in healthy outdoor activities, and are cross-generational. Birds are a direct link between people of diverse cultures, sometimes continents away from each other. A Baltimore Oriole foraging in a Bird Friendly coffee farm in Nicaragua, for example, may find its way to an organic dairy farm in Minnesota; the oriole benefits from habitat found on healthy farms at both ends of its migratory journey, the farmers benefit from the bird’s contributions to the ecosystems, and communities inspired by the bird flourish. These connections can be protected through consumer choices that support healthy, sustainable, bird friendly agriculture throughout the Americas.

Passage of migrating landbirds through the gulf coast region: traffic rate, direction, speed, and altitude of flight.
Farnsworth, Andrew - Cornell Lab of Ornithology; Benjamin Van Doren - Cornell University; Garrett Bernstein - College of Information and Computer Sciences University of Massachusetts Amherst; Kevin Winner - College of Information and Computer Sciences University of Massachusetts Amherst; Wesley Hochachka - Cornell University; Jed Irvine - College of Electrical Engineering and Computer Science; Frank La Sorte - Cornell University; Steve Kelling - Cornell Lab of Ornithology

Many of the billions of North American migrant birds transit the Gulf of Mexico. To date no comprehensive description of spatial and temporal patterns of migrants’ movements over the extent of the Gulf Coast across years, information required to predict magnitudes of potential risks to these birds while in flight and on stopover. Of specific interest is variation in densities of migrants, directions and speed of travel and altitudes at which migrants travel: for example, densities can relate to impacts of terrestrial and

airspace habitat changes; flight directions, speeds, and altitudes may define threats of collisions with anthropogenic structures. We characterized spring migration through airspace within 75 km radii of 12 Gulf Coast weather surveillance radar stations between Brownsville, TX and Key West, FL. Descriptions of migration from 1 March to 31 May for 2008-2015 come from analyses of approximately 170,000 hourly scans processed using a combination of automated methods. Highlights of our analyses include the following results. Mean densities were generally highest over the western Gulf Coast, where typical direction of movement was to the north. In contrast, directions of movement from Louisiana to the Florida Panhandle were northerly or northeasterly and northerly and northwesterly in Peninsular Florida. Groundspeeds were generally highest over Texas and lowest over Florida, perhaps explained by speed and direction of prevailing winds in those areas. Flight altitudes were generally highest over Texas and lowest over Florida. Such characterizations, despite a lack of species-specific information, can complement on-the-ground observations characterizing species composition and habitat associations.

Breeding songbird response to Marcellus-Utica shale gas well and infrastructure development

Farwell, Laura - West Virginia University; WV Cooperative Fish and Wildlife Research Unit; Petra Wood - USGS WV Cooperative Fish and Wildlife Research Unit; James Sheehan - West Virginia University; WV Cooperative Fish and Wildlife Research Unit; Gregory George - Delaware Valley University

In the last decade, unconventional drilling for natural gas from the Marcellus-Utica shale has increased exponentially in the central Appalachians, a heavily forested region that contains important breeding habitat for many neotropical migratory songbirds, including several species of conservation concern. We evaluated the effects of unconventional gas development on forest habitat and breeding songbirds at a predominantly forested site from 2008–2015. Construction of gas well pads and infrastructure (e.g., roads, pipelines) contributed to an overall 4.5% loss in forest cover at the site, a 12.4% loss in core forest, and a 51.7% increase in forest edge density. We evaluated the relationship between land-cover metrics and species richness within three avian guilds: forest-interior, early-successional, and synanthropic, in addition to abundances of 21 focal species. Land-cover impacts were evaluated at two spatial extents: a point-level within 100-m and 500-m buffers of each avian survey station, and a landscape-level across the study area (4,326 ha). Although we observed variability in species-specific responses, we found distinct trends in long-term response among the three avian guilds. Forest-interior guild richness declined at all points across the site and at points impacted within 100 m by shale gas but did not change at unimpacted points. Early-successional and synanthropic guild richness increased at all points and at impacted points. Our results suggest that shale gas development has the potential to fragment regional forests and alter avian communities, and that efforts to minimize new development in core forests will reduce negative impacts to forest dependent species.

Achieving a Dynamic Forest Landscape in the Appalachians: bridging science, implementation, and capacity

Fearer, Todd - Appalachian Mountains Joint Venture

While much of the Appalachian landscape is forested, the majority of this forest is homogeneous, mature second growth that lacks the structural diversity to support a full suite of forest-obligate birds and other wildlife species. Active and continued forest management, based on the best available science, is necessary to maintain a healthy, dynamic forested landscape capable of sustaining populations of these species. This

presentation will discuss how partners of the Appalachian Mountains Joint Venture have the capabilities to strategically coordinate and implement this management at a landscape scale that will achieve population level changes in our priority bird species, as well as other taxa. These partners are providing the scientific foundation, field capacity for delivery, and monitoring to inform existing and future conservation projects that target specific priority species, such as Golden-winged and Cerulean warblers. For example, AMJV partners are implementing the first year of the Cerulean Warbler Appalachian Forestland Enhancement Project. Our goals for this 5-year project, funded through the Natural Resources Conservation Service Regional Conservation Partners Program, are to enhance 12,500 acres of privately owned forest and reforest 1,000 acres of legacy surface mines to improve habitat for Cerulean Warblers across five states. These management projects, which individually address various components of forest habitat in strategic areas, are serving as the building blocks for creating a dynamic forest landscape that benefits avian species of concern and increases overall species diversity.

Migratory Bird Joint Ventures: Bridging science and implementation to conserve North American birds
Fearer, Todd - Appalachian Mountains Joint Venture

Migratory Bird Joint Ventures are cooperative, regional partnerships that work to conserve habitat for the benefit of birds, other wildlife, and people. Established by the North American Waterfowl Management Plan in 1986, Joint Ventures (JVs) now cover nearly all of the U.S. and Canada, and much of Mexico. There are twenty-two habitat-based Joint Ventures, each addressing the bird habitat conservation issues found within their geographic area. In addition, three species-based Joint Ventures, all with an international scope, work to further the scientific understanding needed to effectively manage populations of specific bird species. Joint Ventures implement all elements of Strategic Habitat Conservation at scales that influence populations, using science and a landscape perspective to maximize the effectiveness of local delivery. Joint Ventures are self-directed partnerships, governed by a management board that defines, prioritizes, leverages, and leads implementation of JV conservation priorities at the appropriate levels in their respective geographies. While each JV shares this operational structure, they also leverage a diversity of conservation expertise and create collaborations at a variety of scales to uniquely address complex conservation challenges, and this adaptability allows the JVs to quickly respond to developing conservation issues. Joint Ventures are developing a more coordinated JV community that works across state, federal, JV, and international boundaries to address full annual cycle planning and conservation needs for migratory birds.

Do Birders Give Back? (or, Honestly, I'd rather just take a bird walk)
Fenwick, George

As many in this symposium will demonstrate, by any metric, birders demonstrably give back to their hobby. They arguably give more than other segments of outdoor recreationalists – by sheer numbers of donative birders if not by per capita giving. More research on this topic is warranted. However, despite more interest in birds than most avocations, bird conservation relies heavily on general biodiversity organizations instead of the birding community or its organizations. These groups do tremendous good, but often miss the mark in protecting birds simply because birds are not their target. Further, government support for bird conservation and supportive bird regulation underserves the public and the environment because it does not perceive the necessary public support. Finally, American philanthropic organizations, a hallmark of our

society's interest in public sector charitable giving, largely fails to recognize the need to finance bird conservation. This presentation will focus on some reasons why many birders, their organizations, foundations and governments do not support conservation and how we might change these characteristics to grow the ranks of supporters from the birding community, the amount of their giving, and also how government could play a larger role in bird conservation.

The development of feather shape and the evolutionary origins of the modern asymmetrical flight feather

Feo, Teresa - Smithsonian Institution, National Museum of Natural History; Daniel Field - Yale University; Richard Prum - Yale University

Vane asymmetry in flight feathers is an important aerodynamic adaptation that is present in all extant flying birds and also in many Mesozoic stem taxa whose capacity for powered flight is still under debate. Feathers have a complex development and it is not readily apparent how different shapes like vane asymmetry develop. Using a combination of theoretical modeling and empirical investigations we demonstrate that vane asymmetry is developmentally redundant. Different combinations of developmental modifications can create feathers with the same asymmetrical shape but with different underlying barb geometries. Next we investigated the relationship between vane asymmetry and barb geometry across the evolutionary history of feathers. We find that barb geometry significantly varies between vanes with different functions within the wing of extant birds. Leading vanes that function as the cutting-edge of an airfoil during flight are characterized by small barb angles, whereas trailing vanes are characterized by large barb angles. Many Mesozoic stem taxa, including Archaeopteryx, exhibit modern leading vane barb geometry, but only the relatively derived enantiornithine Eopengornis exhibits modern trailing vane barb geometry. Our results suggest that small barb angles in leading vanes are an important aerodynamic adaptation that arose early in the evolutionary history of asymmetrical feathers, whereas large trailing vane barb angles arose crownward of Confuciusornis; coincident with the inferred origin of many of other flight-related characters. This demonstrates a previously unrecognized transitional morphology in the evolution of asymmetrical feathers at a critical interval in the refinement of avian flight.

Local dialects of a geographically variable, female-specific call elicit greater aggression

Ferguson, Stephen - University of Memphis; Stephan Schoech - University of Memphis

Among populations, songs or calls may represent isolating mechanisms due to localized variation and preferences for familiar patterns or structure. Research on geographic variation has typically focused on male song, which tends to be more prominent and variable than female vocalizations in temperate species. Florida scrub-jays (*Aphelocoma coerulescens*; FSJ) are cooperatively breeding, non-migratory corvids that defend single-pair territories. Territorial females use a sex-specific 'rattle' call that presents as one of three main regional dialects: the rapid rattle, the hiccup rattle, and the soft rattle. We hypothesized that FSJs differentiate between rattle call dialects, with the prediction that local dialects would elicit the most aggressive responses. We recorded calls at Archbold Biological Station (Venus, FL; hiccup), Oscar Scherer State Park (Osprey, FL; hiccup), and Seminole State Forest (Eustis, FL; rapid) and conducted playback trials at ABS and SSF. At SSF, FSJs responded more aggressively to the local rattle type than either foreign rattle ($p < 0.001$). At ABS, FSJs responded most aggressively to the local hiccup rattle ($p < 0.001$), and showed a nonsignificant trend to

respond more aggressively to the nonlocal same-dialect rattle from OSSP than the foreign dialect (p= 0.062). These results suggest that in FSJs local female dialects elicit stronger behavioral responses than foreign dialects. Analyses of population-level genetics in FSJs suggest the existence of several distinct genetic groups that roughly mirror the distribution of rattle call dialects. Taken together, these results suggest an important role for female call variation on population-level genetic structure of the species.

Assessing the usefulness of natural protected areas in a changing world: climate change effects on hummingbird distribution

Feria, Teresa - The University of Texas Rio Grande Valley; Carlos Lara - Universidad Autónoma de Tlaxcala; Jon Dale - Texas Citrus Pest & Disease Management Corporation; Mayra Oyervides - Texas Citrus Pest & Disease Management Corporation

Climate change is affecting the distribution of species worldwide. In order to set sound conservation plans, special attention should be given to those species with restricted geographic distributions. Here, we use a maximum entropy approach to forecast the potential effects of climate change (year 2050) on six endemic and endangered Mexican hummingbirds with reduced geographic distribution: *Campylopterus excellens*, *Lophornis brachylopha*, *Thalurania ridgwayi*, *Eupherusa cyanophrys*, *Eupherusa poliocerca*, and *Doricha eliza*. We obtained distributional data from online (GBIF and REMIB) and personal databases and current climate data from WorldClim. We used 2 climate change scenarios (A2 and B2) and 4 general circulation models (CGCM2, CSIRO-MK2, HadCM3, and NIES-99) to construct 10 models per species. Models were evaluated using the AUC in a ROC. Final models and AUC consisted of the average of the 10 models. We converted the averages maps into binary (0-1) maps to calculate loss/gain areas in the future. Our findings show that two of the six target species could experience contractions, a species remains without apparent changes, and three species may have slight expansion in their potential distributions in the future. The contractions could occur in areas where populations of the target species have been recorded. Further studies (e.g., land use/change) are needed in order understand how to mitigate the effects of climate change for these species.

The visual system of the hawk-eyed songbird, the Tree Swallow

Fernandez-Juricic, Esteban - Purdue University; Luke Tyrrell - Purdue University

The vast majority of songbirds (Order Passeriformes) are insectivorous for at least part of the year. However, swallows are one of the only songbird groups that execute all aspects of hunting prey (search, detection, pursuit, and capture) in flight. We examined eye morphology and the retinal ganglion cell layer of wholemounted tree swallow (*Tachycineta bicolor*) retinas, cross-sectioned tree swallow foveae, and measured the dimensions of tree swallow visual fields using the opthalmoscopic reflex technique. We found that tree swallows, unlike other songbirds, have evolved a visual system similar to that of raptors (Orders Accipitriformes and Falconiformes). Like raptors, tree swallows have a retina with two foveae, unique among studied songbirds, which provides them with high acuity vision directed laterally (deep, central foveae) to either side of the head as well as directed forward (shallow, temporal fovea). Tree swallows have unusually long eyes, like raptors, which increase the focal length of the eye and thus the eye's spatial resolving power. Raptors have unexpectedly narrow binocular fields (20-39º) but large blind areas behind the head (60-101º). Songbirds, on the other hand, have symmetrical binocular (average 40º) and blind areas (average 40º). Tree swallows fall out with the distantly related raptors with a blind area (53º) that is

over twice the size of the binocular field (23º). These findings suggest that the organization of visual systems is not entirely constrained phylogenetically, but can be reshaped by the ecological challenges that particular species face.

Dynamics of a hybrid zone between an island endemic and its continental sister species of flameback woodpeckers in Sri Lanka

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Hybridization has provided a unique opportunity to study the interaction between gene flow and reproductive isolation in speciation. In continental islands, where the colonization of taxa from the adjacent mainland can be a main source of species recruitment, such hybridization can elucidate the patterns of island endemicity. The island of Sri Lanka has two species of Dinopium flamebacks; the endemic D. psarodes in the south and D. benghalense in the north near the mainland. The red plumage separates *D. psarodes* from all other species of *Dinopium*. The two forms hybridize when they come into contact. To provide a comprehensive analysis of genotypic and phenotypic variation across this hybridizing complex, we examined the variation of morphometrics (8 characters), plumage (21) and genotypes (autosomal LDH, mitochondrial CO1 and Cyt b) of 80 individuals. Multivariate analyses were performed for each trait and clines were fitted against biogeographic distance and climate. Phenotype and genotype showed concordant clinal variation across the biogeographic distance. Two mitochondrial haplotype groups were found, one in the north and one in the south. A mixture of haplotypes were seen in the hybrid zone. The concordance of phenotypic and genetic markers, narrow width of the hybrid zone compared to neutral expectations, and rarity of hybrids compared to Hardy-Weinberg expectations suggest that some form of selection is acting on this zone limiting the spread of hybrids. Isolation by distance and/or the extent of northern forests might have prevented historical gene flow between these forms, insulating the island endemic from the recent colonist.

Managing Solar Energy while Conserving Birds: State of the Science and Management to Reduce Impacts

Fesnock, Amy - Bureau of Land Management, California State Office; **Thomas Dietsch** - US Fish and Wildlife

Within the last decade, there has been a considerable push towards increasing the amount of renewable energy. While solar development could be incorporated in an urban setting, the primary push has been for large scale solar in natural or abandoned agricultural settings. As we work to address energy demands of our society, we struggle to find the best answers to a complicated question – how to manage solar energy such that impacts to local and migratory bird populations are minimized. Since 2009, thousands of acres have been converted from natural habitat to solar energy developments and the threat of more habitat loss continues. We must be take the recent lessons learned and apply sound science to the siting, development, and mitigation of future solar energy development. While working to minimize the impacts of these developments, we need to be strategic in our approach to mitigation. How to get the maximum benefit for birds – local populations and those migrating through– from compensation and mitigation measures is a deeply complex and contentious issue. The state of the current science will be discussed as well as specific impacts and proposed mitigations for individual projects as well as how we can approach long-term planning and conservation. While many ask whether solar energy will be the demise of bird populations, we ask, “Could industrial solar energy provide

an unprecedented opportunity to implement suites of targeted actions and actually benefit species?"

Estimating Clapper Rail (*Rallus crepitans*) survivorship using automated radio telemetry

Feura, Jared - Mississippi State University; Evan Adams - Biodiversity Research Institute; Robert Cooper - University of Georgia; Mark Woodrey - Mississippi State University; Scott Rush - Mississippi State University

Clapper Rails (*Rallus crepitans*) are a relatively common, yet secretive resident of salt and brackish emergent marshes in the northern Gulf of Mexico. Despite their broad geographic distribution, estimates of annual and seasonal survival are lacking, a critical parameter estimate necessary to more accurately model population dynamics for management purposes. In the breeding seasons of 2015-16 (April – August), 30 individuals were captured and radio-tagged in two (n = 15 birds/site) northern Gulf of Mexico tidal marshes. The two marsh study areas, the Pascagoula River and Grand Bay National Wildlife Refuge, are representative of much of the northern Gulf of Mexico marshes; the Pascagoula River is a riverine dominated system and Grand Bay is largely marine-influenced. These 30 birds are currently being monitored by automated radio telemetry towers, affording survival and course scale movement information over a two year period. Daily variance in signal strength was used to determine the status of individuals, live or dead, to be used in known-fate survival models. Additionally, cyclic patterns in high signal strength were detected and appear to be related to tidal fluctuations. Using loess regression techniques, we attempted to remove noise unrelated to the movements and mortality of the animal to best assess the status of an individual. These estimates of mortality are planned to be used in an individual-based model describing Clapper Rail population changes to tidal marsh habitat change.

Identifying passage locations and habitat preferences of trans-Gulf migrants using broad-scale stopover observations

Fink, Daniel - Cornell University; Benjamin Zuckerberg - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison; Frank La Sorte - Cornell University; Wesley Hochachka - Cornell University; Andrew Farnsworth - Cornell Lab of Ornithology; Steve Kelling - Cornell University

Observations of migrant bird species when they are on stopovers between flights can directly complement information from radar. Data from radar can be used to quantify the total numbers of birds in flight and infer preferred stopover sites based on landing and takeoff locations. On-the-ground observations can complement this information by describing species-level patterns of passage and habitat use during these stopovers. The most geographically comprehensive source of on-the-ground information is the observations of bird watchers. While large volumes of data are being gathered, there are challenges in using these data to gain a better understanding of migration: bird watchers do not collect data following a highly-constrained protocol that controls for factors such as variation in detection rates, or that systematically samples the available habitats. Thus, success in using these data to study migration depends on controlling for sources of bias and uncertainty during analysis. Using data from eBird, we will show that appropriate analyses of bird watchers' observations can provide insights into the use of the Gulf Coast by migrant passerines, both identifying the regions of the Gulf Coast most heavily used by individual species, and providing information on the types of habitats preferentially used during stopovers. Our results suggest that formal integration of eBird's data with other sources of information on Gulf Coast migrants would be a fruitful avenue of applied research.

Harnessing citizen-science data for cross-scale, full life cycle research and conservation

Fink, Daniel - Cornell University; Benjamin Zuckerberg - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison; Frank La Sorte - Cornell University; Wesley Hochachka - Cornell University; Steve Kelling - Cornell University

Understanding how to protect and conserve broadly distributed bird populations requires comprehensive information about species occurrence, abundance, and habitat use across the annual cycle. Citizen science projects are beginning to collect data across sufficiently broad extents and with the necessary resolution to inform full life cycle analyses, however there are challenges in using these data. Because of the heterogeneity in how participants search for birds, it is important to control for sources of bias and uncertainty, e.g. variation in detection rates or sampling coverage of available habitats, during data analysis. In this presentation we will describe the analysis of data from the citizen science project, eBird, to provide a comprehensive source of information about species occurrence, abundance, and land cover associations at regional and continental scales. A multi-scaled approach based on an ensemble of adaptive regression models is used to discover and quantify spatiotemporal patterns while controlling for important sources of bias. We will demonstrate how the results of this model can be used to study patterns of occurrence and land cover associations across spatial and temporal scales.

Foraging effort of adults varies with nestling age for an insectivorous songbird

Fischer, Jason - Disney's Animals, Science, and Environment; Lauren Moscar - Disney's Animals, Science, and Environment; Mackenzie Pearson - Disney's Animals, Science, and Environment; Rebekah Lindborg - Disney's Animals, Science, and Environment; James Mejeur - Disney's Animals, Science, and Environment; Anne Savage - Disney's Animals, Science, and Environment

Parental care is one of the most energetically costly aspects of the life cycle for many bird species, but these costs may change with nestling age. The diet of newly hatched nestlings is limited to small food items while older nestlings are able to eat larger food items. For insectivorous birds, large-bodied insects are less abundant than smaller ones and therefore foraging effort may increase as nestlings grow. Our objective was to determine whether foraging range of adults (used as a proxy for foraging effort) increased with nestling age for an insectivorous songbird, the purple martin (*Progne subis*). We tracked morning movements of 14 different purple martins on April 27th and May 4th in 2016 at Walt Disney World in Orlando, Florida. Each purple martin carried a backpack-mounted GPS transmitter set to record locations at 10-minute intervals beginning 30 minutes before sunrise. Transmitters recorded an average of 6 hours of data and most movements away from the nesting colony were over undeveloped scrub and swamp habitat adjacent to the nesting colony. Foraging range did not vary by sex but did differ based on nestling age. Parents of nestlings older than 10 days flew farther and higher in elevation than birds with nestlings younger than 10 days, suggesting that larger insects eaten by older nestlings are more difficult to locate, thus requiring longer foraging trips.

Fledgling Bachman's sparrow survival, movement, and habitat selection in a landscape managed with frequent fire

Fish, Alexander - North Carolina State University; Christopher Moorman - North Carolina State University; Christopher DePerno - North Carolina State University; Jessica Schillaci - Fort Bragg Military Installation

Many songbird species have exhibited long-term population declines, yet the vital rates driving these declines largely are unknown. Most demographic research has focused primarily on nest success and adult survival, while ignoring juvenile survival; yet, juvenile survival is as critical as nest success for understanding population growth and recruitment. Recent advances in micro-radio-transmitter (*Peucaea aestivalis*) is a species of concern across its range and has exhibited long-term population declines, making it an ideal focal species for a study of juvenile ecology. We attached radio transmitters to juvenile Bachman's sparrows immediately after leaving the nest and tracked movements for 25 days, until independent of adult care. Juvenile survival (0.24) was low compared to many other forest-dwelling songbird species, but was similar to published estimates for grassland birds. Juvenile movement was constrained by the adult territory, and individuals selected areas within the male home range (2-4 ha) that had greater vertical density of shrubs and forbs. Low juvenile survival may be acting as a population bottleneck, contributing to Bachman's sparrow decline. Managing for patches of low woody shrubs within forests dominated by herbaceous groundcover may increase survival of juvenile sparrows during the post-fledgling period.

Habitat selection of Golden-winged Warbler fledglings in managed forests: the importance of structural diversity in local landscapes.

Fiss, Cameron - Indiana University of Pennsylvania; Darin McNeil - Cornell University; Jeffery Larkin - Indiana University of Pennsylvania; Marja Bakermans - Worcester Polytechnic Institute

Like many songbirds, one aspect of Golden-winged Warbler (*Vermivora chrysoptera*) ecology that remains largely unstudied is the post-fledging period. Studies involving other fledgling songbirds have revealed high mortality during this period as well as the use of habitats that are structurally different from nest sites. Currently, state and federal agencies and their partners are implementing management guidelines to create Golden-winged Warbler nesting habitat on public and private forest lands. It is important that these efforts result in nesting habitat that is proximate to quality post-fledging habitat in order to maximize the benefits to population recovery. Using radio-telemetry, we studied the movements and stand-level habitat selection of 78 dependent fledgling Golden-winged Warblers across a managed forest landscape in northeastern Pennsylvania. We created cover type maps in GIS to identify differences in used and available habitat for each radio-tracked bird. Results indicate that fledglings used a variety of cover types and forest age classes besides the regenerating timber harvests in which their nests were located. Average distance moved during the first 4 days post-fledging was 35 m and cover type use was confined primarily to the early successional nesting habitat. However, fledglings moved on average 166 m daily after the first 4 days post-fledging and habitat use became increasingly more varied. These results highlight the importance of managing forested landscapes in a way that optimizes the distribution and diversity of forest structure in areas where Golden-winged Warbler conservation is a goal.

Phylogeography of the Gray-cheeked Thrush (*Catharus minimus*)/ Bicknell's Thrush (*C. bicknelli*) species complex
FitzGerald, Alyssa - University at Albany; Jeremy Kirchman - New York State Museum

During periods of Pleistocene glaciation when northern habitats were completely ice-covered, boreal forest habitats were fragmented and pushed southward. Historical biogeographic studies show that boreal forest birds generally have patterns of genetic divergence that are consistent with a single "boreal" clade in northern and eastern North America whereas any genetic structure or morphological differences, if present, are found in the western portions of their range. However, the *Catharus bicknelli*/*minimus* clade shows a well-defined species break in the east between the Bicknell's Thrush and Gray-cheeked Thrush. Using a phylogeographic approach that combines population genetics with species distribution models (SDMs), we examine the evolutionary history of this boreal species complex. Sequence divergence (2.33%) between the Bicknell's Thrush (n=187) and Gray-cheeked Thrush (n=78) based on the mitochondrial gene ND2 was an order of magnitude greater than divergence within each species. Gray-cheeked Thrushes had greater genetic diversity than the threatened Bicknell's Thrush. One individual captured in southern Labrador, phenotypically a Gray-cheeked Thrush, carried a widespread and common Bicknell's Thrush haplotype. We also sequenced the nuclear intron ADAMTS6 on the Z-chromosome from a subset of 74 thrushes, but there was essentially no variation at this locus in our sample. SDMs of the Last Glacial Maximum revealed that the species both had suitable habitat in two or three distinct eastern refugia; the Gray-cheeked Thrush also had a western refugium. Coalescent analyses show that the divergence between the Bicknell's Thrush and Gray-cheeked Thrush was mid-Pleistocene, and divergence may have been maintained by residence in different late-Pleistocene refugia.

Could Birders Become the Next NRA?
Fitzpatrick, John - Cornell Lab of Ornithology

The National Rifle Association (NRA) promotes one of the most successful public relations campaigns in modern history. Beginning in 1977, NRA converted its century-old hobby organization into a focused political force. Lobbying became its priority, and a reinterpreted Second Amendment became its bible. Right to bear arms became sacrosanct, and otherwise reasonable debates about guns and ammunition in society became debates about freedom versus tyranny. Today, NRA annually devotes just $3M on lobbying, but its 4 million members are emotionally invested with near-religious fervor. They vote as a block, demonstrate, advertise, contact public officials, and threaten political figures so effectively that legislation is affected despite overwhelming public sentiment to the contrary. Millions of bird lovers share some key emotional attributes of NRA members. They are passionate, knowledgeable, love the outdoors, and perceive that the focus of their hobby is under imminent threat. Therefore, birders ought to be capable of mounting an enduring public relations campaign about conservation that is just as powerful and effective as that of the NRA. To date, however, they have failed to do so. Biodiversity conservation is essentially absent from the political dialog. Could one or a few missing ingredients galvanize birders into focused activists that rival the NRA in power and influence, or is the challenge more nuanced and complex than allegiance to a right to bear arms? If, as I suggest, the former is the case, then the overriding challenge is to identify and supply the missing ingredient(s).

Comparison of statistically rigorous methods for estimation of avian species richness in the Great Basin

Fleishman, Erica - University of California, Davis; Matthias Leu - College of William and Mary; David Dobkin - High Desert Ecological Research Institute; Matt Farnsworth - Conservation Science Partners; Barry Noon - Colorado State University; Rick Scherer - Colorado State University; Jian Yen - University of Melbourne

Species richness long has been used as a metric to prioritize conservation investments and management actions. Potential drivers and methods for estimation of species richness also have a long history of examination in ecology. We compared trade-offs among three robust statistical methods for estimation of species richness of breeding birds in the Great Basin over 15 years. First, we applied spatially hierarchical models, which examine the extent to which environmental variables at different scales are associated with species richness at a given extent. Second, we applied taxonomically hierarchical Bayesian models. These allow one to infer species richness of a guild or community, and associated covariates, on the basis of detection-weighted, species-level occurrence probabilities. Third, we estimated species richness on the basis of indicator species in the same taxonomic group or a different taxonomic group. In all cases, relatively little of the variance in species richness was explained. Spatially hierarchical models identified topographic and vegetation-related variables associated with species richness, but 2/3 of the variation in species richness was unexplained. Taxonomically hierarchical models tended to generate unrealistically high estimates of guild-level species richness, and were highly responsive to environmental associations of the most common species. Indicator-species models explained up to 91% of variance in species richness in the data used for their construction, but predicted a maximum of 48% of the variation in species richness in other locations or time periods. Unpredictable distributions of resources and climate extremes may complicate estimation species richness of birds in highly variable environments.

Evaluating the large-scale effects of hyperabundant geese on sympatric-nesting shorebirds

Flemming, Scott - Trent University; Lisa Kennedy - Western University; Erica Nol - Trent University; Paul Smith - Environment and Climate Change Canada

In some areas, populations of geese are significantly altering their Arctic breeding and staging grounds. The resulting habitat changes could impact sympatric-nesting shorebirds. Overgrazing and grubbing by geese can result in habitats with shorter graminoids or exposed sediment, providing less cover for shorebirds. Shared predators of geese and shorebirds may also be attracted to goose colonies potentially elevating the risk of predation for nesting shorebirds. Many populations of Arctic-breeding shorebirds are declining, possibly in part due to goose-induced habitat alteration. Our research seeks to evaluate the effects of Lesser Snow (*Chen caerulescens caerulescens*) and Ross' (*Chen rossii*) Geese on sympatric-nesting shorebirds. Using shorebird surveys carried out across the Canadian Arctic as part of the Program for Regional and International Shorebird Monitoring (PRISM), we relate shorebird abundance and community composition to the distribution of breeding geese. We show evidence that at large scales (within 30km) goose colonies are positively influencing the abundance of avian predators and negatively influencing the abundance of cover-nesting shorebirds. At the local scale, using camera monitoring and artificial nests, we show that predator abundance near a goose colony is elevated, translating to a lower daily survival probability of nests. The dramatic increases in the abundance of geese in the Eastern Arctic and concurrent declines of shorebirds in this

region suggest at least the potential for an issue of conservation concern. My research should provide information on whether and how geese might affect other shorebirds, so that goose management can acknowledge the needs of these populations.

Advances in network analysis isolate the roles of movement and reproduction for population connectivity in an endangered bird

Fletcher, Robert - University of Florida; Ellen Robertson - University of Florida; Brian Reichert - University of Florida; James Austin - University of Florida

Understanding connectivity is essential for several problems in ecology, evolution, and conservation. Yet across these diverse problems, divergent perspectives on connectivity emerge from different fields emphasizing different types of movement as well as inconsistent incorporation of potential post-movement reproduction into connectivity thinking. Recently theory suggests that variation in post-movement reproduction can generate similar patterns of connectivity as dispersal, yet it is currently unclear if and the extent to which realized population connectivity is largely limited by dispersal or post-dispersal reproductive success. To address this gap, we extend network analysis to isolate the role of movement and reproduction on resulting connectivity. We then contrast demographic and genetic connectivity of an endangered bird, the snail kite (*Rostrhamus sociabilis*), across its entire geographic range. To do so, we couple 9 years of mark-resight data, nesting data of marked kites, and population genetic analyses based on microsatellite markers to populate networks based on annual movements, breeding dispersal (movements between nest-site locations), effective dispersal (dispersal plus post-dispersal reproductive success), and genetic distance. Network analyses reveal that post-dispersal reproductive success plays a large role in realized population connectivity (contributing up to 67% of network metrics). Furthermore, genetic connectivity cannot be explained by dispersal alone; rather understanding post-movement reproductive success is necessary for interpreting genetic connectivity. In general, demographic connectivity is more limited than genetic connectivity for this endangered bird. These results highlight the value of network analysis and emphasize how the spatio-temporal interplay of movement and reproductive success can alter connectivity across landscapes.

Impacts of olfactory predator communities on nest-site selection and nest success of a ground nesting bird

Fogarty, Dillon - Oklahoma State University, Department of Natural Resource Ecology and Management; R. Dwayne Elmore - Oklahoma State University, Department of Natural Resource Ecology and Management; Scott Loss - Oklahoma State University, Department of Natural Resource Ecology and Management

Predation is often the leading cause of nest failure for birds; to reduce predation risk, birds should select nest-sites that reduce detection by prevalent predators. Because many predators use olfaction to detect nests, nest sites should be selected at least partly for olfactory concealment. Olfactory concealment can be provided by air flows—specifically, updrafts and high turbulence—that diffuse and disperse prey odor , making it difficult for predators to detect and follow to the source. However, evidence of nest-site selection for olfactory concealment has not yet been shown. Our objectives were to determine whether Northern Bobwhite select nest-sites for olfactory concealment and whether olfactory variables influence nest survival. To determine if bobwhite select for olfactory concealment, we compared updraft and turbulence between nest-sites and randomly selected points in grasslands, with measurements taken using a 3D sonic anemometer. To evaluate nest survival, we monitored bobwhite nests and used logistic

exposure models to determine importance of the same airflow variables and daily weather conditions that can influence olfactory detection (e.g., precipitation, soil moisture, wind speed). Preliminary results indicate that turbulence was higher at nest-sites compared to random points. Updrafts were similar between nests and random points, and we found little support for olfactory variables in explaining daily nest survival rates. Our results provide evidence that birds select nests for olfactory concealment. Ongoing work will increase nest replication and better clarify whether these nests are less susceptible to predation. Nonetheless, we hypothesize that olfactory nest-site selection may be widespread among birds.

Habitat selection in Canada's boreal forest by the Common Nighthawk
Foley, Gabriel - University of Regina

The Common Nighthawk is a bird currently listed as Threatened in Canada. It is a member of the fastest declining group of birds in Canada, the avian insectivores. Additionally, traditional survey methods such as the Breeding Bird Survey do not detect this cryptic, crepuscular species well and have only sampled southern populations, biasing an already poor population estimate. Although significant populations may exist in Canada's boreal forest, these populations have not been well surveyed and the focus of virtually no research. My project seeks to fill this gap in our knowledge. I hypothesize that the bare ground and open space created by wildland fire will promote nesting and feeding by this species. Understanding how these birds use post-fire habitat will help managers understand where nighthawks are likely to occur in the boreal forest, how this habitat compares to conventional habitats, and how their short- and long-term population will be affected by fires. In addition, nighthawks are known to use gravel roads as a temporary roost site after dark, which can lead to road mortalities. However, the reasons behind this proclivity are unclear. Identifying existing patterns in their road use, mortality rates, and why nighthawks appear to preferentially select these road sites may help avoid unnecessary mortality.

Melding Research and Education in a Zoological Setting
Foote, Dustin - Sylvan Heights Birds Park; Matthew McKim Louder - East Carolina University

Zoos are a critical and often primary source of conservation education for rural populations. Both zoos and research scientists are under pressure to evaluate their educational footprint and have been encouraged to substantiate claims that learning has taken place during education and outreach activities. We set out to evaluate educational efforts at Sylvan Heights Bird Park (SHBP) in Scotland Neck, North Carolina. SHBP is a unique facility compared to other zoological institutions with its exclusive focus on birds and its remote, rural location. Here we aimed to gain a better understanding of the perceptions and expectations of its visitors. In this study, we attempt to quantify the use and effectiveness of various sources of information by conducting a survey of visitors to SHBP. We also specifically evaluated an exhibit on brood parasitic birds, aimed at teaching about host-parasite coevolution. A total of 233 visitors were provided with a double-sided survey after their visit to SHBP. We found that the level of reliance on exhibit signage was influenced by both age and gender. We also found that perceptions of zoos' role in conservation varied by age and gender. Lastly, we found that respondents that engaged in active engagement with park staff better recalled details of the exhibit on brood parasitic birds. Our findings suggest that zoo exhibits should be designed differently based on target audience, and that specific features can be implemented to reach the broadest possible audience.

Hybridization and genetic structure of Mottled Ducks in the western Gulf Coast
Ford, Robert - Louisiana State University; Will Selman - Louisiana Department of Wildlife and Fisheries; **Sabrina Taylor** - Louisiana State University, School of Renewable Natural Resources

In Florida, Mottled Ducks hybridize with Mallards and are genetically differentiated from populations in the western Gulf Coast. In the western Gulf Coast, levels of hybridization and fine scale genetic structure have not been extensively examined despite the potential impact this information might have on: 1) management of Mallards to prevent introgression in the Mottled Duck lineage, and; 2) identification and organization of current management units. We provide estimates of hybridization and genetic structure obtained by genotyping 405 ducks at 36 microsatellite loci. Overall, genetic analyses revealed lower rates of hybridization (5.4%) in the western Gulf Coast compared to rates previously reported in Florida (~9%). Several analyses of population structure indicated that Mottled Ducks are a single genetic population across the western Gulf Coast. Ongoing habitat loss and alteration may ultimately increase levels of hybridization in Mottled Ducks, consequently, we suggest that levels of hybridization be periodically monitored.

Migratory Connectivity of Sora, Virginia and Yellow Rails
Fournier, Auriel - Arkansas Cooperative Fish and Wildlife Research Unit; Kiel Drake - Bird Studies Canada; Douglas Tozer - Bird Studies Canada; David Krementz - USGS Arkansas Cooperative Fish and Wildlife Research Unit

Rails are elusive marshbirds that have a broad breeding and winter distribution across North America, although little is known about their migratory connectivity. To assess migratory connectivity using stable hydrogen isotopes, we collected Sora (*Porzana carolina*), Virginia Rail (*Rallus limicola*), and Yellow Rail (*Coturnicops noveboracensis*) feathers on the breeding grounds and at 8 migration sites across the U.S. east of the Rocky Mountains in 2015. Stable hydrogen isotopes achieve good latitudinal resolution, but broad longitudinal resolution. To improve this, we used a Bayesian framework to refine estimates of origins conditional on species distribution models derived from state and provincial marshbird monitoring data. Combined analysis of stable hydrogen isotopes and species distribution models predicted that Soras migrating through the Mississippi and Central Flyways most likely bred from the prairie potholes to the St James Bay. Soras migrating through eastern locations most likely bred in the Great Lakes region. Eastern Virginia Rails were assigned to the Great Lakes, while in Missouri migrating individuals were assigned to the Canadian prairie pothole region. Migrant Yellow Rails were only assigned to the Canadian prairies. This first look at migratory connectivity suggests that there may be an east-to-west cline of rail connectivity in North American, but future work across a wider range from both north to south and east to west with additional methods (GPS transmitters or geolocators) and larger sample sizes for some species will be needed.

The Breeding Bird Survey and Bird Conservation in North America
Francis, Charles - Canadian Wildlife Service, Environment and Climate Change Canada

The North American Breeding Bird Survey (BBS) was established in 1966 in response to a lack of reliable data on changes in populations of many bird species, especially songbirds. Population trend data can support conservation in many ways, including identifying conservation priorities, evaluating hypotheses about potential causes of population change, and evaluating impacts of management actions. This presentation reviews some of the ways BBS data

contribute to each of these. Despite some limitations, the BBS now provides the most reliable data currently available on regional and continental trends of many species. BBS data contribute to status assessment under the Species at Risk Act in Canada; several species have been listed based mainly on BBS data. BBS data have also been used to identify candidate species under the U.S. Endangered Species Act. BBS data are also a major source of information on priority species for conservation action (e.g., Partners in Flight Watch List species). BBS data have also helped to understand causes of population change. Geographic and temporal variation in trends can be used to evaluate the potential importance of population drivers such as climate fluctuations, geographic variation in habitat loss or pesticide use or other stressors. Comparison with demographic monitoring data such as MAPS can further test hypotheses about seasonal variation in population drivers. BBS data have been less used for evaluating management actions, though they have helped document recovery of many species post DDT, and could be used for managing harvest of species such as Mourning Doves.

The functional significance of soundscapes in coupling biodiversity, psychological ecosystem services and conservation

Francis, Clinton D. - Cal Poly San Luis Obispo; B. Derrick Taff - Pennsylvania State University; Peter Newman - Pennsylvania State University; Crow White - Cal Poly San Luis Obispo; Christopher A. Monz - Utah State University; Jesse Barber - Boise State University

The acoustic environment serves untold functions in the lives of distantly related animals and its importance is widely recognized for birds. Sounds of nature are also known to enhance the quality of nature-based experiences for humans. Globally, however, human-made sounds (i.e., noise) now dominate many acoustic environments, or soundscapes. Recent research has demonstrated that human-made noise negatively influences birds and humans; noise affects bird behavior, distributions and reproductive success, plus human health, sleep and cognition. Here, we argue that soundscapes play a critical role in coupling human experience and ecological systems through psychological ecosystem services. First, we provide a conceptual overview of how natural and anthropogenic sounds can independently affect humans and birds and contribute to feedbacks between the two. Second, through the lens of sensory ecology and the concept of listening area, we use an agent based model to demonstrate how soundscapes degraded by human-made noise can explain bird distributions through several mechanisms and contribute to the quality of human observers' experiences in nature. Third, with field data we demonstrate how the acoustic environment influences human-bird encounters. Sound levels strongly influence bird detections by impairing the abilities of human observers. Additionally, sounds limit observers' abilities to approach birds due to altered flight initiation distances that are associated with a switch to vision as the primary surveillance modality. Given the many ways that human-made sounds can influence birds, humans and interactions between them, we argue that soundscapes should be considered alongside other well-recognized threats to biodiversity and human wellbeing.

Avian Protection and Identifying Electrocution and Collision Risk Areas for Raptors

Frank, Cristina - Pepco Holdings; Elizabeth Mojica - EDM International, Inc.; Richard Harness - EDM International, Inc.

Avian protection is a critical issue for electric power delivery companies. Avian interactions with power lines can result in death/injury for birds and power outages. Pepco Holdings (PHI), a power delivery company, developed

an Avian Protection Program (APP) to improve power reliability, ensure customer satisfaction, and minimize risk to birds. PHI implements its APP to mitigate for avian incidents and proactively minimize electrocution and collision hazards on its electric system. Effective avian protection requires the identification of priority bird risk areas where proactive retrofitting and avian-friendly pole design could prevent electrocution and collision incidents. PHI's service territory includes the Chesapeake Bay and Delaware Estuary where thousands of breeding and migratory bald eagles and other raptors congregate year-round. Collisions and electrocutions associated with electric infrastructure are increasing throughout the region. Mitigation techniques for collision include marking power lines with bird flight diverters to increase visibility to birds. Electrocution risk is addressed by retrofitting equipment with insulating products and with avian-friendly designs that allow raptors to perch safely on structures. PHI collaborated with EDM International, Inc. and New Jersey Division of Fish and Wildlife to identify priority raptor areas where risk mitigation efforts could be strategically implemented. A GIS analysis of biological and natural resource data, including eagle telemetry and roost data was conducted to identify priority raptor habitats throughout the PHI territory. This mapping effort provides guidance for construction of new power delivery infrastructure and retrofitting of existing equipment to safely accommodate growing populations of raptors in the region.

The role of wild birds in disseminating pathogenic and antimicrobial-resistant bacteria: A review

Franklin, Alan - USDA-APHIS-WS National Wildlife Research Center

Pathogenic and antimicrobial-resistant (AMR) bacteria have become an increasing problem over the last three decades in agricultural and human health. For example, the CDC estimates that at least 2 million people in the U.S. acquire serious infections with AMR bacteria each year and at least 23,000 of these cases are fatal. In addition, outbreaks of food-borne bacterial pathogens have increased in both number and magnitude. Wild birds have increasingly been implicated in disseminating both pathogenic and AMR bacteria that may affect human and agricultural health. Wild birds from a wide range of taxonomic groups have been found to carry major food-borne pathogens, such as Salmonella, Shiga-toxin producing strains of E. coli, Camplyobacter, and Listeria with prevalences ranging from 1 to 93.5%. A number of avian species have also been found to carry AMR strains of E. coli, Salmonella and Enterococcus species, all of which are considered high-priority human health risks. However, the potential role that wild birds play in disseminating pathogenic and AMR bacterial strains is still unclear. We present a broad overview of the prevalence of pathogenic and AMR bacteria in wild birds, potential sources and mechanisms for transmission of these bacterial strains, the implications to avian conservation, and key research gaps that need to be addressed to both mitigate impacts of bacterial contamination by wild birds and to resolve conservation and management conflicts.

Timing is everything: The sensitivity of 21 breeding bird species to changing seasonal timing is linked to population change over three decades

Franks, Samantha - British Trust for Ornithology; James Pearce-Higgins - British Trust for Ornithology; Sian Atkinson - Woodland Trust; James Bell - Rothamsted Research; Marc Botham - Centre for Ecology and Hydrology; Richard Harrington - Rothamsted Research; Dave Leech - British Trust for Ornithology

A consequence of climate change has been an advance in the timing (phenology) of seasonal events. Differences in the rate of advance between trophic levels may result in

predators becoming mismatched with prey availability, reducing fitness and potentially driving population declines. Such "phenological mismatch" is hypothesised to have contributed to recent population declines of long-distance migratory birds, which may be more susceptible to mismatch than other species. Using nationwide survey data from taxa at three different trophic levels (flowering plants, aphids, Lepidoptera and birds), we investigated the impacts of annual variation in spring timing on the productivity of long-distance migrants, short-distance migrants, and resident birds. Furthermore, we assessed whether sensitivity to variation in spring timing is related to differences in long-term productivity and population trends across bird species. We found that in warmer springs, birds bred later than normal relative to the first emergence of aphids, but productivity was only marginally reduced as a result, with long-distance migrants, short-distance migrants and residents all exhibiting effects of similar magnitude. However, species that experienced a stronger negative impact on productivity as a result of breeding late relative to aphid emergence demonstrated reduced population growth rates over the last three decades. Our results indicate that while breeding late relative to invertebrate emergence might only marginally reduce population-level productivity, variation in spring timing as a result of climate warming still has the potential to influence long-term population trends at a national scale, perhaps through alternative demographic mechanisms such as survival or recruitment.

Louisiana Waterthrush & Benthic Macroinvertebrate Response to Shale Gas Development

Frantz, Mack - West Virginia University, WV Cooperative Fish & Wildlife Research Unit; Petra Wood - USGS WV Cooperative Fish and Wildlife Research Unit; James Sheehan - West Virginia University; WV Cooperative Fish and Wildlife Research Unit; Doug Becker - Kutztown University; Gregory George - Delaware Valley University

We examined effects of Marcellus shale gas well and infrastructure development on Louisiana Waterthrush (*Parkesia motacilla*) at Lewis Wetzel Wildlife Management Area, WV. During 2009-2015, we quantified waterthrush nest survival, territory density, and return rates on 57.9 km of headwater streams (n=14). For each nest, we quantified local land cover, a waterthrush Habitat Suitability Index (HSI), and the EPA Rapid Bioassessment index for in-stream characteristics important to aquatic macroinvertebrates. In 2011, we collected benthic macroinvertebrate samples in stream reaches to characterize waterthrush prey availability in unimpacted and impacted streams. Territory density in 2011 was positively correlated with higher GLIMPSS scores, total benthic density, and EPT density. Unimpacted streams had greater GLIMPSS scores, greater overall and EPT richness, and a smaller percentage of tolerant taxa compared to impacted streams. Waterthrush demographic trends across years suggest decreasing territory density, return rates, and nest survival. With Program MARK, we found that average daily rainfall had a strong positive effect on daily survival rate (DSR). After accounting for temporal effects, we also found weak negative effects on DSR associated with shale gas development. HSI and EPA indices were lower for nests in shale gas impacted territories suggesting a decline in habitat quality. One additional result of note was increased parasitism rates of waterthrush nests since 2010 by Brown-headed Cowbirds

(*Molothrus ater*); no parasitism occurred before 2010. All results suggest a decline in site quality for waterthrush with an increase in shale gas development.

Does early-life diet shape stress physiology? Insights from δ15N and feather corticosterone across life-history stages

Freeman, Nikole - University of Guelph; D. Ryan Norris - University of Guelph; Dan Strickland - Algonquin Provincial Park; Amy Newman - University of Guelph

The ecophysiological links between early-life conditions and the hypothalamic-pituitary-adrenal (HPA) axis are fundamental to developmental programming. However, the carry-over effects of the early-life environment on stress physiology, behaviour and fitness in natural systems are not well known. During development, a potential source of variation in early-life stress is differential food quality or quantity, which may be especially important to food-caching species. In a long-term, marked population of Gray Jays (*Perisoreus canadensis*) in Algonquin Provincial Park, we examined the hypothesis that the early-life trophic feeding level influences short and long-term HPA axis activity by quantifying relationships between feather corticosterone, body condition, and trophic feeding level across early life stages in young of the year from 2010-2015. Body condition was assessed as nestlings (11d post-hatch) and several months later as independent juveniles. Using stable nitrogen (δ15N) and feather corticosterone analysis of juvenile rectrices, we inferred trophic feeding levels and HPA axis activity respectively during the nestling (feather tip) and fledgling (feather base) stages, as juvenile feathers begin growing in the nest and are completed after fledging. Our study investigates the vital role that ecophysiological factors in the early-life environment, such as tropic feeding level, play during development and the potential carry-over effects on stress physiology. Understanding these linkages may elucidate the physiological mechanisms underpinning ecological processes at the individual and population level.

Use of Adaptive Sampling Methods to Improve Estimates of Abundance and Occupancy of King Rails (*Rallus elegans*) in the Delmarva Peninsula

Freiday, Timothy - University of Delaware; W. Gregory Shriver - The University of Delaware; Zachary Ladin - University of Delaware; Elizabeth Tymkiw - University of Delaware

Secretive marsh birds face many threats from factors including habitat loss, climate change, and pollution. King Rail (*Rallus elegans*) populations are declining across the entire range of the species, however little information exists on recent population status on the Delmarva Peninsula. King Rails are rare and difficult to detect on standard marsh bird surveys, so improved sampling methods need to be tested to increase the precision of occupancy and abundance estimates. Our objectives were to determine the current status of the population of King Rails on the Delmarva Peninsula and test the efficacy of adaptive sampling techniques for improving the precision of population estimates. To obtain population estimates, we conducted secretive marsh bird surveys at 498 points throughout the Delmarva Peninsula in 2014 and 2015. Surveys were conducted according the standardized National Marsh Bird Monitoring Protocol. We developed an adaptive cluster sampling procedure at a subset of locations, whereby additional points were added to the primary sampling unit upon the detection of a King Rail. We tested this adaptive cluster sampling in 9 hexagons in DE and 17 hexagons in MD. This technique was effective at reducing the standard error of abundance estimates, and represents a valuable tool for sampling rare and clustered species.

Microclimate predicts within-season distribution dynamics of montane forest birds

Frey, Sarah - Oregon State University; **Adam Hadley** - University of Toronto; Matthew Betts - Oregon State University

Climate changes are anticipated to have pervasive negative effects on biodiversity and are expected to necessitate widespread range shifts or contractions. Such projections are based upon the assumptions that (a) species respond primarily to broad-scale climatic regimes, and (b) that little variation in climate exists at fine spatial scales. However, in montane forest landscapes, high degrees of microclimate variability could influence occupancy dynamics and distributions of forest species. We used dynamic occupancy models to test the degree to which microclimate affects distribution patterns of forest birds in a heterogeneous mountain environment of the Central Cascade Mountains, Oregon, United States of America. We hypothesized that high vagility of most forest bird species combined with the heterogeneous thermal regime of mountain landscapes would enable greater settlement and lower vacancy at sites with moderated temperatures. In all models we statistically accounted for vegetation structure, vegetation composition, and potential biases due to imperfect detection of birds. Fine-scale temperature metrics were strong predictors of bird distributions; effects of temperature on within-season occupancy dynamics were as large or larger (1 to 1.7 times) than vegetation effects. Our results emphasize that high-resolution temperature data increase the quality of predictions about avian distribution dynamics.

Smaller beaks for colder winters: Beak size of Australasian songbirds evolves in response to thermoregulatory challenges, not diet

Friedman, Nicholas - Okinawa Institute of Science and Technology; Lenka Harmáčková - Univerzita Palackého v Olomouci; Evan Economo - Okinawa Institute of Science and Technology; Vladimír Remeš - Univerzita Palackého v Olomouci

Birds' beaks play a key role in foraging, and most research on their morphology has focused on this function. Recent findings suggest that beaks may also play a prominent role in thermoregulation, as predicted by Allen's rule. However, the relative roles of diet versus thermoregulation in the evolution of beak size during diversification remain unclear. Furthermore, it remains unclear whether the need for retaining heat in the winter or dissipating heat in the summer plays the greater role in selection for beak size. Comparative studies are needed to evaluate the relative importance of these functions in the evolution of beak size. We addressed this question in a clade of birds exhibiting variation in both diet and climatic niche: the honeyeaters and allies (Meliphagoidae). Across 158 species, we compared species' diets and climate conditions extracted from their ranges to beak size measurements in a combined spatial-phylogenetic framework. We found that winter minimum temperature, but not diet, was positively correlated with beak size. This suggests that while diet and foraging behavior may drive evolutionary changes in beak shape, changes in beak size are often better explained by the beak's role in thermoregulation, and winter heat retention in particular.

Climate change and habitat conversion interact synergistically to favor the same tropical bird species

Frishkoff, Luke - University of Toronto; **Daniel Karp** - University of California Davis; Jon Flanders - University of Bristol; Jim Zook - Unión de Ornitólogos de Costa Rica; Elizabeth Hadly - Stanford University; Gretchen Daily - Stanford University; Leithen M'Gonigle - Florida State University

Earth is experiencing multiple global changes that will, together, determine the fate of many species. While much research has characterized patterns in species' responses to individual drivers of global change, how multiple pressures interact to affect biological communities is still largely unknown. In particular, linkages between species' responses to habitat conversion and climate change are poorly understood. Here, we assess the combined effects of climate change and habitat conversion on tropical birds, using a spatially and temporally extensive dataset consisting of 118,127 bird encounters over 12 years in Neotropical forest and agriculture. Across >300 species, we show that affiliation with drier climate zones is associated with an ability to persist in and colonize agriculture. Further, we find that avian species shift their habitat use along a precipitation gradient such that species prefer forests in drier regions and agriculture in wetter regions. Finally, we report that forest-dependent bird species are most likely to experience significant decreases in habitable range size if current drying trends in the Neotropics continue as predicted. This linkage suggests a little-recognized synergy between the primary drivers of biodiversity loss. Because they favor the same bird species, climate change and habitat conversion are likely homogenizing biodiversity more severely in combination than they would in isolation.

Mechanisms of heteropatry in migratory and sedentary dark-eyed juncos (*Junco hyemalis*)

Fudickar, Adam - Indiana University; Timothy Greives - North Dakota State University; Jonathan Atwell - Indiana University; Mark Peterson - Viterbo University; Eli Bridge - Oklahoma Biological Survey; Craig Stricker - USGS Fort Collins Science Center; Ellen Ketterson - Indiana University

Heteropatry, a distribution in which migratory and sedentary populations are sympatric outside of breeding, is common among broadly distributed species. In late winter and early spring while residents enter reproductive condition, migrants delay reproduction and prepare to migrate. Heteropatry provides an opportunity to examine mechanisms regulating divergence in timing of reproduction and migratory behavior. We asked whether differences in timing in migratory and sedentary dark-eyed juncos (*Junco hyemalis*) result from differential responses to supplementary and/or photoperiodic cues, and how migrants and residents vary in seasonal expression of genes associated with migration and reproduction. We held resident and migrant juncos in a captive common-garden environment under natural photoperiod and mild conditions over a four-week period in late winter and early spring. We measured testosterone, gonad mass, corticosterone, seasonal fat deposition, and nocturnal restlessness. Throughout the study, sedentary juncos had higher testosterone and larger gonads, while migrants stored more fat and displayed delayed reproductive maturation. We found a negative relationship between testis mass and feather hydrogen isotope ratios, indicating testis growth was delayed in individuals making longer migrations. While genes associated with reproduction were more highly expressed in residents in early spring, genes involved in lipid transport and metabolism were more highly expressed in migrants. We conclude that differences in reproductive timing in

heteropatric migratory and sedentary birds can result from a differential response to photoperiodic and supplementary cues in a common garden, and as a result, gene flow between migrants and residents may be reduced by environmental control of reproductive development.

Using phylogenetic distinctiveness to prioritize species conservation in the largest family of songbirds (Thraupidae)
Funk, Erik - San Diego State University; Kevin Burns - San Diego State University

As molecular data are becoming more readily available, more studies are incorporating phylogenetic information into conservation evaluations. For example, the EDGE metric combines scores based on evolutionary distinctiveness (ED) of a species calculated from a phylogeny with the level of global endangerment (GE) according to the IUCN red list. These values are then used to prioritize species for conservation attention. Tanagers (Thraupidae) are a diverse clade of Neotropical birds spanning nearly all zoogeographic regions and terrestrial habitats in Central and South America. Thus, they are an ideal group for guiding conservation priorities, particularly in the Neotropics. We used a recently published molecular phylogeny for tanagers to calculate ED and EDGE values. ED values ranged from 2.57 (*Geospiza magnirostris* and *Geospiza conirostris*, the least phylogenetically distinct species) to 40.33 (*Charitospiza eucosma*, the most phylogenetically distinct). EDGE values ranged from 1.27 (*Geospiza magnirostris* and *Geospiza conirostris*) to 5.35 (*Gubernatrix cristata*). Thus, *Gubernatrix cristata* is the most evolutionarily distinct and globally endangered tanager. Other high ranking species include *Rowettia goughensis*, *Poospiza rubecula*, and *Cnemathraupis aureodorsalis*. We also calculated ED and EDGE values by zoogeographic regions. The region with the highest total ED is the Central Andes, and half of top 50 ranking EDGE species occur in the Northern and Central. Although not many tanagers are found in the Greater Antilles, this region had the highest average ED score. Overall, our study provides EDGE values for tanagers, and highlights species and regions particularly important to Neotropical avian diversity and conservation.

Ecological and evolutionary consequences of broad elevational ranges in the tropics: a comparison of four songbird species on the Andean west slope
Gadek, Chauncey R. - University of New Mexico; Seth D. Newsome - University of New Mexico; Elizabeth J. Beckman - Museum of Southwestern Biology, University of New Mexico; Andrea Chavez - Bureau of Land Management; Spencer C. Galen - Sackler Institute for Comparative Genomics, American Museum of Natural History; Christopher C. Witt - Museum of Southwestern Biology, University of New Mexico

Tropical songbird species tend to have narrow elevational distributions, but a few are distributed continuously across broad elevational gradients. Exposure to different altitudes exerts diversifying selection due to PO2 and temperature differences; therefore, elevationally widespread species should be diversifying. Conversely, gene flow counteracts local adaptation, so species that are highly vagile or undergo elevational movements should be more resistant to diversifying selection. Here we tested for elevational movements by measuring stable hydrogen isotopes (δ2H) in four Andean songbird species that are continuously distributed across a ~50 km gradient spanning >4000 m elevation. We used morphometric and mtDNA analyses to test for genetic differentiation. We found two different elevational patterns in stable isotope ratios (δ2H): (1) decline in delta2H with elevation in two terrestrial-foraging songbird species (House Wren and Rufous-collared Sparrow); and (2) no relationship between δ2H and

elevation in two vagile, non-terrestrial species (Cinereous Conebill and Hooded Siskin). Morphometric analyses showed no differences between high and low populations for conebills, subtle differences for sparrows and wrens, and dramatic differences for siskins. mtDNA was well-differentiated between high and low populations of sparrows, but not for any other species. Lack of mtDNA differentiation in conebills and siskins is consistent with elevational movements suggested by δ2H. In contrast, siskin populations demonstrated strong morphometric divergence despite elevational movements, indicating strong selection. Three of four species exhibited genetic evidence of recent demographic expansion. In sum, species' idiosyncratic patterns of movement, divergence, and demography suggest that broad elevational ranges are a recently evolved, unstable phenomenon.

Experimental hypobaria alters inter-specific competitive dominance in elevational replacement hummingbird species

Gaffney, Ariel - University of New Mexico; Jeremy McCormick - University of New Mexico; Christine Mermier - University of New Mexico; Christopher Witt - University of New Mexico

The role of hypoxia tolerance in limiting species elevational distributions is poorly understood. Species distributions are predicted to shift upslope with warming, causing exposure to hypobaric hypoxia. Hummingbirds exhibit exceptional O2 consumption rates which make them particularly susceptible to changes in PO2. If species differ in their tolerance to hypoxia, species interactions could change with elevation. The lowland Black-chinned Hummingbird and montane Broad-tailed Hummingbird are elevational replacement species that compete for nectar resources at mid-elevations where they overlap. We captured adult males of both species from the zone of overlap to test the effects of reduced pressure on activity levels and inter-specific competitive dominance. We used a hypobaric chamber simulate elevations ranging from 1600 m to 4600 m to compare their responses to hypoxia. Specifically, we asked: Do behavioral responses to experimentally reduced pressure differ between high and low elevation species? Is competitive dominance by the low elevation species diminished at high simulated altitudes? To measure competitive dominance, naïve adult males of each species were allowed to compete for perches of differing heights. To evaluate whether species differed in their physical responses to hypobaric hypoxia, we quantified activity levels as simulated elevation increased. The lowland Black-chinned Hummingbird experienced a more severe reduction in activity under hypobaria. Competitive dominance of Black-chinned Hummingbirds at simulated low elevations did not persist under simulated high elevations. This suggests that differential adaptation to atmospheric pressure contributes to the maintenance of stable elevational replacement distributions in hummingbirds.

Flowering plant richness explains hummingbird migration better than a remotely sensed proxy

Gambino, Laura - Stony Brook University; Laura Graham - Stony Brook University; Catherine Graham - Stony Brook University

The green wave hypothesis postulates that the availability and diversity of resources influences the movement of migratory herbivorous species. Hummingbirds require a continuous supply of nectar due to extremely low body size, low fat reserves, and high metabolism. The timing and patterns of hummingbird migration have been studied, but the factors influencing these patterns are not well understood. Given hummingbirds' dependence on nectar, phenology of flowering plants could explain the seasonal distribution of hummingbird species. Climate change is expected to cause phenological shifts in these flowering plants, which could

lead to changes in hummingbird distribution patterns. A number of studies have increasingly used remotely sensed data, such as enhanced vegetation index (EVI), as a proxy for plant phenology. However, the utility of EVI, especially for flowering plants, is still unclear. I use flowering plant richness and EVI to explain the variation in annual and seasonal migration of four hummingbird species (*Archilochus alexandri*, *Selasphorus calliope*, *S. platycercus*, and *S. rufus*). My findings suggest that flowering plant richness based on a coarse phenology is a more suitable measure than EVI for flower resources utilized by hummingbirds. The strong relationship between hummingbird migration and flowering plant richness shows that the green wave hypothesis can be extended to include nectarivorous species.

Carotenoid-based coloration, diet and healthiness in nestlings of a threatened and endemic Southern African raptor, the Black Harrier.

Garcia-Heras, Marie-Sophie - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Beatriz Arroyo - Instituto de Investigación en Recursos Cinegéticos; Robert Simmons - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Pablo Camarero - Instituto de Investigación en Recursos Cinegéticos; Rafael Mateo - Instituto de Investigación en Recursos Cinegéticos; François Mougeot - Instituto de Investigación en Recursos Cinegéticos

The Black Harrier is an endemic raptor to southwestern Africa, considered as regionally Endangered. The reasons for its scarcity remain poorly known. In this context, it is useful to assess the health status of the population to better understand potential limitations and threats. Carotenoid-based ornaments displayed by many birds have been proposed to reliably indicate an individual´s condition and health status: carotenoids (acquired through diet) may be allocated to increased coloration, or mobilized to specific uses such as self-maintenance. Here, we evaluate to what extent carotenoid-based coloration of nestlings (yellowness of cere and tarsus) could be used as an indicator of health. We show that both carotenoid-based coloration and circulating carotenoids (blood plasma) increased with age ($p < 0.0001$, $p=0.021$, respectively), and when diet included increasing proportion of birds versus rodents ($p=0.030$, $p < 0.0001$, respectively), but not when nestlings were in better condition (weight relative to age). This suggested that carotenoid availability reflected the quality of ingested food rather than quantity. Most importantly, we found that nestlings eating more birds also had greater levels of DDTs, and that the circulating carotenoid levels were negatively associated with DDT levels ($p=0.004$). No effects of PCBs or DDTs were found on coloration. Our results suggest that diet quality strongly influence carotenoid availability as well as pesticide (DDTs) intake. Nestlings feeding primarily on rodents, the species' main prey, were less exposed but more carotenoid-limited. We discuss the broader implications of these results for the health assessment and conservation of the Black Harrier population.

Vocal vs. genetic variation within species with and without vocal learning

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Many subspecies may actually represent cryptic species, as subspecies/species delimitation needs to be reassessed through the reexamination of phenotypic variation and the incorporation of molecular information as

well. Avian vocalizations are regarded as important for species delimitation, as they are involved in mate choice and can play a key role in isolating species. We analyzed intra-specific vocal variation in two passerines: the Lesser Woodcreeper (*Xiphorhynchus fuscus*, a suboscine) and the Blue-black Grosbeak (*Cyanocompsa cyanoides*, an oscine). Our objectives were to evaluate how vocal variation relates to genetic variation in species with and without song learning; and to discuss taxonomic implications, determining if vocal variation supports that at least one subspecies within each taxon should be considered as a separate species. In the Lesser Woodcreeper, we found two main types of song, one that is common to all subspecies, and one that has three geographical variants. Boundaries of these variants, subspecies and genetic clades do not fully coincide, except in the case of *X. f. atlanticus*. In the Blue-black Grosbeak, the most genetically divergent subspecies (*C. c. rothschildii*) shows clear vocal differences compared to the rest, but vocal variation among the remaining subspecies follows a clinal pattern. Thus, in both species the congruence of vocal and genetic differentiation is partial, but supports the elevation of one subspecies to the species level. Noteworthy, vocal variation showed taxonomic value in distinguishing an apparently cryptic species in both the suboscine and the oscine we studied.

Functional morphology of the avian syrinx: A comparative histological analysis of the syrinx in select passerines
Garcia, Sarah - University of Utah; Cecilia Kopuchian - Centro de Ecología Aplicada del Litoral (CECOAL)- CONICET; Matthew Fuxjager - Wake Forest University; Tobias Riede - Midwestern University; Franz Goller - University of Utah

Vocal behavior of birds is highly diverse and encompasses a broad range of acoustic features. Despite centuries of study of the morphology of the avian vocal organ, the syrinx, relatively little is known on how morphology relates to function. Histological features of the syrinx, particularly those of the labia as sound producing structures, play an integral role in phonation. The elastic properties, size, orientation, and muscular control of the labia significantly impact phonation. Here, we present data on the diversity of syringeal histological composition in the context of comparing suboscines to oscines. The current histological data describing oscine syringes indicate a positive and nonlinear correlation between vocal and histological complexity of labia. We test the hypothesis that vocal learning and vocal motor control is associated with morphological complexity. We compare histological composition across 7 oscine species and 7 suboscine species, and relate this to key acoustic variables determined by syringeal design and motor control. Various specializations characterize the syrinx of different species, suggesting a morphological basis for specific acoustic features of the respective vocal repertoires.

Reproductive senescence in three cooperatively breeding species
Garcia, Victoria - Old Dominion University; Reed Bowman - Archbold Biological Station; John Fitzpatrick - Cornell Lab of Ornithology; Walter Koenig - Cornell University; Jeffrey Walters - Virginia Tech; Eric Walters - Old Dominion University

Senescence is a decline in physiological functioning with age that can lead to reduced survival and decreased reproductive output. Patterns of reproductive senescence are not well understood, and the extent to which reproductive behaviors such as cooperative breeding mitigate or affect senescence are unknown. Here we examine patterns of reproductive senescence in three species of birds that breed cooperatively: Acorn Woodpecker, Red-cockaded Woodpecker, and Florida Scrub-Jay. Risk of mortality between the sexes, cooperative breeding system, and other factors differ among these

species. These differences suggest hypotheses about how reproductive senescence should affect each type of breeder. We found evidence of reproductive senescence in each species and sex examined, but the shape of the relationship between reproduction and age was often not as expected. Also contrary to expectations, monogamy did not confer delayed reproductive senescence in comparisons among species and females senesced earlier than males in all species. Cooperative breeding alone did not appear to delay onset of reproductive senescence, although comparisons are hindered by lack of similar studies.

Temporal changes in avian body size over the last 50 years are associated with heat dissipation in Australian passerines
Gardner, Janet - The Australian National University; Tatsuya Amano - University of Cambridge; Matthew Symonds - Deakin University; William Sutherland - University of Cambridge; Brendan Mackey - Griffith University; Anne Peters - Monash University

Changes in animal body size have been hailed as a pervasive response to contemporary climate change, alongside changes in species' phenology and distributions. Changes in size have important implications for the thermal tolerances and energetics of species, and thus for individual fitness and population persistence. Recent reviews highlight considerable variation in the magnitude and direction of size responses among species: some species are decreasing in size while others are increasing or show no change at all. Here, we characterise changes in body size of 93 species of passerine from the large and diverse Meliphagoidea using museum specimens sampled across each species' geographic range over the last 50 years. Using a phylogenetic comparative analysis, we test two climate-based hypotheses as drivers of body size responses across species using climate data characterised for each species' distribution. First, the heat dissipation hypothesis predicts that increasing temperature will be associated with declines in body size, and in accordance with this hypothesis we show that body size declines are associated with increasing mean temperature. Second, we found no support for the starvation resistence (fasting endurance) hypothesis, which predicts that increasing body size will be associated with increasing climate variability to facilitate improved capacity to carry greater body reserves and thereby endure extreme events. Our analyses illustrate how long-term museum collections can provide important insights into population responses to ongoing climate change.

Little birds, big impacts: investigating the ecological consequences of tidal-marsh sparrow extirpation from local food webs
Garey, Laura - University of Maine; Thomas Hodgman - The Saltmarsh Habitat and Avian Research Program; Dennis Anderson - University of Maine; Brian Olsen - The University of Maine

Trophic interactions are important forces for shaping the structure of ecological communities. Removing predators from a food web can produce trophic cascades where herbivores are released from predator control and overgraze vegetation. For example, the removal of insectivorous birds has been correlated to higher insect abundance and damage to plants. The saltmarsh sparrow (*Ammodramus caudacutus*) is an exclusively insectivorous songbird in Northeastern tidal marshes, but their abundance continues to decline and current estimations predict extinction in 50 years. Understanding the impact of the sparrow's absence to the tidal-marsh food web is imperative in predicting potential trophic cascades and ecological consequences of extirpation. In summers of 2014 and 2015, we conducted predator-removal experiments across the saltmarsh sparrow's range to test if the exclusion of avian predators would result in a measurable

trophic cascade. At the exclosures and paired control plots, we conducted bird, invertebrate, and plant surveys throughout summer seasons to describe spatial and temporal community changes. In locations where sparrows were excluded, we generally found higher plant biomass at the end of the growing season. In the southern-most site, however, sparrow exclusion caused a decrease in plant biomass, possibly suggesting a more complex cascade with additional trophic levels. In support of this hypothesis, the effect size, as predicted by bird density, was dampened relative to the northern sites, as predicted by trophic ecology theory for increased food-web complexity. We present invertebrate survey data as a critical test of this hypothesis.

Future directions for bird-provisioned pest control studies in conventional agricultural systems

Garfinkel, Megan - Univeristy of Illinois at Chicago; Christopher Whelan - Illinois Natural History Survey

Agricultural expansion is a major conservation threat to birds and other taxa. Paradoxically, birds may provide an important pest-removal service to farmers. Historical interest in biological control by birds waned after the advent of synthetic pesticides in the 1920's, but interest is once again increasing as people search for a sustainable way to both feed a growing population and conserve biodiversity. Most of the current research on biological control by birds in agriculture takes place in "wildlife friendly" and tropical systems, where birds have found to be effective at removing pests. However, in the US, large conventional farms comprise most of the cultivated land area. Conventional farms differ from wildlife-friendly farms in their structural, floristic, and landscape complexity and in their resulting bird communities. Nevertheless, birds may provide equally significant pest control services on conventional farms. Ecological theory suggests that the strength of top-down effects will increase with (1) increasing plant productivity, (2) little intra-guild predation, and (3) niche complementarity among predator species. Conventional farms may fit these criteria for strong top-down effects well. I address future directions for bird pest control services research, and present preliminary results from a study in conventional agriculture. More study is needed to determine the existence and/or strength of these ecosystem services in conventional agriculture, and how they are distributed within and among farms. With this information, we can determine whether some of the negative impacts of conventional farming can be reduced by encouraging birds on farms, decreasing pesticide use, and maintaining crop yield.

Estimating Male Sage-Grouse Population Abundance by Stratified-Random Sampling of Sage-Brush Spatial Units Using Lek Counts

Garton, Edward - University of Idaho; John Connelly - University of Idaho; Courtney Conway - U.S. Geological Survey, Idaho Cooperative Fish & Wildlife Research Unit

Repeated counts of displaying Sage-Grouse males are conducted at thousands of lek sites each spring but the counts are done only at known leks and are used as an index to minimum male abundance rather than to estimate true displaying male abundance. We propose recasting lek surveys within a probability sampling framework in order to obtain unbiased estimates of displaying male abundance. We demonstrate the potential of this approach through a retrospective analysis of lek surveys in Craters of the Moon National Monument and Preserve (CRMO). Repeat counts at 79 leks along 6 lek routes have been conducted for over 50 years with maximum sightings in 2015 of 672 males at 78 spatial units. We cast 2-km by 1-km spatial units along the lek routes as coming from 3 sampling strata consisting of 34 persistent lek units (with counts of 5 or more males in 3 or more of the past 5 years), 31

historic lek units (previous record of a lek) and 13 additional units of potential Sage-Grouse habitat based on results of previous surveys along these same roads. Applying estimators that treat these counts as stratified random samples from the 2724 spatial units comprising CRMO plus a 2-km buffer around the periphery yields a population estimate of 1335 male Sage-Grouse (268 SE, 90% CI 906-1763). We found no significant differences in displaying male Sage-Grouse abundance on spatial units on lek routes compared to non-lek-route spatial units in any of the 3 strata.

Transforming Citizen Science into Informative Range Maps
Gast, Laura - Penn State MGIS Program

The primary point of any map is to communicate a message to the audience. In biology and conservation sciences, we often use maps to display where a particular species is located, how a species is distributed throughout an environment, or to describe the impacts of urbanization, climate change, and other challenges. Our audiences can be highly varied as well, from novice bird-watchers using a guidebook in the field, to bioclimatologists evaluating the myriad facets of the effects of climate change on the habitat of a single species. It is becoming increasingly easy for any individual or group to create maps. Unfortunately, many of these results are poor quality cartographic products, and as such, are unable to effectively and efficiently communicate their significance. In this presentation, we will be using citizen science point data for the black-bellied whistling duck as a foundation for analysis and discussion. We will be looking at two facets of creating maps - model choices and cartographic choices - and the implications of these choices for two different audiences - amateur birdwatchers and scientists evaluating the effects of climate change on species abundance and distribution.

Foraging habitat of wading birds in an intertidal zone: are freshwater models applicable?
Gawlik, Dale - Florida Atlantic University; Leonardo Calle - Department of Ecology, Montana State University

Seasonal water level fluctuations in the freshwater Everglades control habitat and food availability for wading birds, but these relationships may not be transferable to intertidal habitat, where water levels fluctuate hourly. In the Florida Keys, the Little Blue Heron forages diurnally whereas the Great White Heron forages during both day and night. During 2011-2013 we conducted quarterly wading bird distribution surveys along extensive intertidal flats in the lower Florida Keys. In contrast to habitat models for freshwater ecosystems in South Florida, hydrologic characteristics were not the primary determinant of wading bird abundance in the intertidal zone. Moon phase corresponded to a 7-fold change in foraging abundance from quarter to full/new moons for the Little Blue Heron versus a 3-fold change in abundance for the Great White Heron. Area of available foraging habitat, driven by tidal fluctuations, was positively correlated with the foraging abundance of both species and was the second most important factor in explaining changes in abundance. Area of foraging habitat produced a 5-fold increase in abundance over the data range for the Little Blue Heron, versus a 2-fold increase for Great White Heron. Habitat availability for the Great White Heron was affected significantly by moon phase. Surprisingly, there was not a significant relationship between habitat availability and moon phase for the Little Blue Heron, a diurnal forager, suggesting that birds were responding to changes in the environment that were strongly linked to the moon phase but not to changes in habitat availability per se.

Brown pelican (*Pelecanus occidentalis*) foraging and movement ecology in the northern Gulf of Mexico
Geary, Brock - Tulane University; Scott Walter - Tulane University; Paul Leberg - University of Louisiana at Lafayette; Jordan Karubian - Tulane University

Modern developments in animal tracking technology have enabled unprecedented insights into individual-level behaviors, the proximate drivers of their movements, and the ultimate consequences of movement strategies. Seabirds have maintained consistent popularity as subjects of these studies, as they can accommodate the most current developments in bio-logging technology and often serve as valuable monitors of ecosystem health over long time periods of interest. In the northern Gulf of Mexico, brown pelicans (*Pelecanus occidentalis*) navigate a foraging landscape that is patchy and dynamic at a variety of spatial scales, due to both natural and anthropogenic stressors. The species is therefore an ideal subject through which the trophic dynamics of the Gulf, as well as the broader significance of behavioral plasticity in uncertain environments, can be understood. From 2012-present, we have attached GPS transmitters and accelerometers to breeding adult pelicans on Louisiana barrier island colonies and simultaneously monitored nesting success throughout the summers. Individuals have shown consistent variation across several foraging metrics, and cohorts have shown annual variability overall, with possible linkages to prey availability and the expansion of the Gulf hypoxic zone. Future work will combine these observations with a combination of simulation modeling, population genetics, and ecotoxicological assays to understand the relative contributions of individual foraging strategies, density-dependent resource distributions, and contaminant exposure to fitness in heavily disturbed systems. Results will also create population-level forecasts under real and hypothetical scenarios while providing unprecedented insight to the current movement ecology and demography of an ecologically important Gulf seabird.

An introduction to integrated population models in avian biology
Gebreselassie, Fitsum Abadi - University of the Witwatersrand

Understanding the population dynamics of species is crucial in designing efficient management and conservation actions. This indeed requires reliable and accurate estimate of demographic parameters such as survival and fecundity. The recently developed integrated population models (IPMs) allow a single, coherent analysis of demographic data and population counts to estimate demographic parameters and to determine the potential factors driving variation in those parameters. In this talk, I will present an overview of IPMs and illustrate the benefits of IPMs using results from a simulation study. I will also demonstrate the potential of IPMs to study the population dynamics of different bird species including little owl (*Athene noctua*), peregrine falcon (*Falco peregrinus*), and two long-distance migratory birds, Hoopoe (*Upupa epops*) and Wryneck (*Jynx torquilla*).

Reducing Avian Collisions with Communications Towers
Gehring, Joelle - Federal Communications Commission

Scientists estimate that each year 6.8 million birds, primarily Nearctic-Neotropical migrants, collide with U.S. and Canadian communications towers during migration. Weather, tower location, height, lighting, and tower support system influence the numbers of avian collisions. Tall, guyed towers with non-flashing lights located in areas with low visibility weather conditions and high bird concentrations are involved in significantly more bird fatalities than short, unguyed, unlit towers sited in areas with clear weather and

low migratory bird concentrations. The Federal Aviation Administration recently changed their tower lighting recommendations to systems that eliminate non-flashing lights, reduce tower lighting and maintenance costs to the industry, and reduce migratory bird collisions by as much as 70%. These lighting changes can be accomplished at almost no cost to the tower owner and they reduce maintenance and energy costs long term. Extinguishing non-flashing lights on existing towers and excluding them from future constructed towers is one of the most effective and economically feasible means of achieving a significant reduction in avian fatalities at communications towers. Education of the industry and natural resources agencies is critical to implementation on existing towers. Tower application reviews should include these more bird-friendly options.

Do environmental conditions experienced in flight affect flight metabolism, body condition at stopover, and refueling rate?
Gerson, Alexander - University of Massachusetts, Amherst

Each year, migratory birds travel long distances between their breeding and wintering grounds by completing a series of long distance flights, each followed by a period of stopover. Migratory birds fuel these long flights almost entirely with fat, but it has become apparent that protein is also used as a metabolic fuel during flight resulting in dramatic reductions in organ and muscle mass and function after flights, placing a physiological constraint on stopover refueling. Yet, until recently we did not know if the rate of protein catabolism is modulated in response to extrinsic factors, or is simply a by-product of sustained fat catabolism. Since the catabolism of protein yields 5-times more water then the catabolism of fat, protein catabolism may be modulated to offset high rates of water loss during flight. Here we present evidence that supports this hypothesis – providing a direct link between environmental conditions experienced aloft with the rate at which functional tissues are catabolized in flight. Therefore, conditions experienced during flight could profoundly influence physiological processes critical during stopover. Using non-invasive quantitative magnetic resonance body composition analysis, we investigated how overnight temperature influences body condition and refueling rate of migratory songbirds during stopover. High overnight temperatures resulted in lower lean mass and low refueling rates, which could extend stopover durations and delay migrations. These findings emphasize the need for a more thorough understanding of the environmental physiology of migratory birds in order to more fully understand proximate and direct consequences of climate change.

Differential use of hyperthermia as a thermoregulatory strategy in birds exposed to high temperature.
Gerson, Alexander - University of Massachusetts, Amherst

Desert dwelling birds regularly experience air temperatures far in excess of body temperature; conditions that impose a substantial thermoregulatory challenge. In order to thermoregulate under such extreme conditions, desert birds have evolved a suite of behavioral and physiological strategies. One such strategy is the use of hyperthermia – the regulated increase in body temperature above resting levels. It was the goal of this study to investigate the use of hyperthermia and its potential benefits to thermoregulation among a number of desert birds ranging in size from 7 g to 150 g. Resident desert birds were captured during summer and were exposed to temperatures typical of desert habitats (30°C up to 60°C) while metabolic rate and evaporative water loss were measured using flow through respirometry. Body temperature was continuously monitored using implanted temperature sensitive PIT tags. We found the use of hyperthermia depended greatly on air

temperature, body size, and the evaporative strategy used. Species that primarily utilize cutaneous evaporation maintained much lower body temperatures, metabolic rates, and rates of water loss and were able to maintain much greater gradients between Tb and Ta than birds that rely primarily on respiratory evaporation. The use of hyperthermia by birds that rely primarily on respiratory evaporative water loss may have evolved as a means to increase respiratory evaporative water loss rates, without concomitant increases in breathing frequency and metabolism. However, these species must also deal with the potential detrimental effects of high Tb.

Full life cycle population model for an imperiled migratory shorebird suggests variable associations between winter habitat conditions and breeding season survival

Gibson, Dan - Virginia Tech; Dan Catlin - Virginia Tech; Melissa Bimbi - USFWS; Francie Cuthbert - University of Minnesota; Vincent Cavalieri - USFWS; Meryl Friedrich - Virginia Tech; Chelsea Weithman - Virginia Tech; Kelsi Hunt - Virginia Tech; Alice Van Zoeren - University of Minnesota; Jim Fraser - Virginia Tech

Assessment of demographic processes for migratory species can be difficult as migrants often use spatially distinct seasonal habitats and it is difficult to establish the relative importance of seasonal habitats on population dynamics. For imperiled migratory species, such as piping plovers, recovery efforts are focus on increasing productivity on the breeding grounds; however, decreased survival during winter may offset gains from breeding season productivity. Currently little information exists regarding how winter conditions influence plover demography and population sustainability. We have developed a full life-cycle population model to estimate multiple demographic rates using winter resights, and counts of marked and unmarked individuals in coastal South Carolina and Georgia, supplemented by resights throughout the breeding range. We estimated that individuals were available, and susceptible, to the conditions of wintering grounds for 4.5 months. Monthly overwinter survival was, on average, high and constant across space and time (0.86), except under during extreme weather events (0.65). We found that winter temperatures were associated with immediate overwinter survival, apparent annual survival was far more sensitive to winter temperatures, which suggested a potential carry-over effect of winter conditions on survival during the breeding season. Annual survival and influence of winter temperature on survival, varied related to the breeding population an individual was associated with, which suggested that the Atlantic Coast (ϕa =0.54; $\beta temp$=0.61) and Great Lakes (ϕa =0.58; $\beta temp$=0.83) breeding populations had lower annual survival and substantially more sensitive to poor winter conditions than individuals from the Great Plains (ϕa =0.75; $\beta temp$=0.23) breeding population.

Factors Influencing Nest Survival of White-tipped Doves in the Lower Rio Grande Valley, Texas

Giese, Jordan - Tarleton State University; Heather Mathewson - Tarleton State University; T. Wayne Schwertner - Tarleton State University; Jeff Breeden - Tarleton State University

The White-tipped Dove (*Leptotila verreauxi*) is a sedentary gamebird whose northernmost range extends into the Lower Rio Grande Valley (LRGV) of south Texas. Little research has been devoted to the species' nest ecology, predation, and survival. In the LRGV, White-tipped Doves nest in both citrus agriculture and native woodland habitats. The objectives of this study were to investigate the impact of habitat and land use variations on nest survival and to identify nest predators. During the summers of 2015 and 2016, we conducted nest searches and placed camera systems on a subsample of

nests to determine causes of nest failure. Real-time, infrared emitting cameras allowed for 24 hour monitoring of nests. We employed AIC model selection to determine what environmental variables predicted nest survival. In 2015, we located 21 dove nests and placed camera systems on 10 nests. All nest failures were attributed to predation (n=9). Of the five predator species identified by video surveillance, Green Jays (*Cyanocorax yncas*) were the most common predator of White-tipped Dove nests. Nest concealment parameters made up the entirety of our top three models. There was no difference in nest survival between habitat types. The presence of camera systems was not among our top models (AICcWt=0.01). We observed a nestling stage lasting up to 15 days post-hatch, revealing a possible bias in previous nest survival studies that estimated fledging after 10 days. Our use of nest monitoring and video surveillance has provided new information on White-tipped Dove nest ecology in the LRGV.

Conservation value of tropical agroecosystems to migratory and resident birds in the Guatemalan Highlands

Gifford, Gemara - Cornell University; Amanda Rodewald - Cornell University; Wesley Hochachka - Cornell University; Viviana Ruiz Gutierrez - Cornell Lab of Ornithology

Reconciling agricultural production with conservation is an increasingly complex task, especially in regions where high levels of biodiversity and poverty converge. Although empirical support for diverse farmland-forest landscapes continues to grow, most studies have been restricted to few species or a single time frame. We studied the relative ability of Q'eqchi' Mayan agroecosystems to support 15 resident, endemic, and migratory birds during breeding and non-breeding seasons in the Alta Verapaz Highlands of Guatemala, a region known for its remarkable biocultural diversity. Specifically, we examined local and landscape-level use of three forest and three non-forest habitats (monocultures, polycultures, shade coffee, pine plantations, secondary forest, and primary cloud forest). We identified habitat associations of individual species using separate single-species, single-season occupancy models. In general, focal species responded strongest to structural diversity and forest cover within the landscape. Neotropical migrants showed high use of simple habitats (monocultures, semi-shade coffee), compared to forest residents with high use in complex habitats (i.e. polycultures, cloud forest) and a higher proportion of forest in the matrix. However, seasonal patterns of habitat use by several forest-dependent birds might suggest that specialization is higher in the breeding season. As a whole, our findings indicate that the conservation value of agroecosystems can be improved by retaining >20% canopy cover in farms and >60% in forests, maintaining 150-550 trees/ha, protecting epiphytes, and managing landscapes for 25-40% forest within the matrix. Efforts to plant fruit trees and diversify food systems are thus likely to restore or enhance avian habitat within agroecosystems.

Advancing grassland bird conservation at the ecoregional scale

Giocomo, James - Oaks and Prairies Joint Venture - American Bird Conservancy

Grassland bird population declines in North America are largely driven by degradation and conversion of functioning grassland ecosystems for agriculture and urban development. In an effort to address declines in the grasslands of Oklahoma and Texas, a number of governmental agencies and Non-Governmental Organizations have partnered through the Oaks and Prairies Joint Venture (OPJV) to more strategically and collaboratively deliver conservation actions. The OPJV partners work together by implementing a fully integrated Strategic Habitat Conservation framework that works at multiple scales to conduct biological planning,

landscape conservation design, habitat tracking and population monitoring in support of conservation efforts for a variety of bird and pollinator species that depend on healthy grasslands. The OPJV partners put together a grassland bird conservation business plan with four main conservation strategies to be implemented in seven focal regions consisting of clusters of 2-8 counties. The main conservation delivery strategy is the Grassland Restoration Incentive Program (GRIP) which since it was created in 2013 has improved habitat for grassland wildlife on over 60,000 acres (24,000 Ha) of working lands in focus areas in the OPJV geography. GRIP is accompanied by a full complement of conservation delivery strategies that support prescribed burning associations and other landowner cooperatives, utilize market-based conservation delivery strategies, and implement strategic outreach. Finally, the effort is supported by over 4,000 point counts annually. Combining the efforts of multiple partners ties the range-wide population and habitat objectives with on-the-ground conservation actions for grassland birds.

The Conservation of Upland Forest in West-Central Nicaragua: "El Nisperal" Coffee Farm as a Case Study
Gladstone, Sarah - Finca El Nisperal and Private Wildlife Reserve; **Jack Hruska** - University of Kansas

The "El Nisperal" farm and private wildlife reserve, located in the Sierras de Managua hills in west-central Nicaragua, has produced organic coffee under native forest canopy for 20 years. This management style has maintained a 70 hectare refuge for over 150 species of birds, and for the habitat components and food sources that support them. The farm is embedded in over 50,000 contiguous hectares of habitat similarly composed of shade-coffee farms, which provide a large-scale habitat block for overwintering and for stopover sites for neotropical migrants. The Smithsonian Migratory Birds Center's Bird-Friendly seal has permitted our coffee to enter a differentiated and significantly higher-paying market aimed at the conservation of birds. The income from this more valuable coffee sustains the farm and allows us to improve and protect habitat from surrounding threats and to resist more lucrative land-use opportunities that would destroy forest. We hope that an expansion of such an opportunity to the rest of the forest still preserved in the Sierras de Managua, will sustain this most important resource for neotropical migrants and resident species of birds.

Rapid evolutionary change of introduced forest birds on the Hawaiian island of Oahu
Gleditsch, Jason - University of Illinois Urbana-Champaign; Jinelle Sperry - Engineer Research and Development Center, US Army Corp of Engineers

Rapid evolutionary change is a common phenomenon that occurs across all types of life. Introduced species in particular can express very rapid divergence from their native ranges that can be intensified when species are introduced onto islands. Many island ecosystems are characterized by high rates of species turnover and species introductions. The Hawaiian island of Oahu has suffered a great number of extinctions and extirpations of native avian fauna resulting in an almost completely non-native forest bird community. By comparing museum specimens to wild birds, we described the morphological divergence of five potentially ecologically important non-native forest birds. We found significant divergence between Oahu populations and that of their native range in three of the five species. The species that have diverged significantly were among the earliest introductions and had characteristics that were between one and ten percent different from their native range. By looking at the change in these characteristics over time on Oahu and their native range we determined

that some of the diverged characteristics may have underwent adaptive change. Interestingly, some characteristics showed evidence of founder effects and not all diverged characteristics were due to adaptive change. The five species we selected may fulfill critical seed disperser roles on an island where all native seed dispersers have been extirpated. Since rapid evolutionary change happens within ecological time, it can influence ecological processes, like seed dispersal, and therefore influence ecosystem stability and regeneration.

Rangewide assessment of the influence climate change on lesser prairie-chicken population persistence

Godar, Alixandra - Texas Tech University; Blake Grisham - Texas Tech University; Beth Ross - U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research; Clint Boal - Texas Tech University/U.S. Geological Survey Texas Cooperative Fish and Wildlife Research Unit; Sarah Fritts - Texas Tech University; Cody Griffin - Texas Tech University; Christian Hagen - Oregon State University; David Haukos - U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, Department of Biology, Kansas State University; Michael Patten - Oklahoma Biological Survey, University of Oklahoma; Jim Pitman - Western Association of Fish and Wildlife Agencies

Integrated population models allow researchers to simultaneously assess multiple vital rates, and their drivers, on population trends. The lesser prairie-chickens (*Tympanuchus pallidicinctus*) has been a species of conservation concern for greater than two decades. Previous research on the species has indicated that variation in weather conditions affect temporal trends in vital rates; however, minimal effort has been made to include this variation into population models. To address this question, we developed an integrated population model to assess the effect of contemporary weather patterns on female survival, brood survival and nest survival to facilitate the development of forecasting long-term population trends, given climate change forecasts for the Great Plains. We collected data in the four geographic ecoregions across the five-state distribution of lesser prairie-chickens: the short-grass prairie (2013–2014), the sand sagebrush (*Artemisia filifolia*) prairie (1997–2002), the sand shinnery oak (*Quercus havardii*) prairie (2000–2011), and the mixed-grass prairie (2013–2014). We selected three weather parameters for each vital rate by ecoregion using model-model selection from numerous a priori models developed in Program MARK. We then inserted the weather parameters and survival data into the Bayesian joint-function and calculated reproductive rates, survival rates and lambda from 1995 to 2099 based on climate projections. Preliminary results suggest weather influences vital rates disproportionately among the four ecoregions, and climate change is likely to have a greater negative effect lesser prairie-chicken populations in sand shinnery oak prairies compared to the other three ecoregions.

SRY Mice: Genetic approaches to controlling invasive rodent populations on islands

Godwin, John - North Carolina State Univerity; Megan Serr - North Carolina State University; Caroline Leitschuh - North Carolina State University; Gregory Backus - North Carolina State University; Dona Kanavy - North Carolina State University; David Threadgill - Texas A&M University

Invasive rodents have devastating effects on island biodiversity. Although islands account for less than 5% of the earth's land area, they are home to 20% of bird, reptile and plant species. Because of unique characteristics and vulnerabilities of their native faunas, islands have also been the site of 69%, 90%, and 95% of all extinctions of mammals,

reptiles, and birds, respectively. The best current approach to eradicating invasive rodents on islands is through large scale, blanket coverage with rodenticides. Despite very important contributions to biodiversity conservation, this approach also presents key challenges including expense, off-target effects and complexities of application on inhabited islands. This talk will describe a collaborative effort to assess the potential for transgenic technologies to reduce and eliminate invasive rodent populations on islands. Our studies are focused on house mice, which represent a significant threat to biodiversity on many islands while also being genetically tractable model systems. Our studies are focused in several areas. Inserting the male sex-determining gene sry into a naturally occurring selfish genetic element, the t-allele, should produce close to 100% male offspring sex ratios. Companion studies are aimed at assessing the characteristics necessary for male success in competitive mating situations using mice derived from Farallon Islands founders, where wild house mice threaten Ashy Storm Petrels. Finally, mathematical modeling is addressing release strategies to produce reductions in mouse populations. Current rodent control technologies have important limitations and transgenic approaches may present a more effective and targeted alternative to protect island biodiversity.

A decade of advances in Black-capped Petrel (*Pterodroma hasitata*) Research and Conservation

Goetz, James - Dept. Nat. Resources, Cornell University; Adam Brown - Environmental Protection in the Caribbean; Ernst Rupp - Grupo Jaragua; Anderson Jean - Société Audubon Haiti; Matthew McKown - Conservation Metrics; Patrick Jodice - USGS South Carolina Cooperative Fish & Wildlife Research Unit, Clemson University; George Wallace - American Bird Conservancy; Jennifer Wheeler – BirdsCaribbean

The Black-capped Petrel is an endangered Caribbean endemic confirmed to nest only on Hispaniola. Over the past decade, the International Black-capped Petrel Conservation Group has united a diverse collective of researchers and conservationists to dramatically increase knowledge of this enigmatic species. From 2006-2010, aural surveys confirmed populations at historic sites on Hispaniola. Radar surveys from 2012-14 quantified petrels in flyways and confirmed relative population estimates between sites. sOn Dominica in 2015, we detected 968 petrels with radar, and 8 visually, providing evidence for nesting petrels, although 10 field days in 2016 failed to confirm nesting there. On Jamaica in 2016, radar detected 6 targets, suggesting a small population, but leaving unanswered which *Pterodroma* species might nest there. Autonomously recorded calls show promise for developing count indices at nesting sites. In 2011 we monitored the first nests for this species; over 4 years success was 70-77% (N=47 nests). Abandonment and predation cause most failures. In 2015, data from satellite tags on three adult petrels on Hispaniola showed frequent use of the Caribbean Sea during chick-rearing, shifting post-breeding to continental shelf waters off the Carolinas, and the eastern edge of the Gulf Stream. The greatest threat is deforestation for agriculture at Massif de la Selle, Haiti, which may harbor ≥75% of the global population. Fatal attraction to lights, (fires, cities, communication towers) is an additional serious threat. Current conservation efforts include: 1) outreach and environmental education; 2) nest monitoring, exploring new sites, and 3) planning using Open Standards for Conservation.

When is additional shorebird habitat most needed in California's Sacramento Valley?

Golet, Greg - The Nature Conservancy; **Mark Reynolds** - The Nature Conservancy; Candace Low - San Francisco State University; Katie Andrews - The Nature Conservancy; Simon Avery - The Nature Conservancy; Julia Barfield - The Nature Conservancy; Laura Jensen - Sacramento San Joaquin Delta Conservancy; Sandi Matsumoto - The Nature Conservancy; Chris McColl - The Nature Conservancy; Paul Spraycar - The Nature Conservancy; Karen Velas - The Nature Conservancy; Jordan Wellwood - The Nature Conservancy

In the Sacramento Valley, much of the historic wetland area is now planted in rice (*Orza sativa*). When winter flooded this crop serves as critical surrogate habitat—some years providing 85% of the total wetland area. Rice fields provide suitable shallow habitat conditions for shorebirds during initial floodup and when being drawn down; however, the timing of these events may not coincide with the needs of shorebirds, and optimal habitat conditions may be short-lived. To enhance habitat we launched BirdReturns, a program that incentivizes farmers to create shallow-water habitat before and after the traditional winter flooding season. To test the value of this habitat, we monitored enrolled and unenrolled fields. Enrolled fields were highly successful in attracting shorebirds. The greatest added value of the created habitat came in late August and September when shorebird densities in enrolled fields were the highest of the entire year, despite fewer shorebirds being in the region relative to some other times. Our data suggest a large amount of shallow water habitat is available in February, but habitat limitations may present themselves in March and April. Although we did not find significant differences in shorebird density, richness or diversity between enrolled and unenrolled fields in January, densities in the subset of flooded fields that were shallow were among the highest recorded. This suggests that although there is a great deal of flooded habitat in the Sacramento valley during mid-winter, there may be a shortage of habitat at appropriate depths for shorebirds.

Metabarcoding and compound-specific stable isotope analysis of amino acids reveal how diet shapes the migratory strategies of birds

Gomez, Camila - Universidad de Los Andes; Astrid Ibañez - Universidad de Los Andes; Brian Popp - Department of Geology & Geophysics, University of Hawaii; Keith Hobson - Environment Canada; Daniel Cadena - Universidad de Los Andes

Diets of migratory animals can reveal intricate relationships between ecological and evolutionary aspects of migratory behavior. Despite the importance of diet in the success of migration, there is still little information about the diet of Nearctic-Neotropical birds and much less about the effects of diet on their migratory strategies. Recent technological advances allow for a detailed study of animal diets which is unprecedented. In this study we use high throughput sequencing and Metabarcoding, in particular the recognition of unique short DNA sequences in mixed samples, which allows identification of prey items in fecal samples that may not be detectable visually. Similarly Amino Acid carbon and nitrogen Compound-Specific Isotope Analysis (AA–CSIA) from animal tissues is used to trace the dietary origins of amino acids and to derive relative trophic position without the need to document the isotopic composition at the base of the food web. Results of AA–CSIA in tissues with different turnover rates has the potential to track diet and trophic position of migratory birds associated with different periods of the annual cycle. We used a combination of metabarcoding and visual inspection of fecal samples, and AA-CSIA from feathers, blood and claw of the Gray-cheeked Thrush (*Catharus minimus*), to describe long-term dietary shifts and explore how diet

composition affects the migration strategy of this species during a critical spring stopover in Colombia. The combination of diverse analytical methods represents a new era in investigations of evolutionary constraints on many migratory birds and their conservation throughout the annual cycle.

A coordinated radio-telemetry system tracks the intercontinental flights of migratory songbirds

Gomez, Camila - Universidad de Los Andes; Nicholas Bayly - SELVA: Investigacion para la conservación en el Neotrópico; Stu Mackenzie - Bird Studies Canada; Philip D Taylor - Acadia University; Keith Hobson - Environment Canada; Daniel Cadena - Universidad de Los Andes

Tracking animals across space and time is essential to integrate information from throughout their life cycle, with the goal of understanding ecological processes, population dynamics, and ultimately ensuring species conservation. Radio-telemetry has long been used to study animal movements, and although it has typically been restricted to small spatial scales, automated radio-telemetry systems have greatly increased the scale at which detections are possible. We report on the first intercontinental detections of migratory birds using automated radio-telemetry. Thirty-six Gray-cheeked Thrush (*Catharus minimus*) migrating through northern Colombia were fitted with radio-transmitters to determine stopover durations and migration pathways. After a mean stopover in Colombia of 13 days, 14 individuals were detected by at least one automated receiving station in North America, primarily within a narrow corridor in the state of Indiana, USA, ~3400 km from the tagging site. One individual was detected as far north as Hudson Bay, Manitoba, Canada, >5000 km from Colombia. Migration rates varied between 121 – 982 km/day, some of the fastest recorded for migratory landbirds. Our results confirmed predictions that this species can cover distances >3000 km on leaving Colombian stopover sites and reveal how information on routes and stopover regions of small migratory animals can be achieved through coordinated continental-scale telemetry systems.

Deterministic turnover of tropical bird communities along a steep rainfall gradient

Gomez, Juan Pablo - University of Florida; Jose Miguel Ponciano - University of Florida; Scott Robinson - Florida Museum of Natural History

One of the main goals of community ecology is to understand the influence of the abiotic environment on the abundance and distribution of species. It has been hypothesized that dry forests are harsher environments than wet forests, which leads to the prediction that environmental filtering should be a more important determinant of patterns of species abundance and composition than in wet forest, where biotic interactions or random assembly should be more important. We attempt to understand the influence of rainfall on the abundance and distribution of bird species along a steep precipitation gradient in an inter-Andean valley in Colombia. We gathered data on species distributions, abundance, morphological traits and phylogenetic relationships to determine the influence of rainfall on the taxonomic, functional and phylogenetic turnover of species along the Magdalena Valley. We demonstrate that there is a strong turnover of community composition at the limit of the dry forest. The taxonomic turnover is steeper than the phylogenetic turnover, suggesting that replacement of closely related species accounts for a disproportionate number of changes along the gradient. We found evidence for environmental filtering in dry forest as species tend to be more tolerant of higher temperature ranges, stronger rainfall seasonality and lower minimum rainfall. On the other hand, wet forest species tend to compete actively for nest space but not for

the resources associated with the axes we measured. Our results suggest that rainfall is a strong determinant of community composition when comparing localities above and below the 2400 mm rainfall isocline.

Migratory connectivity of the Canada Warbler unveiled using stable isotopes analysis of feathers

Gonzalez, Ana - University of Saskatchewan; Nicholas Bayly - SELVA: Investigacion para la conservación en el Neotrópico; Gabriel Colorado - Universidad Nacional de Colombia sede Amazonía; Keith Hobson - Environment Canada

Determining the origins of migratory species from across their non-breeding grounds is a question of critical importance in order to understand their full life-cycle ecology, model population dynamics and determine conservation priorities. We determined migratory connectivity in the Canada Warbler (*Cardellina canadensis*), a declining Neotropical migratory bird, and evaluated the degree to which the Andean mountains influence winter population structure in this montane forest specialist. We inferred breeding and natal origins of Canada Warblers overwintering in seven study sites across the Colombian Andes by analyzing stable hydrogen isotope values (δ2H) in feathers and assigning wintering populations to breeding origins using an established feather δ2H isoscape for North America. We found strong evidence for parallel migration between breeding and wintering sites, giving rise to moderately strong migratory connectivity between distinct breeding and wintering regions. The model best explaining population structure in the Colombian Andes implied that populations were most similar within valleys, which gave rise to differential usage of the three Andean ranges in Colombia. Over 50% of individuals overwintering in the Western Andes were assigned to the northwest of their breeding range, and over 80% of individuals overwintering in the Eastern Andes originated from the southeast of their breeding range. The strength of migratory connectivity found in Canada Warblers may inhibit evolutionary responses to environmental change, and the more rapid population declines recorded in eastern breeding populations may be related to steeper rate of habitat loss in the Eastern Andes, where individuals from these populations were more likely to overwinter.

Energetic importance of forest vs shade-grown coffee as winter habitat for Neotropical migrants

Gonzalez, Ana - University of Saskatchewan; Nicholas Bayly - SELVA: Investigacion para la conservación en el Neotrópico; Keith Hobson - Environment Canada

The Northern Andes of South America are an exclusive wintering area for several Nearctic-Neotropical migratory species; however, over 90% of this region has been deforested. Population declines in the Canada Warbler (*Cardellina Canadensis*) and other Nearctic-Neotropical migrants that spend the non-breeding season in South America are often associated with habitat loss and deterioration on the wintering grounds. Unprecedented rates of habitat loss have led to consider shade-grown coffee plantations as being the only suitable habitats left for Neotropical migrants in this region since many Neotropical migrants are known to use shade coffee during winter. Yet, our understanding of the suitability of shade grown coffee vs native forest as winter habitat for Neotropical migrants is limited. We studied overwinter mass changes in Canada Warblers overwintering in three montane forest and three shade coffee plantations in the western slope of the east Andean Cordillera of the Colombian during three winter periods (2013, 2014, 2015). Capture-recapture data indicated that birds gained condition in shade coffee and forest in two of the study sites, and condition decreased slightly over the season in both habitats in the third site. Our results provide evidence of the similarity of shade coffee plantations and native forest as

overwintering habitats for Canada Warblers. Shade coffee plantations have been rapidly disappearing with more than 60% of shade coffee being converted to sun coffee in Colombia alone. Conservation strategies would benefit of initiatives that incentive the maintenance of shade-coffee plantation over the Canada Warbler winter range.

The gift that keeps on giving: using Motus tags on wintering migrant birds in Colombia

Gonzalez, Ana - University of Saskatchewan; Nicholas Bayly - SELVA: Investigacion para la conservación en el Neotrópico; Stu Mackenzie - Bird Studies Canada; Keith Hobson - Environment Canada

Neotropical migratory bird populations have seriously declined in recent decades and those that overwinter in South America are declining at greater rates than those wintering elsewhere. Habitat loss and deterioration on the wintering grounds is a likely contributing factor but knowledge about overwinter habitat use by long-distance migrants is limited. We used radio telemetry to study the movements of 33 Canada Warblers (*Cardellina Canadensis*), 104 Swainson's Thrushes (*Catharus ustulatus*), and eight Gray-cheeked thrushes (*Catharus minimus*) overwintering in native forest and shade-grown coffee plantations in Colombia, South America, during the winters of 2014 and 2015. Mean spring departure date for Swainson's Thrushes was April 18th; birds in forested habitats departed an average of one day later than birds in shade-grown coffee plantations. Canada Warbler mean spring departure was April 19th; and birds in forest departed four days earlier (April 16th) than birds in shade-grown coffee. In addition to useful habitat data acquired on the wintering grounds, the Motus Wildlife Tracking system broad-scale array also provided "recoveries" of several of our wintering birds en route to their breeding grounds. Thus, in contrast to conventional radio tracking, using tags that can be intercepted elsewhere provides an additional benefit for studies of wintering migratory birds.

Exploring the habitat characteristics and landscape patterns on terrestrial bird assemblages in Cuban archipelago

Gonzalez, Hiram - Instituto de Ecología y Sistemática, Ministerio de Ciencia de Investigaciones Tecnología y Medio Ambiente; Carlos A. Mancina - Institute of Ecology and Systematic

The relationship of habitat and landscape structure to bird assemblages is critical to achieving effective conservation and management. This study aimed to determine the role of habitat characteristics and landscape structure using species richness and capture rates in woodland bird assemblages in the Cuban archipelago. Birds were sampled during 24,776 mist-net hours, complemented with count points from 27 localities across the Cuban archipelago during several winter residence seasons of birds. Survey sites comprised fragmented evergreen and semi-deciduous forest, and pine and mangrove forests. We determined the relationship of ecogeographical variables and landscape metrics with species richness and capture rate of resident, migrant, and total birds using a geographical information system. The predictor variables were extracted from circular buffers. A total of 101 forest bird species (44 residents, 57 Nearctic migrants) were recorded in the study areas. The mean bird richness was 37.5 (range 27 to 57 species) and mean capture rate was 0.97 birds/100 mist-net hours. Seven neartic and four resident bird species were found in almost all the sampled localities. Three resident species and four migrant had the highest rates of capture. We found a multivariate regression with the overall species richness and resident richness; however, we detected no such relationship with migrants. Capture rate was highest in localities with low elevation and near coasts. Our results showed that edge density and

mean patch size were the most important landscape metrics across bird assemblages. The highest bird species richness occurred in landscapes comprising moderately fragmented forest habitat.

A Natural Pair: Zoo Professionals and Ornithologists Working Together to Save Local Bird Populations

Good, Shane - Akron Zoo; Kimberly Cook - Akron Zoo

The 230 AZA-accredited zoos and aquariums and their 180 million annual visitors represent to ornithologists a great partnering opportunity to save local bird populations. Together we can assemble both professional and citizen-scientists, identify threats to local bird populations, develop action plans, raise resources and engage the public. At the Akron Zoological Park, conservation is a central theme in our mission, and we work to educate and empower our zoo audience, volunteer base, and conservation partners to protect local bird populations. The Akron Zoological Park partners with the Greater Akron Audubon Society by engaging citizen-scientists in the annual Christmas and Summer Bird Counts, and by providing speakers at Audubon meetings. Our “Birds of Ohio” aviary is themed around teaching zoo visitors what they can do for wildlife in their own backyards, and teaching them about the wonderful species of birds that exist in their own neighborhoods and woodlots. An instructive course on birding is offered at the zoo on a semi-annual basis. Additionally, the Akron Zoological Park works with a professional ornithologist and students from Hiram College in Ohio on bird banding, student research projects, and the management of the Hiram College Duck House that teaches students avian husbandry. The Akron Zoological Park and other zoological institutions can assist ornithologists by housing post-research birds, and by consulting on potential husbandry issues in research populations.

Time-Activity Budgets of Stiff-Tailed Ducks in Puerto Rico

Goodman, Nickolas - West Virginia University; Jack Eitniear - Center for the Study of Tropical Birds, Incorporated; James Anderson - West Virginia University

Northern Ruddy Duck (*Oxyura jamiacensis jamaicensis*), West Indian Ruddy Duck (*Oxyura j. jamaicensis Gmelin*), and Masked Duck (*Nomonyx dominicus*) are stiff-tailed ducks found in Puerto Rico. These duck taxa are often found in the same wetland and have similar niches, yet little is known about their behavior, habitat use, and niche partitioning. Time-activity budgets are useful in collecting this information. We collected 24 hour time-activity budgets on each taxa of stiff-tailed duck in Puerto Rico from January to May 2015 and 2016 by observing them for 5 consecutive minutes and recording a behavior activity every 10 seconds. The behavioral activities were classified using 8 categories: (1) Aggression, (2) Feeding, (3) Inter-dive loaf, (4) Resting, (5) Locomotion, (6) Courtship, (7) Comfort movement, and (8) Sleeping. We tested these 8 activities using a MANOVA for differences among taxa, between sexes, and among sampling times (3 diurnal and 3 nocturnal). We collected a total of 5,338 behavioral observations: Northern Ruddy Duck (n=1,401), West Indian Ruddy Duck (n=3,795), and Masked Duck (n=142). Our results indicate that all activities except aggression and rest differed among taxa, all activities except inter-dive loaf and aggression differed with sampling times, and all activities except locomotion and sleep differed between sexes ($P < 0.05$). The most common activity varied by taxa: Masked Duck (rest; 26.97% and feeding; 26.16%), Northern Ruddy Duck (sleep; 30.14% and rest; 28.65%), and West Indian Ruddy Duck (rest; 30.31% and sleep; 23.34%). The 3 taxa of stiff-tailed ducks behave differently and have separate feeding locations within wetlands.

Introduction to the symposium: Identifying unifying factors driving bird population declines: are life history traits all that matter?

Gow, Elizabeth - University of British Columbia

Globally, numerous avian species are declining. The factors influencing those declines are complex. Ornithologists have long sought to group birds based on species traits such as phylogenetic relatedness, plumage, habitat use, and behavior. Conservation biologists have similarly sought to identify unifying factors grouping species that share vulnerabilities to perturbations and, consequently, exhibit similar population trajectories. In this era of global change, traits associated with vulnerability to global warming, deforestation, and agricultural expansion may provide a convenient method of grouping species for conservation prioritization and management. But do these species groupings provide valuable insights or obscure underlying species-specific variation? As many migratory species exhibit different traits and behaviors across their annual cycles, at which stage(s) should unifying factors be assigned? I will introduce the symposium, “Identifying unifying factors driving bird population declines: are life history traits all that matter?”, by briefly discussing why this topic is relevant to ornithologists, conservationists and the general public. I will review some potential unifying factors, mentioned above, that may be used to group species. Such as, habitat use (from macro to micro scales), migratory strategies, overwintering location, diet, foraging behavior, nest type and location, dominant predators, and physiology. Finally, I will introduce the goals we hope to achieve through this symposium and the general topics that will be covered.

Parental feeding effort in relation to extra-pair mating and inbreeding: insights from a genetic pedigreed island population of song sparrows

Gow, Elizabeth - University of British Columbia; Jane Reid - University of Aberdeen; Peter Arcese - University of British Columbia

Given a cost to parental care, and potential for trade-offs in current and future investment in reproduction, theory suggests that there is a negative relationship between the rate of cuckoldry and male parental care. However, theoretical models about parental care are based on the assumption that two parents are unrelated and offspring share half of each parent’s genes thus, degree of inbreeding of social mates is often overlooked in studies on parental care. Using feeding rate data from 2003, 2007 and 2008 of a genetic pedigreed population of song sparrows (*Melospiza melodia*) breeding on Mandarte Island, British Columbia, we tested the hypotheses that male, song sparrows adjust their feeding rate in response to either the fraction of extra-pair offspring in a brood or, a new metric, ‘parental kinship difference’, indicating parental relatedness to the brood. In addition, we examined whether the degree of inbreeding influenced feeding effort. Males fed at lower rates to broods with more extra-pair offspring or a higher parental kinship difference, supporting the hypothesis that parents invest more in related young. Parents did not alter their feeding rate with their degree of inbreeding. These results suggest males may be able to assess their certainty of paternity and adjust their feeding effort accordingly.

Immigrant song: Dispersal, cultural diversity, and song variation in duetting male and female tropical birds

Graham, Brendan - University of Windsor; Daniel Heath - University of Windsor; Ryan Walter - California State University, Fullerton; Daniel Mennill - University of Windsor

A fundamental hypothesis about song learning behaviour of birds is that young birds learn songs in their natal areas. When individuals disperse to breed outside of their natal areas, they will introduce new songs into their breeding areas. We tested this hypothesis in a tropical bird, the Rufous-and-white Wren (*Thryophilus rufalbus*), where both sexes produce learned songs. We collected blood from 146 adult wrens from three populations in northwestern Costa Rica. We genotyped individuals at 10 polymorphic microsatellite loci, and identified first-generation migrants using partial Bayesian genotype assignment. We quantified acoustic variation by comparing song sharing, repertoire novelty and fine-scale acoustic structure between first-generation migrants and residents. We found significant population-level differences in singing behaviour and acoustic structure of songs between the three populations. Of the 146 individuals genotyped, 17 individuals were classified as first-generation migrants. In contrast to our predictions, however, we found that male and female first-generation migrants and residents did not exhibit differences in singing behaviour or acoustic structure. We conclude that first-generation migrants must learn local songs in their breeding populations, following dispersal. The prevalence of population-specific songs at our three study sites highlights the different selection pressures that may exist at each site. Understanding and quantifying patterns of cultural evolution at broad and local scales is important, as it may help to explain why biodiversity is greater in the tropics and provide insight into how behavioural barriers, such as acoustic signals, contribute to speciation events.

Linking patterns and processes across scales: a case study with Neotropical hummingbirds

Graham, Catherine - Stony Brook University; Ben Weinstein - Stony Brook University

A fundamental challenge in ecology is connecting broad scale biogeographical and macro-evolutionary mechanisms with local scale patterns of diversity. Community phylogenetics attempts to create this link by evaluating patterns of relatedness, and often trait similarity, among co-occurring species at multiple sites to generate hypotheses about the role of different mechanisms governing community assembly. In Neotropical hummingbirds, biogeographic studies show that closely related species co-occur less frequently than expected when compared to a species pool that considers environmental filtering or predicted species range overlaps. This pattern may result from limiting similarity and competitive exclusion of closely related species. However, traits that should influence these mechanisms are not highly conserved and community level analyses of phylogenetic and trait spacing does not always correspond. As a result, the precise role of limiting similarity and niche conservatism in influencing local assemblages is difficult to infer from biogeographic patterns alone. This is perhaps because competition occurs among individuals in local assemblages and cannot be deduced from broad-scale studies. In contrast, local scale studies often use manipulative experiments to evaluate how competition affects specific ecological processes. However, generalization of local scale studies across different assemblages or to broader geographic extents remains elusive. To address this scale mismatch we present an experiment which evaluates if hypotheses developed at biogeographic scales are consistent with local scale observations of competition in Neotropical hummingbirds. This study provides an initial link between patterns established by broad

scale biogeography and mechanisms learned from local scale community ecology.

Answering conservation questions for a species at risk, the Piping Plover
Gratto-Trevor, Cheri - Environment and Climate Change Canada

Piping Plovers are listed as threatened or endangered throughout their range. By 2001, there were several major conservation questions involving the interior subspecies: 1.) as estimated from an earlier population model, do we really need 1.25 fledged young/pair/year to maintain prairie populations; 2) is there, as suggested by the International Census data, considerable movement of birds between Prairie Canada and the U.S. Great Plains, and 3) are there differences in where different breeding populations concentrate in winter? To answer these questions, a population and movements study of 782 individually color marked adults and 182 uniquely marked known-fledged chicks, was carried out in several areas of Saskatchewan, Canada from 2002 to 2009. Our estimate of true annual survival (using both summer and winter resightings), plus age of first breeding, was used in a stochastic simulation to determine that only 0.86 fledged young/pair/year was necessary, so expensive and potentially detrimental techniques such as nest exclosures, were not necessary in Saskatchewan. Both for birds banded as adults and chicks, only 2% moved to the U.S. Great Plains, so this could not explain wide fluctuations in survey numbers. Saskatchewan birds concentrated in Texas, although there was overlap with birds from other breeding populations. Therefore, we could conclude that the Deepwater Horizon oil spill in Louisiana, for example, would affect significantly more birds from the U.S. Great Plains than birds from Canada. Research studies such as this can more effectively direct conservation efforts.

Determining Wintering Areas and Migration Routes of Red-throated Loons and Northern Gannets in Atlantic Offshore Waters Using Satellite Tracking
Gray, Carrie - Biodiversity Research Institute; Iain Stenhouse - Biodiversity Research Institute; Andrew Gilbert - Biodiversity Research Institute

Increased interest in renewable energy has led to the identification of offshore Wind Energy Areas (WEAs) for potential development in Federal waters of the Mid-Atlantic U.S. Offshore wind turbines have been shown to affect seabirds and other marine wildlife, exposing them to potentially increased mortality through direct collision, and/or increased energetic costs due to habitat loss, changes to prey distributions, and displacement from foraging areas. Red-throated Loon and Northern Gannet populations have previously been identified in European studies as exhibiting a behavioral response of avoiding offshore wind facilities. Substantial proportions of both species occur in the mid-Atlantic region during their winter and migration periods; however, large data gaps exist within this region regarding their wintering distributions, including concentration and timing of use, migratory routes, and stopover areas. In 2012-15, as part of a Bureau of Ocean Energy Management (BOEM) and USFWS project focused on collecting information on distribution and behavior of diving birds, we captured Red-throated Loons and Northern Gannets at sea on their wintering grounds in the Mid-Atlantic region and implanted them with satellite transmitters. We calculated composite kernel density (KDE) maps using movement data to identify key wintering areas, as well as important migration habitats and stopover areas for Red-throated Loons and Northern Gannets along the Atlantic Flyway.

Adaptive harvest and habitat management of northern bobwhites: balancing population recovery and cultural heritage
Green, Adam - Bird Conservancy of the Rockies; Richard Hamrick - Mississippi Department of Wildlife, Fisheries, and Parks; Guiming Wang - Mississippi State University; Mark McConnell - Warnell School of Forestry and Natural Resources, University of Georgia; James Martin** - UGA

Northern bobwhite populations have been in decline for decades yet remain an important game species in the Southeastern US. Managers often consider habitat management to restore bobwhite populations, but bag limits remain high. To sustain bobwhite populations while allowing harvest, it is important to identify an appropriate strategy that considers the uncertainties with immediate and long-term responses of populations to habitat management, harvest, and their interaction. We developed an adaptive harvest and habitat management framework for bobwhite using data collected from 17 Wildlife Management Areas (WMA) in the Southeastern US to optimize trade-offs among competing and conflicting management objectives, including population persistence, harvest, hunter satisfaction, and cost. We developed a population simulation model using estimates of density and population growth rates from previous research and vital rate estimates from the literature to predict the response of bobwhite populations to various harvest rates and timings, habitat management, and predator control. We then used a policy iteration algorithm to identify the optimal decision strategies under a range of objective weights. Optimal strategies varied widely based on objective weights. Habitat management was recommended in most cases because of its strong positive effect on population growth, and recommended harvest rates generally increased with bobwhite density. Our approach can be adapted for other sites and species. Additional information on harvest rates and management effects on bobwhite populations can be collected and used to reduce uncertainty in the decision process to inform future decisions.

Mortality across the annual cycle: the winter and breeding seasons are as hazardous as migration for yellow warblers
Green, David - Simon Fraser University; Michal Pavlik - Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University; Simon Valdez Juarez - Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University

Migratory bird populations may be regulated by processes that operate on the wintering grounds, on the breeding grounds or during migration. Migration may be associated with increased exposure to predators, elevated levels of competition at stopover sites, and/or adverse weather conditions that increase mortality. Few studies, however, have compared mortality rates on migration with mortality rates during the stationary periods. We estimate annual and seasonal survival rates of yellow warblers on the Pacific flyway using an 11-year dataset from B.C., Canada, and a 4-year dataset from Jalisco, Mexico. In B.C., males had slightly higher annual apparent survival (0.518±0.030) than females (0.485±0.032). However, female monthly apparent survival during the breeding season was higher than for males (0.982±0.032 vs 0.923±0.018). In Jalisco, yellow warblers in natural riparian habitat and irrigated agricultural habitat had higher monthly apparent survival than those in dry scrub habitat. Average female monthly apparent survival during the winter was lower than for males (0.934±0.032 vs 0.969±0.015). Using these seasonal survival rates and assuming a 3-month breeding season, a 7-month wintering season, and a month for both fall and spring migration, we estimated monthly survival rates of females and males on migration to be 0.909 and 0.906, respectively. Migration mortality rates are 1.2–5.1 times mortality rates during the stationary periods,

but account for only 18% of mortality during the annual cycle. Migration may therefore be less hazardous for songbirds using the Pacific flyway than other flyways where migration involves flights across a major geographic barrier.

The enemy of my enemy: indirect interactions mediate how seabirds become prey on an oceanic island
Green, David - Simon Fraser University; Sarah Thomsen - Simon Fraser University

Changes to predator-prey dynamics have been increasingly recognized for their potential role in contributing to declining avian populations. On Santa Barbara Island, California, small nocturnal seabirds, Scripps's Murrelets (*Synthliboramphus scrippsi*), face threats from native predators including the Barn Owl (*Tyto alba*) as well as an endemic deer mouse (*Peromyscus maniculatus elusus*) that consumes murrelet eggs. These deer mice undergo extreme variations in density and are also important prey for owls. Therefore, we investigated climate effects on the density of owls and deer mice and predator effects on murrelet adults and their eggs. Specifically, we evaluated evidence for both positive and negative effects on murrelets from sharing a predator with another enemy. First, we confirmed the links between an ENSO-driven rainfall pulse, terrestrial productivity, and the subsequent increase and sharp decline in mouse and owl numbers on the island from 2010 to 2013. Next, we evaluated evidence for prey switching in Barn Owls. Our results are consistent with the alternative prey hypothesis, with a nearly 15-fold increase in the number of murrelets killed after the mouse population crashed. Lastly, we also examined whether changes in owl abundance influenced mouse foraging activity (by measuring giving up densities) and therefore egg predation rates via a behaviorally mediated cascade. Mice were sensitive to predation risk and foraged less with increasing owl abundance. Murrelet egg predation was consequently lower with increasing owl abundance. This means that nest success and survival of adult murrelets are both positively and negatively influenced by climate-driven indirect interactions with predators.

Recovery of Birds Under the Endangered Species Act
Greenwald, Noah - Center for Biological Diversity; Kieran Suckling - Center for Biological Diversity; Ryan Beam - Center for Biological Diversity; Loyal Mehrhoff - Center for Biological Diversity; Brett Hartl - Center for Biological Diversity

One hundred twenty birds have been protected under the Endangered Species Act. Three potential metrics were used to assess the efficacy of the Act, and its implementation; (1) how population levels of listed species have increased or declined since listing, (2) how population trends in listed birds compare to trends in unlisted bird, and (3) the number of bird taxa expected to be delisted by 2015 versus the actual number delisted. Ninety-seven birds were including in our analyses (23 were excluded because they were not observed after listing, were recently listed, or were delisted due to taxonomic, definitional changes, or court order. We found that 53 percent of bird taxa had increased in numbers since listing, 19 percent remained stable, 25 percent declined in numbers, and four percent had unknown trends. Birds from Hawaii and the Pacific Islands did comparatively worse than birds from the mainland and Caribbean Islands, with only 60 percent of the former increasing or stable, versus 85 percent. Ten birds have likely become extinct after listing; with nine of those coming from the Hawaiian and Mariana Islands. Listed birds were more likely to show increased populations (74% vs 39%) and less likely to have declining populations (18% vs 44%) than unprotected birds. Finally, recovery plans anticipated 12 birds would meet their recovery goals by 2015. This expectation was met, with 12 birds having

been delisted due to recovery, though the species predicted to reach recovery were not the species that were delisted.

The impacts of continent-wide supplemental feeding on bird populations
Greig, Emma - Cornell Lab of Ornithology; David Bonter - Cornell Lab of Ornithology

Despite the 50 million people in the US offering billions of pounds of seeds to birds every year, we know very little about the consequences of this hobby on native species in North America. Increased food availability may promote survival and reproductive success. Alternatively, the potential negative consequences of supplemental feeding are numerous and include increased disease transmission, increased predation, reduced reproductive success, and changes in migratory behavior. No quantitative research has focused on the potential population-level effects of supplemental feeding. Here, we use 30 years of data on thousands of feeders from the citizen science program Project FeederWatch to address this question. We predict that if supplemental feeding is ecologically detrimental for the species that consume the most, then we should see long-term population declines in those species. We assessed population trends in the 50 species most commonly visiting feeders in North America. Overall, species that utilize bird feeders were doing better over time, rather than worse, and the few species showing declines include non-native species or species suffering from novel diseases. Future work examining the community-level effects of supplemental feeding are required, but for now we have no reason to suspect that feeding birds is impacting the populations of species that visit feeders in a negative manner.

A range–wide assessment on the influence of anthropogenic structure dispersion and land cover patch size on lesser prairie-chicken lek attendance
Griffin, Cody - Texas Tech University; Alixandra Godar - Texas Tech University; Sarah Fritts - Texas Tech University; Daniel Greene - Texas Tech University; Blake Grisham - Texas Tech University; Clint Boal - Texas Tech University/U.S. Geological Survey Texas Cooperative Fish and Wildlife Research Unit; David Haukos - U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, Department of Biology, Kansas State University; Grant Beauprez - New Mexico Department of Game and Fish; Michael Patten - Oklahoma Biological Survey, University of Oklahoma; Jim Pitman - Western Association of Fish and Wildlife Agencies; Christian Hagen - Oregon State University

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) has declined precipitously across its native range within the central and southern Great Plains of the United States. Across all four ecoregions within native prairies where lesser prairie-chickens occur, alterations such as the addition of anthropogenic structures have been shown to negatively affect the quality of nesting and brood-rearing habitat for females. However, the influence of these structures and other land cover patterns on lek attendance and persistence are unknown. Therefore, we used a long-term data set (1996–2015) to assess the influences of anthropogenic structures on lek attendance from annual count data. We developed dispersion index to account for the distribution of structures (e.g., density, distance, clustering) and land cover types (e.g., cropland, bare, shrubland, grassland, and Conservation Reserve Program lands) within 4.8 km of known leks. We assessed relationships among lek attendance (maximum number of birds per lek per year) and predictive variables including land cover patch indices and anthropogenic structure dispersion values with generalized linear

mixed models. Our results suggested that lesser prairie-chicken's response to anthropogenic structure varied depending on the ecoregion and structure type. Likewise, responses to land cover patches varied across ecoregions with negative responses primarily associated with the conversion of native grasslands to agriculture. We speculate that responses varied due to the variation in landscape characteristics between ecoregions, and negative responses were associated with decreases in quality and quantity of available nesting and brooding habitat around leks.

Population differentiation and evidence of adaptive divergence in subspecies of Song Sparrow (*Melospiza melodia*)
Griffin, Josie - University of Minnesota

Song Sparrows (*Melospiza melodia*) are the most polytypic bird in North America and show dramatic phenotypic variation in body size and plumage coloration across their range which has greatly expanded since the time of the last glacial maximum. This variation appears correlated to their geographic distribution and seemingly suggests strong evidence of local adaptation; however, previous genetic studies have found limited to no population structuring based on geography. I used a genomic single nucleotide polymorphism (SNP) dataset generated by a RAD-sequencing to investigate the historical demography and population structuring in 15 populations currently described as distinct subspecies of Song Sparrow. Using this genomic approach I found substantially more genetic variability and differentiation among populations than was detected via low-throughput methods. Additionally, outlier analyses revealed loci that are under directional selection and are the likely drivers of adaptive divergence among populations and subspecies. These results show that using a genomic dataset can provide greater demographic resolution in species where overall genetic differentiation is low and can potentially identify loci involved in rapid evolution.

Early-life Microbial Colonization and Succession of the Avian Gastrointestinal Tract
Grond, Kirsten - Kansas State University; Richard Lanctot - U.S. Fish and Wildlife Service; Ari M. Jumpponen - Kansas State University; Brett Sandercock - Kansas State University

Gut microbiota are essential in maintaining organismal health, through its roles in nutrient uptake, immune functioning and detoxification. Altricial birds can directly shape their offspring's microbiota, but parental influences in precocial shorebirds appear to be limited to indirect transfer. We investigated age and time related patterns in microbial abundance, identified the major bacterial groups involved in community turnover, and assessed how microbial environment was reflected in the gut microbiota of chicks at different ages. We applied VHF transmitters to one chick per brood of 42 broods (22 Red Phalarope and 20 Dunlin) in Barrow, AK, and collected fecal and environmental samples at different time intervals. 16S rRNA copy number abundance was determined using Taqman qPCR, and samples were sequenced using the Illumina MiSeq platform. Bacterial abundance increased exponentially during the first two days of life, and reached a plateau at approximately 106 copy numbers at day 3. We observed large variation in community profiles for chicks of age 0-2 days. At day 3 of age, we observed a sharp increase in the relative abundance of Firmicutes, and community composition stayed relatively similar on subsequent days. The large increase in bacterial abundance and high variability in community composition during the first two days of life indicate a quick colonization by environmental microorganisms after which some selection pressure appears to stabilize communities. We are currently sequencing the

environmental samples collected at each sampling site, and we will be able to address these predictions when sequences are obtained.

Disease Risk of Shorebirds in the Western Hemisphere

Grond, Kirsten - Kansas State University; Verónica D'Amico - Applied Ecophysiology Lab of Wildlife Management and Conservation at Centro Nacional Patagónico-CONICET; Claudia Ganser - University of Florida

Migratory shorebird populations have experienced large declines due to both natural and anthropogenic causes. Little is known about the effect of disease on shorebird populations and on how pathogen pressure varies throughout their annual cycle. The majority of studies have focused on the occurrence of one pathogen species in one or more bird species at a single site or time period, which limits interpretation and extrapolation of results to a broader suite of species and sites. In our presentation, we will summarize current knowledge on shorebird disease patterns, and address current knowledge gaps by discussing the diversity of viral, bacterial and protozoan pathogens of migratory shorebirds, as well as assessing the prevalence and infection intensity of common pathogens that are of special interest for avian and public health. We collected fecal and blood samples from 13 shorebird species at 10 Arctic breeding sites in Alaska and Canada, two staging sites (Washington & Delaware, USA) and two non-breeding sites (Peru & Argentina) throughout the Western Hemisphere, which we analyzed using high-throughput sequencing and targeted (quantitative) PCR. We aimed to shed light on the physical health of shorebird populations over a large geographical gradient, and identify areas of increasing infection risk.

Phenological synchrony during fall migration

Grunzel, Dave - University of Maine; Richard Feldman - Yucatan Center for Scientific Research; Seth Benz - Schoodic Institute at Acadia National Park; Hannah Webber - Schoodic Institute at Acadia National Park; Brian Olsen - University of Maine; Abe Miller-Rushing - Acadia National Park

Evidence is mounting that climate-driven phenological mismatch during the breeding season affects avian survival and reproduction. Whether phenological mismatch affects birds during fall migration has not been studied. At Acadia National Park we are using big data modeling and intensive field research to study synchrony between birds, their major food resources, and climate during fall migration. We have built an online platform that uses innovative visualizations to show how peak date of fall raptor migration has not been tracking temperature or plant productivity over the past 20 years. At the same time, we have been collecting data on the phenology of fruit availability, arthropod biomass, and bird abundances at Acadia to test for phenological mismatch at specific stopover sites. We found that bird abundances - indexed by capture rates at mist nets - peaked in early October, after the peak in fruit availability of the two most common shrubs and the peak in arthropod biomass. Our study demonstrates how large scale citizen science data can be integrated with intensive field research to investigate and communicate the importance of phenology to our understanding of fall migration.

Artificial nests and perches as tools for research, conservation and education

Guerrero, Simón - Iberoamerican University (UNIBE); Segura, Yeral - Ministry of Environment

We report on the results of an ongoing project implemented at the Ébano Verde Scffientific Reserve, Las Malvinas Eco-Park, and the

Iberoamerican University campus. We have installed artificial nests for four birds endemic to Hispaniola: Hispaniolan Trogon (*Priotelus roseigaster*), Palmchat (*Dulus dominicus*), Hispaniolan Woodpecker (*Melanerpes striatus*) and Hispaniolan Parakeet (*Psittacara chloroptera*). Three of them nest in cavities. Palmchat (Our National Bird) nests mainly in palm trees. Artificial nests serve to collect scientific information on breeding biology and provide cavities for nesting, contributing to bird conservation, since the lack of cavities is the second major threat to cavity nesters. Three of them breed in urban areas, so some nests were installed on school grounds and university campuses, which allow teachers and students real-time observations in breeding activities through a camera installed in the roof of the nest. In the same areas we have also installed artificial perches which are used for endemic and native birds such as Palmchat, Black-crownded Palm Tanager (*Phaenicophilus palmarum*), Hispaniolan Woodpecker (*Melanerpes striatus*) and Gray Kingbird (*Tyrannus dominicensis*). In a soil substrate at the bottom of the perch, seeds dropped by birds can germinate, making plant identification easier. Artificial perches provide scientific data on frugivory and show what birds are actually eating, which is useful information for the arborization of other areas. They can also be used for teaching biological and conservation concepts such as plant-bird interaction, seed dispersal, pioneer plants, and the bird´s role in natural restoration.

Phylogeography of the *Neopelma* genus (Tyrant-manakins), connecting the Amazon, Cerrado, and Atlantic Forest histories

Guimaraes Capurucho, Joao Marcos - University of Illinois at Chicago; John Bates - The Field Museum

The connections among Atlantic and Amazon forests (AF and AM, respectively) and the gallery forests of cerrado played an important role in the biogeography of South American birds. Two spatiotemporal connections are proposed: a middle to late Miocene and a Pliocene-Pleistocene connection. The first is mainly associated to Andes uplift, while the latter is related to Quaternary climatic oscillations. We studied the *Neopelma* phylogeography (four of five species included) to understand the connections between AF and AM and the effects of Pleistocene glacial cycles on the genetic diversity of the group. Mitochondrial (ND2 and COI) and nuclear (Fib5) DNA was obtained for *N. chrysocephalum*, *N. sulphureiventer*, *N. pallecens*, *and N. chrysolophum* (but *N. aurifrons* was not included in this study), totaling 68 samples. We used ML and BI to estimate phylogenetic relationships of the *Neopelma* species. BSPs were built to evaluate for demographic oscillations. All *Neopelma* species are monophyletic. The first split occurred between *N. chrysolophum* (AF) and the ancestral of the remaining species. It was followed by a split between *N. pallecens* and the Amazonian species. The last split separated the two AM species (*chrysocephalum* and *sulphureiventer*). Genetic structure was found within *N. chrysocephalum* and *N. sulphureiventer*. Only *N. chrysocephalum* shows a weak signal of expansion since the LGM. The results showed that the *Neopelma* evolution is in agreement with the younger connections between AF and AM. It evidences that gallery forests connected the AF and AM, but also provided a chance for species diversification.

Large bills may aid thermoregulation in Asian tropical forest birds

Gulson-Castillo, Eric - Cornell University; David Winkler - Cornell University

Bird bills are effective thermal radiators - birds can use them to exchange heat with their surroundings and this may favor larger bills in hotter environments. We hypothesized that life in the exposed canopy of tropical forests, as opposed to the more-shaded strata below, selects for larger bills in

Bornean birds. We exposed a variety of mid-sized Bornean lowland rainforest birds to a temperature gradient of 20 to 40 °C, taking infrared images to measure surface temperatures and calculate heat exchange. We found that larger bills with more surface area allowed birds to lose proportionately more heat through their bills. To evaluate the potential contribution of heat radiation from the bill in the thermoregulation of these birds, we measured fluid specimens of lowland Bornean birds paired with a closely related congener in the cooler montane forests to control for phylogeny and dietary similarities. We predicted that lowland birds and birds that spend most of their time in the exposed canopy would have larger bills than those living at higher elevations and in less exposed habitat strata. Analyses to date show that lowland birds have similarly sized or larger bills than those of their highland counterparts. We will present the results of on-going analyses teasing apart the effects of canopy stratum and body mass on the magnitude of this difference, as well as how body proportions may affect heat loss in small- to medium-sized birds.

PHENOLOGY OF BREEDING IN ARCTIC SHOREBIRDS – CAN THEY KEEP UP WITH CLIMATE CHANGE?

Gurney, Kirsty - Environment & Climate Change Canada; David Ward - Alaska Science Center, USGS; David Douglas - Alaska Science Center, USGS; Michael Budde - Earth Resources Observation and Science (EROS) Center, USGS

Current models predict early and disproportionately large changes in climate at high northern latitudes, and data are consistent with this idea. In adccess and population declines have been observed in long-distance migration, observed increases in the onset and duration of the growing season, as determined by thawing and freezing of soils, are enhanced in arctic regions. Concurrent with these climatic changes, plant phenology appears to be advancing. Although the extent to which such large-scale environmental change will affect arctic-breeding birds is unknown, impacts will likely vary among species and populations. For example, reduced reproductive suants and in those whose breeding phenology is dependent on non-climatic cues. Conversely, species that migrate over shorter distances and those that advance the onset of breeding to keep pace with advancing spring phenology may benefit from predicted changes in climate. The proximate cues that arctic-nesting shorebirds use to determine timing of breeding, however, have not been studied across a broad taxonomic scale and remain poorly quantified for many species. The objectives of our study, therefore, are (i) to evaluate hypotheses about processes that influence timing of breeding across a range of shorebird taxa and (ii) to identify potential vulnerabilities of arctic-nesting shorebirds in the face of global climate change. Specifically, we will present results of a pan-Arctic meta-analysis that combines remotely-sensed indices of spring phenology (date of spring thaw and spring green-up) with nesting data collected across multiple sites and years.

Conservation Status of Grand Cayman and Cayman Brac Parrots

Haakonsson, Jane

Two subspecies of *Amazona leucocephala* inhabit the Cayman Islands –the Grand Cayman Parrot (*A. l. caymanensis*) and the Cayman Brac Parrot (*A. l. hesterna*). As distinct conservation units, both subspecies are threatened by habitat loss, hunting by farmers, the collection of nestlings, and hurricanes. In this article, we use before-after reproduction distance sampling surveys to assess the conservation status of parrots in the Cayman Islands. On Grand Cayman, estimated density (parrots ha−1) increased from 0.172 ± 0.026 SE (95% CI = 0.128–0.210) in August 2005 to 0.411 ± 0.077 (0.279–0.578) in August 2014 (Z = −2.94, P = 0.002). Estimated population size

was 6,395 ± 1,202 (4,340–8,987) parrots after reproduction on Grand Cayman in 2014. On Cayman Brac, estimated density increased from 0.160 ± 0.021 (0.116– 0.222) in July 2008 to 0.219 ± 0.028 (0.171–0.280) in July 2015 (Z = –1.69, P = 0.09). Estimated population size was 772 ± 97 (603–989) parrots after reproduction on Cayman Brac in 2015. Parrot distribution became more clumped probably as a result of habitat loss, which in combination with other anthropogenic disturbances can decrease population resiliency to hurricanes. Population rate of change before-after reproduction, suggested a small number of breeding pairs on both islands. Therefore, based on our results and using IUCN categories, we recommend classifying the Grand Cayman Parrot as Vulnerable and the Cayman Brac Parrot as Endangered.

Pre-dispersal movement patterns and social networks in the cooperatively breeding Acorn Woodpecker (*Melanerpes formicivorus*)

Hagemeyer, Natasha - Old Dominion University; Eric Walters - Old Dominion University; Walter Koenig - Cornell University

Dispersal is an important life history stage for many organisms, but remains poorly understood, due primarily to the difficulty of studying the permanent relocation of organisms. Pre-dispersal movements, such as forays or floating, may be important information-gathering systems to inform dispersal decisions; in cooperatively dispersing species, pre-dispersal social interactions may predict dispersal coalitions. The cooperatively breeding acorn woodpecker (*Melanerpes formicivorus*) provides a model system with a well-documented social environment and a complex system of cooperative dispersal. Over 2 years, we monitored 60 individuals continuously using a novel automated radio telemetry system and solar-powered nanotags. Helpers (N = 29) exhibited extremely high foray rates, with many individuals detected >90% of the time outside their natal territories. Related same-sex same-clutch helpers (N = 8) had high spatiotemporal overlap, while different-clutch helpers (N = 11) had lower overlap, and both different-sex helpers (N = 16) and unrelated helpers had little to no overlap. This suggests that cooperative dispersal coalitions may form prior to dispersal events and are involved in foray decisions. As expected, breeders (N = 31) forayed less often and more solitarily, but cliques in the social network were not limited to group members, suggesting repeated interactions with extra-group individuals. Helpers had significantly higher degree centrality than breeders, suggesting that helpers possess more information about the social landscape, potentially in order to detect breeding vacancies. These findings reveal for the first time the surprising extent of cryptic movement and extra-group social connections in this cooperative species.

What birders want: Editing a magazine about birds for backyard birdwatchers, listers, and ornithologists

Hagner, Charles - Madavor Media LLC

BirdWatching is a 29-year-old bimonthly magazine about wild birds and birdwatching published by Madavor Media LLC, of Braintree, Massachusetts, and available on newsstands across the United States and Canada. To support sales, the magazine attempts to learn as much as possible about the preferences of its readers and advertisers and birdwatchers in general. It has relied on a variety of information sources through the years, including surveys of subscribers and newsstand customers, online surveys, focus groups, advertiser feedback, direct-mail results, newsstand data, letters to the editor, comments received online and via social media, face-to-face interactions at festivals and other events, and analyses of other publications. From such sources, and from trial and error, the following assumptions can be made about communicating effectively about conservation: BirdWatching readers

care deeply about conservation but also feel overwhelmed by bad news and turn to the magazine, in part, as a respite. They prefer stories about birds over stories about programs, initiatives, and policies meant to benefit birds. In general, they want information they can use to find, attract, and identify birds, to understand what birds do, and to connect with the wider birding community. The magazine's audience, and the wider conservation audience, includes both readers who describe themselves as "birders" and reject the label "birdwatcher," and readers who watch and care for birds but refuse to call themselves "birders." Communicating effectively about bird conservation requires bridging this divide.

Parental adjustments in the face of danger: is it for the birds?

Hague, Michael - University of Wyoming, Game and Fish Cooperative Research Unit; Anna Chalfoun - USGS Wyoming Cooperative Fish & Wildlife Research Unit, University of Wyoming; Scott Sillett - Smithsonian Migratory Bird Center

Nest predation can strongly limit fitness in birds. Selection should therefore favor individuals that are better able to assess nest predation risk and adjust their nesting behavior accordingly. To test this hypothesis, we studied how variation in predator assemblages is related to parental care behavior in Island Scrub-Jays (*Aphelocoma insularis*) by 1) quantifying mean on and off bout lengths during incubation, 2) estimating an activity index for primary nest predators (Common Raven *Corvus corax* and Island Fox *Urocyon littoralis*) on focal territories within two habitat types: oak chaparral and pine woodland, and 3) estimating daily nest survival probabilities. We located and monitored 245 nests in 2015 and 2016, and deployed 24-hour cameras at a subset of those nests to quantify mean bout lengths during incubation. We used distance sampling of fox scat along transects and conducted raven surveys within individual territory boundaries (n = 64) to index nest predator activity. We found that mean on and off bout lengths were longer, and daily nest survival rates were lower in territories with higher nest predator activity. Additionally, raven activity was higher and fox activity was lower in the pine woodland, where mean on and off bout lengths were longer, on average. Our results suggest that Island Scrub-Jays can adjust parental behavior in response to ambient nest predation risk and that these adjustments are conditional on nest predator species. This study advances our understanding of how animals mitigate predation risk through behavioral adaptations.

Adverse effects of wind energy facilities on birds: state of science and management techniques for minimizing impacts

Hale, Amanda - Texas Christian University

Wind power has experienced tremendous growth over the past 10 to 15 years, both in the U.S. and internationally, as counties have sought to increase energy independence and reduce greenhouse gas emissions by developing alternatives to fossil fuel consumption for electricity generation. Nonetheless, with this rapidly growing source of renewable energy, there are increasing concerns about the negative impacts wind energy development may have on wildlife, especially birds and bats. In this talk, I will first summarize what is known about the direct (e.g., collision mortality and habitat loss) and indirect (e.g., changes to movement patterns and displacement from otherwise suitable habitat) impacts of land-based wind energy development on birds by highlighting several recent studies from the peer-reviewed literature. Second, I will discuss management techniques for minimizing adverse effects and how this knowledge may be used to inform or enhance current wind energy siting guidelines for birds. And third, I will outline several research needs and provide recommendations for future research. In general, direct impacts are relatively well-

understood in comparison to indirect impacts, although both types of effects appear to be site- and species-specific making it difficult to develop siting guidelines or management techniques that can be applied broadly. Future research efforts should focus on species or populations of conservation concern and strive to elucidate the underlying mechanisms leading to these adverse impacts. Furthermore, there is a pressing need for publically available data evaluating the effectiveness of a range of impact minimization strategies to guide policy and management decisions.

Parental Behavior and Attendance Patterns of Nesting White-tipped Doves (*Leptotila verreauxi*) in the Lower Rio Grande Valley of Texas

Hall, Jared - Tarleton State University; Jordan Giese - Tarleton State University; Heather Mathewson - Tarleton State University; Jeff Breeden - Tarleton State University; T. Wayne Schwertner - Tarleton State University

The White-tipped Dove (*Leptotilla verreauxi*) was designated as a gamebird in Texas in 1984. Since that time there has been little research conducted on the species providing little insight on the ability of this population to sustain itself under hunting pressure. White-tipped Doves reach the northernmost extent of their range in the Lower Rio Grande Valley (LRGV) of south Texas. In the region, an estimated 95% of native vegetation has been destroyed for agricultural and urban use. The objectives of this study were to investigate nest attendance patterns and adult behavior throughout the nesting cycle in two different habitat types. We hypothesized that doves nesting in citrus groves would experience increased disturbance resulting in increased erratic behavior. We located nests in citrus groves and native woodland habitats in the LRGV. We used real-time, infrared emitting video camera systems to monitor behavior at the nest. We sampled video to establish time budgets for ten nests; however, only six reached the nestling stage. Our results indicated a significant increase in time spent feeding each day as nestlings increased in age (R= 0.33, P= 0.02). There was no significant difference between A.M. and P.M. parental switch times, female recess times, or return time to nest following disturbances between habitat types. While we detected more disturbances in citrus (n = 32) than native woodland (n = 8), there was not a significant difference between the habitat types. Our use of video surveillance has provided new information on White-tipped Dove nest ecology in the LRGV.

Gene flow and connectivity of black rails following a century of wetland loss in San Francisco Bay

Hall, Laurie - University of California, Berkeley; Steven Beissinger - UC Berkeley

Habitat loss and fragmentation can alter the connectivity and demographic processes of metapopulations, and may lead to decreased genetic diversity and increased genetic differentiation. Wetlands of the San Francisco Bay Area, California have been reduced by greater than 80 percent from intense urbanization and agriculture over the past century. We assessed spatial patterns of genetic differentiation of a secretive and threatened wetland bird, the California black rail (*Laterallus jamaicensis coturniculus*), from 11 wetlands throughout the San Francisco Bay Area. Despite the extreme loss and fragmentation of tidal wetland habitat, population- and individual-level measures of genetic differentiation indicated that gene flow was moderate to high for black rails among remaining wetlands across the Bay Area (FST range: 0.014 to 0.067). Gene flow was especially high across wetland sites in the North Bay, but was lower between sites in the North Bay and South Bay (FST = 0.018). Bayesian clustering and Moran's eigenvector mapping indicated that black rails from the South Bay represent a unique genetic population that is distinct from rails in the North Bay and Delta. In the future, habitat loss and fragmentation will be exacerbated by

rises in sea level due to climate change. Our results indicate that black rails appear capable of adapting to rising sea levels and colonizing protected or newly created wetlands if these habitats are separated by tens of kilometers.

Experience Migration on Bird House Plateau
Hallager, Sara - Smithsonian National Zoological Park

The renewal of the Smithsonian National Zoo's 1928 Bird House is a paradigm shifting exhibition project which will broaden public access to Smithsonian science and collections. The architecture of the Bird House will be transformed to offer multi-sensory, immersive experiences. The exhibit is projected to open in early 2021 following 24 months of construction. The project engages audiences in visitor activated learning experiences that combine the resources of the Smithsonian Migratory Bird Center's research with a correlated, revitalized animal collection. "Experience Migration" highlights the annual cycle and long distance journeys of migratory birds in the western hemisphere. The story leads the visitor through phases of a migrating bird's journey depicting key habitats for breeding, stopovers, and overwintering. Three walk-through aviaries will feature migratory and resident birds of the western hemisphere. Learning Objectives and Interpretive messages include: 1) migratory birds travel great distances between breeding and non-breeding grounds in response to seasonal changes in food availability; 2) long distance migrators are in steep decline and need study and conservation action; 3) bird migration journey is perilous, spectacular and awe inspiring; 4) understanding that the same bird lives in multiple places connects people and 5) bird populations are indicators of the health of our environment so now is the time to study and protect them and their habitats.

Multi-generational kinship, multiple mating, and flexible modes of parental care in a breeding population of the Veery (*Catharus fuscescens*), a trans-hemispheric migratory songbird
Halley, Matthew - Academy of Natural Sciences of Drexel University; Christopher Heckscher - Delaware State University; Venugopal Kalavacharla - Delaware State University

We discovered variable modes of parental care in a breeding population of color-banded Veeries (*Catharus fuscescens*), a migratory species long thought to be socially monogamous, and performed a multi-locus DNA microsatellite analysis to estimate parentage and kinship in a sample of 37 adults and 21 offspring. We detected multiple mating in both sexes, and four modes of parental care that varied in frequency within and between years including multiple male feeders at some nests, and males attending the nests of multiple females. Unlike other polygynandrous systems, genetic evidence indicates that multiple generations of close genetic kin breed at our study site, and this was corroborated by the capture of an adult male Veery in 2013 that had been reared by multiple male feeders and banded as a nestling in 2011. All genotyped adults (n = 37) were related to at least one other bird in the sample at the cousin level or greater ($r \geq 0.125$), and 81% were related to at least one other bird at the half-sibling level or greater ($r \geq 0.25$, range 0.25–0.60). At nests where all adult feeders were genotyped (n = 9), male(s) were unrelated to the female (mean $r = -0.11 \pm 0.15$), whereas genetic data suggest close kinship ($r = 0.254$) between two male co-feeders at the nests of two females in 2011, and among three of four females mated to the same polygynous male in 2012.

Perceived predation risk modulates benefits of extra-pair paternity in Tree Swallows (*Tachycineta bicolor*)

Hallinger, Kelly - Cornell Univerity; Maren Vitousek - Department of Ecology & Evolutionary Biology, Cornell University; David Winkler - Cornell University

Extra-pair paternity (EPP) – the siring of offspring by a male other than a female's social partner – is a widespread phenomenon in birds. Researchers have long hypothesized that EPP must confer a fitness advantage to extra-pair young, but empirical support for this hypothesis is mixed. Largely unexplored in the extra-pair literature, environmental context provides a remarkably simple explanation: perhaps benefits of EPP are only observed in some studies because they only exist in some environments. From 2013-2015, we manipulated perceived predator density in a population of Tree Swallows (*Tachycineta bicolor*) breeding in New York. We discovered that extra-pair young were larger than within-pair young, but only in nests that had been exposed to predator mounts. In nests exposed to non-predator mounts, within-pair young were larger than extra-pair young. However, these patterns only existed on one side of our site, where older, larger males with higher corticosterone stress responses preferentially settled. Thus, we suggest that benefits of EPP vary with predator exposure, but that females are only able to realize these benefits when surrounded by a pool of high-quality sires in possession of specific high-value traits. Future research should seek to understand the mechanisms underlying the differences in nestling growth that we observed, as well as their consequences in later life. Our study suggests the potential for EPP to facilitate adaptation to environmental challenges; whether this is the case remains to be seen.

The strength of migratory connectivity affects demography of two Neotropical migratory songbirds

Hallworth, Michael - Migratory Bird Center, Smithsonian Conservation Biology Institute; Scott Sillett - Smithsonian Migratory Bird Center; Nick Rodenhouse - Wellesley College; Peter Marra - Smithsonian Migratory Bird Center

Understanding how the annual cycle of migratory songbirds shapes demography and population dynamics necessitates that we know where individuals are throughout the year. The miniaturization of archival tracking technology such as light-level geolocators and GPS units has allowed researchers to make direct links between the different phases of the annual cycle. We deployed archival light-level geolocators on two migratory songbirds breeding within Hubbard Brook Experimental Forest, N.H. to quantify the strength of migratory connectivity and identify where they spend the non-breeding season. We then used remotely sensed data of their wintering locations to make inferences about how climatic factors experienced during the non-breeding season correlate with demographic parameters the subsequent breeding season. We found that both the Black throated Blue Warbler and the Ovenbird exhibit moderate connectivity with the majority of individuals wintering on the islands of Cuba and Hispaniola. The amount of precipitation on the islands of Cuba and Hispaniola during the non-breeding season (Nov-May) was positively correlated with demographic parameters at both local (plot-level) and landscape (watershed) scales. These findings suggest that environmental conditions experienced throughout the annual cycle contribute to variation in demographic rates observed on the breeding grounds. Demographic studies of linked populations during both the breeding and non-breeding grounds will greatly improve our understanding of how seasonal interactions shape populations and ultimately how populations respond to a changing climate.

Microgeographic and temporal variation in haemosporidian prevalence in the Black-Throated Sparrows (*Amphispiza bilineata*) at Mexican dryland habitats

Ham-Dueñas, José - Instituto Potosino de Investigación Científica y Tecnológica A.C.; Leonardo Chapa-Vargas - Instituto Potosino de Investigación Científica y Tecnológica; Christine Stracey - Guilford College; Elisabeth Huber-Sannwald - Instituto Potosino de Investigación Científica y Tecnológica A.C.; Gerardo Argüello-Astorga - Instituto Potosino de Investigación Científica y Tecnológica A.C.

The study of factors influencing haemosporidian (Phyllum Apicomplexa, subclass Haemosporidia) prevalence of infection and parasitemia in birds allows understanding ecological aspects related to these interspecific associations. Studies focusing on haemosporidians from arid regions are scarce in spite of the importance of these regions. Therefore, the aim of this study was to identify spatial and biological factors that influence haemosporidian prevalence and parasitemia in the Black Throated Sparrow (*Amphispiza bilineata*; BTSP). Our study area is embedded in the highland Plateau of San Luis Potosí, located in Central Mexico, within the southern portion of the Chihuahua Desert. Smears, blood samples and data were taken from captured individuals. Compound microscope was used to identify and count haemosporidian parasites (prevalence and intensity of infection) in the blood samples. DNA extraction, amplification and sequencing process were also carried out to identify hemoparasite lineages. We assessed the effects of several factors influencing prevalence and intensity of parasitemia. Overall, 105 birds were captured from shrubland-dominated sites that are either moderately degraded or highly degraded by tree extraction and overgrazing. In addition, sites that are either exposed to mining-related pollution, or unexposed were sampled. Overall prevalence was 21.9% (Haemoproteus = 16.19%, Plasmodium = 5.71%). Haemoproteus coatneyi was identified as the most common parasite. The breeding season showed higher prevalence than the non-breeding season, and the Heterophils – Lymphocytes ratio, a measure of ecological stress in birds, correlated negatively with intensity of parasitemia.

Are nuthatches good at dispersing?

Han, Kin-Lan - University of Florida; James Cox - Tall Timbers Research Station and Land Conservancy; Garth Spellman - Denver Museum of Nature & Science; Rebecca Kimball - Department of Biology, University of Florida

Current patterns of genetic diversity and population structure reflect a combination of historical, demographic, and current factors. These patterns are driven by the interaction of gene flow with factors such as genetic drift, selection and/or mutation. We used microsatellites to examine the effect of habitat fragmentation on Brown-headed Nuthatches (*Sitta pusilla*), a cooperatively breeding bird endemic to mature pine forests of the southeastern U.S. We found little genetic structure in the fragmented south Florida populations compared to less fragmented populations in northern Florida. This may be due to insufficient time having passed for population differentiation to occur following anthropogenic changes. We examine the effects of fragmentation over evolutionary timescales in the Pygmy Nuthatch (*S. pygmaea*), which forms a superspecies with Brown-headed Nuthatches. The two species share similarities in behavior and habitat preferences, but have a naturally fragmented distribution occurring in western North America. Using microsatellites, we failed to detect strong genetic structure. Sampling in Pygmy Nuthatches was less extensive and could explain the absence of detected structure. We obtained data using ddRadseq to explore whether the use of thousands of loci could compensate for the lack of structure previously identified. If levels of

structure remain low, this suggests that nuthatches may be good at long-distance dispersal.

Increasing Power of the Breeding Bird Survey: Joint Analysis of Roadside and Off-road Data to Assess Avian Population Trends in Alaska
Handel, Colleen - USGS Alaska Science Center; Courtney Amundson - USGS Alaska Science Center; John Sauer - USGS Patuxent Wildlife Research Center

Alaska and other northern regions of North America host significant populations of breeding birds, and habitats there are changing rapidly in response to climate-mediated and anthropogenic factors. However, the restricted network of roads in these remote areas compromises our ability to monitor population trends through the North American Breeding Bird Survey. In assessing the appropriateness of drawing region-wide inferences about population trends based on limited roadside surveys, questions arise regarding potential biases due to differences in habitat and disturbance regimes between roadside corridors and the vast natural areas that exist in the North. We estimated regional population trends for a suite of landbirds and shorebirds using roadside Breeding Bird Surveys and off-road surveys from the Alaska Landbird Monitoring Survey, a cooperative program that was initiated in 2003 to sample remote, protected lands. We analyzed survey data for individual species in parallel hierarchical models, implemented in a Bayesian framework, to test if population trends differed between roadside and off-road areas and found that trends were either concordant (70%) or only slightly discordant (30%) but no species showed opposing trends between survey types. We then evaluated how power to detect regional population trends may increase through combined analysis of the two datasets in a joint hierarchical model and what insights may be gained through comparisons.

Extent of Introgression Detected in Spotted Owls and Western Barred Owls
Hanna, Zachary - Museum of Vertebrate Zoology, University of California, Berkeley

The Barred Owl has invaded the western U.S. in the last 50-100 years. Over the course of this period it has become broadly sympatric with the Spotted Owl, now extending from British Columbia to southern California. This represents one of the few documented cases of natural, dynamic, and ongoing invasion with secondary contact that can be studied across space in real time. Although it is well documented that Barred Owls ecologically displace Spotted Owls, debate remains as to whether the situation is being exacerbated via hybridization between these two species. To explore this question we have assembled a draft Northern Spotted Owl genome from an individual collected prior to contact with Barred Owls. Prompted by the observation that some Barred Owl populations have high frequencies of morphotypes that appear intermediate between Barred and Spotted Owls, we expect to detect owls representing admixed individuals. We report our results based on a whole-genome assessment of hybridization from over 50 individuals from throughout the range of overlap between the two species.

Being civil: Common Nighthawk activity patterns at the northern limit of the breeding range and recommendations for surveys.
Hannah, Kevin - Canadian Wildlife Service, Environment and Climate Change Canada; Andrew Campomizzi - Bird Ecology and Conservation Ontario; Russ Weeber - Canadian Wildlife Service, Environment and Climate Change Canada

Activity patterns during the breeding season are fairly well established for many bird groups, enabling surveyors to focus their efforts during specific periods to maximize species detectability. The activity patterns for the nightjars is less well known, impairing the

design of efficient surveys. Studies of Common Nighthawk (*Chordeiles minor*) activity have been largely confined to the southern part of their breeding range and may not represent the timing of activity and other characteristics associated with detectability for the large proportion of the population breeding in northern latitudes. In 2014, we used 15 autonomous recording units (ARU's), placed at 8 geographic locations across a 3,000 km span, representing approximately 17° of latitude, to document activity patterns in this species. ARU's were programmed to record from 1 hour before sunset to 1 hour after sunrise every 4 days, starting 1 June 2014. Common Nighthawk daily activity, as measured by audible cues, was bimodal, with the majority of activity occurring during civil twilight (after sunset) and nautical twilight (before sunrise) across the range of latitudes. Seasonal activity was also bimodal, with a sharp peak in activity in mid-June, followed by a second, smaller peak in mid-July. Temperature and moon phase were not important predictors of nighthawk activity. To maximize detection of audible cues in this crepuscular species, we recommend future surveys of the Common Nighthawk be conducted during civil twilight in the dusk period, or nautical twilight during the pre-dawn period, between mid-June and mid-July.

Reconstructing the skull of *Hesperornis regalis*: The first three-dimensional model of a Cretaceous toothed bird with insights into early avian functional morphology, plesiomorphy, and convergence

Hanson, Michael - Yale University, Department of Geology and Geophysics; David Burnham - University of Kansas Biodiversity Institute & Natural History Museum; Bhart-Anjan S. Bhullar - Yale University, Department of Geology and Geophysics

The giant, aquatic, toothed bird, *Hesperornis regalis* from the Late Cretaceous of Kansas represents the closest taxon to crown Aves known from nearly complete and undistorted cranial material, making it key for understanding the evolution of the functional anatomy of the skull in the lineage leading to modern birds. Previous studies regarded *Hesperornis* as belonging to a lineage of modern aquatic birds, and concluded that its adductor chamber, palatal, and rostral structures were more similar to neognathous rather than palaeognathous birds, and that the neognathous palate was plesiomorphic for crown Aves. Recent phylogenetic analyses demonstrate, however, that the Palaeognathae (ratites and tinamous) are the earliest-diverging lineage of living birds, and that *Hesperornis* nests outside the crown, making it important for polarizing cranial characters ancestral to crown Aves, necessitating morphological reevaluation. In our study, Hesperornis skull elements were *μ*CT scanned and digitally prepared to construct a 3D reconstruction for comparative anatomical and functional studies. Reconstruction of the cranial kinetic system and adductor musculature was aided with comparative data from a crocodilian (Alligator), palaeognath (Nothoprocta), and neognath (Gallus). We show that the anatomical characteristics of the *Hesperornis* palate and rostrum compare favorably with a palaeognathous and rhynchokinetic structure, where the palate lacks joints and the bill shifts upwards due to deformation of the premaxillary dorsal process. We also show *Hesperornis* has a suite of characters in the skull to accommodate enlarged adductor musculature similar to that seen in several disparate modern aquatic bird lineages such as cormorants, loons, and kingfishers.

The Effects of Simulated Translocations on the Population Viability of Greater Prairie-Chickens in Central Wisconsin, USA

Hardy, Michael - Department of Forest and Wildlife Ecology, University of Wisconsin-Madison; Scott Hull - Wisconsin Department of Natural Resources; Benjamin Zuckerberg - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison

Greater Prairie-Chickens (*Tympanuchus cupido*) have exhibited dramatic population declines in Wisconsin, USA and are currently restricted to four isolated breeding sites (BV, PO, LE, ME) in the central part of the state. Despite a history of intensive management, no formal population viability analyses have been conducted and the long-term effects of previous translocations remain poorly-understood. Consequently, we used lek survey data collected from 1950-2015 to conduct population viability analyses and examine the effects of six simulated translocation scenarios on the long-term persistence of prairie-chickens in Wisconsin. Under the baseline scenario, two sites (BV, PO) had a moderate probability of quasi-extinction in the next 50 years, whereas two other sites (LE, ME) were highly likely to become functionally extirpated within the next decade. Under the first five translocation scenarios, introducing prairie-chickens from Minnesota into Wisconsin decreased the probability of quasi-extinction for each site and for the entire Wisconsin population; these effects were especially pronounced when birds were introduced to LE and ME. However, simulated translocations from BV and PO to LE and ME enhanced the long-term viability of the two most vulnerable breeding sites while increasing the likelihood of quasi-extinction for BV, PO, and the entire population. Based on these findings, the persistence of prairie-chickens in Wisconsin will largely depend on the continued conservation of two key populations. Although translocations from Minnesota are predicted to have beneficial effects, attempts to mimic metapopulation dynamics by moving individuals among breeding sites within Wisconsin might actually increase the risk of statewide population collapse.

Quality of sapsucker-sap: What can sap tell us about sapsucker-plant interactions?

Haribal, Meena - Boyce Thompson Institute

Sapsuckers and some allied species of the woodpecker family have evolved a unique strategy of drilling into the phloem or xylem of plants to utilize sap. To understand the mechanisms involved in sapsucker-plant interactions, I undertook study of sap chemistry. I collected sapsucker-sap of Yellow-bellied Sapsucker (*Sphyrapicus varius*) from wells of eight species - American and European mountain ash, shagbark hickory, European alder, Japanese Zelkova, Willow sp., White Birch and an apple var. I analyzed sugars and amino acids contents of sap using GC-MS and HPLC as they are nutritionally most important components. The saps of different species differed qualitatively and quantitatively among the species and within a species differed at different holes. Overall, the newer holes had higher amounts of sugars and polyols. Amino acid contents differed in different species. The compositions also vary both diurnally and nocturnally. I compared contents of alder sapsucker-sap with phloem-sap of undamaged plants collected during same season. The Wards method of Hierarchical cluster analyses showed that the chemistry of the sapsucker-sap was significantly different from the phloem-sap. This suggests that the woodpeckers may induce changes in the plant-sap quality. Eventually, the plants induce defense responses in plant and ultimately sap flow is reduced and stopped. I hypothesize that this change in chemistry may be a clue as to how woodpeckers initiate a newer hole. Optimal quality of the sap is necessary for energy and growth of sapsuckers.

Bird hazard or national resource? Inter-agency collaboration for a wildlife hazard management plan and Greater Sage-grouse conservation efforts at the Jackson Hole Airport

Harmon, Lisa - Mead & Hunt, Inc.

Jackson Hole Airport (JAC) in Grand Teton National Park, Wyoming is the only U.S. airport located wholly within a national park. The 542-acre airport includes habitat for many wildlife species, including a lek for the Greater Sage-grouse (*Centrocercus urophasianus*) that has persisted in the Runway Safety Area since the 1940s. The Federal Aviation Administration's (FAA) National Wildlife Strike Database includes 34 strikes with the Greater Sage-grouse from 1990-2015, of which 33 occurred at JAC. Approximately half the strikes resulted in aircraft damage; 4 strikes resulted in substantial (>$200,000) damage. When the FAA required the JAC Board to prepare a Wildlife Hazard Management Plan (WHMP) in 2012, the Board understood that the plan would have to satisfy numerous federal, state and local agency requirements, as well as regional sage-grouse conservation initiatives. At the time the plan was prepared, the Greater Sage-grouse was a candidate for federal protection under the Endangered Species Act. The Board facilitated a collaborative effort by a large working group that involved representatives from several federal agencies, state wildlife officials, researchers with species-specific expertise, and consultants. The effort culminated in the development of a WHMP in 2014 that provided a triple win for the agencies, the sage-grouse, and the traveling public. The presentation provides an overview of the WHMP for JAC, particularly the long-term sage-grouse habitat restoration measures to be implemented jointly by the FAA and National Park Service. The objective is to provide additional brood-rearing habitat and lek sites outside of aircraft movement areas.

Social and display behavior of the Golden-winged Manakin Masius chrysopterus and its implications for the evolution of cooperative courtship display in manakins (family Pipridae)

Harris, Grady - University of Wyoming

All but a handful of the 51 species of manakin (family Pipridae) are lek-mating, making it one of the"lekkiest" taxa. Even more unusually, cooperative courtship display, where multiple males coordinate their displays to attract females and mate, is widespread among manakins. While the social and display behavior of several cooperatively displaying manakin species has been studied in depth, the evolutionary pathways by which cooperative courtship display can evolve from solitary courtship display have been neglected. Previous research suggested that the Golden-winged Manakin *Masius chrysopterus* could represent an intermediate stage between solitary and cooperative courtship display, but its behavior remained poorly known. I conducted a two-year study on Masius in order to provide a more complete account of its social and display behavior. Unlike previous authors, I recorded apparently cooperative multi-male displays for females. In contrast to other cooperatively displaying manakins, Masius cooperative courtship displays did not include extensive coordination, but Masius does perform highly coordinated multi-male displays in the absence of females. These coordinated multi-male displays probably serve as ritualized contests and to enforce dominance relationships between males. I propose that a comparison of Masius social and display behavior with that of two species in the closely related genus *Corapipo* provides evidence that highly coordinated, cooperative courtship display in manakins originates as ritualized male-male contests readapted for courtship.

Wild Bird Highly Pathogenic Avian Influenza Surveillance in the US (Winter 2014-Spring 2015)
Harris, M. Camille - US Geological Survey Office of Ecosystems; Hon S Ip - DVL/NWHC/USGS/Department of the Interior

Migratory birds are known to play a role in avian influenza dynamics. Detection of H5 highly pathogenic avian influenza (HPAI) viruses in wildlife can provide an early warning for susceptible poultry. The U.S. Geological Survey's National Wildlife Health Center (NWHC) worked with the U.S. Department of Agriculture (USDA) and state partners to conduct passive and active HPAI surveillance during the recent US outbreak. This presentation will provide an overview of NWHC HPAI surveillance and the resulting insights into surveillance strategies and global HPAI viral dynamics. NWHC's 2014 investigation of an aspergillosis outbreak in wild birds in Washington state led to the first detection of HPAI H5N8 in the US. An active surveillance program based on opportunistic sampling (oropharyngeal and cloacal swabs) of hunter-harvested birds was conducted in Washington and Oregon and showed apparently healthy wild birds were infected with the highly pathogenic virus. This was bolstered by a nation-wide passive surveillance program of avian mortality events that indicated raptors are highly susceptible to the virus. Laboratory testing and confirmation was conducted in partnership with USDA and the National Animal Health Laboratory Network. Together these programs showed that the introduced H5N8 virus had reassorted into two variants (H5N2 and H5N1). All eight segments of the H5N8 were >99% similar to those for the 2014 Group A H5N8 strain from South Korea, but phylogenetic analyses revealed the reassortants contained replacement genes from North American wild bird lineage. Passive surveillance detected HPAI at a higher rate (3.4%) than active surveillance (0.8%).

Connectivity of threat: A review of entanglement of banded North American birds
Harrison, Autumn-Lynn - Smithsonian Conservation Biology Institute; Amy Scarpignato - Smithsonian Migratory Bird Center

Ranging from Passeriformes to Procellariiformes, nearly 12,000 banded North American birds from 16 orders have been reported entangled. These birds were caught by or recovered from fishing gear, including line, hooks, and nets. We visualize the occurrence of entanglements through time and space to review the spatio-temporal patterns of reported entanglement events and model these occurrences relative to reporting biases. For species with a high number of reported entanglements relative to other band recovery types (including albatross, booby, pelican, and tern species), we present colony connectivity metrics to estimate colony-specific incidence and location of entanglement and compare to independent migratory connectivity datasets, including tracking data.

Diversification and distributional limits of avian malaria across contrasting regions of Africa
Harvey, Johanna - Texas A&M University; Gary Voelker - Texas A&M University

Understanding the distribution and limitations of parasites and pathogens is becoming exceedingly important as human populations rise leads to increases in habitat fragmentation, climate change, and the introduction of non-native species. Here we examine the influence of avian life history characteristics, climatic data and the diverse suite of vectors transmitting parasites to better understand the distributional patterns of avian malaria. We apply a molecular approach to examine and identify avian malaria of birds (including Plasmodium, Haemoproteus, Parahaemoproteus and Leucocytozoon) that are transmitted by

various dipteran species across Benin (birds, n=205) and the Democratic Republic of the Congo (birds, n=427) across diverse habitats and bioregions. Mitochondrial DNA sequence data from the Cytochrome b gene was collected for infected individuals and new lineages were determined, using BLAST (NCBI) and MALAVI (the avian malaria database). We employ a phylogenetic approach to assess this diversity and relatedness across sampling habitats. We use model testing (generalized linear and random forest) to determine predictor traits for host-parasite relationships given the broad array of life history strategies (such as social structure, group size, feeding behavior, and habitat type) seen across birds. Determining predictors of presence and colonization of avian malaria is necessary to elucidate the how changes in abiotic factors (WorldClim database: temperature, precipitation, seasonality, etc.) will alter the distribution of avian malaria across the landscape. It is necessary to assess disease systems in wild birds in order to broaden our understanding of the evolution, distribution and life history of pathogens.

Contrasting evolutionary histories between birds of upland and floodplain forest in the Amazon

Harvey, Michael - University of Michigan; Alexandre Aleixo - Museu Paraense Emilio Goeldi; Camila Ribas - Instituto Nacional de Pesquisas da Amazônia; Robb Brumfield - Louisiana State University

Floodplain forest and upland forest are widespread across the Amazon Basin, and many species specialize on one type of forest or the other. We compared the evolutionary histories of 20 pairs of closely related bird species in which one occurs in the floodplain and the other in upland forest. We estimated genetic diversity and population history for each species using DNA sequence data from 2,300 ultraconserved elements and 90 exons from individuals sampled across the Amazon Basin. We found similar levels of population structure between species from the two habitats, but species of upland forest exhibited larger effective population sizes, greater geographic divergence, and deeper population histories than floodplain forest species. Our results suggest that species ecology in the form of habitat selection predicts genetic diversity and evolutionary history and that knowledge of natural history can serve as a proxy for population genetic processes potentially important for species conservation.

Fly By Night: Nocturnal Flight Calling Behaviour in Migrating Passerines

Hasson, Rachel - University of Windsor; Blaine Landsborough - University of Windsor; Jennifer Foote - Algoma University; Daniel Mennill - University of Windsor

Multiple abiotic factors, including weather, influence migration behaviour in birds. Often, however, the effects of weather on migration behaviour are studied using diurnal sampling methods, rather than studying nocturnal migration directly. Acoustic monitoring of nocturnal migration is now possible by recording nocturnal flight calls produced by migratory birds in flight. Nocturnal flight calls are short vocalizations, 50-300 ms in duration, that are produced by diverse nocturnal migrants. Many birds produce species-specific nocturnal flight calls, which allows for species identification based on distinct spectro-temporal characteristics, providing a way to study active nocturnal migration based on acoustic recordings. In this study, we present a multi-year study of bird migration through the Great Lakes, and the effects of abiotic factors on bird migration. We used a large microphone array, spanning 1300 km, to monitor the timing and magnitude of avian migration through the Great Lakes Region. We detected more than 60 species of passerines in total, and we examined the effects of weather on the number of migrants detected. Our results reveal substantial variation in the number of night flight calls produced per night, with most

vocal output occurring in the first half of the night. Several features of the abiotic environment, including temperature, precipitation, wind speed, and wind direction, influence the number of migrants passing through the Great Lakes. This is the first Canadian study to use a large-scale acoustic recording transect to monitor migratory behaviour and responses to abiotic conditions.

Hazards to Birds from Open Metal Pipes
Hathcock, Charles - Los Alamos National Laboratory; Jeanne Fair - Los Alamos National Laboratory

There are published reports of open polyvinyl chloride (PVC) pipes causing bird deaths in the western United States. There are numerous other anecdotal reports of other types of pipes trapping birds as well. Here, we document cases of open bollards and open pipes on gates causing bird deaths in northern New Mexico. At Los Alamos National Laboratory (LANL), a 10,240-ha site, over 100 uncapped 10.16 cm diameter protective bollard posts were examined, and 27% of the open bollards contained dead birds. A total of 88 open pipes used as gate posts, with diameters of 8.89 cm or 10.16 cm, were examined, and 11% contained dead birds. We conducted a preliminary assessment of open pipes on gates along a highway on federal land north of LANL, and 14% of the open pipes contained dead birds. This gate configuration, with open pipes anchoring the gate on either side, is very common in the western United States. In all cases, Western Bluebirds (*Sialia mexicana*) composed the majority of the identifiable birds we discovered. Based on these findings, the number of bird deaths from this source is potentially very large and should be a concern in bird conservation and management. Birds are faced with a myriad of anthropogenic threats, it's rare to see a threat that is easy and inexpensive to fix. Just cap it.

Climate change, cannibalism, reproductive synchrony, and tipping points in seabirds
Hayward, James - Andrews University

High sea surface temperature (SST) and concomitant resource paucity associated with El Niño events can cause abrupt changes in feeding and reproductive strategies in colonial seabirds. We show that high SST is associated with increased egg cannibalism and synchronized ovulation in Glaucous-winged Gulls, important sentinels of climate change in the Pacific Northwest and traditional models of animal behavior. Mathematical models suggest that if SST remains high, such changes may produce tipping points leading to population collapse. Our results provide insights into the possible effects of climate change on the life history strategies and population dynamics of seabirds.

Community-driven research and interactive mapping tools for sea ice knowledge with Inuit and Cree in Hudson Bay, Canada
Heath, Joel - The Arctic Eider Society

The Arctic Eider Society (AES) has developed a collaborative network of Community-Driven Research (CDR) towards addressing issues affecting communities among the overlapping jurisdictions of Nunavut, Nunavik and the Eeyou Marine Region in east Hudson Bay/James Bay. In particular, programs focus on evaluating cumulative impacts of hydroelectric developments on winter sea ice ecosystems and impacts on marine birds and mammals including Common Eiders and Belugas. This presentation will demonstrate results of ongoing winter sea ice research programs in Sanikiluaq, Inukjuaq, Umiujaq, Kuujjuaraapik and Chisasibi towards connecting the bigger picture of cumulative impacts in the region. Coordinating research activities, managing data and meaningfully engaging communities

across regional boundaries remains a major challenge in the north. To overcome these challenges AES has developed a social media network and interactive knowledge mapping platform (IK-MAP) designed with and for northerners. IK-MAP provides a compelling user-friendly platform supporting near-real time exchange of results and knowledge from community programs. The platform provides tools integrating traditional and scientific knowledge, high resolution sea ice imagery, training/education materials and social media functionalities including the ability to tag photos, results and other content using dynamic profiles including Inuktitut sea ice terminology and wildlife species. These tools allow users to incorporate their own knowledge systems into interpretation of results from community-based research. This provides capacity to bring together a wide range of knowledge towards action for communications, education and developing capacity for communities and stakeholders working together towards environmental stewardship for Hudson Bay and across the Arctic.

Ecology, behaviour and morphology of landbirds in Grenada

Heathcote, Alexandra - University of Manitoba; Paulson Des Brisay - University of Manitoba; Chelsea Enslow - University of Manitoba; Christoph Ng - Natural Resources Institute, University of Manitoba; Andrew Horn - Dalhousie University; Paula Grieef - Oak Hammock Marsh Interpretive Centre; Nicola Koper - Natural Resources Institute, University of Manitoba

Numerous species and sub-species of landbirds are unique to Grenada and a few adjacent islands within the Lesser Antilles, but little is known about the ecology and natural history of most species on this island. In November 2015, and April to May 2016 we banded 266 and 163 individuals respectively of 16 species of resident land birds in Grenada. The majority of the species had never been banded in Grenada and the near-endemic Grenada flycatcher and Lesser Antillean tanager had not, to the best of our knowledge, been previously banded anywhere, enabling us to collect novel data on numerous restricted-range species. Moult periods differed from those observed in wetter, cooler islands such as Dominica. During the first banding trip in November, 14 species were undergoing a prebasic moult, allowing us to develop preliminary aging criteria. Our results also suggest significant variation in the morphology, song structure, and reproductive timing of some species in Grenada compared to conspecifics from other relatively close populations on other islands of the Lesser Antilles. Black-faced grassquits, bananaquits, black-whiskered vireos, common ground-doves and other species show morphological trends consistent with hypotheses that some species may have experienced ecological release due to low diversity of landbirds on this island. Future research should aim to identify causal factors that lead to species-specific patterns in divergence in ecology among island bird populations in the Lesser Antilles.

Is there more to song matching than meets the ear? Evidence from a complex singer

Hedley, Richard - UCLA; Robert Weiss - UCLA

One function of bird song is to mediate territorial interactions between neighboring birds. A behavior commonly employed during these interactions is song matching, where a bird responds to a rival’s song with the same song type. Song matching has been shown to convey aggression in a variety of species. I conducted playback experiments to understand this phenomenon in Cassin’s Vireo, but instead discovered that song matching did not occur at all. Instead, subjects engaged in a lesser-known behavior that I call song advancing, wherein they responded to a perceived song type by progressing to the next song type in their preferred sequence of song types. I propose

that song matching and song advancing are underpinned by a common mechanism, song mirroring, defined as responding to a perceived song type as though one sang it oneself. Under this hypothesis, the tendency of a vocal response to result in song matching will depend on the bird's singing mode: eventual variety singers, which repeat each song type several times before switching to another song type, will tend to respond with a match. Immediate variety singers, characterized by infrequent repetitions of song types, will tend to engage in song advancing. This hypothesis provides a new perspective on the existing literature on song matching, and also offers a framework within which singing behavior can be studied in species that deliver their songs in complex ways. I will discuss the implications of this for the evolution of singing modes and bird song in general.

Sick birds delay migration – Immune function influences migration phenology
Hegemann, Arne - Lund University; Sissel Sjöberg - Lund University; Rachel Muheim - Lund University; Thomas Alerstam - Lund University; Jan-Åke Nilsson - Lund University; Dennis Hasselquist - Lund University

Most migrating birds make a number of stopovers during migration, and most energy and time of a migratory journey is spend during stopovers rather than on flight bouts. Among individuals a huge variation in the duration of stopovers exists. Some of this variation can be explained by weather conditions or fat stores. However, a considerable part of the variation remains unexplained. We explored whether the health status of a bird influences stopover duration and individual timing of migration. We caught long-distance migrants (LDM) and short-distance migrants (SDM) during autumn migration in Falsterbo, Sweden. We applied radio-transmitters to quantify individual stopover durations and experimentally immune-challenged half of the birds. We compared stopover duration between control and experimental birds and within and among SDM and LDM. We show that immune challenged birds prolong their stopover duration by almost 80% when undergoing an immune response. We also related baseline immune function to stopover duration and show that haptoglobin concentrations, a marker of inflammation, are positively related to stopover duration. Moreover, baseline immune function was related to individual timing of migration. Among LDM, early migrating individuals had lower levels of baseline immune function than late migrating individuals, while this pattern was reversed in SDM. Our data support the hypothesis that LDM are more time constrained than SDM. Moreover, our data suggest that in LDM high quality individuals leave first, while in SDM high quality individuals migrate later. Overall, our data provide evidence that immune function helps to explain individual variation in migration patterns.

Building the habitat pipeline: The role of forest management in diversifying forest structure at multiple scales
Heggenstaller, Daniel - Pennsylvania Game Commission

Most eastern deciduous forests are approximately 100 years old, resulting in a lack of structural complexity at the stand and landscape level. Recent work suggests that for species such as the Golden-winged Warbler, fledgling success may depend on the availability of a range of age-classes near the nest site. Through strategic interspersion of young forest habitat, managers can make an important contribution toward the conservation of Golden-winged Warbler while meeting sustainable forest management goals. Studies regarding habitat selection of Golden-winged Warbler adults and fledglings in managed forests will inform managers as to the most effective arrangement and scale of forest age classes. The ephemeral nature of desired conditions created through forest management, coupled with the widespread lack of desirable regeneration, requires

managers to plan harvests years in advance. Various preparatory treatments, such as deer fencing, low shade removal, and prescribed fire are often necessary to ensure the establishment of competitive regeneration, a process that can take a decade or more. As a result, managers must also take advantage of immediate opportunities to maintain and restore areas of permanent early successional habitat, such as scrub oak barrens. Mowing and prescribed burning have been effective at quickly restoring and expanding native shrub habitat. By combining timber sales and non-commercial shrub-land management foresters can sustainably create Golden-winged Warbler nesting and post-fledging habitat now while ensuring a landscape of long-term structural diversity.

Mechanistic modeling and conservation implications of climate change for the endangered Black-capped vireo

Heinrichs, Julie - University of Washington/Colorado State University; Aaron Sidder - University of Washington; Joshua Lawler - University of Washington; Chad Wilsey - Audubon

The endangered Black-capped vireo requires successional habitat and the continued control of cowbird nest parasitism to persist near Fort Hood, in their Texas breeding range. To gauge the impact of future climate conditions on vireo persistence and assess the level of management support needed preserve the species on Fort Hood military base in Texas, we predicted vireo responses to future climatic conditions. We evaluated past climate-demography relationships (1998-2014) for adult survival, territory success and number of fledglings. We then predicted future demographic responses for 2050 and 2100 using 2 climate scenarios (RCPs) and 8 global circulation models. Demographic improvements were associated with higher minimum spring temperatures, greater precipitation and negatively associated with drought intensity. Climate conditions indicate that future conditions are generally likely yield improvements to vireo survival, territory success, and number of fledglings per successful territory. Using a spatially explicit individual-based simulation model, we also integrated future demographic rates with climate-induced changes in vegetation, shifts in fire regimes, and fire management strategies to predict vireo outcomes under combined changes in habitat and demography. In most scenarios, vireo habitat availability and demographic conditions increased, suggesting that climate change may yield increases in black-capped vireo abundance, possibly lessening the need for intensive management intervention.

Manipulating baseline corticosterone alters reproductive decisions and reproductive success in an Arctic-nesting seaduck

Hennin, Holly - University of Windsor; Pierre Legagneux - Université du Québec à Rimouski; Joël Bêty - Université du Québec à Rimouski; H. Grant Gilchrist - Environment and Climate Change Canada/ Carleton University; Mark Forbes - Carleton University; N. Jane Harms - Environment of Yukon, Government of Yukon; Catherine Soos - Prairie and Northern Wildlife Research Centre/University of Saskatchewan; Oliver Love - University of Windsor

Reproduction is an energetically demanding life history stage in which individuals must carefully manage energetic resources to maximise their reproductive success. Species reliant on capital stores for reproduction are under a unique set of energetic constraints because they must accumulate substantial fat stores prior to reproducing; however, the underlying mechanisms influencing the accumulation of resources are currently poorly understood. Corticosterone (CORT) is an energetic hormones that influences resource acquisition and management, making it a strong candidate mechanism linking resource acquisition, reproductive decisions and success. We manipulated baseline CORT using three different

treatments (control, low baseline dose and high baseline dose) in free-living Arctic-nesting common eiders (*Somateria mollissima*), a mixed capital-income breeding strategy species. Pre-recruiting females (i.e., those not yet committed to breeding) with low baseline CORT plasma levels administered high CORT treatments had the earliest laying phenology (shortest delay in laying following arrival from migration and the earliest laying dates). Females administered the low CORT treatment had the highest reproductive success, with high CORT intermediate between low and control treatments. Females already committed to breeding (i.e., recruiting follicles at the time of the treatment) appeared insensitive to the manipulation, with no changes to reproductive phenology or reproductive success. Results from this study combined with previous work in seaducks suggests that elevated baseline corticosterone prior to investment in reproduction has a direct positive impact on resource acquisition and play a strong mechanistic role in driving variation in key life history decisions in diving seaduck species.

Intersection of Big Data, movement ecology, and resource selection research in birds

Hepinstall-Cymerman, Jeffrey - Warnell School of Forestry and Natural Resources, University of Georgia; Anjelika Kidd - Warnell School of Forestry and Natural Resources, University of Georgia; Maureen Murray - Warnell School of Forestry and Natural Resources, University of Georgia; Sonia Hernandez - Warnell School of Forestry and Natural Resources, University of Georgia & Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, University of Georgia

In studies of movement ecology and resource selection by birds, at least three major advances are propelling the field forward: availability of GPS transmitters that fit an ever-larger number of species; availability of synoptic or global remotely sensed datasets; and open-source software for data management and geospatial and statistical analysis of increasingly large data streams. Linking animal movement to behavioral processes is essential to our understanding of how individual movements scale to population and community level processes. This linkage is especially important where individuals are responding to changing resources, whether from changing climate or land use. We review the current state of the science regarding analysis of movement data to understand resource selection. As a case example to explore opportunities and challenges facing the use of Big Data in ornithological research, we use GPS-tag data on 32 American white ibis (*Eudocimus albus*) tagged in 2015-2016 in West Palm Beach, Florida with up to 12 locations/day. In south Florida, the white ibis is becoming a consistent visitor to urban areas. Preliminary results indicate these “urban ibis” appear to have modified their behavior to exploit urban resources. However, until the advent of GPS tags paired with temporally proximate geospatial data layers, ornithologists were unable to explore the seasonal movement patterns of semi-nomadic and potentially urbanizing species such as the ibis. Such fine-scale data allows us to track resource selection and paths of individuals but requires us to account for statistical and processing issues in analyzing tens of thousands of locations.

Individual Specialists, Population Generalists, and Gentoo Penguin Foraging Ecology Across the Scotia Arc

Herman, Rachael - Louisiana State University; Michael Polito - Louisiana State University

Individual specialization is frequently found within populations of generalists. Ecological theory indicates that generalist populations fall under two categories: type A generalist populations exhibit large within-individual

variation and little variation between individuals, whereas type B generalist populations comprise individual specialists with large variation between individuals. However, it is unclear if specialization strategy varies between populations within a species. Gentoo Penguins (*Pygoscelis papua*) are foraging generalists with a large distribution, making them an appropriate model species for a comparative study of individual specialization between populations. They exhibit regional differences in population size, prey assemblage and prey abundance, which may result in variation in foraging strategy. We conducted stable isotope analysis of δ15N and δ13C through serial sampling of Gentoo Penguin tail feathers from four geographically distinct breeding populations across the Scotia Arc (Western Antarctic Peninsula or WAP, South Shetland Islands, South Georgia, and Falkland Islands) to assess individual variation over time and determine the type of generalist strategies that different populations utilize. Monte Carlo resampling procedures of individual variance in δ15N and δ13C values detected significant degrees of individual specialization in all four populations concurrent with type B generalism. However, degrees of individual specialization varied by population, with the WAP population exhibiting the lowest and South Georgia exhibiting the highest individual specialization. Variation in the degree of individual specialization between populations may be driven by geographic differences in population size, prey abundance and diversity. The prevalence of type B generalism may help buffer Gentoo Penguin populations from environmental change.

Matrix and area effects on the nutritional condition of understory birds in Amazonian rainforest fragments

Hernandez-Palma, Angelica - School of Renewable Natural Resources, Louisiana State University; Philip Stouffer - Louisiana State University

Habitat fragmentation ranks among the most significant threats to biodiversity. Effects of fragmentation on birds have been widely documented, with fragment size being a strong predictor of abundance for most species. However, matrix and landscape-level characteristics have been shown to affect dynamics within the fragments as well. Recovery of vegetation around fragments lessens some of the deleterious effects of fragmentation. As second growth around the fragments ages, it becomes more suitable for animal use and movement. Feather growth rate can serve as an indicator of the nutritional condition of birds, which can be helpful for examining habitat quality. Here we analyze feather growth rate in 12 understory bird species captured in 1, 10, and 100 ha Amazonian forest fragments and continuous forest during a 21-year period at the Biological Dynamics of Forest Fragments Project near Manaus, Brazil. Feather collection began in 1991. Since then, the landscape around fragments has varied, but has generally recovered as second growth forest, allowing us to assess the nutritional condition of birds in response to a dynamic landscape. Preliminary results suggest that as fragment size and age of vegetation around the fragments increase, so does the nutritional condition of birds in the fragments. However, responses varied among species, generally in accordance with sensitivity to habitat fragmentation. Information on bird's nutritional condition can be a useful tool to evaluate habitat quality, helping understand how the matrix can affect conditions within the fragments, which is especially important in dynamic regenerating landscapes.

Bird migration across western Cuba

Hernández, Alina Perez - Centro de Investigaciones y Servicios Ambientales ECOVIDA, Pinar del Rio, Cuba; José M. de la Cruz Mora - Centro de Investigaciones y Servicios Ambientales ECOVIDA; Roberto Varela Montero - Centro de Investigaciones y Servicios Ambientales ECOVIDA; Alejandro Llanes Sosa - Instituto de Ecología y Sistemática; Hiram González Alonso - Instituto de Ecología y Sistemática

The Guanahacabibes Peninsula in the Pinar del Rio Province at western part of Cuba is one of the main migratory flyways. For the past five years, through permanent observations during migration, we conducted fixed point counts in different times of the year and established a permanent banding station during the fall migration. We have concentrated in the phenology and composition of migratory raptors assemblage, aquatic birds and forest birds. Twelve species of raptors are characterized in passing in the study area. *Elanoides forficatus* has a main migration with a maximum of 2,841 individuals in 2014. Nine previously unrecorded aquatic bird species elevate the group to 56 species for the country. The higher relative abundance was encountered in the winter season residents (2,116.03 birds/hour) and the bird species with a higher numerical dominance were: *Anas discors*, *Eudocimus albus*, *Himantopus mexicanus* and *Fulica americana*. The Key "Pájaros" shows the second place with more number of *Frigate magnifecens* individuals recorded in Cuba with around 300 individuals and 32 nests. 2015 we registered 66 species of forest birds, 43 of them are migratory and the rest are permanent residents. A total of 2,084 individuals were banding and 146 were recaptured. The species with more numbers of captures were: *Vireo griseus*, *Setophaga ruticilla*, *Dumetela carolinensis* and *Catharus ustulatus*. The incidence of meteorological variables is valued in the migration.

Relative effects of landscape characteristics on within-season occupancy dynamics of a rare and highly mobile grassland bird: a multi-scale approach

Herse, Mark - Kansas State University Division of Biology; Alice Boyle - Kansas State University

Breeding habitat selection is a fundamental process in animal ecology that influences individual fitness and population viability. Landscape theory and prior research suggests prospecting animals can respond to both habitat amount and configuration (i.e. fragmentation) while assessing landscapes, with configuration becoming increasingly important as focal habitat amount declines. However, empirical data is lacking to identify the percent range of habitat amount where fragmentation effects are most likely to occur—if at all—for many species. We will test whether habitat use by a rare and highly mobile grassland bird—the Henslow's Sparrow (*Ammodramus henslowii*)—is driven primarily by (1) habitat amount, (2) habitat fragmentation, (3) fire disturbance, or (4) an interaction between multiple factors. We conducted 3,855 6-min point-count surveys at 1,421 sites along 57 20-km transects in eastern Kansas from April to July 2015. We detected 39 Henslow's Sparrows at 32 sites. Interestingly, we never detected Henslow's Sparrows at the same location more than one time, despite revisiting each site 2–4 times. We are relating Henslow's Sparrow occurrence to multi-scale (400 and 1200 m radii) measures of landscape composition, configuration, and fire disturbance using dynamic robust-design occupancy models. During the winter of 2015-16 we added an additional 825 survey stations to our study area. Field data collection will resume in April 2016. Identifying the relative effects of landscape characteristics on habitat use by Henslow's Sparrows will improve our understanding of the breeding site selection process and help to mitigate further losses of habitat and biodiversity.

Exposure- and trait-based evaluation of local climate change vulnerability in tropical Andean birds: key vulnerabilities over replicated elevational gradients
Herzog, Sebastian - Asociacion Armonia; Daniel Ruiz-Carrascal - International Research Institute for Climate and Society, Columbia University in the City of New York,; Bruce Young - NatureServe

Climate change impacts on tropical birds are almost unstudied and poorly understood. A handful of observational studies documented slight upslope range shifts of birds in tropical mountains, whereas climate envelope modeling has been employed in some tropical regions to determine potential future spatial responses of birds to climate change. We used the recently developed tropical Andes version of the NatureServe Climate Change Vulnerability Index, a combined exposure- and trait-based approach incorporating sensitivity, risk, and adaptive capacity, to determine vulnerabilities of 1133 resident tropical Andean bird species over two elevational gradients from 200-4500 m: the Amazonian slope in the Peru-Bolivia border region; and the Pacific slope in the Colombia-Ecuador border region. In both study areas, the most highly vulnerable species were ecologically specialized and inhabit high-elevation (>3000 m) ecosystems – projected to experience the greatest temperature increase – or foothill forest (< 800 m) – projected to experience the greatest humidity decrease. Most are passerines, insectivores with specialized foraging requirements (e.g., specific foraging substrates, army-ant followers), have narrow elevational ranges (≤1000 m), and are cold-adapted or expected to be sensitive to changes in humidity. Combined exposure- and trait-based climate change vulnerability evaluations are a promising new approach that is less laborious and costly than field research and less speculative than climate envelope modeling, which ignores constraints imposed by interspecific ecological interactions and fragmented landscapes on the ability of species to successfully track their climatic niches. Perhaps more importantly, this approach is particularly suited for informing the conservation and adaptation planning process.

Nest survival of the Two-Banded Plover (*Charadrius falklandicus*) population in Northern Chubut Province, Patagonia Argentina
Hevia, Glenda - Centro para el Estudio de Sistemas Marinos (CESIMAR - CENPAT - CONICET); Verónica D'Amico - Centro para el Estudio de Sistemas Marinos (CESIMAR - CENPAT - CONICET); Marcelo Bertellotti - Centro para el Estudio de Sistemas Marinos (CESIMAR - CENPAT - CONICET); Daniel Galindo-Espinosa - Centro de Investigación Científica y de Educación Superior de Ensenada - Unidad La Paz; Brett Sandercock - Kansas State University

Current efforts to monitoring the Two-Banded Plover (Charadrius falklandicus), an endemic shorebird to southern South America, have provided information on their breeding biology at beaches with human disturbance in northern Patagonia, Argentina. We estimate annual nest survival and describe causes of nest failure at two beaches with high and low levels of human disturbance located in Puerto Madryn (42°S, 65°W). Fieldwork surveys were conducted by foot using the nearest road track between October and December, 2012. We recorded spatial coordinates of each nest and the distance to the: high tide line, road track, nearest con-specific nest. We floated eggs to estimate hatching dates and nests were monitored 3-5 weekly to verify success (≥1 egg hatched) or failure (human impact, flooding, abandoned, and predation). We used encounter histories for 41 nests found throughout an 89-day nesting season to estimate the DSR (Daily Survival Rate) from the beginning of incubation and analyze competing models with RMark package in R. The most common cause of nest failure at Parana was human impact: vehicles trampled eggs (80%, n=7), followed by predation (20%,

n=2). By contrast, at Las Canteras the most common cause was flooding by extraordinary high tides (50%, n=3), followed by parental abandonment (33%, n=2) and human impact (17%, n=1). The DSR was highest in Las Canteras (0.983; n=22), than in Parana (0.966; n=19). Management actions to protect plovers from harmful human disturbance are urgently need it.

Identification and exclusion of nest predators of Florida dry prairie birds using video surveillance and predator deflection fencing

Hewett Ragheb, Erin - Florida Fish and Wildlife Conservation Commission; Karl Miller - Florida Fish and Wildlife Conservation Commission

Low nest survival is thought to contribute to population decline for the endangered Florida Grasshopper Sparrow (*Ammodramus savannarum* floridanus) yet specific nest predators have not been previously confirmed. In 2014 and 2015, we installed nest cameras and recorded the fates of nests from 46 Florida Grasshopper Sparrows, 10 Bachman's Sparrows (*Peucaea aestivalis*), 16 Eastern Meadowlarks (Sturnella magna), and four Common Ground-Doves (*Columbina passerina*). Sixty-two percent of nests fledged, 8% flooded, 3% were abandoned, and 28% were depredated. Corn snakes (Pantherophis guttatus) and eastern spotted skunks (Spilogale putorius) were responsible for 57% of all recorded predation events. In 2015, we also tested the effectiveness of open-topped predator deflection fences, installing them at half (n=31) of the Florida Grasshopper Sparrow nests. We estimated daily survival rates (DSR) of nests with (2015) and without (2013-2015) fences using Shaffer's logistic exposure method. DSR of fenced nests (0.95 [95% CI: 0.92-0.97]) was higher than unfenced nests (0.91 [0.88-0.93]; likelihood ratio p=0.045). Thus, nests fenced on day 1 would be 2.5 times more likely to fledge than unfenced nests (survival = 34.2% vs. 13.5%). However, the mean age of nests when fenced in our sample was 12 days after the start of incubation, which is equivalent to an improvement factor of only 1.5. Fencing individual nests is unlikely to result in population growth unless fence efficiency is improved, a higher proportion of nests are fenced, or fences are installed earlier in the nest cycle.

Heard and not seen: Tropical wrens rely more on acoustic than visual signals for intra- and interspecific discrimination

Hick, Kristina - University of Windsor; Stéphanie Doucet - University of Windsor; Daniel Mennill - University of Windsor

Animals may use multiple signaling modalities to discriminate between conspecific versus heterospecific animals, or between individuals that represent a threat versus a mating opportunity. Animals use multimodal signalling because different signals may show different transmission properties through different habitats. We investigated how two congeneric wrens, rufous-and-white wrens, *Thryophilus rufalbu*s, and banded wrens, *Thryophilus pleurostictus*, use acoustic and visual signals for species discrimination in tropical forest habitats. We coupled song playback experiments with visual models to assess the importance of these signals, both in combination and in isolation. We assessed vegetation density in the territories of both species to investigate if more densely vegetated territories will influence the use of visual signals. We presented both rufous-and-white wrens and banded wrens with conspecific and congeneric song treatments, model treatments, and song-accompanied-by-model treatments. We found that both species responded strongly to song and song-accompanied-by-model treatments, but showed little or no response when the model was presented alone, suggesting that wrens rely more on acoustic signals than visual signals for discrimination. We found an asymmetrical response to playback trials with rufous-and-white wrens showing little

response to the congeneric trials but banded wrens responding strongly to both conspecific and congeneric trials, suggesting that there may be a social dominance relationship between these two species. No previous studies have investigated the relative importance of acoustic and visual signals in both males and females for species discrimination. Our results suggest that acoustic signals are more important than visual signals for inconspicuous animals living in dense environments.

Speciation and sexual selection as processes to maintain mitonuclear coadapation
Hill, Geoffrey - Auburn University

Eukaryotic performance hinges on the coordinated function of the products of the nuclear and mitochondrial genomes in achieving oxidative phosphorylation. Because two genomes are involved, function is maintained only through perpetual selection for mitonuclear coadaptation. I propose that these fundamental features of the genomic architecture of eukaryotes results in both pre- and post-zygotic sorting for coadapted mitonuclear genotypes leading to both speciation and sexual selection. Mitonuclear coevolution in isolated populations leads to speciation because population-specific mitonuclear coadaptations create between-population mitonuclear incompatibilities and hence barriers to gene flow between populations. In addition, selection for adaptive divergence of products of mitochondrial genes, particularly in response to climate or altitude, can lead to rapid fixation of novel mitochondrial genotypes between populations and consequently to disruption in gene flow between populations as the initiating step in animal speciation. By this model, the defining characteristic of a metazoan species is a coadapted mitonuclear genotype that is incompatible with the coadapted mitochondrial and nuclear genotype of any other population.

Socio-ecological inter-specific association networks: disentangling drivers of species association patterns in mixed species parrot flocks
Hobson, Elizabeth - Santa Fe Institute; Donald Brightsmith - Texas A&M University

Mixed species flocks of birds can provide benefits to individuals through increased predator vigilance or foraging efficiency, but costs and benefits of associating with flocks can vary widely depending on the species composition of the flock. Species are thus expected to preferentially associate with flocks that maximize their benefits and minimize costs. However, species often have differing underlying ecological characteristics, such as different annual or daily activity patterns, which constrain the probability of multispecies flock membership. Using a species-level network approach, we examined a system of mixed species flocks of parrots at a clay lick in Peru to test multiple hypotheses about inter-specific associations. For each species pair, we quantified the amount of overlap in annual, daily, and spatial use patterns at the clay lick to form three species similarity networks, and quantified observed flock membership in a species association network. We then tested hypotheses about observed flock membership using the similarity networks to control for overlap in underlying ecological patterns or preferences. We found that some species, such as chestnut-fronted macaws and mealy parrots, had very similar annual and daily patterns and were often observed together, but that other species, such as large macaws and cobalt-winged parakeets, had high overlap in daily patterns, but were very rarely observed in the same flock. We discuss how using a combination of ecological constraints and social factors in investigations of mixed-species flock association patterns provide more detailed insight into the decisions individuals make about the benefits of associating with other species.

Dietary and energetic inferences from the isotopic analysis of bird breath
Hobson, Keith - Environment Canada; David Ferrier - University of Western Ontario; Christopher Guglielmo - Western University

The measurement of naturally occurring stable isotope ratios in avian tissues and their prey is a well-established tool to infer diet, trophic level and source of feeding. This approach relies on isotopic differences between putative dietary endpoints as well as an understanding of the isotopic discrimination between diets and various tissues. Less well known is the use of breath samples for the measurement of the stable isotopes of carbon (δ13C) and oxygen (δ18O) in breath CO2. These measurements allow inferences of short-term (i.e. hours) dietary carbohydrate and lipid metabolism and can also be used to track the shift between recently ingested foods and the use of lipid stores in fasted birds. A remaining challenge in this field is the establishment of isotopic discrimination factors between dietary macromolecules and breath. Here, we will describe the theory behind the use of breath CO2 isotopic measurements and the apparatus used to sample bird breath in the field. We illustrate our presentation with examples from the literature and our own work using several captive species raised on known isotopic diets. We suggest key experiments required to improve quantitative estimates of avian diet using this approach.

22 years later: long-term dynamics of House Finch populations and virulence evolution in an endemic pathogen
Hochachka, Wesley - Cornell University

Three years after the emergence of a novel bacterial pathogen in the 1993-1994 winter, roughly half of the House Finches in the eastern North America had died. Long-term experimental studies of the bacteria, *Mycoplasma gallisepticum*, suggest that it is still actively affecting House Finch populations and that M. gallisepticum has evolved increasing virulence upon becoming endemic. However, the long-term effects of the pathogen on House Finches abundance have not been studied. The patterns of changing bacterial virulence, along with other finds, suggest the hypothesis that there is an “arms race” of ever-increasing immunity of House Finches selecting for increasing virulence of the bacteria. This should be manifested in nature by stable or even increasing densities of House Finches, because ever-declining populations of House Finches would favor bacteria of lower virulence. Variation in densities of House Finches through space and time are: (1) consistent with low finch densities leading to evolution of lower virulence, the only observed decline in virulence being associated with the bacterias’ dispersal across the middle of North America, an area of low densities of House Finches; and (2) in keeping with an arms race, following establishment of *M. gallisepticum* in any region the densities of House Finches have remained relatively stable, without widespread increases. We conclude that *M. gallisepticum* is the factor limiting House Finch densities in the long term.

Environmental variability influences the evolution of the glucocorticoid receptor in African starlings
Hofmeister, Natalie - Cornell University; Dustin Rubenstein - Columbia University

The glucocorticoid stress response enables vertebrates to cope with environmental change using a hormonal feedback mechanism in the hypothalamo-pituitary-adrenal (HPA) axis. However, organisms can respond to environmental stressors only when circulating glucocorticoid hormones bind to the glucocorticoid receptor. A variety of environmental stressors influence glucocorticoid receptor expression, but DNA sequence variation in the glucocorticoid receptor gene (Nr3c1) also affects hormone binding affinity and transcriptional activity. Genetic variation in the HPA axis—and

particularly in the glucocorticoid receptor—may facilitate adaptation to changing environmental conditions. Here we examined signatures of selection in the glucocorticoid receptor in African starlings (Family: Sturnidae). African starlings occupy a range of environments that vary in rainfall across seasons and years, and many species may be behaviorally and physiologically adapted to this variable environment. We sequenced Nr3c1 in 27 species of African starlings to investigate whether vertebrates cope with changing environmental conditions via adaptive genetic variation. Although we found low levels of sequence variation in Nr3c1 across African starlings, substitution rate (dN/dS) is correlated with variance in annual precipitation. This relationship suggests that environmental variation does influence evolution of the glucocorticoid receptor in African Sturnidae, such that changes in rainfall resulted in genetic canalization. During the radiation of African starlings, fluctuating selective pressures may have enabled these birds to cope with environmental stressors by suppressing maladaptive variation in Nr3c1. Understanding how the HPA axis evolved in African starlings allows us to isolate causal genetic mechanisms for adapting to environmental variability.

Towards an integrated understanding of songbird vocalization through micro-dissection and 3D modeling and animation

Homberger, Dominique G. - Louisiana State University; Amanda Cozic - Louisiana State University

Current understanding of avian vocalization is based on a patchwork of functional-morphological studies of various parts of the vocal tract (e.g., syrinx, trachea, tongue, palate, beak) and of physiological, behavioral, neurobiological and evolutionary studies of vocalizations in a variety of birds. To gain an integrated understanding of avian vocalization, the morphology of the vocal tract of songbirds (the Northern Cardinal, *Cardinalis cardinalis*, and House Sparrow, *Passer domesticus*) was studied through micro-dissection, which revealed, among other structures, paired subcutaneous cervical diverticula of the cervico-cephalic and interclavicular air sacs, which are covered by apterial skin whose muscular-elastic layer can change the skin tension without changing the skin area. A 3D model based on x-ray CT data was animated and matched frame by frame with x-ray videos of singing Northern Cardinals synchronized with sound recordings to correlate postures with particular frequencies and amplitudes. An extended cervical vertebral column, a retracted lingual apparatus and trachea, a constricted neck, and an open beak produces high frequencies and amplitudes, whereas a retrocurved cervical vertebral column, a protracted trachea and lingual apparatus, an expanded neck, a retroflexed head, and an almost closed beak produces low frequencies and amplitudes. The latter posture inflates the subcutaneous air sac diverticula, and the former posture deflates them. The tension of the walls of the asymmetrical air sac diverticula can be tuned by the overlying musculo-elastic skin layer to the frequencies generated by the asymmetrical duplex syringes to create melodic songs based on harmonic sounds

Morph-specific variation in VIP expression in the brain of the behaviorally polymorphic white-throated sparrow correlates with reproductive strategy.

Horton, Brent - Department of Biology, Millersville University; Christina Michael - Department of Biology, Millersville University; Donna Maney - Department of Psychology, Emory University

Our ongoing research examines the neuroendocrine and genetic bases of alternative reproductive strategies in the polymorphic white-throated sparrow (*Zonotrichia albicollis*). In this unique model species, plumage color and behavioral

phenotype segregate according to the presence of a large rearrangement of the second chromosome. Individuals of the white-striped (WS) morph, which are heterozygous for the rearrangement, show higher aggression, less parental effort, and more mate seeking than do TS individuals, which lack the rearrangement. Here, we quantified expression of the hormone vasoactive intestinal polypeptide (VIP) in the brains of birds characterized for aggression and parenting behavior in the wild. The gene for VIP is captured by the chromosomal rearrangement in this species, and VIP is a hormone hypothesized to influence social behavior and prolactin release in other vertebrates. We found that, in both sexes, VIP mRNA was higher in WS than in TS individuals in the anterior hypothalamus (AH); VIP expression in this region is thought to promote aggression. In contrast, VIP expression during the parental phase was higher in TS than in WS males in the infundibular nucleus (INF) of the mediobasal hypothalamus. VIP produced in the INF is thought to stimulate pituitary release of prolactin, a hormone that promotes parental care in birds. Thus, differences in VIP expression between the two morphs in the AH and INF correlate with morph differences in aggression and parenting behavior, respectively. Together, these findings suggest a role for central VIP expression in mediating alternative reproductive strategies.

Avian flight strategies, exploring how migrants cope with wind drift across a latitudinal gradient
Horton, Kyle - University of Oklahoma; Jeffrey Kelly - University of Oklahoma

Migration is a nearly universal behavior among animal taxa. A basic question has fascinated scientists for millennia: how do animals navigate routes of upwards of 2500 kilometers with spatial and temporal precision? A variety of en route tactics have been suggested, including wind drift compensation, full wind drift, and partial adjusts for wind drift. But studying these behaviors across trips that carry animals across continents and oceans remains a principle challenge. Here we show how a vast and mostly untapped resource – weather surveillance radar, can illuminate the tactics used by long distance migrants. We use level-II weather surveillance radar (WSR-88D) data from 20 Great Plains sites from spring 2013-15 to study nocturnal flight behavior. We chose these sites because they cover an extensive latitudinal gradient (~20°) with no major ecological barriers (e.g. mountains, lakes, deserts, etc.) or leading lines (i.e. coastlines). Using these data we were able to determine migration intensity, migrant heading, track, groundspeed, and subsequently airspeed from March 1st to June 15th. Across all sites we found relatively high degrees of wind drift compensation (range 0.14-0.47, 0– complete wind drift compensation, 1– complete wind drift), with no apparent latitudinal shift in wind drift compensation ($p=0.255$). These patterns will shed light on large-scale processes exhibited by millions of individuals, and is a key component to understanding migratory phenomena on the scale in which they occur.

Evolution of vagility and convergent island gigantism in quail (Aves: *Coturnix*)
Hosner, Peter - University of Florida; Joseph Tobias - Imperial College London; Ed Braun - University of Florida; Rebecca Kimball - Department of Biology, University of Florida

Phasianids (pheasants, partridges, grouse, turkeys, and relatives) are generally considered poor dispersers incapable of crossing permanent marine barriers. The Old World Quail (*Coturnix*) are a notable exception, these birds evolved small body sizes and long narrow wings that facilitated long-distance migratory behavior and the colonization of oceanic archipelagos throughout the Eastern Hemisphere. Two monotypic phasianid genera, *Margaroperdix* of Madagascar and *Anurophasis* of alpine New Guinea, may represent additional

examples of trans-marine dispersal in Phasianidae. However, *Margaroperdix* and *Anurophasis* are partridge-like with short rounded wings typical of poorly-dispersive phasianids. Here, we present the first species-level molecular phylogeny of the Old World quail, inferred from over 4000 ultraconserved element loci, and reconstruct evolution of wing shape and body size in Phasianidae in relation to insular colonization. *Margaroperdix* and *Anurophasis* are each nested within the Old World quail as traditionally defined. Ancestral state reconstructions support that *Margaroperdix* and *Anurophasis* independently evolved larger body size and short wings from small-bodied, long-winged ancestors. We postulate that *Margaroperdix* and *Anurophasis* are each "island giants" that evolved from vagile, *Coturnix*-like ancestral populations that dispersed to and became isolated on Madagascar and New Guinea. Their partridge-like morphology is the result of convergence towards that of continental partridges.

The population consequences of migratory connectivity

Hostetler, Jeffrey - Florida Fish and Wildlife Conservation Commission; Scott Sillett - Smithsonian Migratory Bird Center; Peter Marra - Smithsonian Migratory Bird Center

The strength of migratory connectivity (MC) has been shown to have an important effect on response to habitat loss, local adaptation, range expansion, and equilibrium population size for migratory animal populations, but its effects on population viability have not been explored. We present two hypotheses: 1) that MC affects viability through source-sink dynamics and winter competition; and 2) that MC mediates the relationship between environmental factors and viability. We test our hypotheses using a four-season full-annual-cycle population model that includes multiple populations, environmental stochasticity in all seasons, and density dependence in summer and winter. We estimate probability of quasi-extinction at the population and species levels and examine quasi-extinction risk's sensitivity to vital rates under a range of MC strengths. We found little effect of MC on quasi-extinction risk of identical populations, but a greater effect if populations had different habitat quantity or quality, highlighting the role of source-sink dynamics. Stronger winter competition also increases the importance of MC. Increased MC can increase the importance of other vital rates on quasi-extinction risks, particularly those involved in winter density dependence. Thus MC can alter the relationship between winter environmental factors and population viability. These results can inform decisions about research priorities for migratory animals of conservation concern.

B10K: The genome sequencing of all extant birds.

Howard, Jason - Duke University; M. Thomas Gilbert - University of Copenhagen; Guojie Zhang - China National GeneBank, BGI, China; Gary Graves - Smithsonian Institution; Erich Jarvis - Duke University Medical Center, HHMI

The goal of the B10K project is to sequence the genomes of all extant bird species. The project will be conducted in four phases: (i) sequencing the genomes of all the 30+ bird orders; (ii) sequencing the genomes of all the 230+ bird families; (iii) sequencing the genomes of all the 2200+ bird genera; (iv) sequencing the genomes of all the remaining bird species. So far we have sequenced over 200 avian genomes, representing at least one genome from each of the bird orders. We have sequenced the genomes of over 90% of the bird families. For the family level sequencing, we sequenced at 30X coverage using a 500bp paired end library and a 2kb mate paired library for scaffolding. Moving forward to the genera level phase we are testing out using PacBio long reads and BioNano Genomics optical maps to generate a hybrid assembly. Having all genomes sequenced from an entire class of vertebrates

will lead to a better understanding of the genomics involved in complex traits, morphology, disease, and evolution. Additionally, having endangered species' genomes sequenced will enable conservation biologists to create a novel set of loci and neutral molecular markers for identifying diversity. These markers can be used to increased diversity in populations through strategic breeding of individuals. Lack of species genetic diversity is a leading contributor to species going extinct.

Planning and Application of Conditions of Approval for Projects Affecting Prairie Grouse

Howard, Randy - BLM

In New Mexico, the lesser prairie-chicken (LPC) formerly occupied a range that encompassed the easternmost one-third of the state, extending to the Pecos River, and 28 miles west of the Pecos near Fort Sumner. Currently, populations exist only in five counties, comprising about 23 percent of the historical range. Bureau of Land Management (BLM) Pecos District established the Special Status Species Resource Management Plan Amendment (2008 RMPA) to provide specific management prescriptions to ensure the continued habitat protection of two special status species, the LPC and dune sagebrush lizard, while allowing other resource uses and activities to continue. The final rule to list the LPC as threatened was published in the Federal Register on April 10, 2014; however, was vacated by a federal district judge on Sept 1, 2015. The species remains a special status species for BLM, and will continue to be managed as such per the 2008 RMPA. The BLM is mandated to manage public land resources for a variety of uses, such as energy development, livestock grazing, recreation and timber harvesting, while protecting a wide array of natural, cultural, and historical resources. This can be challenging given that LPC are sensitive to energy development, livestock grazing and recreation. Proposed actions are analyzed by the National Environmental Policy Act (NEPA) and Conditions of Approval (COA) are a mechanism used to mitigate anticipated human impacts. COA's are constantly a work in progress as new science becomes available or on the ground observations reveal a need.

Phenotypic integration among melanic morphological trait, stress hormone profiles and personality in male Northern Cardinals (*Cardinalis cardinalis*)

Huang, Ping - Department of Biology, University of Florida; Rebecca Kimball - Department of Biology, University of Florida; Colette St. Mary - Department of Biology, University of Florida

Phenotypic integration describes the covariation among multiple functionally-related traits in a given organism. The melanocortin system not only facilitates an animal's grey-black coloration, but is also associated with the hypothalamic-pituitary-adrenal (HPA) axis that initiates release of the stress hormone, corticosterone (CORT), which results in behavioral responses. Given that the HPA response variation has been proposed to be the cause of animal personality, which is defined as the consistent individual behavioral differences over time and across situation, the melanocortin system should, in theory, lead to phenotypic integration among melanic morphological traits, CORT profiles and animal personality. In this study, we used wild-caught Northern Cardinals (*Cardinals cardinalis*) to investigate this hypothesized covariation. Melanin-based face mask size was scored upon capture. Cardinals were kept in captivity for 8 days to run through 5 behavioral trials. Fecal samples were collected to profile individual CORT levels. We first applied common principal component analysis to identify and calculate individual personality scores from our behavioral data. Pearson's correlation analysis was then used to identify the personality axes correlated with either face mask or CORT profiles. Finally, to test for

phenotypic integration, we applied structural equation modeling. Resulting model demonstrated phenotypic integration among face mask, short-term stressed CORT level and the neophilia personality scores. However, the pattern was observed in male cardinals only; in females, while the behavior-hormone correlation was also observed, neither was related with face mask. The result stresses the necessity of investigating the role of sex in phenotypic integration in future studies.

Modeling bird distributions in response to coastal restoration scenarios

Hucks, Katrina - University of Louisiana at Lafayette; Paul Leberg - University of Louisiana at Lafayette

Coastal systems are facing many challenges including climate change, sea level rise, storm surge, and erosion, all of which contribute to land loss. In Louisiana, this has led to the development of the coastal master plan supported by Habitat Suitability Index models to predict wildlife responses under various management scenarios. However, these models were not originally intended for this purpose and their functionality at large spatial scales is unclear. The goal of this project is to use Maxent to predict how various bird distributions might change with coastal restoration and management. During the summer of 2015, we surveyed southern Louisiana for Mottled Duck, Brown Pelican, and Roseate Spoonbill. We measured salinity, temperature, water depth, SAV presence and cover, and recorded surrounding vegetation. Using a predictive vegetation model, we projected the probability of occurrence for each target species. We had strong model fit for all models. Important variables for Mottled Duck were water, Schoenoplectus californicus, bare ground, Paspalum vaginatum, and Typha domingensis. Important variables for Brown Pelican were water, Spartina alterniflora, T. domingensis, Sagittaria lancifolia, and Taxodium distichum. Important variables for Roseate Spoonbill were water, bare ground, S. alterniflora, Avicennia germinans, and S. californicus. We plan to incorporate other environmental variables in future analyses to project habitat changes over a 50 year period. These results will help us understand how coastal change is affecting distributions of avifauna in southern Louisiana.

How rhodoxanthin from exotic shrubs is altering the appearance of colorful birds in North America

Hudon, Jocelyn - Royal Alberta Museum

Rhodoxanthin, a carotenoid of deep red hue found in the berries of two Asiatic bush honeysuckles, the Tatarian and Morrow's honeysuckles, now naturalized in North America, is altering the coloration of carotenoid-bearing feathers in several species of wild birds that ingest it. First identified in the Cedar Waxwing, we have since found the pigment in aberrantly reddened feathers of the Northern Flicker, the Northern Oriole, and the White-throated Sparrow, and suspect it in additional species with altered plumages (Prairie Warbler, American Redstart, Yellow-breasted Chat, Scarlet Tanager, etc…). The exogenous rhodoxanthin can be detected spectrophotometrically on a reflectance spectrum from a shoulder at 570 nm, lacking in species, like the Western Tanager, that deposit the pigment naturally. In Yellow-shafted Flickers, rhodoxanthin shows up in the yellow vanes and shafts of flight feathers, often appearing rather abruptly in earlier-molted primaries (often p4 or p5). At least in the flicker, the pigment is metabolized and appears to interfere with the production of the main yellow pigment in this form, lutein, a common yellow carotenoid of songbirds. Using data on the timing of replacement of primaries in Northern Flickers banded at Manomet we were able to infer that the flickers broadly ingest the pigment in early August. In the future, feather reddening caused by dietary rhodoxanthin could be

used to identify species, or subsets of individuals, that incorporate berries in their diets in the fall, timing of feather replacement, as well as feathers that are molted in the spring's pre-alternate molt.

Introductory whistle is sufficient for species recognition in golden-crowned sparrow nestlings

Hudson, Emily - University of Nebraska-Lincoln; Daizaburo Shizuka - University of Nebraska-Lincoln

Mate-recognition is a critical behavior for all sexually reproducing animals; failure to correctly recognize appropriate mates can lead to wasted time, gametes and resources. In animals that learn mate-recognition signals, selection is therefore expected to favor mechanisms to reduce the risk of mistakenly learning heterospecific signals. Song learning in oscine birds shows many adaptations that may fulfill this function, such as auditory templates that enable naive birds to distinguish conspecific songs from other sounds in the environment. Research in white-crowned sparrows suggests that auditory templates may often involve a species-characteristic auditory cue (the introductory whistle) that guides learning toward appropriate models. If so, nestling birds should be able to distinguish their own species' whistle from that of related sympatric species, prior to beginning song learning. We tested the hypothesis that the descending introductory whistle in the song of the golden-crowned sparrow allows nestlings to discriminate conspecific from heterospecific (white-crowned sparrow) song. We temporarily removed 10-day-old golden-crowned sparrows from their nests, and exposed them to recordings of the introductory whistle of either conspecific or heterospecific song. Several behavioral responses were then recorded, including number of chirps and latency to chirp and hop in response to whistles. Nestlings exposed to conspecific whistles gave a stronger behavioral response than those exposed to heterospecific whistles. Moreover, nestlings exposed to conspecific whistles alone responded equally strongly as chicks exposed to full conspecific songs. Consistent with previous research, our results indicate a potential role for introductory whistle in guiding conspecific song learning.

Sex-specific, inverted rhythms of activity in a polar breeding seabird

Huffeldt, Nicholas Per - Dept. of Biology, Wake Forest University & Dept. of Bioscience, Aarhus University; Flemming Merkel - Greenland Institute of Natural Resources & Dept. of Bioscience, Aarhus University

Predicting the future would provide a fitness advantage, and most organisms have endogenous timing systems; an example is circadian clocks. These timing systems are used to anticipate cyclic events and improve an organism's performance by synchronizing behaviors to appropriate environmental cues (zeitgebers) that predict resource availability. The primary zeitgeber is the geophysical light-dark cycle, but during polar day and night around the equinoxes (summer and winter, respectively) the dichotomous light-dark cycle is absent. A variety of diel activity patterns are exhibited by polar organisms, from entrained 24-h rhythms to arrhythmicity. In Arctic Greenland (73.7°N, 56.6°W) during polar day, we observed colony attendance rhythms and period length of breeding thick-billed murres (*Uria lomvia*; n = 21 pairs), a charadriiform seabird, which provide biparental care at the colony. We found that *U. lomvia* have rhythmic incubating and brooding attendance with a rhythm entrained to the geophysical day (mean ± 95% CI = 24.13 ± 0.52-h). Sexes and individual pair members had rhythms that were sex-specific and inverted ("antiphase") at both the population and within-pair levels. Two hypotheses are discussed as possible causes: the energetic risk-partitioning hypothesis and the sex-specific aggression hypothesis. The findings have implications for

our understanding of the endogenous circadian timing system, because the results suggest that the endogenous circadian clock or its behavioral output is flexible, or that the behavior is dictated by an alternative interval-timer or is masking the circadian clock.

Parasite mediated sexual selection and speciation in the barn swallow species complex.

Hund, Amanda - University of Colorado at Boulder; Joanna Hubbard - University of Nebraska; Yoni Vortman - Tel-Hai Academic College; Tomas Albrecht - Charles University in Prague; Rebecca Safran - University of Colorado, Boulder

Many related populations are distinguished by variation in sexual traits, yet little is known about how sexual traits diverge and influence speciation. Determining what females gain from sexual traits is important to understanding these questions. Parasites have been associated with sexual traits in single populations, but it remains unclear how parasites may drive sexual trait divergence. To test this, we are using the barn swallow species complex, which is characterized by sexual trait divergence. We found that parasite communities vary significantly across populations, but that sexual traits signal information about the most costly parasite, thus giving adaptive information to females. Male color in North America, tail streamers in Europe, and both color and streamers in the Middle East, all correlate with nest parasites found in a male's territory. These parasites are costly as they impact nestling survival, growth, and future sexual trait expression. As nest parasites feed primarily on nestlings, we can exclude established physiological mechanisms that tie sexual trait expression to parasite loads. We suggest that behavioral mechanisms are linking sexual trait expression to territory quality in each of these populations.

Forestry and conspecific attraction affect habitat use and selection by Canada Warblers (*Cardellina canadensis*) at multiple spatial scales

Hunt, Anjolene - University of Alberta; Erin Bayne - University of Alberta / Department of Biological Sciences; Samuel Hache - Canadian Wildlife Service / Environment and Climate Change Canada / Government of Canada

Canada Warblers (*Cardellina canadensis*) are considered a threatened species in Canada due to long-term population declines. Alteration of habitat on breeding and wintering grounds by timber harvest is suggested as a threat, but empirical data on the scale and magnitude of forestry's effect on population dynamics is scarce. In western Canada, this species is generally associated with old-growth deciduous stands, but individuals have also been detected in post-harvest stands (i.e. 11-30 years post-harvest) and remnant unharvested patches. However, the density of individuals supported by post-harvest stands and the extent of use throughout the breeding season remains unknown. Furthermore, Canada Warblers are purported to exhibit a clumped distribution, suggesting that conspecific attraction could play a role in selection and use of post-harvest stands. In this study we quantified the relative importance of timber harvesting (i.e. amount, structure, configuration, and landscape context) and conspecific attraction (presence and proximity) on habitat selection and use by Canada Warblers at multiple spatial scales (regional, ~500km2 management areas; grid, 17.3 ha each; point count; and individual home ranges) in Alberta, Canada. Preliminary results suggest that abundance of Canada Warblers in Alberta is higher in western than eastern regions, in grids < 50% harvested and near other occupied grids; selection ratios are higher for points nearer to remnant unharvested patches and conspecifics. Results from home-range use analyses will also be presented. We will discuss how these

results can guide best practices in forest management and recovery strategies for this species at risk.

Let the good times roll: piping plover (*Charadrius melodus*) demographic response to historic flooding on the Missouri River

Hunt, Kelsi - Virginia Tech; Dan Catlin - Virginia Tech; Jim Fraser - Virginia Tech; Meryl Friedrich - Virginia Tech; Sarah Karpanty - Virginia Tech

For many avian species, the quality and quantity of nesting and foraging habitat affects population levels. On the Missouri River, piping plovers (*Charadrius melodus*) are limited by the amount of sandbar habitat available for breeding. From 2005–2014, we examined the effect of habitat creation (both anthropogenic and natural) on population growth of Missouri River piping plovers. Throughout the duration of our study, we monitored 1,071 nests and uniquely marked 986 piping plover adults and 2021 chicks. From 2004–2009, the U.S. Army Corps of Engineers constructed sandbar habitat on the Missouri River, and we investigated the effectiveness of the 'engineered' habitat by examining a number of demographic parameters and found that parameters such as reproductive output were initially high, but decreased over time. During the 2010 and 2011 breeding seasons, flooding covered all habitat and resulted in increased adult mortality and complete reproductive failure. However, the high flows created an abundance of new sandbar habitat, and we compared the effectiveness of the 'post-flood' habitat with that of the pre-flood engineered habitat. We found that reproductive output and hatch-year survival were higher on post-flood habitat and, unlike engineered habitat, did not decrease as the habitat aged. Continued high demographic rates resulted in population growth each year following the flood, compared to one year of population growth during the pre-flood portion of our study. On the Missouri River, density-dependent mechanisms are driving population growth as the abundance of flood-created habitat resulted in lower nesting densities and relatively low levels of density-dependent predation.

A tale of the nearly tail-less: the biogeography of the Crombecs (genus: *Sylvietta*)

Huntley, Jerry - Texas A&M University

Sylvietta is a broadly distributed group of African species inhabiting a wide range of habitats and present an interesting opportunity to investigate the historic mechanisms that have impacted the biogeography of African avian species. We collected sequence data from 51 individuals and used model-based phylogenetic methods, molecular divergence estimates, and ancestral area estimates to construct a time-calibrated phylogeny and estimation of biogeographic history. We estimate a southern African origin for Sylvietta, with an initial divergence splitting the genus into two clades. The first consists of arid-adapted species, with a southern African origin and subsequent diversification north into Ethiopia-Somalia. The second clade is estimated as having a Congolian forest origin with an eastward pattern of colonization and diversification as a result of Plio-Pleistocene forest dynamics. Additionally, two members of the genus Sylvietta display interesting patterns of intra-specific diversification. *Sylvietta rufescens* is an arid-adapted species inhabiting southern Africa and we recover two sub-clades with a divergence dating to the Pleistocene, a unique pattern for avian species which may be explained via isolation in arid habitat fragments in the early Pleistocene. Secondly, *S. virens*, a species endemic to Afro-tropical forests, is recovered with little genetic diversification across its broad range, an interesting result given that recent investigations of several avian forest species have found substantial geographically-structured genetic diversity relating to Plio-Pleistocene forest

fragmentation. Overall, Plio-Pleistocene habitat cycling played a significant role in driving diversification in Sylvietta, and this investigation highlights the substantial impact of climate-driven habitat dynamics on the history of Sub-Saharan species.

The macroecology of resource availability for North American bird communities
Hurlbert, Allen - University of North Carolina

Both theoretical and empirical investigations have suggested that resource availability constrains many facets of avian populations and communities. Exploring these constraints at a macroecological scale is challenging because the Big Data that is readily available for describing bird distribution and occurrence is not matched by any corresponding datasets on resource availability. My goals in this talk are two-fold. First, I provide an example of how remotely sensed proxies of resource availability shed light on the factors driving geographic patterns of species richness, and how the distinction between "core" and "transient" species improves our understanding of such relations. Second, I describe more recent efforts to develop geographic-scale datasets on arthropod food resources which may help to answer questions about phenomena ranging from diversity patterns to phenological mismatch. Developing Big Data resources for the resources, predators, and pathogens of birds will be a powerful complement to existing Big Data resources on the birds themselves.

Boldness in response to alarm calls in urban populations of song sparrow (*Melospiza melodia*)
Hyman, Jeremy - Western Carolina University

Many studies in birds have described higher boldness in urban populations. One common measure of boldness in such studies is flight initiation distance, while other studies have measured boldness in response to loud noises, cars or small remote-controlled vehicles. However, urban birds are likely to have more experience with humans, loud noises, cars, and other mechanical objects than rural birds, leading to the possibility that such studies measure habituation to these stimuli, rather than measuring general boldness. Other studies have measured boldness in response to playback of predator vocalizations. However, one could find greater boldness in urban animals due to greater general boldness, due to reduced responses to predators in the absence of predators in the urban environment, or, if the urban animals have habituated to humans, due to transfer of habituation. In this study, we attempt to clarify if greater boldness in urban birds is due to habituation or greater generalized boldness. We measured boldness in Song sparrows (*Melospiza melodia*) using playbacks of heterospecific alarm calls. Song sparrows respond to alarm calls with an active, mobbing approach, thus a bolder response would not be the result of habituation. We conducted heterospecific alarm call playbacks in urban and rural birds from 20 different populations. Results showed that urban birds were bolder in response to alarm calls, and thus suggest that greater boldness is a general trait of urban birds.

A new hypothesis for explaining differences in winter distributions of male and female ducks in North America
Iemola, Elyse - SUNY ESF; Michael Schummer - SUNY Oswego

The traditional view for birds is that the largest or 'best' males, or those individuals that are more dominant, winter at greater latitudes and do not have to endure the cost of migration. However, it seems counter-intuitive for larger, dominant males to maintain winter residency at higher latitudes if their potential mates winter at southern latitudes, at least for species of ducks that begin to pair in October or November. In early pairing ducks, dominant males pair earlier and must follow their females south during autumn, while late pairing ducks need not

follow females. There is evidence that spring migrating teal in Spain switch mates at stopover sites. Such evidence suggests there may be fitness consequences depending on the choice to winter south with a mate/potential mate or to sustain at northern latitudes to court and pair with females on their way to breeding grounds in spring. We hypothesized that differences in winter distributions between female and male ducks occurs, not solely because females winter farther south or dominant males winter farther north, but because unpaired males, for species that pair late, remain at northern latitudes where they can encounter and court females returning north in late-winter and spring. We predicted that latitudinal differences in ratios of M:F among latitudes would be greatest for late pairing species. Using data from USFWS Part Collection Survey from December – January 1995 – 2014, our models support that differences in M:F ratios among latitudes would be greatest for late pair species.

Influence of a century of climate and habitat change on desert birds
Iknayan, Kelly - UC Berkeley; Steven Beissinger - UC Berkeley

Using a unique historic resource in a climate change hotspot, we investigated the effects of climate and land-use change over the past century on birds of the Mojave Desert. As part of the Grinnell Resurvey Project, we resurveyed 57 sites primarily in Death Valley, Mojave and Joshua Tree National Parks that were first sampled for avian diversity prior to significant climate warming (1908-1945) to quantify the community-level effects of climate and habitat change. We hypothesized that both abiotic and biotic factors have influenced changes in site occupancy, and that sites with greater change in temperature, precipitation and habitat characteristics should exhibit higher rates of turnover (colonization and extinction) than sites experiencing less change. All resurvey sites warmed over the past century to varying degrees, but some became wetter while others dried. In total, 116 breeding bird species were detected in either historic or modern times. Since resurveys occurred primarily in protected areas, the main drivers of structural habitat change have been invasive plants, grazing, and fire. Analyses used a multi-season multi-species occupancy model to account for variation in detection that can arise from differences in survey methods in each time period. Half of species had stable occupancy probabilities (< 10% change), and half had decreasing occupancy probabilities. Initial results suggest that the extent of grazing and fire had a community-wide negative influence on colonization of sites. Responses to changes in precipitation and temperature varied widely with species identity, and did not show a community-level trend.

Conservation of the Cuban Parakeet (*Aratinga euops*).
Inigo-Elias, Eduardo - Cornell Lab of Ornithology; Maikel Canizares Morera - Instituto de Ecologia y Sisematica/Sociedad Cubana de Zoologia; Vicente Berovides Alvarez - Universidad de la Habana

The Cuban parakeet is an endemic species to the Cuban Archipelago. The species is considered endangered in Cuba and the IUCN Red List the species as vulnerable. Currently the population is decreasing do to habitat modification and primarly captured for the illegal wild caught bird trade across the country and international. Population remains fragmented with historical isolation patches along the entire species distribution area. Our reserch evaluates the current population status and distribution of this species in the main island of Cuba. We present 10 year data on nesting biology, reproductive success and chick development. We present data from two comparative localities in two distinct habitat types where the species occurs. According to our data, the Cuban Parakeet is seemingly better adapted to the savannas with palms than to the low

mountain forests, however the first habitat type is the most disturbed. We analyzed the results of the main management actions that have been developed in different protected areas and and we evaluate the perspectives and challenges that represent the long term conservation of this species.

Move over aerial insectivores: aquatic nutrient and mercury subsidies to forest songbirds traced through stable isotopes
Jackson, Allyson - Oregon State University, Department of Fisheries and Wildlife; Collin Eagles-Smith - U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center

Mercury (Hg) has historically been thought to be isolated to aquatic systems. However, exposure and impacts of Hg in terrestrial foodwebs is becoming recognized as a potentially important pathway when there is a strong reliance on aquatic nutrient subsidies. For riparian songbirds, we still do not understand the basics in terms of the magnitude of Hg transfer, bioaccumulation, and effects of Hg on these sensitive species. The objectives of this study are to explain variation in Hg exposure between individuals and species based upon their diets, traced through stable isotopes of carbon and nitrogen. In 2013, songbird blood samples (n = 480) were collected from 21 different species at 11 sites along the Willamette River in Oregon, a water body with a legacy of Hg pollution from gold and Hg mining in its headwaters. This project focused on thrush, sparrow, and warbler families that are not thought to forage exclusively on emergent aquatic prey, as opposed to more commonly studied aerial insectivores. Aquatic and terrestrial invertebrates were also sampled at each site to assess baseline isotopic signatures. Preliminary data suggest that both mercury exposure and songbird reliance on emergent aquatic prey varies with distance from the river and foraging specialties of families and individuals. In main-stem sites, the proportion of aquatic prey in the diet of individual birds was correlated with mercury exposure. This study has important implications for understanding the connection between aquatic and terrestrial systems; bird species that eat more aquatic-based prey likely bioaccumulate higher levels of Hg.

Dynamics of Woodpecker-Starling interactions: A comparison of Old World and New World species and populations
Jackson, Jerome - Florida Gulf Coast University; Bette Jackson - Florida Gulf Coast University

Woodpecker species whose cavities are most usurped by Common Starlings (*Sturnus vulgaris*) are species that are widespread, generalists in their use of habitats, and similar in size or slightly larger than the starling. These include the Great Spotted Woodpecker (*Dendrocopos major*) of Eurasia and the Northern Flicker (*Colaptes auratus*) and Red-bellied Woodpecker (*Melanerpes carolinus*) of North America. Other woodpecker species, especially melanerpine woodpeckers, also have cavities usurped in habitats favored by starlings. Concern about cavity usurpation by starlings is much less in Eurasia, where the starling is native, than in North America, although the same behavioral ecology seems in play. Usurpation occurs primarily in human-dominated urban, suburban, and exurban habitats with pastures, sports fields, and other open areas that are prime feeding areas for starlings. Cavities are most at risk for usurpation just as they are completed by woodpeckers and before egg-laying. Woodpecker habitat losses and fragmentation not only reduce woodpecker habitat quality, but improve starling habitat quality, thus exacerbating woodpecker-starling interactions. The only woodpeckers that might become in danger of extinction as a primary result of cavity usurpation by starlings are likely island species with small populations, such as Fernandina's Flicker (*Colaptes fernandinae*) of Cuba – if starlings were to become established in Cuba. The

starling is currently known only as a rare wintering species in Cuba, but North American populations now extend to Key West, Florida, and their eventual establishment in Cuba seems likely.

Status of the Egyptian Goose (*Aplochen aegyptiacus*) in Northwestern Arkansas
James, Douglas - University of Arkansas; Cameron Chesbro - University of Arkansas

The original range of the Egyptian Goose is throughout eastern, western, and southern Africa. It has escaped captivity in Europe where it has become an invasive pest causing crop deprivations and interacting negatively with other avian species. In its native range it is also a crop pest. It was discovered in northwestern Arkansas in the 1980s. Since then two feral population centers were established, both adjacent to large artificial ponds. Roadside surveys in 2012 and 2013 showed the existence of a scattered population with some successful nesting.. Principal Components analysis indicated that the first three PCs were useful, PC1 described distance to the nearest woods and also area of the adjacent pond, PC2 was distance to the nearby pond, and PC3 was distance to the nearest large isolated tree in the surrounding open pastureland. Average numbers were around 25 birds both years. Peak numbers were 43 birds in October in 2012 and 26 birds in June and August 2013. The Egyptian Goose was added to the Christmas Bird Count in 1988. This provided a nationwide count ever since. The results show there was a gradual yearly increase in numbers in California, but a significant increase in Florida. It is recommended that the Egyptian Goose be eradicated in Arkansas and the USA before it becomes the pest it has become in Africa and Europe.

The evolutionary relationships and locomotory mode of the "mole-duck," *Talpanas lippa*, of Kauai
James, Helen F - Division of Birds, Smithsonian Institution; Megan Spitzer - Smithsonian Institution; Misaki Ouchida - Smithsonian Institution; Teresa Feo - Smithsonian Institution, National Museum of Natural History

The "mole-duck," Talpanas lippa, is perhaps the most remarkable and least-understood member of Hawaii's endemic Anatidae. Known from a Holocene cave site on Kauai, the species was terrestrial, had very poor vision, and apparently had extremely well-developed sensory perception in the beak. A study of the comparative neuroanatomy of Talpanas is underway, and meanwhile in this presentation we focus on its evolutionary relationships and transformation from an aquatic to a terrestrial life mode. We present a parsimony analysis of the species' phylogenetic relationships, but considering that the parsimony criterion can be misleading for highly autapomorphic taxa, we also more closely examine parts of the skeleton that are likely to be the least transformed from the ancestral state, such as the vertebrae. If the hypothesis that Talpanas' ancestor was a foot-propelled diving anatid is correct, then its evolution on Kauai to become a bipedal terrestrial animal represents a novel evolutionary transformation of a highly aquatic animal. We illustrate the comparative postcranial osteology of Talpanas, emphasizing its vertebral column and oddly transformed pelvis and synsacrum, to evaluate whether the species walked with upright posture, like a penguin, or with a more horizontal posture like a kiwi.

Nesting strategies of birds in the world's southernmost forests: the impact of a novel invasive predator
Jara, Rocío - Department of Biological Sciences, University of North Texas, USA.; Ramiro Crego - Department of Biological Sciences, University of North Texas, USA;

Instituto de Ecología and Biodiversidad, Departamento de Ciencias Ecológicas, Facultad de Ciencias, Santiago, Chile.; Justin Williams - Department of Philosophy and Religion, University of North Texas, USA.; Francisco Arellano - Departamento de Ciencias y Recursos Naturales, Facultad de Ciencias, Universidad de Magallanes, Chile.; Ricardo Rozzi - Sub-Antarctic Biocultural Conservation Program, Department of Philosophy and Religion, University of North Texas, Denton, TX, USA, Omora Ethnobotanical Park, Universidad de Magallanes, Puerto Williams, and Institute of Ecology and Biodiversity, Chile; Jaime Jiménez - Department of Biological Sciences, Sub-Antarctic Biocultural Conservation Program, University of North Texas, Denton, TX, USA, Omora Ethnobotanical Park, Universidad de Magallanes, Puerto Williams, and Institute of Ecology and Biodiversity, Chile

The Cape Horn Biosphere Reserve (CHBR), at the end of the Americas, lacked wild mammal predators until the end of the 20th century, when the American mink (*Neovison vison*) was introduced. Thus, birds evolved without anti-mammal-predator behaviors in this area. Here we study for the first time on Navarino Island (in the CHBR) (55oS), Chile, bird reproductive ecology, focusing on the nesting strategies and causes of nest failure of five open-cup forest-nesting passerine species. The following results represent the first two seasons of nest searching and monitoring with camera traps (2014-2015 and 2015-2016). Regarding the placement of their nests, *Zonotrichia capensis* nested at the lowest height off the ground (1.24 ± 1.24 cm.)(mean ± SE), whereas Elaenia albiceps nested at the highest height (116.6 ± 16.6 cm.). Of the 56 nests monitored, 61% failed. Of the failed nests, 10 (29%) were abandoned and 23 (68%) were depredated. We recorded only two predators, Milvago chimango (*Chimango caracara*) and *N. vison* accounting for 48% and 4% of the 23 depredation events, respectively. Comparing our results to those from lower latitudes reveals that both *E. albiceps* and *Turdus falcklandii* place their nests at lower heights off the ground in Navarino Island. However, even though this theoretically puts them at a higher risk of predation by American mink, our results indicate that mink predation was a minor factor in nest failure as we only recorded one mink predation event. The information reported in this study is crucial to complement long-term research in Navarino Island.

Changes in functional and phylogenetic diversity of avian assemblages across continental scales

Jarzyna, Marta - Yale University; Walter Jetz - Yale University

Research on the implications of climate change to biodiversity has mostly focused on shifting species distributions and resulting changes in taxonomic diversity (TD). TD alone, however, often fails to fully describe community structure and can compromise our ability to understand the implications of climate change to biodiversity. Metrics of functional (FD) and phylogenetic (PD) diversity contain invaluable information regarding ecosystem functioning and community evolutionary history and are thus better suited to identifying the underlying processes that determine biodiversity dynamics and thus the consequences of climate change. Here, we quantified temporal changes in avian FD and PD over the span of five decades by using bird species occurrence data from the North American Breeding Bird Survey. We used multispecies occupancy models in order to account for species imperfect detection in the estimates of FD and PD. Using Gower's distances and UPGMA clustering, we built functional and phylogenetic dendrograms, weighted dendrogram branch lengths by probability of species occurrence, and estimated diversity by summing up weighted branch lengths. To estimate assemblage dissimilarity across time, we considered the commonly used

Sørensen and Simpson's dissimilarity indices. We found that TD, FD, and PD increased through time, but on average both declines and increases in FD and PD were smaller than declines and increases in TD at the respective sites. Collectively, our results indicate that—despite increasing diversity—avian communities across the US have undergone functional homogenization.

Sea ice conditions and individual state influence breeding decision in an arctic partial capital breeder

Jean-Gagnon, Frankie - Carleton University; Pierre Legagneux - Université du Québec à Rimouski; H. Grant Gilchrist - Environment and Climate Change Canada/ Carleton University; Simon Bélanger - Université du Québec à Rimouski; Oliver Love - University of Windsor; Joël Bêty - Université du Québec à Rimouski

Determining how environmental conditions can interact with individual intrinsic properties is important to unravel the underlying mechanisms that drive variation in reproductive decisions among migratory birds. We investigated the influence of early season sea ice conditions and individual state at arrival on the breeding propensity and timing of laying in common eider ducks (*Somateria mollissima*) breeding in the Arctic. Using Radarsat satellite images acquired from 2002 to 2013, we estimated the proportion of open water in the intertidal zone in early summer to track the availability of potential foraging areas for pre-breeding eiders. Timing of ice-breakup varied by up to 20 days from one year to another and strongly impacted both breeding propensity and the timing of laying. During years with late ice-breakup, fewer pre-laying individuals were resighted nesting in the colony and laying was also delayed. Interestingly, the effect of early summer sea ice dynamics on reproduction was modulated by the state of individuals at arrival on the breeding grounds: females arriving in low condition were more strongly affected by a late ice-breakup. Open water accessibility in early summer at river mouths is apparently a reliable proxy of foraging opportunities, and is thus important for eider reproductive decisions and success. A stronger predictive capacity in determining how Arctic-breeding sea birds respond to variation in sea ice conditions will be necessary to anticipate the increasingly intensive stochastic effects of climatic change on populations breeding at high latitude.

Molecular scatology and high-throughput sequencing reveal bluebirds consuming predominately herbivorous insects in California vineyards

Jedlicka, Julie - Missouri Western State University; Elaine Vo - OpenBiome

Determining the ecosystem function of high-order predators is critical for evaluation of food web interactions. Insectivorous birds are abundant predators in many ecosystems yet because they forage upon such small taxa, it remains largely unknown whether birds are providing ecosystem services in the form of pest control or disservices by preying upon predaceous arthropod species, functioning as intraguild predators. We extracted DNA from non-invasive fecal samples of adult and nestling Western Bluebirds (*Sialia mexicana*) nesting in California vineyards. Using universal arthropod-specific primers, we targeted mitochondrial cytochrome c oxidase I amplicons and sequenced prey items via massively parallel sequencing on the Illumina MiSeq platform. Bluebirds were found to consume a broad diet comprising 66 unique arthropod species from six orders and 28 families. *Aedes sp.* (mosquitoes: Culicidae), a previously unknown prey item to Western Bluebirds, were the most common prey recovered, occurring in over 100 fecal samples. Herbivorous insects, primarily from the orders Hemiptera and Lepidoptera, represented over half (56%) of the prey items in bluebird diets. Ectoparasitic bird blowfly (Protocalliphora) DNA was found in three adult and 18 nestling samples. Because larvae feed at night and retreat deep in nests

during the day, it was previously thought that blowflies avoid direct consumption. Intraguild predation (of predator or parasitoid arthropods) represented only 3% of adult and nestling dietary items. As high-throughput Illumina sequencing becomes more accessible, the powerfully informative techniques molecular scatology offers can be more widely applied to reveal the ecosystem function and services provided by abundant yet cryptic foragers.

Are postfledging songbirds selecting different habitat from nesting birds?
Jenkins, Julianna - University of Missouri; Frank Thompson - Forest Service Northern Research Station; John Faaborg - University of Missouri

Resource selection on the breeding grounds may change during the postfledging period. However, the degree to which selection preferences change from nesting to postfledging and whether all or only a few species alter their resource use is unclear. We compared resource selection for nest sites and resource selection by postfledging juvenile Ovenbirds (*Seiurus aurocapilla*) and Acadian Flycatchers (*Empidonax virescens*) using radio telemetry in Missouri mature-forest fragments in 2012–2015. We used an information theoretic approach with Bayesian discrete choice modeling to evaluate support for local vegetation factors on the probability of selection for nest-sites and locations utilized by postfledging juveniles. Acadian Flycatcher habitat selection relaxed from nesting to postfledging, with only canopy cover positively contributing to selection postfledging. Resource selection for Ovenbirds shifted from a preference for open understory mature forest nest sites, to preference for high understory foliage density and high sapling density. Habitat management based upon nesting requirements would likely be sufficient for postfledging Acadian Flycatchers, but insufficient for postfledging Ovenbirds. Our results illustrate that we should not assume that species occupying similar nesting habitat will have similar changes in habitat requirements after fledging. We recommend that the postfledging habitat selection of at least the guild level be considered in future conservation programs dealing with Neotropical migrants and other forest breeding songbirds.

The National Park Stage: Conserving Current and Future Bird Assemblages
Jensen, Caitlin - Audubon; Chad Wilsey - Audubon; Gregor Schuurman - National Park Service

Bird species and assemblages are fundamental resources at many national parks, 70% of which track bird population trends as indicators of natural resource condition. Future projections of avian climate suitability can be used to examine ongoing changes in bird populations, inform hypotheses behind these trends, and ultimately to provide a strong scientific basis for climate-smart resource management. Projections are also useful for educating the public about the potential impacts of climate change on species they may observe in parks. We characterize projected changes in bird communities across national parks in the U.S. using an existing suite of species distribution models for 475 species of breeding birds. The model set was created based on observation data from the North American Breeding Bird Survey. Predictions of future climatic suitability were generated for early-, mid-, and late-century under medium (RCP 4.5) and high (RCP 8.5) greenhouse gas emissions scenarios. We then summarized projected changes in climatic suitability across species within approximately 280 national parks units. We characterized patterns of change among guilds and taxonomic groups across regions and make recommendations for management. We also ask whether species currently protected across national parks will continue to be protected in the future as well

as whether parks increase in importance for some species.

Genomic Adaptation of Cooper's Hawks to Urban Environments
Jensen, Meghan - West Virginia University; Brian Millsap - U.S. Fish and Wildlife Service; Todd Katzner - U.S. Geological Survey; Niel Infante - West Virginia University; Amy Welsh - West Virginia University

Understanding the way in which species adapt to the changes that accompany urbanization is an immediate interest to ecologists. Cooper's Hawks (*Accipiter cooperii*) once primarily nested in forests and woodlands, but more recently have also been found dwelling in urbanized areas in relatively high densities. Numerous studies have highlighted the phenotypic (e.g., physiological, reproductive, and behavioral) changes that occur when species colonize urban areas. The extensive body of research on urban versus exurban Cooper's Hawks makes this species an ideal candidate for studying the genetic responses of avian predator populations to urbanization. Given the rapid pace of observable phenotypic change between urban and rural hawks, we expected that these changes would be driven by differences in gene expression (rather than sequence changes, which is a slower process). We performed RNA-seq analysis on eight urban-nesting and eight exurban-nesting Cooper's hawks from Albuquerque, NM. High throughput sequencing on the Illumina HiSeq1500 produced at total of 375 million reads. Preliminary analysis using the White-tailed Eagle (Haliaeetus albicilla) reference genome indicated 30 genes that were differentially expressed between urban and exurban females. However, only 15% of the reads mapped to the White-tailed Eagle reference, emphasizing the need to perform a de novo transcriptome assembly using the Cooper's Hawk RNA-seq data. These preliminary results suggest that gene expression differences exist between urban and exurban nesting birds, and this highlights the importance of phenotypic plasticity for species inhabiting urban environments.

Rapid changes in cell physiology as a result of acutet hermal stress in House sparrows, *Passer domesticus*.
Jimenez, Ana - Colgate University; Joe Williams - The Ohio State University

It is important to consider how extreme heat events might affect the physiology of a species. The implications of more frequent heat wave events for birds have only recently begun to be addressed, however, the impact of these events on the cellular physiology of a species is difficult to assess. We explored how short-term thermal stress at the whole animal level might affect cellular rates of metabolism. House sparrows were separated into a "control group" and a "heat shocked" group, the latter acclimated to 43 ºC for 24 h. We determined the plasticity of cellular thermal responses by assigning a "recovery group" that was heat shocked as above, but then returned to room temperature for 24 h. Primary dermal fibroblasts were grown from skin of all treatment groups and the pectoralis muscle was collected. We found that glycolysis (ECAR) and oxygen consumption rates (OCR), measured using a Seahorse XF 96 analyzer, were significantly higher in the fibroblasts from the heat shocked group of House sparrows compared with their control counterparts. Additionally, muscle fiber diameters decreased and, in turn, Na+-K+-ATPase maximal activity in the muscle significantly increased in heat shocked sparrows compared with birds in the control group. All of these physiological alterations due to short-term heat exposure were reversible within 24 h of recovery at room temperature. These results show that acute exposure to heat stress significantly alters the cellular physiology of sparrows, but that this species is plastic enough to recover from such a thermal insult within 24 hrs.

Advances in the study and conservation of waterbirds and shorebirds in Cuba

Jiménez, Ariam - Faculty of Biology, Universidad of Habana, Cuba; Martín Acosta - Universidad of Habana, Cuba; Lourdes Mujica - Universidad of Habana, Cuba; Ianela García-Lau - Universidad of Habana, Cuba; Alieny González - Universidad of Habana, Cuba

Waterbirds are an important component of Cuban bird fauna, comprising 41% of the species recorded. In this paper we aimed to summarize the main findings during the last 15 years of waterbirds in Cuba. Efforts have been focused in: 1) Identify important areas for waterbirds; 2) Provide the ecological basis for assessing their conservation in Cuban habitats; and 3) Standardize and validate methodologies procedures that facilitate investigations in Cuba. Census and monitoring data unveiled the importance of rice paddies for the conservation of waterbirds. Also, these results derived in the proposal of new protected areas, changes in the status of rare Cuban waterbirds (eg., White Pelican, American Avocet) and the identification of wintering and breeding areas for species of conservation concern (eg., Piping Plover, Reddish Egret). Ecological studies have provided the base line results for trace elements levels in Cuban waterbirds and revealed interesting patterns such as a longitudinal cline on the dark morph of Reddish Egret. Further, experimental results showed the positive effects of waterfowl on the control of weed species during the rice paddies preparation. Most of these studies and results have been possible through the production and validation of methodologies adapted for the study of waterbirds in Cuban. Results obtained thus far lay crucial foundations for long-term management and conservation programs for waterbirds in Cuba and the region.

Influences of Individual Quality and Energetic Carry-Over Effects on Reproductive Success

Johns, David - University of Saskatchewan; James Devries - Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada; Robert Clark - Wildlife Research Division, Environment and Climate Change Canada

Individual quality, an important component in determining timing of breeding and reproductive success, may be highly responsive to time-varying energetic demands or environmental conditions. While studies of waterfowl primarily focus on either extrinsic (i.e. habitat, environmental) or intrinsic (i.e. female age, body condition) factors; few investigate for potential cross-seasonal effects. Corticosterone, an energy regulating hormone, is deposited in feathers (CORTf) and represents an integrated record of energetic demands during feather molt. We examined whether reproductive timing and success were related to individual quality, in terms of current (measured upon capture; age, body condition, and timing of breeding) and antecedent (CORTf from previous breeding and wintering periods) periods. We measured CORTf in mallard (*Anas platyrhynchos*) wing feathers (n=536), collected during an 8-year study of reproduction and habitat use across 19 sites in the Canadian prairie-parklands. We found that CORTf was related to both the age of the bird as well as prior environmental/habitat conditions; where newly recruited breeding individuals and those likely originating from regions with favorable wetland conditions had higher CORTf levels in feathers. Despite strong spatial variation in CORTf across the Canadian parklands, we found no support for direct energetic carry-over effects from prior breeding seasons on future reproductive performance. Using this integrated approach, combining large-scale observational and fine-scale physiological data, we provide new information to bridge our understanding of variation in energetic conditions and

reproductive success across ecological, spatial and temporal scales.

Experimental evidence of energy expenditure–feather corticosterone relationships

Johns, David - University of Saskatchewan; Tracy Marchant - University of Saskatchewan; Graham Fairhurst - University of Saskatchewan; Catherine Hambly - University of Aberdeen; Robert Clark - Wildlife Research Division, Environment and Climate Change Canada

When energy demand exceeds physiological set points, as modulated by glucocorticoid hormones, an individual's physiological state may be adversely affected. In birds, the glucocorticoid hormone corticosterone is used as a biomarker for energetic demand as it is incorporated into growing feathers (CORTf). Found to correlate with components of fitness, the use of CORTf has increased in ecophysiological studies, particularly investigations of cross-seasonal effects in migratory birds. However, the assumed positive relationships between past and current energy demands and CORTf have not been adequately evaluated. We tested whether changes in allostatic load (i.e., energy demand) were reflected in CORTf, and if effects of past energetic demand influenced future CORTf signatures. Daily workloads in female mallard (*Anas platyrhynchos*) ducklings were experimentally increased over a 6-week period using obstacles and/or carrying back-mounted weights. We measured daily energy expenditure (DEE), growth, body size, and CORTf in growing ducklings. Then, we conducted a cross-over, induced feather molt and reapplied workload treatments. Ducklings which coped with higher workloads suppressed body mass, growth and had higher DEE and CORTf values. When birds were subsequently exposed to additional workload treatments we found CORTf patterns reflected current rather than past energetic demand. Our study experimentally validates the previously untested assumption that CORTf reflects current energetic demand during feather growth and provides a physiological foundation for informing interpretations of ecological patterns using hormone biomarkers.

Heterospecific sociality mediated by song discrimination in fairy-wrens (*Malurus sp.)*

Johnson, Allison - University of Chicago; Stephen Pruett-Jones - University of Chicago

Positive heterospecific associations (e.g. mutualisms) are common in animals. However, such interactions are often broad and non-specific to individual members of participating species. We have identified a novel case of heterospecific interaction between variegated and splendid fairy-wrens (*Malurus lamberti* and *splendens*, respectively). These species often share and co-defend overlapping territories, travel together, and jointly respond to threats. We asked if these species gain from these associations and whether their interactions are mediated by song recognition. Using playback experiments, we documented that variegated and splendid fairy-wren males respond differently to songs of co-resident heterospecifics than to those from a neighboring or a foreign territory, demonstrating discrimination between shared and non-shared territory heterospecifics. We also compared daily movements, nesting behavior and success, and extra-pair paternity of the two species when sharing territories and when living solitarily to investigate the consequences of association. Variegated fairy-wrens exhibited an increased duration of foraging, decreased vigilance, were more likely to attempt to re-nest, and in small groups showed decreased rates of extra-pair paternity when associating with splendid fairy-wrens than when alone. We suggest that individual discrimination facilitates cooperative territory defense between these two species, and that the formation of coalitions may benefit both species. Heterospecific group member

recognition and selective cooperation may represent another important mechanism through which species interactions drive ecology and behavior.

Modelling the breeding distribution of Loggerhead Shrikes (*Lanius ludovicianus*) in Southeastern U.S.

Johnson, Amy - Smithsonian Conservation Biology Institute and George Mason University; David Luther - George Mason University; William McShea - Smithsonian Conservation Biology Institute; Scott Sillett - Smithsonian Migratory Bird Center

Loggerhead Shrike (*Lanius ludovicianus*) populations have declined significantly throughout their U.S. range, but maintain moderate breeding densities in some regions. Although habitat characteristics for the species have been identified at local scales, our ability to manage Loggerhead Shrike populations requires an understanding of how environmental factors interact with habitat structure at regional scales. We present a zero-inflated binomial, species distribution model for the southeastern U.S. to (1) test the relative contribution of environmental variables relevant to shrike occurrence and (2) map the probability of shrike occurrence. Occurrence data were downloaded from stationary checklists on eBird submitted during the breeding season (April-July) between 2008 and 2015 across 17 physiographic areas where shrikes still persist. Predictions of occurrence were based on five environmental variables, two observation covariates, and non-autocorrelated presence-absence records (n=1656). Maximum normalized difference vegetation index (NDVI), distance to forest, and road density were the most important environmental variables to the model. Road density, included as a measure of development, exhibited a negative relationship with shrike occurrence while increasing distance to forest increased probability of occurrence. The most significant variable in the model was an interaction of distance to forest and maximum NDVI, suggesting the importance of open spaces with sparse vegetation. Our model identified areas with a high probability of shrike occurrence that can be used by conservation managers to prioritize national scale conservation actions. Results can be used to strategically direct conservation resources to areas best suited for standardized population studies, habitat preservation and reintroduction planning.

Can We Count Birds?

Johnson, Douglas - USGS Northern Prairie Wildlife Research Center

Surveys of birds are foundational to many scientific, conservation, regulatory, and management actions. Yet bird surveys are fraught with a variety of problems, with the detection of any individual bird depending upon its availability to be detected and its perceptibility to an observer. Availability varies by species, time of year, time of day, breeding status, presence of conspecifics or predators, weather conditions, and more. Perceptibility in turn depends on survey protocol, observer skills, habitat, weather conditions, distance from bird, etc., etc. Many surveys are designed either to maximize availability and/or perceptibility or to reduce their variability. In addition, a plethora of methods have been developed to numerically adjust observed counts to account for some of the factors affecting availability or perceptibility. These methods essentially divide the observed count by a number less than one, often substantially so, and with an unknown variance. The potential for impossibly large estimates of the actual number of birds present is substantial. I am not optimistic about the general utility of these mathematical adjustments for many applications. Rather than unthinkingly attempting to adjust observed counts for their shortcomings, I argue that we should more stringently clarify the purposes of the surveys, understand the role that survey imperfections

may play, and make only those adjustments necessary to meet survey objectives.

Tropical Birds Do and Don't Molt Like Temperate Birds

Johnson, Erik - Audubon Louisiana; Jared Wolfe - USDA forest Service Pacific Southwest research station Arcata

The scheduled replacement of feathers (molt) is an energetically demanding life history stage, for which the timing, frequency, extent, and duration has been shaped through multiple evolutionary forces. These aspects of molt remain an important knowledge gap for many Neotropical species. We describe molt patterns in 186 non-passerine and passerine species across 37 families at the Biological Dynamics of Forest Fragmentation Project, near Manaus, Brazil. Based on over 65,000 captures between 1979 and 2013, museum specimens, and a literature review, we explore similarities and differences compared to temperate bird species. Most species followed a Complex Basic Strategy, but 15 showed evidence of a Complex Alternate Strategy (Bucconidae, Tyrannidae, Tityridae, and Thraupidae). Typically found in Neotropical-Nearctic migrants, prealternate molts in Amazonian birds occurred in year-round residents occupying tropical forest canopy or pasture. Preformative molts ranged from limited to complete, and were eccentric in 18 species (Alcedinidae, Galbulidae, Bucconidae, Tyrannidae, Vireonidae, and Thraupidae). One suboscine*, Percnostola rufifrons*, showed evidence of two preformative molts, similar to some temperate oscines. Delayed plumage maturation, where male plumages were acquired during the second or later prebasic molt, occurred in 17 species (Trochilidae, Thamnophilidae, Cotingidae, Pipridae, Tityridae, and Thraupidae). Primary feather replacement was often protracted, lasting 310 days in *Pithys albifrons*, but was sometimes more accelerated as in temperate species; increased molt duration increased the probability of molt-breeding overlap. These findings reveal important variation in molt strategies among Neotropical species, but also that they fundamentally follow patterns in more widely studied temperate species.

Assessing Migratory Connectivity of Prothonotary Warblers using Light-Level Geolocators

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The Prothonotary Warbler is a top conservation priority species that breeds primarily in southeastern U.S. bottomland hardwood forests and winters in lowland and other mesic forests in Central America and northwestern South America. Demographic analysis have shown regional variation in breeding population declines, and long-term declines have outpaced the loss of breeding habitat, suggesting that factors outside of breeding habitat loss may be at least partially driving population change. To better interpret breeding populations declines, we deployed 0.4-g and 0.5-g light-level geolocators on Prothonotary Warblers in 2013 and 2014 from two core breeding population centers: 1) in the lower Mississippi Alluvial Valley (south Louisiana, n = 21), and the mid-Atlantic Coastal Plain (Virginia, n = 25; South Carolina, n = 1). Recovery rates among sites and sexes were variable, being lowest in Virginia females with 0.5-g geolocators, but overall return rates were statistically consistent with color-banded controls

(geolocators: 36.2% of 47; controls: 47.3% of 110; X2 = 1.65, P = 0.20). Among 10 geolocators analyzed from LA and 5 from Virginia and South Carolina, all wintered in Panama or Colombia, with 11 probabilistically centered on coastal and inland stretches of the Magdelena River. These data suggest a high degree of mixing among eastern and western breeding populations on the wintering grounds. Additional geolocators were deployed in Ohio and Arkansas in 2015, and in Louisiana, Wisconsin, and South Carolina in 2016 to better resolve potential overlap among breeding populations on wintering grounds.

Heath Hen de-extinction: prospects and considerations based on whole genome analysis

Johnson, Jeff - University of North Texas; Giri Athrey - Texas A&M University; Rich Adams - University of Texas Arlington; Todd Castoe - University of Texas Arlington; Ben Novak - Revive & Restore, The Long Now Foundation

Our planet has experienced unprecedented increases in extinction rate at both the local and global scale over the past few centuries, largely due to the influence of human activities. Recent advances in biotechnology and genetic engineering are allowing us to imagine what it would be like to reverse this trend and bring species back from extinction. Discussions have moved from whether it is even possible to when it will happen. To what degree our attempts to revive a particular extinct species succeed largely depends on our ability to accurately predict and engineer (or re-engineer) its genomic content. The Heath Hen (*Tympanuchus cupido* cupido) is one such extinct species that is under consideration for de-extinction. Once consisting of population sizes in the millions, Heath Henwas a gallinaceous bird that ranged along the northeast coast of the United States and was extinct by 1932. As a first step towards reconstructing and reviving the Heath Hen genome, we have leveraged whole-genome alignments for multiple prairie grouse species to identify the phylogenetic placement of Heath Hen. Here we describe our progress on this project thus far and provide novel insight into the evolutionary history of this extinct species and the prairie grouse clade in general. Importantly, these first step analyses of species-level relationships among prairie grouse lineages will provide a comparative framework for both our Heath Hende-extinction program and further investigations into the unique evolution and genomic composition of the clade.

The discovery of hatching and the transition to feeding young by males in the cavity-nesting Mountain Bluebird

Johnson, L. Scott - Towson University; Chelsea Connor - Towson University; Andre Nguyen - Towson University

In many birds, only females incubate eggs but both sexes feed hatchlings. How males in such species discover hatching and transition to feeding remains largely unknown. Of most interest are species such as cavity-nesters in which the nest contents are concealed from view. We used continuous video-recording of nests to document the male's transition to feeding young in the cavity-nesting Mountain Bluebird (*Sialia currucoides*). We saw no evidence that females use a vocal or visual display to signal hatching to males. Simply observing one's mate carrying eggshells away from, or food into, the nest cavity did not trigger male provisioning. Rather, males did not begin feeding until they had come to the nest and presumably sensed the presence of hatchings directly. Individual males varied, however, in how, and how often, they inspected nest contents before starting to feed. While most males fully entered the nest cavity where they could see, touch, hear and possibly smell hatchlings, other males may have detected hatchlings by only sound or possibly smell while perched at the cavity entrance. Previous research suggests that direct sensation of offspring of some type may be necessary to activate

relevant neurons in the area of the brain responsible for parental care. Additional work is necessary to test this, and to examine the effects of factors such as testosterone levels and breeding experience on the means and rapidity by which males discover hatching and transition to nestling provisioning.

Hearts, minds, or wallets? Balancing intrinsic, cultural, and economic values in narratives of bird conservation
Johnson, Matthew - Humboldt State University

Bird conservation is motivated by values, broadly classified as either instrumental or intrinsic. Instrumental values of birds include ecosystem services that can, in some cases, be monetized. The aesthetic value of birds is sometimes wrongly ascribed as intrinsic and regarded as “higher” than use values, but aesthetic value is nonetheless instrumental, a means for human fulfillment. The intrinsic value of a bird, of course, does not depend on its beauty. Instead, intrinsic values of birds have philosophical foundations in society’s valuation of sentience, respect, and kinship. The growth in studying and quantifying ecosystem services provided by birds and other wildlife has triggered a heated debate over which values to emphasize. Competing viewpoints in this debate range from an outright rejection of instrumental rationalization for conservation to the endorsement of valuation as the only viable solution to current environmental problems, which are framed as market failures. In between, many conservation organizations embrace valuation of ecosystem services as a practical short-term conservation tool to influence policy. Understanding this debate requires clarifying different stages of an economic argument for conservation, and placing that argument within a context of an environmental ethic that also recognizes intrinsic value. Moreover, recent work suggests that the comparatively little-studied area of cultural services of birds merits additional research. These recognitions reveal that instrumental and intrinsic values of birds need not be at odds. Rather, to advance the conservation of birds, we should simultaneously appeal to peoples’ hearts, minds, and wallets.

Phylogeographic patterns of Amazonian river-island birds
Johnson, Oscar - Louisiana State University, Museum of Natural Science; Robb Brumfield - Louisiana State University

The bird community found on river islands in the Amazon basin is characterized by decreased diversity and increased abundance in comparison to bird communities in more widespread Amazonian habitats such as terra
firme and varzea forests. The global distribution of a set of nineteen species is restricted entirely to river islands within the Amazon River system, and the riverine scrub and secondary forest found primarily on these islands. Due to riverine flow dynamics, these islands are highly ephemeral, necessitating that the associated bird species disperse frequently to track the constantly shifting terrestrial habitat. The ephemeral nature and highly linear distribution of these islands combine to afford a unique context in which to investigate population genetic and phylogeographic patterns of Amazonian bird species. Here, I use comparisons of all river island obligate bird species, and a selection of terra firme and varzea species, to investigate genetic structure, dispersal ability, and biogeographic and phylogenetic patterns. I hypothesize that river island bird species show little genetic divergence across their range, when accounting for linear distance. I predict that this is because the increased dispersal abilities required to live on river islands precludes the formation of population barriers that structure bird populations in other habitats in the Amazon basin. Additionally, using a paired-taxon approach by comparing each river island species to its sister taxon, I examine the phylogenetic

patterns that influence the evolutionary history of river island bird species.

Escape performance and structure of shorebird communities

Johnston Gonzalez, Richard - Center for Wildlife Ecology - Simon Fraser University; David Lank - Simon Fraser University; Ron Ydenberg - Center for Wildlife Ecology- Simon Fraser University

Competition is important in structuring of communities, but animals also select habitats based on perceived risk of predation and their individual ability to escape predators. This vulnerability is seldom considered in the context of community structure. We hypothesize that shorebird flight performance might influence spatial segregation of shorebird communities, such that heavily wing-loaded species would have poorer escape abilities and be less common on sites with higher predation danger. We measured morphometric traits associated with wing-loading and take-off speed on shorebird species wintering along the Southern Pacific coast of Colombia and explored if differences in those traits could explain the use of sites that vary in the level of predation danger. Between 2012-2016 we surveyed 143 sites, measured 1045 individuals and video-recorded take off flights (N=425) for nine shorebird species. Contrary to our expectations, despite of differences on wing loading, most species maintained high levels of flight performance, particularly amongst smaller sandpipers. However, medium-sized shorebirds (e.g. dowitchers) were heavily wing-loaded and slower than smaller species. The use of dangerous sites by some of these more vulnerable species was lower than expected by chance, but this didn't apply to all species. If more vulnerable species are using dangerous sites, they must invest more in alternative anti-predator strategies (e.g. higher development of flight muscles, vigilance, flocking, within-site habitat selection) than do their less vulnerable counterparts. Together with variation in resource related morphology, escape performance and assessments of predation risk could account for differences in local habitat usage among species of shorebirds.

Learning about predators: Florida scrub-jays (*Aphelocoma coerulecens*) form lasting memories of a single predatory encounter.

Jones, Blake - University of Memphis; Sara Bebus - University of Memphis; Stephen Ferguson - University of Memphis; Philip Bateman - Curtin University; Stephan Schoech - University of Memphis

In addition to morphological and behavioral traits, the evolution of cognitive capacities has likely been influenced by interactions with predators. It is well established that many animals, including avian species, learn how to identify and respond to potential predators. However, biologist have yet to assess how efficiently animals acquire information about potential predators or how long information is retained. One might predict that most species have evolved the ability to form long-lasting memories (those that last months to a lifetime) from only one encounter with a predator, given that failure to learn the dangers of a predator after it first attacks may lead to a failure to survive a second attack. We tested the ability of free-living Florida scrub-jays (*Aphelocoma coerulecens*) to form long lasting memories of a single encounter with a novel predator. We developed a novel fear conditioning protocol in which subjects were either chased by a novel predator or exposed to a control. We measured flight initiation distance (FID) 48 h, 11 mo, 2 yr, and 4 yr after conditioning or control exposures. Subjects previously chased by the novel predator maintained significantly longer FIDs for at least 4 yr. Additionally, an individual's response to the novel predator was not influenced by the responses of neighboring conspecifics, and fear conditioned subjects did not generalize their fear response to other novel stimuli. We determined that FSJs can learn the dangers of a novel predator after a

single threatening encounter and retain this information for multiple years.

Call relevance and foraging ecology determine reliance on social information in an avian eavesdropping network
Jones, Harrison - University of Florida; Kathryn Sieving - University of Florida

Vertebrates obtain social information about predation risk by eavesdropping on the alarm calls of sentinel species, which can act as community-wide informants for large numbers of heterospecifics. However, the importance of this social information to different eavesdropping species is unknown. We tested the relative importance of four hypotheses from the literature (foraging ecology, sociality, call relevance, and local microhabitat) in determining reliance on the alarm call of the Tufted Titmouse (*Baeolophus bicolor*) in a Florida winter bird community. We presented 16 species, covering a spectrum of ecological variability, with a titmouse alarm call and quantified behavioral response in the absence of a predator. Foraging ecology and sociality of all species were determined though behavioral observation. We ran generalized linear models on behavioral response (overall response, response type) using 11 predictor variables, and determined best predictors by model averaging a candidate set of models ($\Delta AICc < 2$). Overall response was best predicted by foraging ecology and call relevance, with species that forage in the canopy and use more aerial maneuvers responding less often. Smaller species relative to the titmouse were more likely to respond than those of titmouse size or larger. Escape behavior was species-specific and best explained by the distance of the foraging niche from the trunk. Species that foraged on foliage far from the trunk were more likely to dive for cover, while near-trunk foragers were more likely to freeze. Our work highlights the importance of aerial foraging in determining eavesdroppers' reliance on social information.

A case of mistaken identity: Understanding the stimulus of agonism between two wood warblers
Jones, John - Tulane University; Anna Tisdale - Appalachian State University; Jennifer Tucker - Appalachian State University; Marja Bakermans - Worcester Polytechnic Institute; Jeffery Larkin - Indiana University of Pennsylvania; Curtis Smalling - Audubon, North Carolina; Lynn Siefferman - Appalachian State University

When multiple species occur sympatrically, divergence in morphological and behavioural traits associated with species recognition and resource use are expected. Individuals that engage in interspecific aggression often suffer fitness consequences if the benefits of securing resources do not outweigh the risks associated with agonism. In the southern Appalachians, interspecific aggression frequently occurs between chestnut-sided (*Setophaga pensylvanica*) and golden-winged (*Vermivora chrysoptera*) warblers, a species that is experiencing sharp declines in population numbers. Using a combination of correlative and experimental approaches, we explored two potential explanations for interspecific aggression: interspecific competition and mistaken identity. First, in 2014, we documented spatial overlap of the two species and measured reproductive success and habitat preference (using remote sensing) of golden-winged warblers. We found that golden-winged warblers that settled among high densities of chestnut-sided warblers were more aggressive, but chestnut-sided warbler density did not negatively influence their reproductive success; rather, habitat structure best predicted reproductive success. Next, in 2015, we tested for misidentification using models of con- and hetero-specifics in simulated territorial intrusions. We found that the warbler species were equally likely to attack the con- and hetero-specific models, and that the most aggressive individuals were more likely to attack models. Our data suggest that, from the golden-winged

warbler's perspective, sympatry is not detrimental and aggression is likely a function of mistaken identity. Yet, these behavioural interactions should be maladaptive, which may lead to the segregation of habitat types or divergence in crown morphology between species.

Spatial Patterns of Seed Dispersal by Two Toucan Species in a Fragmented Tropical Forest Landscape

Jones, Landon - University of Louisiana at Lafayette; Scott Duke-Sylvester - University of Louisiana Lafayette; Paul Leberg - University of Louisiana at Lafayette; Derek Johnson - Virginia Commonwealth University

Habitat loss and the resulting fragmentation can decrease seed dispersal distances and dispersion across landscapes. These interactions are particularly important in tropical forests, where up to 80% of tree species are dispersed by animals. Avian species are often regarded as effective dispersers because they can potentially move more often and move more easily between forest fragments than most other taxa. We compared spatial patterns of seed dispersal created by a medium-sized, social toucan species, the Collared Araçari (*Pteroglossus torquatus*), with a larger, non-social species, the Keel-billed Toucan (*Ramphastos sulfuratus*). We collected data on movement distances and time between movements by radio tracking 23 individuals of both species in a fragmented forest landscape in Costa Rica from Jan 2012 to May 2013. We also conducted toucan gut retention trials for three tree species, two larger (8mm, 12mm) and one smaller (1mm). Using these data, we parametrized a spatially-explicit, individual-based model to compare seed dispersal distances from parent trees and dispersion (seed distances from each other) for both toucan species. Time between movements and gut retention times were similar for both species, but Keel-billed Toucans exhibited 30% higher movement distances. Both toucan species dispersed seeds of all three tree species long-distances (>100 m) from parent trees; Keel-billed Toucans dispersed seeds from 4-15% further than Collared Araçaris. Keel-billed Toucans dispersed the two larger seed species from 23-48% further from each other than Collared Araçaris. However, Collared Araçaris dispersed seeds of the smallest seed species approximately 11% further from each other than Keel-billed Toucans.

Science and decision-making at the Joint Venture scale

Jones, Malcolm - United States Fish and Wildlife Service; Kirsten Luke - Atlantic Coast Joint Venture

The Atlantic Coast Joint Venture has been working with collaborators to develop models that inform biological planning and conservation design for wetland dependent birds. Our models have initially focused on the non-breeding season and allow us to evaluate the importance of a given location to a specific guild (waterfowl, shorebird or waders) of birds based on a bio-energetics approach. However, the ultimate goal of these efforts is to direct our Partnerships habitat conservation programs to the best place for particular species. Towards that end, we are beginning to link our non-breeding models to decision support tools (DST) that incorporate the future effects of global climate change. Our first DST is focused on saltmarsh conservation where we are evaluating the impacts of future sea-level rise and urbanization at 2050 and 2080. We have used structured decision making techniques and held multiple elicitations to inform the development of our tool. In turn, we hope to guide our Partner's habitat conservation efforts toward those areas of saltmarsh that are most valuable now and in the future.

Variation in Nestling Body Condition and Wing Development at Fledging Predict Post-fledging, Cause-specific Mortality in the Dickcissel (*Spiza americana*)

Jones, Todd - University of Illinois; Michael Ward - University of Illinois at Urbana-Champaign; Thomas Benson - Illinois Natural History Survey, University of Illinois; Jeffrey Brawn - University of Illinois at Urbana-Champaign

Phenotypic traits developed in one life history stage can carryover and affect survival in subsequent stages. Such carryover effects may therefore be critical for survival during important periods of an animal's life; such as the juvenile life history stage. For songbirds, carryover effects from the pre- to post-fledging period may be crucial for survival but are poorly understood. We assessed whether juvenile body condition and wing development at fledging influence survival during the post-fledging period for fledgling Dickcissels (*Spiza americana*) in east-central Illinois, USA. We found pre- to post-fledging carryover effects on fledgling survival for both traits during the early part of the post-fledging period. Survival benefits of each trait were conditional upon cause-specific sources of mortality; individuals in better body condition were less likely to die from exposure, whereas those with more advanced wing development were less likely to be preyed upon. Fledglings with more advanced wing development were also comparatively more active and mobile earlier in the post-fledging period, suggesting they were better able to avoid predators. Our results provide some of the first evidence linking development of juvenile phenotypic traits to survival against specific sources of post-fledging mortality in songbirds. Further investigation of pre- to post-fledging carryover effects may provide important insights into avian life history evolution.

Using occupancy models to plan regional multi-species grassland bird conservation

Joos, Cara - Central Hardwoods Joint Venture; Chris Lituma - West Virginia University; David Buehler - University of Tennessee; Jane Fitzgerald - Central Hardwoods Joint Venture

The Central Hardwoods Joint Venture (CHJV) is a partnership of state, federal, and non-for-profit wildlife conservation agencies and organizations that work together to insure the long-term viability of native bird populations across the Central Hardwoods Bird Conservation Region (CHBCR). Many CHJV priority grass and scrub-shrub birds are experiencing steep declines. Targeted habitat conservation is needed to reverse these trends. Here we demonstrate how we used occupancy modeling to plan on the ground habitat management activities. We monitored occupancy of nine priority grassland and shrubland nesting species via ~ 5000 roadside point counts in 37 conservation priority counties in seven states. Routes were randomly places within grassland, agricultural, and scrub-shrub habitats. We modeled detection probability and occupancy in Program MARK and used the coefficients from the most supported model for each species to build regional occupancy maps and quantify focal areas in a GIS framework. These maps allow the CHJV partners to target conservation for either individual or multi-species conservation and increases the efficiency of on the ground conservation management.

Shroom with a view: fungal communities associated with Acorn Woodpeckers and their excavations

Jusino, Michelle - USFS NRS Center for Forest Mycology Research; Natasha Hagemeyer - Old Dominion University; Mark Banik - USFS NRS Center for Forest Mycology Research; Jonathan Palmer - USFS NRS Center for Forest Mycology Research; Daniel Lindner - USFS NRS Center for Forest Mycology Research; Walter Koenig - Cornell University; Eric Walters - Old Dominion University

Recent work has proposed a potentially mutualistic symbiotic association between one woodpecker species and the communities of fungi found within its excavations. It is likely that cavity excavators world-wide are also associated with communities of fungi, but these complex relationships have not yet been elucidated. Here we utilize a field survey and next-generation sequencing (NGS) to examine the fungal communities associated with Acorn Woodpeckers (*Melanerpes formicivorus*) and their nesting and roosting cavities, located in old-growth valley oak (*Quercus lobata*) and blue oak (*Quercus douglasii*). We sampled complete and incomplete Acorn Woodpecker excavations and non-excavated trees. We also swabbed Acorn Woodpecker bills and feathers. We extracted DNA from our samples, then amplified and sequenced the fungi present in our samples using the Ion Torrent semiconductor NGS platform. Prior to this study, NGS had not been used to describe the fungi associated with woodpeckers and their excavations. Acorn Woodpeckers and their excavations harbored over 1000 fungal taxa, including hundreds of putative wood-decay fungi. In particular, samples taken from woodpeckers were extremely diverse, with as many as 300 fungal taxa observed on a single bird. Furthermore, the fungal communities found on the birds were similar to those found in their excavations, especially their incomplete excavations, but were not similar to the fungal communities found in non-excavated trees. These results suggest that symbiotic associations between woodpeckers and diverse communities of fungi may indeed be widespread among cavity excavators.

Unexpected kin relationships in a group-living Old World tropical babbler

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Although the highest diversity of birds occurs in tropical regions, little is known about the genetic mating systems of most tropical species, especially in the Old World tropics. Our understanding of the diversity of avian mating systems and their prevalence is therefore biased toward temperate species. We conducted a 6-yr parentage study of the grey-throated babbler, *Stachyris nigriceps*, in Kinabalu Park, Malaysian Borneo. Grey-throated babblers live and breed in territorial groups of two to sixteen (median = 7) individuals and are described as putative cooperative breeders. We used molecular sexing and eight microsatellite markers to measure genetic parentage and relatedness among breeders, offspring, and group members to investigate group structure, dispersal, and the genetic mating system of this socially complex species. We found that most social groups consisted of a socially monogamous, breeding pair and group members of both sexes (1:1). Only the breeding pair built nests and provided parental care with no assistance from group members. Breeding pairs were non-relatives and showed low levels of genetic polygyny. Surprisingly, group members of both sexes were on average unrelated to the breeding pair, although we documented some first-order relatives of one or both of the breeders. Our results suggest that grey-throated

babbler social groups are mostly composed of unrelated birds that have dispersed, but are constrained from both independent and within-group breeding. Although their social system resembles cooperative breeding, this study challenges their mating system classification and illustrates the importance of documenting the diversity of mating systems in underrepresented tropical birds.

Age-related patterns of spring migration timing and performance in a trans-hemispheric migratory songbird
Kaminski, Nicole - University of Manitoba; Kevin Fraser - University of Manitoba

Breeding arrival date has important consequences for migratory songbirds, where earlier arrival can confer fitness advantages. In many species, arrival dates are patterned by age, with older birds arriving earlier than first-year birds, and potential senescence in this trait as birds age. Both intrinsic and extrinsic hypotheses may explain these patterns, whereby selection may favor a later and slower migration in younger birds to avoid competition at breeding sites (intrinsic) and/or younger birds are less efficient in preparing for and completing migration (extrinsic). Both support overlapping predictions regarding breeding arrival date; however, an understanding of timing and performance during the migration period could yield important new insights into age-related patterns. We used a large direct-tracking (geolocator) dataset for a trans-hemispheric migratory songbird (purple martin, *Progne subis*) to test age-related hypotheses for migration behavior. We compared broad age classes (first-year or older), individuals of known specific age (1-6 year olds), and examined within-individual patterns for birds tracked in more than one spring. We determined how age influenced spring migration departure date, speed, overall rate, duration, distance, and arrival date. As birds aged, they departed earlier, traveled at a faster rate and speed, and arrived earlier at breeding sites. However, while spring departure and arrival dates both advanced with age, migration speed and rate peaked at 3 years of age, suggesting potential senescence in these traits. Our results reveal how age-related timing and performance during the migratory period itself contribute to patterns of breeding arrival date in a songbird.

Quadcopter Drone Photography as a Means of Characterizing Breeding Habitat in the American Kestrel (*Falco sparverius*)
Kamm, Matthew - Tufts University

Understanding habitat selection is a crucial step in conserving species threatened by loss of habitat. American Kestrels (*Falco sparverius*) are widespread but declining falcons that utilize a variety of open habitats, including grazed pastures, cranberry bogs, oak-pine savannas, capped landfills, and many others. Because this species is a secondary cavity nester, and is believed to be nest-site limited, conservation efforts have been focused on increasing available breeding habitat through the erection of artificial nest boxes. Many nest box programs have reported declining occupancy in recent years, however, which suggests the possibility that not all boxes are located in equally desirable habitat. Kestrel territories are too large to map efficiently on foot, but too small to readily map from satellite imagery. Unmanned Aerial Vehicle (UAV) photography has seen recent use in separating and identifying vegetation classes for forestry. Here, we report a similar approach for quantifying different structural classes in areas of kestrel habitat. We employed a Phantom II Vision + quadcopter camera drone to take photographs at 25m and 50m elevation above both occupied and unoccupied kestrel nest cavities in Massachusetts, USA. Photographs were orthorectified and analyzed through a low-pass filter in program ENVI to analyze texture through frequency of color changes in a region of interest. Supervised classification using regions of interest were employed to

quantify the proportion of different cover classes surrounding both occupied and unoccupied nest boxes. These proportions were compared to determine whether suitable kestrel habitat can be identified through aerial photography.

Plover Paparazzi: Use of Game Cameras to Improve Nest Monitoring of Great Lakes Piping Plovers

Kane, Michelle - Lake Superior State University; Heather Douglas - Algoma University; **Jennifer Foote** - Algoma University; Shannon Rowell-Garvon - Algoma University; Jason Garvon - Lake Superior State University

Both breeding success and adult survival of endangered bird species are critical for population growth and recovery. Great Lakes Piping Plovers are endangered, ground-nesting shorebirds and have been protected and carefully managed. Population recovery has benefited from intense nest monitoring by people engaged in deploying nest exclosures, salvage/captive rearing of abandoned eggs, and public outreach to beach users. In order to assess monitoring efficiency of nesting plovers we placed two cameras on the exclosures surrounding nests of 23 Piping Plovers in Michigan, USA from 2014-2015. We tested the use of off-the-shelf game cameras to detect incubation exchanges and compare the time spent scanning photos and videos taken by cameras to the time spent observing nest exchanges with a spotting scope. We also measured investment in incubation by male and female plovers, predator presence, and hatching using photos and videos taken with game cameras. We found that the time to scan game camera footage is significantly lower than visual nest monitoring and has the potential to free monitors to invest more energy in education and outreach. Additionally, camera footage was useful for making management decisions and confirming the timing of adult mortality and the identity of local predators. We found that males and females contribute equally to incubation and that nest exchanges occur round-the-clock. Our results suggest that monitoring Piping Plover nests using game cameras is a useful addition to on-site monitoring associated with management in this population. Furthermore, this method provides additional data on natural history.

Avian diversity in forest fragments

Karubian, Jordan - Tulane University; Luke Browne - Tulane University; Scott Walter - Tulane University; Renata Ribeiro - Tulane University

Avian response to habitat loss and fragmentation varies across systems and contexts, and many questions remain about what may drive this variation. To address this knowledge gap, we assessed response to forest loss and fragmentation for three distinct guilds – large-bodied frugivores, nocturnal birds, and understory birds – in the Chocó rainforest, northwest Ecuador. We evaluated the relative importance of landscape (e.g., elevation, surrounding forest cover) and fragment (e.g., area, habitat quality, various tree metrics) variables on richness, diversity, and community composition of each guild, and additionally investigated changes over time for understory birds. Our findings suggest that the factors associated with diversity and community composition vary among guilds. Nocturnal bird diversity increased and community composition changed with larger fragment size, more canopy openness, and lower elevation, whereas patterns in large-bodied frugivores were best predicted by the amount of forest cover in the matrix surrounding each fragment. Understory birds exhibited complex patterns, with a strong response to forest quality. This study highlights the importance of considering a wide breadth of foraging and life history strategies when assessing impacts of forest loss and fragmentation and prioritizing alternative conservation measures.

Environmental correlates of breeding success of a long-distance migrant small falcon

Katzner, Todd - U.S. Geological Survey; Evgeny Bragin - Naurzum Zapovednik; Alexander Bragin - Rostov Biosphere Reserve

Variation in reproductive output of migrant birds is influenced by a suite of environmental or individual-specific factors. Most tests of these relationships have focused on passerines and inference to other species, especially predators, is not clear. We evaluated environmental correlates of breeding success of red-footed falcons, a globally threatened long distance migrant raptor that breeds in forest-steppe habitats from Hungary to central Siberia. Over 19 years we monitored >500 breeding attempts by falcons in north-central Kazakhstan and we linked variation in reproductive parameters to variation in temperature and precipitation monitored at a weather station in the reserve. Preliminary analyses suggested that red-footed falcons arrived on breeding grounds in early May, laid eggs ~20-30 days later and fledged chicks in mid-July. Lay date of falcons and the number of nestlings they produced were best described by complex models that included terms for precipitation and temperature aggregated across spring, as well as a suite of habitat-related and behaviorally-driven factors. In contrast, numbers of eggs and numbers of fledglings produced were best described by more simple models with terms for precipitation and temperature in May. The fact that different stages of the nesting cycle were driven by different environmental parameters suggests that demography of long-distance raptor migrants is influenced by a complex series of interacting habitat and predator-prey relationships. Although carry-over type processes have a role in demography of migratory birds, these analyses highlight how long-term data can provide insight into the influence of conditions on breeding grounds for avian demography.

The birds and the bucks: Using birder economics to build support for regional conservation efforts

Kaufman, Kenn - Black Swamp Bird Observatory

According to a 2011 survey, U.S. citizens spend about 15 billion dollars per year on travel related to birding. These expenditures are not randomly distributed: traveling birders gravitate to hotspots known for bird numbers or diversity or for unique species, so the economic impact of their pursuit is concentrated in certain locales. For some regions, studies have shown that birding tourism brings a major economic benefit. This can lead to local attitudes of support for bird habitat and bird conservation—but this outcome is not guaranteed, and doesn't happen automatically. A survey of regional efforts reveals some effective principles in building such attitudes. The most successful approaches have laid the groundwork with community leaders well in advance of any specific conservation question, especially anything that might be controversial. Partnerships with travel / tourism bureaus and chambers of commerce prove to be exceptionally powerful. Elected officials, regardless of their views on the environment, often respond very well to evidence that birding is good for the economy. Attempts to promote bird-tourism must be seasonally appropriate and based on some genuine attraction for birders, but efforts that cater only to the most serious birders will miss out on some potential benefits. This presentation will review strategies that have proven successful in connecting bird tourism to conservation action, and suggest how they can be applied elsewhere.

Speciation reversal in ravens: genomic evidence of mosaic genomes in western North America

Kearns, Anna - University of Maryland Baltimore County; Marco Restani - Montana Audubon; Ildiko Szabo - Cowan Tetrapod Collection, UBC Beaty Biodiversity Museum; Silje Hogner - Natural History Museum, University of Oslo; Jin Ah Kim - University of Maryland Baltimore County; Hayley Richardson - University of Maryland Baltimore County; Matthias Gobbert - University of Maryland Baltimore County; John Marzluff - University of Washington; Robert Fleischer - Smithsonian Institution; Arild Johnsen - Natural History Museum, University of Oslo; Kevin Omland - University of Maryland, Baltimore County

Speciation reversal is an understudied process in which introgressive hybridization causes previously distinct lineages to collapse into a single lineage with an admixed/mosaic genome. Most known cases involve recently diverged lineages (e.g., ~12,000 ya) and are human caused. However, in the Common Raven (*Corvus corax*) speciation reversal involves two cryptic mtDNA lineages ("Holarctic" and "California") that diverged ~2 million years ago, and is suspected to have begun following secondary contact during the Pleistocene. Here we test this mtDNA-based hypothesis, using genome-wide SNPs, Z chromosome and autosomal introns and more geographically extensive mitochondrial sampling. We find that all four datasets show strikingly concordant geographic structuring that delineate (1) a region with pure "Holarctic" ancestry in Eurasia, Canada and eastern USA, (2) a region with almost pure "California" ancestry in southwestern US and Mexico, and (3) a broad region of admixed California/Holarctic ancestry across the western US. All datasets show clinal variation in the proportion of California/Holarctic ancestry along a north-south axis with higher frequencies of "Holarctic" ancestry in the north and "California" ancestry in the south. However, genomic SNPs, Z-linked and autosomal introns show more extensive northward introgression of "California" alleles compared to mtDNA. We also found that mtDNA and nuclear backgrounds were uncoupled at the individual-level within the western US. Meaning that "Holarctic" and "California" mtDNA was found against the entire range of California/Holarctic nuclear allele frequencies. Such uncoupling is consistent with a lack of reproductive isolation and long-term interbreeding between the two lineages throughout western North America.

Migration patterns of greater sandhill cranes (*Grus canadensis tabida*) from Ohio

Kearns, Laura - Ohio Dept Nat Res - Division of Wildlife; Dave Sherman - Ohio Dept Nat Res - Division of Wildlife; Jason Tucker - AECOM; Bob Gates - School of Environment and Natural Resources, The Ohio State University

The greater sandhill crane (*Grus canadensis tabida*) population, while greatly increasing throughout most of their range in North America, are still considered state-endangered Ohio, mainly because of limited wetland habitat. To better understand the full life cycle of the crane population in Ohio, we satellite-tagged 21 cranes, 16 adults and 5 juveniles, between 2011-2014 from various locations in Ohio. During this time, we documented 34 separate fall migration patterns (including patterns of non-migration), and patterns varied widely among individuals and years. In several instances, tagged birds did not migrate at all (26%, 9/34). If cranes migrated, they wintered at locations in Indiana, Kentucky, Tennessee, Georgia, and as far south as central Florida. Interestingly, 76% (19/25) of crane migrations resulted in the individual staging or wintering at Hiawassee State Wildlife Refuge, in Tennessee, which is an important stopover and wintering location for the eastern sandhill crane population. We further investigate the

potential driving factors of these migratory patterns by exploring the relationships between migration decisions (i.e. 1) to migrate or not, 2) timing, and 3) migration distances) and weather patterns, including temperature, wind speed and direction, precipitation, and barometric pressure.

Measurement of Triglyceride and Beta-Hydroxybutyrate in Baltimore Orioles a Migratory Songbird in South Central Nebraska

Keele, Emma - University of Nebraska-Kearney; Letitia Reichart - University of Nebraska-Kearney

Variation in lipid metabolism is linked to differences in resource use and innate genetic variation. South central Nebraska is an important migratory stopover site because birds use it for refueling along their migratory path. Acquiring lipids on stopover sites is especially important to allow birds to complete the remaining portion of their migration. In addition, birds able to maintain lipids throughout migration are more likely to breed successfully. We developed an appropriate assay to detect Triglyceride (TRIG) and Beta-Hydroxybutyrate (BUTY) concentrations in blood plasma for Baltimore Orioles(*Icterus galbula*) (BAOR) captured during spring migration of 2015. Lipid metabolism in each species is variable, thus baseline information must be collected for each species captured. We collected blood samples within ten minutes of capture from the brachial vein and then samples were stored on ice. Plasma was removed from the remaining blood components and then stored at -80°C until analysis. We collected 101 plasma samples from BAOR, but used a subset of 36 samples to analyze for TRIG and BUTY. Mean TRIG Serum was 0.048 (mM) ± 0.039 (SD). Mean BUTY was 0.213 (mM) ± 0.129 (SD). Further lab work, modification of the procedure, and analyses need to be done. Results from this study will be used to formulate new testable hypotheses regarding lipid metabolism for BAOR that use south central Nebraska as a migratory stopover site.

Filling in the gaps of conspecific cue use for habitat selection: experiments with the Yellow Warbler (*Setophaga petechia*).

Kelly, Janice - University of Illinois at Urbana-Champaign; Michael Ward - University of Illinois at Urbana-Champaign

For songbirds, breeding habitat selection is important because of its direct effects on fitness. There is growing evidence that songbirds use the presence of conspecifics, or conspecific attraction, to select habitat by settling near members of their species. Using conspecific cues (conspecific vocalizations or visual presence) may be an effective management technique to replenish songbird populations in target areas. Before implementing such techniques, it is critical to understand if: (1) types of conspecific cues differ in how effectively they attract conspecifics to habitat, and (2) apparent conspecific density (number of conspecific cues simulated) positively or negatively influences habitat selection. To address these questions, we first conducted a playback experiment evaluating if Yellow Warblers (*Setophaga petechia*), a species with two distinct song types (Type 1 and 2), select habitat based on which song type is more prevalent in the environment. We broadcast Yellow Warbler song Type 1, Type 2 and silent controls during the breeding season at sites across Illinois. More Yellow Warblers occurred at Type 2 sites compared to Type 1 sites; both song treatment sites had more individuals than silent controls. We then conducted a playback experiment addressing whether apparent conspecific density influenced settlement decisions. Yellow Warbler counts were the same at low and high conspecific density treatments (playback of one and five birds/ha), but individuals clustered more closely at high density treatments. Results from these studies will be useful to improve playback techniques in

management plans designed to recruit songbird populations in protected or restored habitats.

Environmental cues associated with continental-scale avian migration phenology

Kelly, Jeffrey - University of Oklahoma; Kyle Horton - University of Oklahoma; Phil Stepanian - Rothamsted Research; Kirsten DeBeurs - University of Oklahoma; Todd Fagin - Oklahoma Biological Survey; Eli Bridge - Oklahoma Biological Survey; Phil Chilson - University of Oklahoma

Rapid changes in seasonal avian migrations provide compelling examples of biotic response to climate change. Seasonal waves of land-surface phenology and temperature are thought to be primary exogenous cues that migrants use to fine tune migration timing. Exploration of the role these cues play in regulating migration timing requires better spatial, temporal, and taxonomic sampling than is typically available. We analyze weather surveillance radar and eBird citizen science data in an effort to understand the macro-scale relationships among migration phenology and seasonal waves of land-surface phenology and seasonality of temperature. We demonstrate that both WSR and eBird data provide similar estimates of migration timing at local (within 100 km) and macro scales (>20o of latitude). These measures of avian phenology were positively correlated with spring temperatures, and land surface phenology (extended spring index of first leaf date; SI-x), which followed a south to north wave. Start-of-spring, estimated from a remotely sensed index of vegetation greenness, did not show the expected pattern from south to north and appears unlikely to be a useful exogenous migration cue within the study region. Future analyses of WSR and eBird data have the potential to provide high-resolution phenology data that may be useful in understanding spatiotemporal dynamics of migration systems and there responses to climate change.

A Riverscape of Fear: The impacts of eagle nest usurpation on the foraging behavior of a heron siege

Kennedy, Brian - University of Idaho; Knut Marius Myrvold - University of Idaho

Trophic interactions among top consumers can be complex and have significant effects on resources. Here, we study a natural experiment where a pair of bald eagles (*Haliaeetus leucocephalus*) usurped the nesting site of a great blue heron (*Ardea herodias*) colony and displaced them 4km upstream in the Clearwater River, Idaho, United States. Niche overlap of food resources is minimal, but the eviction from the original nest site caused a shift in the herons' consumption of juvenile salmonids. We used Passive Integrated Transponder (PIT) data on over 7 million juvenile salmonids to quantify how their taxonomic-, life-history-, and geographic representation in heron diets changed with rookery relocation. Selection for specific salmon species changed between periods driven by a geographic shift, whereby herons avoided the bald eagle nesting location. Consequently, diet composition changed significantly, with the largest increase in coho (*Oncorhynchus kisutch*) and largest decrease in Chinook salmon (*O. tshawytscha*). The representation of Chinook life-history type also shifted. Fall Chinook (ocean type) juveniles were the numerically dominant migratory strategy in the diet, but decreased relative to spring- and summer Chinook following relocation. Finally, herons used a nearby tributary watershed more following the relocation. These results demonstrate that nest-site usurpation and subsequent shifts in space use can cause changes in the predation pressure on lower trophic levels. We discuss these findings in the context of fear landscapes whereby the presence of a predator or strong competitor can affect the behavior of individuals in a population.

Migratory Bird Conservation Milestones in Canada

Kennedy, Judith - Canadian Wildlife Service

The signing of the Migratory Birds Convention one hundred years ago laid the foundation for a spectrum of actions to advance the migratory bird conservation. This presentation will highlight some of the key Canadian milestones in building a comprehensive conservation program. Starting with enacting the Migratory Birds Convention Act in 1917, Canada's federal government assumed the legal mandate for protecting migratory birds, but operates in partnership with provincial and territorial governments to this day. Beginning with the urgent need to address over-harvest, a regulatory framework was put in place. Another conservation approach that grew under the Act was a network of protected areas specifically focused on migratory birds. Monitoring to determine population status and research to better understand emerging issues, such as chemicals in the environment, were built into the expanding program; this year marks the fiftieth anniversary of the Breeding Bird Survey and Migratory Game Bird Hunting Permit. A new approach to wildlife management emerged under the North American Waterfowl Management Plan, the concept of targeted partnerships undertaking land management for migratory birds. This effort gave rise to similar partnerships for other groups of migratory birds, such as the birth of non-game programs in North America. The Convention is as relevant today in supporting the conservation of migratory birds as it was in 1916.

Can Snow Geese and Shorebirds Coexist in a Changing Arctic?

Kennedy, Lisa - Western University; Erica Nol - Trent University; Paul Smith - Environment and Climate Change Canada

Snow geese are increasing in abundance in across the Arctic and breed sympatrically with shorebirds. Interactions between increasing snow goose and declining shorebird populations have not yet been explored. High densities of snow geese are hypothesized to negatively impact shorebird breeding success through direct physical goose presence and/or the indirect effects of habitat degradation from extensive foraging or from attraction of predators. In addition to direct or indirect effects on nest survival, shorebirds may suffer other consequences from the presence of geese. Geese could directly disrupt incubation behaviour and potentially cause stress or decreased physical condition of sympatric shorebirds. Similarly, shorebirds' behaviour or physiology could be influenced indirectly by goose induced changes in habitat quality from foraging or from predators attracted to goose colonies. While these mechanisms of interaction are plausible, there is currently little empirical evidence with which to compare the relative importance of each. I explore whether incubation behaviour is influenced directly by disturbance from snow geese, or indirectly through habitat degradation by monitoring time on and off shorebird nests using time-lapse cameras and temperature probes in concealed nests. Shorebirds nesting in open-landscape sites actively defend their nests from geese, other shorebirds and aerial predators. Activity on and off the nest is very atypical in open-landscape nesting shorebirds where snow geese brood their young suggesting increased activity levels may decrease nest survival. From a conservation perspective, snow geese may both directly and indirectly decrease nest success of arctic-breeding shorebirds.

A snapshot of the movements of White-crowned Pigeons satellite-tracked in Florida and the Caribbean.
Kent, Gina - Avian Research and Conservation Institute (ARCI); Ken Meyer - Avian Research and Conservation Institute; Ricardo Miller - Jamaica National Environment and Planning Agency; Alexis Martinez - Puerto Rico Department of Natural and Environmental Resources; Predensa Moore - Bahamas National Trust; Paul Watler - National Trust for the Cayman Islands

We present satellite tracking data for 17 White-crowned Pigeons from five countries from 2013 to 2016. Fewer long moves than expected. Most breeding birds from Florida made seasonal migrations, some tagged in the Bahamas and Cayman Islands moved short distances within each archipelago, but four birds tagged in Jamaica and Puerto Rico were year-residents with a 5 to 10km seasonal shift in location. Four Florida pigeons migrated to central Cuba for the winter, and three over-wintered in Florida, although two of them died during an exceptionally cold period. Band returns compiled by R. Paul and A. Sprunt in the 1970s showed that the Bahamas were an important wintering destination for Florida's pigeons, at least at that time. T. Bancroft and R. Bowman suggested that "only a small portion" of Florida's breeding population wintered in Florida. We are curious about how decades of hunting in the Caribbean, especially the Bahamas, may be affecting migratory behavior in the Florida population. With a short generation time and high harvest pressure, Florida's pigeon population, which has been mainly migratory for as long as we know, may be experiencing selection for year-round residency or changes in migratory destinations. While increased residency in Florida may avoid harvest pressure in the Caribbean, it also may expose birds to greater winter mortality in Florida due to cold weather and the scarcity of tropical fruit. Greater effort should be given to cooperative, range-wide management that considers both resident and migratory populations of the White-crowned Pigeon.

Does body size divergence in sympatry cause a corresponding divergence in song among closely related species of birds, worldwide?
Kenyon, Haley - Queen's University; Stephanie Kim - Queen's University; Robert Montgomerie - Queen's University; Paul Martin - Queen's University

How does ecological divergence influence traits involved in reproductive isolation and does this divergence vary across the globe? These questions have been central in studies of diversification since the time of Darwin and Wallace, who both suggested that the warm tropics were dominated by biotic selective pressures that influenced species' ecologies and formation. Since then, several studies have identified functional links between ecological traits important for species coexistence (e.g., body size) and traits important for reproductive isolation (e.g., song), but no one has tested whether these connections can result in widespread patterns in the divergence of these traits simultaneously. Recent work studying divergence among closely related birds, however, has identified a broad geographic pattern: species with overlapping ranges are more different in body size (i.e., mass) than those that do not overlap, but only in warm climates, suggesting that size may be a key trait in allowing them to coexist. Here we test the prediction that closely related, sympatric species of birds which are divergent in body size are also divergent in song peak frequency, as previous work has shown that body size can functionally influence song, resulting in lower frequencies in larger animals. Preliminary results indicate that closely related sympatric species in warm climates are indeed more divergent in their peak song frequency and, furthermore, that this pattern is driven primarily by sympatric body size divergence. Analysis of additional

comparisons is ongoing; results from the completed project will be presented at the conference.

Variation in mitochondrial genes in relation to species boundaries
Kerr, Kevin - Toronto Zoo

DNA barcoding employs a short, standardized gene region – specifically, cytochrome c oxidase I (COI) for animal life – as a molecular tool for species identification. The success of DNA barcoding relies on low variation within species and significant variation between them. Birds were selected as an early test group for the barcoding paradigm given their comparatively robust taxonomy. In a number of regional studies, the vast majority of bird species examined could be readily identified via DNA barcodes, while the few exceptions were primarily limited to young species pairs and/or those known to hybridize. The success of DNA barcoding contrasts with predictions based on neutrality that the system would fail because enough mutations would not accumulate rapidly enough to permit the reliable delimitation of species. The apparent separation of species into tight clusters of DNA barcodes prompted a hypothesis implicating selective sweeps as the primary evolutionary agent. However, in birds it was found that the amino acid sequence of COI is heavily constrained, suggesting that the observed pattern of COI diversity in this group may be largely attributable to demographic effects combined with purifying selection. The near absence of amino acid shifts in COI effectively hinders tests of selection, which typically rely on ratios of synonymous to nonsynonymous mutations. COI is exceptional in this regard, suggesting that cyto-nuclear incompatibilities are more likely to stem from other mitochondrial genes.

If we build it THEY will come: Restored tall grass prairies and grassland birds
Keys, Rob - Cornerstone University; Darien Lozon - Cornerstone University

In the early 1800s tall grass prairie covered large areas of the upper Midwest United States. Much of this was converted to agricultural purposes as the country grew. Over the last 35 years many projects have reestablished tall grass prairies in the region. For years many have believed the restoration of native prairies in regions where they once existed would lead to the restoration of the biodiversity of other organisms of the prairie, specifically grassland birds. Our research has monitored restored tail grass prairies of various sizes with paired grasslands of other types (former agricultural fields now in the Conservation Reserve Program (CRP) and mowed fields) to determine the extent to which this is viable conclusion. Results indicate areas of prairie restoration have the lowest obligate grassland bird biodiversity and birds/point (B/P) (H’ = 0.068; B/P = 0.50) when compared to mowed mixed grasslands (H’ = 1.44; B/P = 4.02) and CRP (wildlife) grasslands (H’ = 0.474; B/P = 2.60) and in many cases are devoid of obligate grassland birds of any type after 10+ years of management. We believe a new paradigm of management is called for to restructure these restored prairie grasslands to meet the needs of birds who have adapted over the last 150 years to a non-prairie structure.

Habitat Selection of Nesting and Fledgling Wood Thrushes in Massachusetts
King, David - U.S. Forest Service Northern Research Station; Scott Schlossberg - Dept. Envirnmental Conservation

Wood Thrushes have been experiencing long-term declines in the Northeast, and while winter habitat limitation appears to influence population viability, maintaining suitable breeding habitat is at least equally important in supporting healthy populations and limiting declines. In order to characterize Wood

Thrush nesting habitat, we conducted 120 point counts at four sites in western Massachusetts during 2011 and 2012, and also searched for and monitored wood thrush nests. Since Wood Thrushes are known to switch habitat from nesting sites in mature forest to shrubland or open forest during the postfledging period, and our simulation modeling suggests habitat-specific fledgling survival rates can be more influential on population growth than nest survival rates, we also quantified survival and habitat selection for 90 Wood Thrush fledglings with radio-telemetry. Our results showed that Wood Thrush nesting habitat is typically characterized as mature mixed or deciduous forest with a well-developed shrub and sapling layer on mesic or semi-mesic sites. Fledglings selected habitat with greater understory structure than nesting sites or corresponding random sites that included dense undergrowth within forest as well as forest gaps and regenerating silvicultural openings. Finally, fledging survival was positively related to understory structure. Our results indicate that Wood Thrush habitat in western Massachusetts consists of a mix of structurally diverse mature forest interspersed with shrubland patches.

Advances and challenges in the use of avian radar to reduce bird strikes
King, Ryan - Federal Aviation Administration

The Federal Aviation Administration (FAA) initiated the Bird Radar Research Program in the 1990s when prototype systems for detecting birds at airfields were being introduced. Studies that focused on the performance of commercially available bird radar detection systems began in 2005. For two decades, the FAA Airport Technology Research and Development Branch has directed research on an extensive and varied list of radar technologies. Bird radars have demonstrated valuable functionalities that support various end users in the aviation community. Currently, the primary role of bird radar is a tool to support wildlife hazard assessments at airports and control of hazardous wildlife at or near airport property. However, implementation and application of bird radar detection systems is continually evolving amidst accelerated technological improvements, systems integration, and robust data analysis capabilities. Bird radar manufacturers continue to develop improved equipment that can provide higher-fidelity data on target location, speed, and mass amounting to a potential role in civil air traffic control. Challenges remain in terms of implementing and utilizing surveillance sensors that operate within an ever densified frequency spectrum as well as increasing demand for multi-purposing such systems. The FAA Bird Radar Research Program will continue to address these and other emerging issues, while maintaining a focus on extending bird radar's role to support air traffic control on a local level and augmenting bird radar with other longer-range radar assets to provide coverage on a regional, and perhaps even a national, scale.

Constructing a range-wide migratory network in an aerial insectivore to assess which seasons drive long-term changes in abundance
Knight, Samantha - University of Guelph; David Bradley - Bird Studies Canada; Robert Clark - Environment and Climate Change Canada; Marc Bélisle - Université de Sherbrooke; Lisha Berzins - University of Northern British Columbia; Tricia Blake - Alaska Songbird Institute; Eli Bridge - Oklahoma Biological Survey; Russell D. Dawson - University of Northern British Columbia; Peter Dunn - University of Wisconsin-Milwaukee; Dany Garant - Université de Sherbrooke; Geoff Holroyd - Beaverhill Bird Observatory; Andrew Horn - Dalhousie University; David Hussell - Ontario Ministry of Natural Resources; Olga Lansdorp - Simon Fraser University; Andrew Laughlin - University of North Carolina Asheville; Marty Leonard - Dalhousie University; Fanie Pelletier - Université de Sherbrooke; Dave

Shutler - Acadia University; Lynn Siefferman - Appalachian State University; Caz Taylor - Tulane University; Helen Trefry - Beaverhill Bird Observatory; Carol Vleck - Iowa State University; David Vleck - Iowa State University; Linda Whittingham - University of Wisconsin-Milwaukee; David Winkler - Cornell University; D. Ryan Norris - University of Guelph

Effective conservation of migratory birds requires knowledge of spatial connections throughout the annual cycle. Tree swallows (*Tachycineta bicolor*) are aerial insectivores that breed throughout Canada and the U.S. and overwinter in large roosts in the southeastern U.S., Mexico, Central America and the Caribbean. Significant declines have been documented over portions of their breeding range but, similar to many migratory birds, it remains unclear whether causes of these declines are driven by events during the breeding or non-breeding season. In this study, we construct a range-wide migratory network using year-round, daily locations obtained from light-logging geolocators attached to 137 individuals at 12 breeding sites ranging from Alaska to Nova Scotia to North Carolina. We show a complex pattern of connections between the breeding and non-breeding season that are broadly structured at a regional level but also demonstrate several key stopover and overwintering sites that are used by individuals originating from multiple breeding populations. We combine this description of the network with long-term nest box occupancy data (234 site-years) to examine whether synchronous fluctuations in population size observed on the breeding grounds, including recent declines in some populations, are driven by distance between breeding sites, degree of overlap in use of stationary overwintering sites, or degree of overlap in use of stopover sites during fall migration. Our study provides the most comprehensive description of a migratory network to date and demonstrates how understanding network dynamics can provide key insights into population trends of migratory songbirds.

Tri-trophic ecology of native nest flies (*Philornis trinitensis*) in grassquits and mockingbirds of Tobago

Knutie, Sarah - University of South Florida; **Jordan Herman** - University of Utah; Jeb Owen - Washington State University; Dale Clayton - University of Utah

Introduced parasites threaten host populations around the world because they tend to be more virulent in novel hosts than in their native hosts. In the case of *Philornis downsi*, a parasitic nest fly introduced to the Galápagos Islands, flies reduce the reproductive success of Darwin's finches but not Galápagos mockingbirds. In this study, we assess whether similar patterns of virulence hold true within the native range of a Philornis species (*P. trinitensis*) in similar coastal scrub habitat on the Caribbean island of Tobago. Parasite load was experimentally manipulated in nests of the black-faced grassquit (*Tiaris bicolor*) and the tropical mockingbird (*Mimus parvulus*). Surprisingly, our results are similar to the effects of *P. downsi* in its invasive range: flies reduced the reproductive success of grassquits, a close relatives of Darwin's finches, but not tropical mockingbirds, a congener of the Galápagos mockingbird. Thus, members of the genus Philornis are not necessarily less virulent in native hosts compared to novel hosts. However, we found that the prevalence of Philornis in Tobago was lower than that of Philornis in the Galápagos, and that presumed enemies of Philornis (parasitoid wasps and ants) were more common in nests of birds in Tobago than in the Galápagos. These results suggest that native hosts of Philornis are not necessarily better defended than novel hosts. Instead, Philornis may be more harmful to novel host populations in its invasive range because it has escaped its native enemies.

Nest fates influence renesting characteristics in a tidal marsh sparrow
Kocek, Alison - SUNY College of Environmental Science and Forestry; Chris Elphick - The University of Connecticut; Laura Garey - The University of Maine; Thomas Hodgman - The Saltmarsh Habitat and Avian Research Program; Adrienne Kovach - University of New Hampshire; Brian Olsen - The University of Maine; Samuel Roberts - University of Delaware; Katharine Ruskin - University of Connecticut; W. Gregory Shriver - The University of Delaware; Jonathan Cohen - SUNY College of Environmental Science and Forestry

Tidal marshes are highly dynamic systems that support few terrestrial vertebrate species due to a combination of salinity, floristic simplicity, daily tidal inundation, and unpredictable flooding events. Those few species inhabiting tidal marshes are often uniquely adapted to this extreme environment. For endemic bird species, breeding failure most commonly occurs due to tidal inundation, leading to multiple nesting attempts per season. As global climate change induced sea level rise amplifies tides and intensifies flooding, predictions are grim for the continued persistence of species such as the saltmarsh sparrow, a tidal marsh-obligate. However, in a recent study we found evidence of previously-undocumented variability in nest substrate use for saltmarsh sparrows that we decided to investigate further. We examined nest placement, characteristics, and fates throughout the species' range to look at the potential for individual behavioral variation among multiple nest attempts. Females that lost a nest to flooding commonly switched from one elevation zone to another during a subsequent nest attempt and built the following nest higher off the ground (X2 test, α=0.05). Individuals that succeeded in their first nesting attempt did not tend to select differing habitat in following attempts but did tend to build their nest higher off the ground, possibly due to seasonal tide height changes. Females that lost nests due to depredation remained consistent in future nest elevation zone and height. Our results provide evidence that saltmarsh sparrows display plasticity in the face of nest loss to flooding, with implications for habitat restoration and persistence time.

Social networks across fission-fusion changes: Temporal organization and reproductive consequences.
Kohn, Gregory - Indiana University-Psychological and Brain Sciences

Many social vertebrates inhabit loosely structured groups where both group size and composition fluctuate over short timescales. The ability to sustain non-random interaction preferences across group changes is important in maintaining social organization. Nonetheless, we currently know very little about which interaction preferences are consistent across fission-fusion changes, the temporal social dynamics responsible for them, and their consequences for reproductive success. Here I discuss a series of studies that investigate the organization of social networks in flocks of Brown-headed Cowbirds across fission-fusion changes. I found that female cowbirds create enduring subgroups with familiar individuals across multiple fission-fusion changes. I then show how moment-by-moment changes in sequential interaction patterns preferentially reinforce familiar connections over others in the network, and that stronger familiarity preferences during autumn predict later reproductive output during the breeding season. These results highlight how investigating the patterns and processes underlying social networks across varying timescales can yield new insights into the emergence and evolution of animal social organization.

Effects of oil infrastructure and noise on grassland songbirds in Alberta, Canada

Koper, Nicola - Natural Resources Institute, University of Manitoba; Jacy Bernath-Plaisted - North Carolina Wildlife Resources Commission; Heather Nenninger - Soil and Water Conservation Districts of Montana; Jody Daniel - St. George's University

New oil wells are continually being developed across the Northern Great Plains, but their effects on grassland songbirds, including species at risk, are poorly understood. We compared effects of different types of oil wells to evaluate which might have lower ecological footprints, and we evaluated whether effects of wells were driven by the presence of infrastructure, or noise, traffic, and human activity associated with infrastructure, by comparing effects of active wells with wells that were turned off. We collected data on abundance (168 transects) and nesting success (813 nests) of grassland songbirds within seventy three 64-ha, native mixed-grass prairie sites in southern Alberta, Canada, from 2012 to 2014. Abundance of Baird's sparrows and Sprague's pipits was significantly and substantially lower in sites with oil wells, while abundance of chestnut-collared longspurs and Savannah sparrows was independent of the presence of infrastructure. Western meadowlarks had higher abundances in sites with screwpumps but not pumpjacks. Nesting success was significantly lower in sites with screwpumps, and we demonstrate that this was driven by the presence of power distribution lines in some sites, which provide perch sites for potential predators. No effects on either abundance or nesting success were caused by noise, traffic, or human activity. Our results demonstrate that ecological effects of wells in grasslands can be mitigated by using lower-impact, commercially available oil extraction infrastructure, and that minimizing the presence of above-ground infrastructure would have greater benefits to grassland songbirds than reducing noise.

Using Unmanned Aerial Vehicles to monitor avian indicator species in Antarctica

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Unmanned aerial vehicles (UAVs) represent a new frontier in environmental research. Nowadays this technology is deployed in areas difficult to access, like Antarctica. Our study presents a successful application of a long-distance fixed-wing UAV based method to collect data for monitoring indicator species populations in Antarctica. During two Antarctic expeditions (Oct–Dec 2014 and Nov–Dec 2015) UAVs equipped with digital cameras, GPS sensors and autonomous control systems were used. Small-format aerial photography taken from low altitudes (350 m AGL) made it possible to obtain large scale images (ground sample distance for the digital camera < 5cm). These images allowed us to identify, observe and measure the photographed objects, such as nesting penguins, so called krill dependent predators. Penguins have been termed marine sentinels, this is why they are used as a CCAMLR (The Commission for the Conservation of Antarctic Marine Living Resources) Ecosystem Monitoring Program indicator species. The presented study results show successful application of fixed-

wing UAV's used to obtain data for the 14.6 km2 of the area investigated. Analysis of high resolution images enabled us to locate and estimate occupied nests of three Pygoscelis penguin species in seven breeding colonies located at King George Island (South Shetlands, West Antarctica). These results coincide with the results of the ground based visual counts collected by standard methods. Project (No 197810) is funded from Norway Grants in the Polish-Norwegian Research Programme operated by the National Centre for Research and Development.

Old growth forest at the landscape scale mitigates local species loss, community shifts and biotic homogenization of a Neotropical forest bird community

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Tropical conservation strategies traditionally focus on large tracts of pristine tropical forests, but given rapid primary forest loss, it is critical to consider the role that secondary forest remnants play in biodiversity maintenance. Here, we disentangled the effects of landscape composition (forest amount), configuration (fragment size), and forest age (old growth versus secondary forest) on bird communities in human-dominated landscapes of southern Costa Rica. We characterized the bird community in 49 forest fragments representing independent gradients in patch size and amount of forest in the surrounding landscape (forest cover within 1000m radius). While the entire bird community showed no change in species richness and total abundance among fragments, richness and abundance of forest birds decreased in secondary forest and near fragment edges. Avian forest species – particularly insectivores – strongly declined in small fragments, but only when the amount of old growth forest within the landscape was low. Further, bird communities had significantly reduced levels of β-diversity in small vs. large patches - but only in landscapes with little old growth forest. Landscape-scale amount of old growth forest, but not overall forest cover or local patch size, was the most important driver of bird community shifts in small and large fragments. We conclude that secondary forests alone are unlikely to sustain tropical avian biodiversity without the subsidizing effect of old growth; at best, secondary forests play a subordinate role in shaping forest bird communities. Hence, retaining old growth forest within human-modified landscapes is crucial for sustaining biodiversity friendly landscapes.

Corridors restore animal-mediated pollination in fragmented tropical forest landscapes

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Tropical deforestation drives rapid biodiversity loss and puts tropical ecosystem functioning such as pollination at risk. Pollinators are particularly important in the terrestrial tropics, where they ensure the pollination of > 94% of higher plant species. Corridors may facilitate pollinator and pollen movement between habitat fragments, but it remains unclear whether they may avert deforestation-driven breakdown of pollination mutualisms in fragmented tropical landscapes. We combined experiments with observational data to determine the effect of

corridors on hummingbird-mediated pollination in a highly fragmented landscape in Southern Costa Rica. Using resource manipulation experiments with artificial flowers and experimental plants we tested whether corridors facilitate hummingbird movement and pollen transfer between forest fragments surrounded by intensive agriculture. Further, we determined pollinator patch occupancy and pollination success in small forest fragments. Resource manipulation experiments showed that corridors facilitate movement of forest-associated hummingbirds through agriculturally modified habitat and increase pollen transfer. Further, corridors strongly increased forest-associated pollinator availability in small fragments, and increased pollination success. Importantly, isolated patches without corridors showed near-complete pollinator absence, paralleled by pollination failure. Our results indicate that simple corridor elements benefit tropical forest ecosystems beyond boosting local species richness, by functionally connecting mutualistic network partners. Overall, our results indicate that small-scale adjustments to landscape configuration with simple corridors are a promising conservation tool to enhance native pollinators and pollination services in tropical human-modified landscapes worldwide. Corridors may therefore complement large-scale conservation strategies such as parks and represent low-cost - big-gain tools for the conservation of tropical biodiversity in the Anthropocene.

Gene flow and Adaptation in a Tidal Marsh Specialist

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Population genetic variation is influenced by species dispersal patterns and spatial heterogeneity of the environment, often involving the interplay of gene flow and adaptation. We genotyped 1005 individuals at 16 microsatellite loci to characterize genetic variation and environmental influences on gene flow of Saltmarsh Sparrows (*Ammodramus caudacutus*) from 24 marshes across the breeding range in the northeastern U.S. Because the species range spans a hybrid zone with the congeneric Nelson's Sparrow (*A. nelsoni*), we included diagnostic loci in our marker panel to separate the influence of introgression on population genetic structure. Gene flow was relatively high overall, but variable among marshes, with no support for an isolation-by-distance model. Bayesian clustering analysis identified hierarchical population structure, with a broad north-south division coinciding with the southern limits of introgressive hybridization. Finer scale population structure was attributed to site fidelity and habitat differentiation among marshes. We used a landscape genetics approach to identify the influence of marsh-level environmental characteristics on genetic variation. Neutral patterns of gene flow were investigated by modeling the covariance structure of allele frequencies as a function of environmental and geographic distance. For the diagnostic loci, putatively under selection, allele environment associations were investigated with a multivariate ordination approach. We

discuss the variable influences of interspecific interactions, site fidelity, marsh size and isolation, and environmental gradients on fine-scale gene flow patterns in this system. We relate our findings to genome-wide patterns of interspecific adaptive divergence.

Nonbreeding isolation and population-specific migration routes among three populations of Golden-winged Warblers
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Golden-winged Warblers (*Vermivora chrysoptera*) are Neotropial migrants experiencing varied regional population trends that are not fully explained by breeding-grounds factors (e.g., generally high nest success). No information exists on their nonbreeding distributions, migration routes, or timing of migration among populations, and factors outside the breeding period may influence population trends. We tracked annual movements of 21 Golden-winged Warblers from 3 North American breeding locations experiencing varying population trends using geolocators from 2013-2015 to investigate the potential for nonbreeding-site factors to influence breeding populations. We analyzed geolocator data using the template-fit method, which is more accurate than the more commonly used threshold method. Geolocator-marked Golden-winged Warblers exhibited significant isolation among populations during the nonbreeding period and during migration. Golden-winged Warblers from Minnesota, USA (n=12) migrated to areas in Central America from southern Mexico to central Nicaragua; warblers from Tennessee, USA (n=7) migrated to areas along the border of northern Colombia and Venezuela; and warblers from Pennsylvania, USA (n=2) migrated to areas farther east in central Venezuela. Golden-winged Warblers from these three breeding populations exhibited essentially no effective overlap (< 0.001%) during the nonbreeding period. Warblers travelled at a slower rate over more days in fall migration than spring migration. Fall migration routes around the Gulf of Mexico were population specific, whereas spring migratory routes were more varied and overlapped among populations. Our results reveal nearly complete temporal and geographic isolation among three populations of Golden-winged Warblers throughout the annual cycle resulting in opportunities for population- and site-specific factors to differentially influence populations.

NSF's MacroSystems Biology and Early NEON Science program supports regional to continental scale studies
Kratz, Tim - National Science Foundation; Elizabeth Blood - National Science Foundation

Climate change, land use change, and the introduction of invasive species have caused more change in the biosphere in the last 50 years than in any time in human history. Biological and ecological responses to these changing drivers are often non-linear and difficult to predict because of the complex interplay between patterns and processes associated with fine-scales and those occurring at broader scales. In particular, the basic scientific knowledge needed to understand the biosphere at regional to continental scales is difficult to extrapolate from studies conducted at local scales or interpolated from global scales. To help meet this scientific challenge the U.S. National Science Foundation created the MacroSystem Biology and Early NEON Science program to support studies that develop new conceptual frameworks, models, and data applicable to forecasting future

change of the biosphere at regional to continental scales. After an initial five-year run, and one year on hiatus, the program was renewed in late 2015 and is again active and receiving proposals. Current awards are supporting a diverse set of studies ranging from migratory organisms to population dynamics to surface-atmosphere interactions. To enable this research awardees are developing innovative technology, integrating complex data (ranging from genes to remote sensing), and developing new analytical and modeling capabilities. Training and engagement of students, citizens, managers, and policy makers are central to these awards. In this presentation we will discuss research and funding opportunities that may be of particular interest to organismal biologists.

Resource based maternal effects in the Black-throated Blue Warbler (*Setophaga caerulescens*)
Krauss, Nicole - Washington State University; Nick Rodenhouse - Wellesley College; Scott Sillett - Smithsonian Migratory Bird Center; Mike Webster - Cornell University; Hubert Schwabl - Washington State University

Maternal effects are defined as non-genetic influences of female phenotype or environment that contribute to offspring phenotype. Prenatal maternal effects are especially important because of the high plasticity during this critical window in embryonic development. In oviparous species, all of the resources needed until hatch are deposited into the egg before the egg is laid. Income breeders, those that use resources acquired during egg formation rather than energetic stores to form eggs, are expected to be limited by food availability. In this study, we consider maternal contributions to eggs in relation to food availability in a migratory passerine, the black-throated blue warbler (*Setophaga caerulescens*). We tested the hypothesis that females will incur a trade-off between investment in eggs and investment in self, when food is limited during egg formation. In 2013 and 2014, we measured caterpillar, spider, and flying insect abundance on three different plots throughout the breeding season, which historically varied in food availability. Two eggs were collected from a subset of nests on each plot. Yolk C and N isotopes were also measured to evaluate trophic position of female prey during egg formation. Egg mass, yolk mass, and yolk hormone concentrations were used as metrics of egg quality. There was no relationship between food availability or trophic position of diet items and egg quality detected. Given the lack of explained variance in egg metrics, female foraging effort is currently being evaluated.

Because it's all about the birds: Building partnerships between the U.S. Fish and Wildlife Service and zoos
Kreger, Michael - U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service is entrusted with managing migratory birds for the benefit of the American people. With threats ranging from climate change to window collisions, the FWS relies on partners to further avian conservation and policy. Over the years, there has been strong collaboration between FWS migratory bird programs and zoos and aquariums. These include endangered species recovery programs that involve captive breeding and reintroduction, partnering with national wildlife refuges in field research projects, and, this year, educating large and diverse audiences about the importance of migratory birds and actions they can take as we celebrate the centennial of the first Migratory Bird Treaty. There are many more opportunities. We need to continue to benefit from the strengths of our organizations to move towards our common goals. In this session, we will give examples of collaborative projects, discuss current priorities and needs, and how future projects may be initiated.

Vertebrate pest control services from raptors

Kross, Sara - University of California, Davis

Historically, farmers valued birds of prey such as owls for their rapturous appetites for vertebrate pests. However more recently, the widespread use of rodenticides may have lessened the value farmers place on this ecosystem service, and this combined with habitat change, human-wildlife conflict, electrocution, and persecution have caused declines of raptor species worldwide. Nevertheless, raptors continue to provide agriculture with vertebrate pest control services, although these services are rarely documented by the scientific literature. Case studies from my own research demonstrate that raptors provide valuable pest control services for agriculture, the valuation of which support changes in management practices to benefit raptors. For example, in New Zealand the reintroduction of threatened falcons (*Falco novaeseelandiae*) into vineyards led to a 95% reduction in the number of grapes removed-, and a 55% reduction in the number of grapes pecked- by introduced birds; results which have played a role in efforts to mitigate electrocution mortality risks and reduced persecution of the falcons. Similarly, population models reveal that barn owls (*Tyto alba*) in California have the potential to control rodent pests under different pest and owl densities, and a recent survey of farmers in the area reveals that they view raptors as very beneficial for the control of vertebrate pests.

Connecting Breeding and Wintering Populations of the Endangered Least Bell's Vireo

Kus, Barbara - U.S. Geological Survey Western Ecological Research Center; Suellen Lynn - U.S. Geological Survey Western Ecological Research Center; Kristine Preston - U.S. Geological Survey Western Ecological Research Center

Recovery of migratory endangered species has historically focused on improving conditions for breeding populations, yet individuals spend half the year on wintering grounds about which little is known. Conservationists now recognize that a full-life cycle approach is needed to understand and integrate factors affecting birds at all stages of the annual cycle. We sought to expand our studies of breeding Least Bell's Vireos (LBVI) in southern California to include populations wintering in southern Baja California, Mexico. Our goals were to (1) determine connectivity of breeding and wintering populations by resighting color-banded individuals, and (2) compare survival of banded birds across three wintering sites differing in habitat structure and precipitation. Surveys in the 1990's, although successful in locating wintering populations, yielded only a few discoveries of banded LBVI, despite the hundreds of birds banded annually on the breeding grounds. We therefore modelled habitat suitability based on several environmental variables, and used this to identify new areas likely to support LBVI. Birds banded at our three winter study sites provided additional opportunities to link breeding and wintering sites through resighting on the breeding grounds, and since 2011, 16 banded individuals have been observed at both their breeding and wintering sites. Survival was time-dependent, reflecting the effects of drought and a hurricane, but we found no support for site differences in survival. We conclude that connectivity between breeding and wintering populations is weak, that survival may be robust to moderate environmental variability, and that

the wintering locations of the majority of the southern California breeding population remain unknown.

Sympatric-breeding arctic species respond differently to climate cooling
Kwon, Eunbi - Virginia Tech; Willow English - Simon Fraser University; Emily Weiser - Kansas State University; Samantha Franks - British Trust for Ornithology; David Hodkinson - Landmark Ecology Ltd.; David Lank - Simon Fraser University; Brett Sandercock - Kansas State University

Biological impacts of climate change are widely exemplified by shifts in seasonal phenology. However, the effects of climate-induced shifts on the relationships between timing of breeding and different components of reproductive effort and breeding success are largely unknown. We monitored 1,335 nests of three shorebird species at a subarctic site during 1993–1996 and 2010–2014. We examined within season trends in reproductive traits as well as changes in the relationship between breeding timing and performance between the two decades. We found both long-term (42-year window) and short-term cooling trends during the prelaying and laying stages. As a probable consequence of cooling temperatures during the egg-laying stage, birds delayed egg-laying by five days in the 2010s relative to the 1990s. Clutch size and daily nest survival showed strong within season declines; however, for some species, this pattern of within season trends was inverse between the decades. Egg volume showed strong within season declines in Western Sandpiper, but strong increases in Red-necked Phalarope. However, despite the relationship between phenology and reproductive traits and the observed shifts in phenology between decades, mean egg volume and daily nest survival were generally similar between decades. In contrast, a change in incubation duration between the decades was related to parental care strategy, decreasing by two days in the sandpipers with biparental incubation, and increasing by two days in the phalarope, with uniparental incubation. We suggest that different energetic costs of incubation that are dependent on parental care strategy can cause opposite responses to climate variability.

Advancing our understanding of avian migration ecology through Big Data
La Sorte, Frank - Cornell University; Daniel Fink - Cornell University; Wesley Hochachka - Cornell University; Steve Kelling - Cornell University

Migration is a common strategy used by birds that breed in regions containing highly seasonal environments. Understanding the patterns and dynamics of avian migration has remained challenging due to the difficulty observing migratory birds and the broad extents of their movements. Opportunities provided through the growth of Big Data has allowed researchers to develop and apply novel perspectives where migration is studied at the population level across broad geographic extents with rich spatial and temporal detail. For the first time, seasonal movements of entire migratory bird populations can be documented across the full annual cycle within large regions of the globe. From this, basic features can be extracted such as migration flyways, trajectories, and speed, which can be used to address fundamental questions in avian migration ecology. For example, the role of key environmental processes in defining broad-scale migration strategies, such as atmospheric conditions or ecological productivity, can be addressed across the annual cycle; predictions originating from optimal migration theory and the “green-wave” hypothesis can be broadly tested; and current and future implications of land-use and climate change for migratory bird populations can be explored and modeled. In total, recent developments in Big Data ornithology have generated conceptual perspectives and methodological tools that can be readily used to advance theory and

application, thus improving our ability to understand, study, manage, and conserve migratory bird populations worldwide.

Fieldwork and computer simulation reveal cryptic life history variation along an elevation gradient in the Dark-eyed Junco in California

LaBarbera, Katie - Museum of Vertebrate Zoology, UC Berkeley; Eileen Lacey - Museum of Vertebrate Zoology and Department of Integrative Biology, UC Berkeley

We explored life history variation along an elevation gradient to answer two questions: 1) how do the traits that comprise life history strategy transition as the environment changes? and 2) which environmental factors best explain variation in life history strategy? We monitored breeding Dark-eyed Juncos (*Junco hyemalis*) in the Sierras at sites ranging from 1960 to 2660 m a.s.l. Conditions varied significantly among elevations within this range. We found no evidence that abiotic determinants of breeding season length directly determined life history speed, as the abiotic environment exhibited an entirely different pattern of variation among elevations than did life history speed (i.e. breeding season length, broods/season, clutch size, offspring quality). Elevations also differed in extra-pair paternity and nest mortality. A computer simulation suggests that the differences in mortality and breeding season length contribute to substantial elevational differences in reproductive success and the energetic cost of producing a successful offspring. Because these differences arise primarily during the later part of the nesting cycle, they may be difficult to observe through conventional fieldwork protocols. To our initial questions, we conclude: 1) that life history traits do not only transition smoothly across environmental gradients, but also exhibit a variety of other patterns; and 2) that the life history differences across elevations cannot be explained solely by abiotic factors, but may be related to the effects of those factors on the birds' prey base or nesting sites; and that nest mortality rates drive substantial but difficult-to-detect differences in reproductive success.

Learning from experience: Adaptive management for Whooping Crane conservation

Lacy, Anne - International Crane Foundation

Reintroduction of Whooping Cranes in the Eastern Migratory Population (EMP) by the Whooping Crane Eastern Partnership began in 2001 and has grown steadily to a population of over 100 individuals by the end of 2015. The EMP has a high annual survival rate but productivity has been low because of nest abandonment and low fledging rate. As a result of intensive monitoring of this population throughout its' life cycle, much information is known about most individual birds throughout their lives. Field observations have led to discoveries of maladaptive behaviors of this young population and allows for adaptive management to attempt to alleviate some of these behaviors. The EMP has benefited from a collaboration between field personnel and staff with expertise in various captive management techniques. Examples include using the Whooping Crane SSP to increase the genetic variability in the EMP (e.g. alleviate deleterious effects of captive selection); using captive knowledge to modify maladaptive behaviors of wild birds by bringing them back into captivity temporarily (e.g. pairing with Sandhill's in the wild); and training young, or captive adults rearing young for release, to better prepare for situations that may confront birds in the wild (e.g predator avoidance training). Over time, positive outcomes from this partnership will have positive effects for the species as a whole.

Provisioning picky eaters: differences in parent-nestling dietary niche-space overlap in an urban avoiding and urban adapting species.

Ladin, Zachary - University of Delaware; Vincent D'Amico - USDA Forest Service; Deb Jaisi - University of Delaware; Adam Smith - U.S. Fish and Wildlife Service; Scott McWilliams - University of Rhode Island; W. Gregory Shriver - The University of Delaware

Food and nutrient limitation can influence individuals throughout their life history, and can contribute to population-level limiting factors. Differential responses among species to anthropogenic environmental change provide an opportunity to study how dietary flexibility may be related to species' ability to adapt to urbanized environments and novel ecosystems. We compared dietary niche-space patterns between the wood thrush (*Hylocichla mustelina*), an urban avoider and the gray catbird (*Dumetilla carolinensis*), an urban adapter. These Neotropical migratory species share many life history traits and co-occur on the breeding grounds within our study area in Newark, Delaware, USA. Using stable carbon (δ13C) and nitrogen (δ15N) isotopes from blood plasma sampled from individuals during the 2012 and 2013 breeding seasons, we constructed dietary niche-spaces for adults (male and female) and nestlings of both species. We found that parent-nestling dietary niche overlap differed between wood thrushes and gray catbirds. Mean dietary niche-spaces for wood thrush nestlings estimated by Bayesian standard ellipse areas (SEAb) were more than double the niche-space of adults, whereas the dietary niche-spaces of gray catbird nestlings and parents were similar. These results suggest that wood thrush nestlings are functionally "pickier" eaters compared to gray catbirds, which could result in higher energetic costs related to provisioning effort for wood thrush parents. We discuss potential implications of parent-nestling dietary mismatch through modeling the relative contributions of fruits and arthropods to the respective diets of wood thrushes and catbirds in light of their differential responses to anthropogenic change.

Variation in wing morphology of a trans-hemispheric migratory songbird and its significance in migration performance

Lam, Lawrence - University of Manitoba; Kevin Fraser - University of Manitoba

Wing morphology may be a determining factor in migration performance, as wing size and shape impact aerodynamic efficiency. However, differences in migration distance or trade-offs with other life history traits (e.g. reproduction) could result in variation in morphology between individuals or populations. Little is known about whether variation in wing morphology contributes to variation in migration performance in songbirds, because until recently, it was not possible to track songbird migration from start-to-finish. Using light-level geolocators to track the migration of purple martins (*Progne subis*), we examined: 1) whether variation in wing morphology exists between breeding populations, sexes, and age classes, and 2) what morphological factors contribute to migration performance (speed, rate, stopover duration). Measurements for wing loading, aspect ratio, and wingtip pointedness were taken from purple martins at breeding sites across eastern North America. Geolocators were retrieved the year following deployment and provided detailed information on the location of individuals and their timing throughout migration. Mixed effect models were used to examine the relationship between wing morphology and migration performance, while controlling for the effects of weather. By assessing multiple wing measurements and incorporating weather variables, our study provides novel insight on the influence of multiple factors on the in-vivo migration performance of a wide-ranging songbird.

Costs of fear: Behavioral and life-history responses to risk and their demographic consequences vary across species

LaManna, Joseph - Washington University in St. Louis & Tyson Research Center; Thomas Martin - USGS - University of Montana

Behavioral responses to reduce predation risk might cause demographic 'costs of fear.' Costs differ among species, but a conceptual framework to understand this variation is lacking. We use a life-history framework to tie together diverse traits and life stages to better understand interspecific variation in responses and costs. We used natural and experimental variation in predation risk to test phenotypic responses and associated demographic costs for 10 songbird species. General responses across species such as increased parental attentiveness (mean effect size ± SE = 0.37 ± 0.07, P = 0.001) yielded reduced development time (mean effect size ± SE = -0.70 ± 0.09, P < 0.001) and created benefits such as reduced predation probability. Yet, responses to increased risk also created demographic costs by reducing offspring production in the absence of direct predation (mean effect size ± SE = -0.49 ± 0.16, P = 0.014). This cost of fear varied widely across species, but predictably with the probability of repeat breeding. Use of a life-history framework can aid our understanding of potential demographic costs from predation, both from responses to perceived risk and from direct predation mortality.

Evaluating evolutionarily significant units in an alpine-endemic bird: a conservation genomics approach

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The delineation of intraspecific units that are evolutionarily and demographically distinct is an important step in the development of species-specific management plans. Neutral genetic variation has served as the primary data source for delineating evolutionarily significant units across species' ranges. With recent advances in genomic technology, we now have an unprecedented ability to utilize information about neutral and adaptive variation across the entire genome, although to date few studies have integrated genomic information into conservation planning. Here, we apply a reduced-representation genomic approach to delineate evolutionarily significant units in the white-tailed ptarmigan (*Lagopus leucura*), an alpine-obligate species that is distributed from the Yukon to New Mexico. The white-tailed ptarmigan is a species of conservation concern because its distribution is naturally fragmented along mountain ranges and it is potentially vulnerable to changes in climate. Our preliminary analyses revealed substantial genomic divergence across the species' geographic range. The level of distinctiveness was particularly pronounced for subspecies

that are geographically isolated (1) at the southern range extent and (2) on Vancouver Island, British Columbia. We discuss how our results compare to the geographic boundaries of currently recognized subspecies. We also present analyses testing for spatial variation in genetic diversity and adaptive divergence. This work will inform future management and listing decisions for the white-tailed ptarmigan and will contribute to our understanding of how geographic and environmental factors shape patterns of divergence across species' ranges.

Range Mapping - Integrating Bird Conservation on Human Landscapes
Lanham, Joseph - Clemson University

Important Bird Areas (IBA's) provide vital landscape level context for avian conservation. With species prioritized as continently or globally significant, researchers, managers and other stakeholders can more efficiently focus efforts on large-scale geographic networks to conserve birds and habitats. Frank Gill, President Emeritus of the National Audubon Society stated that "IBAs have the unique power to unite people, communities, and organizations in proactive bird conservation, one place at a time". As conservation organizations begin to address the disparities in involvement and recruitment from more diverse perspectives (e.g. people of color), shifts in bird and environmentally-related interests might be expected with concurrent shifts in land ethic and valuation based upon differently hued perspectives. If IBA and community integration are to be effective, we must identify and understand (1) the spatial intersections between communities of color and IBAs; and (2) address and integrate a fuller spectrum of values as they relate to nature and conservation. This presentation will use the South Carolina Lowcountry as a case study for integrating human/bird "habitat requirements" in an exercise termed "eco-psycho-socio range mapping". This exercise will integrate IBA core areas with landowner distribution patterns and new information on land ethic and valuation that can provide revived impetus for uniting people and birds in unique ways that focus on communities of color and those heretofore underserved in the conservation conversation.

Implications of Raptor Population Increases for Management of Migratory Shorebirds
Lank, David - Simon Fraser University

The large and steady increase in the abundance of raptors has over the past 40 years made life more dangerous for many shorebird species. This global phenomenon is likely having effects that are as profound and far-reaching as those occurring following wolf reintroductions into Yellowstone National Park. Several studies estimate substantial shorebird mortality directly attributable to raptors. In addition to these 'density-mediated' effects, raptors – especially falcons - strongly affect shorebird behavior, which can lead to 'trait-mediated' impacts on shorebird populations, and via these behavioral changes indirectly impact the biological communities they inhabit. Studies in other taxa show that trait-mediated direct impacts are often as large or larger than density-mediated impacts. As Raptor populations have increased, shorebirds prioritized anti-predator behavior over other activities, creating tradeoffs. Shorebirds have reduced mid-winter fat loads, redistributed over wintering locations, altered roosting behavior, and changed migratory speed, routing and stopover site use. This behavioral flexibility and tradeoffs should be incorporated into shorebird management programs and planning. The safety/danger profiles of intensively utilized migration or wintering sites, influenced by e.g. raptor perch sites or cover, should be incorporated when managers choose or modify intensively utilized shorebird sites. The interpretation of census data may reflects danger-induced changes in habitat usage rather than real population change. Finally, although direct

mortality occurs, it does not necessarily alter shorebird populations. Anti-predator behavior may partially or even wholly shift mortality to other direct agents. Disentangling causality these factors is a major challenge.

Domestication and adaptation to captivity in the Zebra Finch (*Taeniopygia guttata*)
Lansverk, Allison - East Carolina University; Simon Griffith - Macquarie University; Christopher Balakrishnan - East Carolina University

As a representative of the Oscine Passerines, or songbirds, Zebra Finches have been the subject of extensive neurobiological and behavioral research. The majority of research conducted on these birds relies on domesticated populations, yet little is known about patterns of genomic divergence between domesticated and wild populations. Domestication is known to influence aspects of social behavior, so an understanding of genetic variation between wild and domesticated populations is critical to the advancement of the zebra finch as a model system for studying gene-behavior relationships. In order to derive a complete picture of genetic variation, we used the Illumina HiSeq platform to resequence full genomes at medium coverage (8x) in a sample of 20 domesticated and 19 wild Zebra Finches. Following quality filtering, we mapped the remaining reads to the Zebra Finch reference genome for single nucleotide polymorphism (SNP) calling. We detected 11,284,284 SNPs. We find that populations show a low level of overall genetic differentiation (Fst=0.04). As might be expected, the two populations differ significantly in diversity (theta – wild = 14.9. theta – domesticated = 10.44). Two-thousand twenty one SNPs were found to be significantly differentiated and were in or near 2218 genes. Genes associated with protein binding, regulation of transcription, and plasma membrane were significantly over represented in these regions (P). Our findings highlight genetic divergence is potentially due to both selection and genetic drift and point to putative functional differences between wild and domesticated populations of Zebra Finches.

Rapid environmental disturbance increases social connectivity in a tropical passerine bird
Lantz, Samantha - Tulane University; Jordan Karubian - Tulane University

Both natural and anthropogenic disturbances are altering the environment at increasing rates, yet little is known about individual behavioral responses to these events for most species. When individuals survive habitat disturbances their initial responses are often behavioral, which can in turn alter social structure. Changes to social connectivity can have important consequences for ecological processes, including access to resources such as mates and food. We investigated habitat selection and social connectivity of non-breeding red-backed fairywrens (*Malurus melanocephalus*) before vs. after fire disturbance in Northern Territory, Australia across 2 years. We used social network analyses to quantitatively compare individual and network-level metrics of sociality in fairywrens after naturally occurring bush fires that are frequent in this area. Before fires, fairywrens used habitat that had similar grass cover to available habitat plots randomly generated within our study site. Fire caused a reduction in grass cover, and fairywrens responded by selecting habitat with higher grass cover relative to random plots, for example unburned or remaining patches of grass. After fires, fairywrens flocked in these patches of unburned vegetation, which resulted in a shift in social structure. We found increased sociality at both individual and network levels in areas that experienced fire. Fairywrens in undisturbed areas had similar social structure across these same two temporal periods. These carryover effects from the nonbreeding season may influence reproductive success for these individuals. Future studies should

investigate how social structure impacts breeding pair formation and fitness.

Does social status modulate sperm characteristics in the wild?
Lara, Carlos Esteban - Department of Zoology, University of Otago, Dunedin, Otago, New Zealand; Helen Taylor - Department of Anatomy, University of Otago, Dunedin, Otago, New Zealand; Neil Gemmell - Department of Anatomy, University of Otago, Dunedin, Otago, New Zealand; Shinichi Nakagawa - School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW, Australia

Sperm competition predicts that individuals competing for access to sexual partners produce better sperm to increase fertilization. Although fertilization rates increase with sperm quality, it remains to what extent individuals might modulate sperm traits to heighten reproductive success. Recent studies suggest that subordinate individuals alter their reproductive investment to increase sperm velocity. As social status can change over time, an emerging hypothesis suggests that competing males adjust their sperm quality according to their social status. The dunnock (*Prunella modularis*) is a bird with a variable mating system, where males have different social statuses. We used this variation to evaluate male social status and sperm traits. We monitored a color-banded population of dunnocks in New Zealand (2009-2016), and collected 53 sperm samples (39 males) two breeding seasons. We quantified sperm velocity and morphometry per individual. We used generalized linear mixed models to test whether sperm traits vary with social status. We found that the average sperm velocity decreased with age, but we did not find any evidence to support average sperm quality varying with social status. Interestingly, the variance in sperm velocity was two times higher in beta males than alpha males. Rather than increasing the average sperm velocity, beta males increased variability of sperm velocity. Such manipulation of sperm quality could be considered as 'bet-hedging' – production of variably sized gametes in unpredictable environments. Our data offer a parallel where the unpredictable factor is male paternity. We discuss the strengths and weaknesses of this 'paternal bet-hedging' along with alternative explanations.

Living the dream: a partnership to effectively implement landscape-scale bird conservation across private and public forestlands in Pennsylvania
Larkin, Jeffery - Indiana University of Pennsylvania

Several studies have recently examined nesting and post-fledging habitat selection of many at-risk, forest-dependent songbirds. Collectively, this research provides a substantial body of evidence that suggests forest bird conservation is intimately tied to landscape context and configuration and within-stand structural complexity, regardless of nesting guild. As such, increasing forest age class diversity has become an important focus of many forest-bird conservation strategies. However, there are considerable economic, logistical, and ecological challenges that inhibit such efforts. In 2011, a multi-agency partnership was initiated with the intent to implement science-based habitat guidelines for Golden-winged Warbler and associated species across public and private forests in Pennsylvania. To date, this partnership has created over 20,000 ha of Golden-winged Warbler nesting habitat and continues to grow in membership and long-term vision. An example of this was the 2013 official designation of the Poconos: Golden-winged Warbler Cooperative Management Area (GWCMA). This area is about 100,000 ha and is comprised of one State Forest and five State Game Lands that are interspersed among private forests. The Poconos-GWCMA is proving to be an example of forest-bird conservation that transcends ownership boundaries and operates at biologically meaningful spatial and temporal

scales. This presentation will provide examples of successes and insight as to how a well-funded and well-organized partnership can overcome the many constraints that can often inhibit large-scale conservation implementation.

Nest microhabitat differences of a critically endangered ground nesting bird in native vs. altered habitat

Larned, Archer - University of Maryland Baltimore County; Bernard Lohr - University of Maryland Baltimore County

Vegetation characteristics influence nest site selection by ground nesting grassland bird species. The critically endangered Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*) is a ground nesting grassland bird with only a few remaining populations in central Florida. The two largest of those populations are found on differently managed habitats. One is burned regularly to maintain native prairie habitat and the other is managed for cattle ranching. We surveyed Florida Grasshopper Sparrows nests at both sites, 34 at Three Lakes WMA (Wildlife Management Area) and 24 on a private ranch. Following nest completion, we assessed vegetation characteristics (percent cover for vegetation types (i.e. grass, forbs), density, and height) in a 50cm square centered over the nests. Vegetation percent cover differed significantly between sites, with the private property characterized by primarily grasses and saw palmetto (*Serenoa repens*) and Three Lakes WMA with more forbs and dwarf oak (*Quercus minima*). The average height and density of the vegetation around the nests did not differ between the sites. This result suggests that vegetation structure rather than composition is more important for nesting in this bird. Nests on private property also had significantly lower success, which may be due to either microhabitat cover or differences in predator density. Understanding which vegetation characteristics Florida Grasshopper Sparrows prefer for nesting will help inform habitat management strategies for increasing population numbers of this critically endangered subspecies, with further application to other endangered ground nesting grassland obligate species.

Revisiting the effects of insect-resistant GMO crops in agriculture

Latham, Jonathan - The Bioscience Resource Project

Insect-resistant GMO corn, cotton, and soybeans are widely grown in US agriculture. Often known as Bt crops, they contain one or more transgenes–called cry genes–that encode a proteinaceous insecticide developed originally from the soil-dwelling bacterium Bacillus thuringiensis. It has been widely asserted that these insect-resistant GMO crops benefit wildlife, including bird populations, by reducing insecticide use. However, there are good reasons to doubt any wildlife benefits. One reason investigated by us is that, although the natural versions of CRY proteins probably have low toxicity towards non-target species, the GMO versions are significantly different. Though presented and regulated as ‘natural“, GMO CRY proteins have been altered and selected to increase their bioavailability, to increase their potency, and to broaden their insecticidal activity. Thus novel CRY proteins, that are being produced continuously in GMO crop tissues, including in roots, pollen, leaf debris, etc, are entering ecosystems in vast quantities, effectively without testing.

Avian relationships with wildfire at two dry forest locations with different historical fire regimes

Latif, Quresh - Rocky Mountain Research Station, U.S. Forest Service; Jamie Sanderlin - Rocky Mountain Research Station, U.S. Forest Service; Victoria Saab - Rocky Mountain Research Station, U.S. Forest Service; William Block - Rocky Mountain Research Station, U.S. Forest Service; Jonathan Dudley - Rocky Mountain Research Station, U.S. Forest Service

Wildfire is a key factor influencing bird communities in western North American forests. We need to understand species and community responses to wildfire and how responses vary regionally to effectively manage for biodiversity in dry conifer forests. We compared avian relationships with wildfire burn severity between two locations of Arizona and Idaho. We predicted different responses to wildfire corresponding with regional differences in historical fire regime. We conducted point-count surveys for 3 years following wildfire (Arizona: 1997–1999; Idaho: 2008–2010) and used multispecies hierarchical models to analyze relationships of bird occupancy with burn severity. Consistent with our prediction for mixed-severity fire regimes characterizing the Idaho location, we observed proportionately more positive species occupancy relationships and, consequently, a positive species richness relationship with burn severity in Idaho. We also observed the opposite pattern in Arizona, which was congruent with our prediction for the low-severity fire regime characterizing that location. Cavity nesters and aerial insectivores occupied more severely burned sites following wildfire, corresponding with predicted increases in nesting substrate and foraging opportunities for these species. In contrast, canopy-nesting foliage gleaners and pine-seed consumers exhibited negative relationships with burn severity. Congruence with species life histories and with patterns reported in the literature suggests generality of observed patterns. We therefore suggest that optimal management strategies for maintaining avian diversity could differ regionally. Specifically, intensive fuels management may be ecologically less appropriate for promoting biodiversity in areas such as the Idaho location where mixed-severity wildfires and dense forest stands were historically more common.

Behavioral plasticity of winter bird foraging across a gradient of habitat fragmentation

Latimer, Christopher - University of Wisconsin-Madison; Benjamin Zuckerberg - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison

Energy is the common “currency” of ecology and for birds overwintering in temperate ecosystems, foraging is arguably one of the most important behavioral processes affecting fitness. Habitat fragmentation can influence animals’ foraging decisions through modifications to their thermal environment (microclimate), and/or to their biotic environment (predators). As temperatures decline and resources are depleted, the risk of starvation increases and individuals must forage more intensively to meet their energetic demands during winter. However, as individuals forage more intensely, they devote less time to vigilance and become more susceptible to predation. Therefore, individuals that can more readily respond to changes in their environmental condition (have greater behavioral plasticity) should be better adapted to riskier habitats. Here, we test the hypothesis that wintering birds residing in more fragmented landscapes have higher plasticity in foraging responses during winter in order to balance the antithetic processes of starvation and predation. We predicted that individuals and populations inhabiting more fragmented landscapes would have higher feeder visitation rates and would adjust feeding rates more rapidly in response to changes in ambient temperatures than individuals and

populations residing in less fragmented landscapes. Using radiofrequency identification enabled bird feeders we monitored foraging responses of >600 individuals in 12 landscapes spanning a gradient of forest fragmentation. Individuals in fragmented landscapes had higher feeding rates on average and adjusted foraging responses more rapidly to decreases in ambient temperatures. Our results suggest that habitat fragmentation may select for more plastic phenotypes of which the advantages, consequences and limitations will be discussed.

Northern Cardinal bill morphology variation modeled spatially and temporally in a climatic context

Latimer, Christopher - University of Wisconsin-Madison; Benjamin Zuckerberg - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison; Colleen Miller - University of Wisconsin-Madison

Allen's Rule is a biogeographic rule predicting that appendage sizes of organisms vary along latitudinal gradients so that surface area is minimized or maximized to facilitate heat retention or dissipation in cold and hot climates, respectively. Due to its vascularization, the avian bill plays an important thermoregulatory role, and is therefore likely to conform to these predictions. While Allen's rule has been examined in relation to bird bills over broad geographic gradients, there remains little support for variation in morphology over time. Over the past several decades, many regions of North America have demonstrated a consistent increase in temperature due to modern climate change. Like many resident birds, the Northern Cardinal (*Cardinalis cardinalis*) has expanded its range northward in recent decades, likely in response to warming winters. However, climate change is occurring non-uniformly through space and time, and thus, its impact on populations should vary geographically. We hypothesized that Northern Cardinal bill size has decreased in northerly regions due to increasing climate variability and increased in southerly regions due to warming temperatures. We obtained measurements of bill surface area for Northern Cardinal museum specimens collected over an 85-year period (n =524) and tested the effects of temperature change. We found strong support for our hypothesis that bill surface area decreased over time in northerly latitudes and increased over time in southerly regions as a function of temperature. These results imply that bill size variation follows the predictions of Allen's Rule over space and time.

Avian Responses to Understory Fire Frequency in Oak Woodland

Laughlin, Caitlin - Oklahoma State University; Timothy O'Connell - Oklahoma State University; Stephen Hallgren - Oklahoma State University

Prescribed fire is a frequently used management tool in forests to reduce fuel loads and improve wildlife habitat, requiring an understanding of how long-term changes in understory vegetation influence wildlife. Using bird communities as an indicator, we examined how 25 years of low-severity fire influences understory structure and wildlife responses. We selected a post oak (*Quercus stellata*) dominated study site with a documented 28 year prescribed fire history, ranging from 0-4.3 fires per decade. We conducted two six-minute avian point counts and collected basic compositional and structural vegetation information at 72 points in 2015. We used GLMM and AIC in R 3.1.3 to analyze our results, which varied by species. We found Eastern Wood-Pewee (*Contopus virens*) density was best explained by an interaction between fire frequency and understory structure. Density of Indigo Bunting (*Passerina cyanea*) was best explained by fire frequency or winged elm (*Ulmus alata*) stem count. Yellow-billed Cuckoo (*Coccyzus americanus*) density was best explained by fire frequency and canopy cover. Density of Blue-gray Gnatcatcher

(*Polioptila caerulea*) was not well predicted by any of the models tested. These results reflect that fire frequency has a nonlinear relationship with measures of understory structure. Understanding these complex interactions and their relationships with target bird densities is important in the fire suppressed landscapes of the southern grassland-forest transition zone, where more frequent fire can benefit some species of conservation concern.

Learning to cope with urban noise: Vocal adjustment in black-capped chickadees correlates with prior noise experience and may improve audibility in noisy conditions
LaZerte, Stefanie - University of Northern British Columbia / Thompson Rivers University; Hans Slabbekoorn - Leiden University; Ken Otter - University of Northern British Columbia

Low-frequency urban noise can interfere with avian communication through masking, but birds can reduce this interference by altering their vocalizations. Although several experimental studies indicate that birds can rapidly increase vocal frequencies in response to sudden increases in ambient noise, it is unclear whether this is innate or a learned response that depends on previous noise exposure. Further, it is unclear whether or not these changes actually improve audibility in noisy conditions. Black-capped chickadees (*Poecile atricapillus*) are well suited to addressing these questions as they are known to switch between song frequencies in response to fluctuating traffic and experimental noise. We investigated (1) whether responses to experimental noise exposure depend on territorial noise levels (i.e. familiarity with noise), and (2) whether these responses improved audibility in noisy conditions. We confirmed that males in noisy areas sang higher-frequency songs than those in quiet areas, but found that only males in already-noisy territories shifted to singing fewer low-frequency songs in response to experimental noise; in contrast, males in quiet territories shifted to singing more low-frequency songs. Further, we found that males responded more quickly to playbacks of high- than low-frequency songs embedded in background noise, but only when high-frequency songs were presented first. These results suggest that high-frequency songs may be more audible in noise, but that chickadees may require prior experience with fluctuating noise to learn how to adjust vocalizations to minimize masking. Thus, learning to cope may be an important part of adjusting to acoustic life in the city.

Science, engagement, education: Open, web-based visualization and analysis of animal movement data
LaZerte, Stefanie - University of Northern British Columbia / Thompson Rivers University; Matthew Reudink - Thompson Rivers University; Adriaan De Jong - Swedish University of Agricultural Sciences; Jackson Kusack - Thompson Rivers University; Mark Paetkau - Thompson Rivers University; Ken Otter - University of Northern British Columbia; Jacob Bailey - University of Northern British Columbia; Alistair Sutter - Thompson Rivers University; Jerin Roberts - Thompson Rivers University; Matthew Betts - Oregon State University; David Hill - Thompson Rivers University

Tracking bird movements can inform avian conservation, behaviour, and ecology leading to a better understanding of social interactions, as well as habitat and resource use. In addition, tracking bird movements is also attractive to naturalists, citizen scientists and the general public and thus represents a tool for public engagement in science and science education. However, tracking movements over time and space can be time-intensive, expensive, and complicated by the challenge of interpreting movements across time and space. Although Radio Frequency Identification (RFID) provides a simple, inexpensive, and low-energy approach for examining the movements of birds across a landscape, the sheer amount of data

collected quickly becomes overwhelming. Here we showcase a framework we have developed to address these issues. In conjunction with a campus wide network of RFID feeders, we have developed a web-based platform for the visualization and analysis of bird movements tracked by these feeders. We have developed an R package (feedr) to handle the analysis which can be used either through R directly, or through an R-based, online, user-friendly, web application. This system can be used by professional and citizen scientists alike to track and observe bird movements. Our goal is to extend this application to handle data collected from other static stations (e.g., hair traps, static VIF recorders) and to develop this framework as a meeting point for science, education and community awareness of the movements of birds and other animals. We hope this will inspire citizen engagement while simultaneously enabling robust scientific analysis.

Sister Parks: Creating Connectivity for Migratory Bird conservation between US and Costa Rica national parks and reserves.
Leavelle, Karen - Osa Birds: Research and Conservation

The Osa Peninsula within the Osa Conservation Area (ACOSA) on the south Pacific coast of Costa Rica is one of the most biologically diverse tropical landscapes remaining supporting well over half of Costa Rica's resident and Neotropical migratory avifauna and a number of threatened and endemic species. To better conserve neotropical migratory birds and to draw attention to and raise awareness of the global connections necessary for the conservation and the protection of their breeding and overwintering habitats, the Sister Parks Partnership was formed between the National Park Service of the Upper Midwest and the Costa Rican National System for Conservation Areas (SINAC). Through this international effort, multiple organizations, schools and communities support the Sister Park Partnership and education of Neotropical migratory birds through International Migratory Bird Day festival activities, international educational exchanges, and research and monitoring to better understand species presence and their associated habitats in Costa Rica and factors that may be limiting populations. Since 2014, this initiative has helped to support migratory bird education in more than 15 schools, biological monitoring in rural Osa, varied fundraising projects, and is raising the profile of the Osa Peninsula as an important area for Neotropical Migratory birds.

Safeguarding the rarest bird species in the Latin America and the Caribbean from Extinction
Lebbin, Daniel - American Bird Conservancy

At least 12 bird species in Latin American and the Caribbean have gone extinct in the wild since the 1700s and more species are declining towards extinction. IUCN ranks approximately 311 bird species in Latin America and the Caribbean as Critically Endangered, Endangered, or Vulnerable and 26 of these have no known wild populations and may already be extinct (and a few may await rediscovery). Three species seem to have disappeared from northeastern Brazil in just the last few years. Of surviving species: ~80 are recognized by the Alliance for Zero Extinction as restricted to a single site; ~72 species represent conservation "emergencies" with wild populations numbering less than 100, or a total wild population less than 500 and without any single stable subpopulation numbering more than 100; and ~32 are both AZE and emergency species. Habitat loss and degradation, invasive species, pet trafficking, persecution, and hunting are some of the threats driving species extinction in this region, with habitat loss currently being the most concerning. American Bird Conservancy aims to safeguard these species from

extinction by implementing projects with partners in Latin America and the Caribbean to reduce threats and protect habitat. In this talk, I will summarize some recent successes of American Bird Conservancy and out partners overall, as well as for individual species such as Pale-headed Brush-Finch, Stresemann's Bristlefront, and others. Frequently, these projects also benefit common species in decline, including Neotropical migrants.

Prioritizing and implementing projects for the rarest bird species in the Americas
Lebbin, Daniel - American Bird Conservancy

At least 12 bird species in Latin American and the Caribbean have gone extinct in the wild since the 1700s and more species are declining towards extinction. IUCN ranks approximately 279 bird species in Latin America and the Caribbean as Critically Endangered, Endangered, or Vulnerable and 24 of these have no known wild populations and may already be extinct (or await rediscovery). Including three species that seem to have disappeared from northeastern Brazil in just the last few years. Of surviving species: 79 are recognized by the Alliance for Zero Extinction as restricted to a single site; 70 species represent conservation "emergencies" with wild populations numbering less than 100, or a total wild population less than 500 and without any single stable subpopulation numbering more than 100; and 30 surviving species are both AZE and emergency species. Habitat loss and degradation, invasive species, pet trafficking, persecution, and hunting are some of the threats driving species extinction in this region, with habitat loss currently being the most concerning. American Bird Conservancy aims to safeguard these species from extinction by implementing projects with partners in Latin America and the Caribbean to reduce threats and protect habitat. Some of ABC's conservation successes will be rapidly summarized. Frequently, these projects also benefit common species in decline, including Neotropical migrants.

Factors affecting avian diversity and species abundance in tropical agricultural landscapes: importance of crop heterogeneity and type
Lee, Myung-Bok - Guangxi University; Eben Goodale - Guangxi University

Crop heterogeneity is increasingly considered as part of environmental heterogeneity in agricultural landscapes. However, relatively few studies have examined crop heterogeneity-avian diversity relationship and environmental characteristics that may influence the relationship. We investigated how crop heterogeneity affects avian diversity (species richness) and abundance in a tropical region of southern China. We established 75 sample points in agricultural areas and conducted bird surveys and crop surveys (crop type and size of area covered by the crop within a 100m-radius of a point) during Dec 2015-Jan 2016. Species richness and abundance were estimated using hierarchical multi-species model and N-mixture model with three environmental variables: percent cover of woody vegetation within a 500m-radius, and two principal components indicating a gradient of decreasing crop heterogeneity with increasing rice crop and with increasing sugarcane crop. Although species-level (occupancy) response varied by species, both principal components tended to affect species richness negatively, namely, species richness decreased with decreasing crop heterogeneity. The negative effect was significant and greater at sugarcane-dominant field than at rice-dominant field. Percent cover of woody vegetation influenced species richness positively. While five species used for the abundance analysis showed the similar pattern to what observed in the occupancy analysis, the significance of their responses to the different variables was somewhat inconsistent. Our results suggest that 1) local-scale crop heterogeneity can have positive impacts on avian diversity and

abundance, although its effectiveness may vary between crop types and 2) non-crop vegetation such as trees and shrubs can enhance avian diversity in tropical agricultural landscapes.

Land cover change and the homogenisation of the Amazonian avifauna

Lees, Alexander - Cornell Lab of Ornithology, Cornell University

Due to a series of biogeographic quirks, the vast, yet fast-disappearing forests of Amazonia play to host the world's most speciose avifaunas. New species are still being discovered and described across the region, and such high levels of micro-endemism, coupled with rampant habitat loss are poised to drive a wave of species extinctions. Here, I first focus on broad-scale patterns of threat from forest loss to the Amazonian avifauna, before revealing patterns of local avian extinctions from habitat loss, subdivision and degradation from three different deforestation frontiers with varying landscape histories in the eastern Brazilian Amazon. Although I found patch size to be the most important predictor of species richness, forest structural integrity was crucial in determining species composition, with degradation driving a predictable loss of forest-dependent species and increase in more disturbance-tolerant, geographically wide-ranging species. Although older secondary forests played host to many disturbance intolerant forest bird species, younger secondary forests were found to be relatively depauperate and dominated by edge species, whilst agricultural matrix habitats retained relatively few bird species of little conservation concern. Similar patterns of local avian extinction from these 'space-for-time swap studies' were also evident when examining historical species loss around Belém, eastern Amazonian Brazil, with some species last recorded in the region over a century ago.

Evolution of Sociality Leads to Expanded Call Repertoires in Avian Species

Leighton, Gavin - Cornell Lab of Ornithology

The evolution of sociality often places novel selection on individuals to navigate the social landscape. Individuals in social species can rely on communication to resolve social conflict or to engage in cooperation, and this suggests that sociality can drive the evolution of complex communicative systems in social species. I defined repertoire complexity as the number of distinct vocalizations given in defined behavioral contexts. I then performed an exhaustive literature search of repertoire size among avian lineages. I isolated studies that compiled a vocal repertoire while also assigning behavioral contexts to each vocalization, yielding a dataset of 88 species. I employed Phylogenetic generalized least squares models to examine how other variables influence repertoire size. First, I found that cooperatively breeding species have significantly larger repertoire sizes than species that do not cooperate. I also found an effect of the type of sociality on vocal repertoire size; specifically, species that live in year-round groups have the largest vocal repertoires. A subset of studies provided information on the acoustic properties of each of the vocalizations, and I analyzed the acoustic properties of the the vocal repertoires to determine if sociality simultaneously affects the structure of acoustic signals. I find no clear patterns with respect to the frequency or length of vocalizations in social species versus nonsocial species. I therefore find an unambiguous effect of sociality on vocal repertoire size across diverse avian lineages; specifically, species in stable and cooperative groups have the largest repertoires.

Are birds reliable bioindicators of remnants effects of mining activity? Study Case in central Mexico.

Lemus-Ramírez, Katia - Universidad Michoacana de San Nicolás de Hidalgo; José Fernando Villaseñor-Gómez - Universidad Michoacana de San Nicolás de Hidalgo, CIPAMEX; Francisco Roberto Pineda-Huerta - Universidad Michoacana de San Nicolás de Hidalgo; Rafael Alejandro Medina-Nieves - Universidad Michoacana de San Nicolás de Hidalgo

The region of Tlalpujahua-El Oro had a mining extraction boom (1890-1940) that caused striking environmental impacts that modified the surface structure, changed vegetation, and produced the accumulation of tailings that remain nowadays. After more of 60 years, there is no evidence on remnant impacts that could affect local biological communities. To investigate these potential impacts on bird communities, we compared composition and abundance of bird communities and populations in two sampling sites with similar vegetation cover and topography, representing sites far from tailings' deposition areas (treatment 1= T1) and sites with accumulation of mining waste (treatment 2= T2). Through an effort of 369 point counts (10 minutes, 50m radius, June 2014-June 2015), we registered 110 species (Chao1 estimator suggested 96% of expected species). The U Mann-Whitney statistic test ($P>0.05$), showed no overall differences in composition and abundance of species per count between treatment sites. The similarity analysis (ANOSIM), confirmed a high similarity between communities. However, significant differences were found in the abundance of 18 (16.3%) species. The use of three physiological performance indicators (Condition Index, amount of fat, and H/L ratio) at the individual level, showed significant differences in at least one of the indicators in six of nine focal species (GLM and X2 Wald, $P\leq0.1$), suggesting a trend of diminished physiological performance in the presence of mining waste treatment. Further studies are necessary to determine correlations of these indicators with the exposition to potential toxic elements in the area.

Using automated radio telemetry to link food availability, reproductive success, and habitat use of Barn Swallows

Lenske, Ariel - Trent University; Joe Nocera - Ontario Ministry of Natural Resources & Forestry

Determining fine-scale patterns of habitat use is challenging for many aerial insectivores because they move rapidly but are too small to carry GPS tags. Reasons for recent population declines of aerial insectivores are not well understood but are likely linked to changes in the availability of flying insects. Barn Swallow population declines in particular may be related to loss and degradation of foraging habitat due to changing agricultural practices. To assess fine-scale habitat use, we used an automated radio-telemetry system to track 34 breeding Barn Swallows outfitted with radio-tags. We established two receiver stations ~1 km apart and rotated them among three groups of barn sites. Each station consisted of an array with four 9-element Yagi antennas. Receivers switched between each antenna with a full cycle completed every 62 sec. By deploying stationary transmitters at known locations we developed an equation (fitted model: beta=172.6+/-14.8, $t=11.7$, $P < 0.001$) to determine bearings from receivers to active transmitters, based on relative antenna power. Since towers had overlapping detection radii we can use bearings obtained simultaneously to triangulate locations in a landscape with six potential foraging habitat types. We determined the location and extent of each habitat type within 2 km of barn sites using high resolution aerial photographs. At each site, we also collected data on nest success and on aerial insect abundance in different habitat types. Ultimately, we will combine land cover information, aerial insect abundance, nest success, and fine-scale

habitat use to test drivers of Barn Swallow reproductive success.

Contemporary Cat Management and What It Means for Birds
Lepczyk, Christopher - Auburn University

The impacts of free-ranging cats on birds has a long and rich history that dates back well over 100 years. This history is due to the impacts that cats extoll on birds and wildlife, in particular through depredation and disease. In fact, cats pose one of the greatest current threats to birds across North America. While our knowledge about cat ecology is nearing its apex, the management of cats has lagged behind, in part due to differences in management approaches, policies, and social conflict. Currently, a range of approaches are available to reduce cat numbers and several more are in development that may increase the options in our toolbox. Current and future management approaches will be discussed in terms of their potential to reduce cat numbers and aid in bird conservation.

Past, Present, and Future: A Synthesis of Big Data Ornithology
Lepczyk, Christopher - Auburn University; Frank La Sorte - Cornell University; Jessica Burnett - Nebraska Cooperative Fish and Wildlife Research Unit, School of Natural Resources, University of Nebraska-Lincoln

The past decade has witnessed a tipping point in the types of large databases available for analysis and the computing power with which to analyze them, such that we have now moved into an era of “Big Data.” Ornithology, like many other scientific disciplines, has been increasingly involved in Big Data, which has advanced research and application in new and exciting ways. However, a synthesis on what Big Data has revealed in avian ecology, its current position in the field, and where it may move to in the future has been lacking. As the talks across this symposium highlight, Big Data analyses are occurring at a variety of spatial and temporal scales, on numerous taxa, and using a variety of datasets. In particular, Big Data has allowed us to advance our understanding of avian ecology in exciting and transformative ways. Furthermore, this understanding can aid in conservation and management decisions. Ultimately, we will address what Big Data means for avian ecology and where it is going.

Fire Escapes, Convenience Stores, and 5-star Hotels: Comparing condition of migrant communities to identify stopover site conservation priorities
Leppold, Adrienne - Maine Department of Inland Fisheries and Wildlife; Jennifer McCabe - University of Wisconsin - Madison; Rebecca Holberton - University of Maine; Brian Olsen - The University of Maine

Migration is one of the most challenging phases of many birds’ annual cycle. Suitable stopover habitat is critical to the success of migrant individuals. This is especially important along major migration corridors, such as coastlines, where concentrations of migrants are well documented. Classifying the quality of stopover sites for migrants is, therefore, important for prioritizing conservation actions in these regions. In this study, we used variation in fat content and size-corrected body mass of fall migrants in the Gulf of Maine to understand migration patterns and the relative importance of individual stopover sites. We investigated differences in these condition metrics as a function of species-specific migration distance, foraging guild, age, and location captured (offshore vs. on the mainland). Island location and age were important factors explaining differences in both condition indices. While immatures carried slightly less fat and had lower size-corrected mass than adults, the strongest relationship was between location and size corrected mass. Island individuals had significantly lower masses than individuals caught on the mainland. We also showed that birds at all

sites, and of all ages, significantly increased in mass throughout the capture day, providing evidence of functional stopover habitat. Our finding that birds offshore are in poorer body condition than those on the mainland suggests overwater movements are more energetically expensive. As a result, alteration or loss of island stopover sites may be more likely to result in individual fitness or population level consequences.

Tracking urban bird community change within a socioecological framework in Phoenix, Arizona

Lerman, Susannah - USDA Forest Service; Paige Warren - University of Massachusetts; Riley Burnette - Arizona State University; Heather Bateman - Arizona State University; Kelli Larson - Arizona State University

Studies have characterized urbanization as a key threat to bird diversity and conversely, cities as places that support surprisingly high levels of species richness, especially in suburbia. This conundrum is partially due to the inherent variation found within landscape designs, and has implications for human interactions with nearby nature. We tested whether patterns detected in 2006 persisted in 2011, namely that native bird communities increased in abundance in neighborhoods landscaped with native plants and with higher socioeconomic status, and that households expressed higher satisfaction with local birds in neighborhoods which supported higher native richness. We connected landscape designs, neighborhood demographics (US Census), and human perceptions of bird variety with the bird community in 39 Phoenix, AZ neighborhoods from 2006 and 2011. The majority of desert specialists increased their abundance in neighborhoods with desert landscaping while invasive and generalist species were positively associated with neighborhoods landscaped with exotic plants. Overall, however, bird richness and occupancy decreased between the two time periods, particularly for desert specialists. Socioeconomic patterns held between the two time periods; desert bird communities increased in higher income neighborhoods whilst exotic and generalist species were closely aligned with lower income neighborhoods. Although general satisfaction patterns remained stable, in 2011 we recorded a 10% decrease in overall satisfaction with the local birds. Our study provides longitudinal insight into potential factors driving species turnover, persistence and loss in urban areas. These details can help inform the management of cities that aim to promote native bird communities and human well-being.

Estimating Density of Northern Spotted Owls in a Dynamic Landscape

Lesmeister, Damon - USDA Forest Service, Pacific Northwest Research Station; Elizabeth Glenn - US Fish and Wildlife Service, Oregon Fish and Wildlife Office; Raymond Davis - USDA Forest Service, Pacific Northwest Region

Successful conservation and management of at-risk populations depends on understanding the species' distribution, landscape-specific density, and the ability to monitor changes through time. We developed a distribution model for Northern Spotted Owls (*Strix occidentalis caurina*) that incorporates both habitat suitability and probability of territory occupancy while accounting for competition with Barred Owls (*Strix varia*). We developed range-wide habitat suitability maps for two time periods (1993 and 2012) for Northern Spotted Owls that accounted for regional differences in habitat use and home range size. We used these maps to assess habitat change and estimate the number of potential territories based available habitat for both time periods at a long-term study area. We adjusted the number of potential territories using known occupancy rates to estimate densities for both time periods. We validated our range-wide habitat suitability model using independent survey data. Habitat maps performed well in predicting areas suitable for Northern Spotted Owls. On the demographic

study area, the amount of habitat declined 17.2% between 1993 and 2012, while the habitat-based carrying capacity declined from 150 to 146 territories. Estimated number of occupied territories declined from 94 to 57. Conservation planning and management of Northern Spotted Owls is often limited by the expense of surveying large landscapes. Our approach provides an alternative to surveys for informing conservation efforts. Our modeling approach provided accurate estimates for both the maximum number of possible territories and the estimated number of occupied territories.

Spatial and temporal factors influencing shrubland-bird habitat use on the wintering grounds in the southwestern U.S.

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Short-distance migrants breeding in shrubland ecosystems in the Intermountain West spend more than half of their annual cycle in migration or on the wintering grounds. While factors influencing habitat use for these species on the breeding grounds have been well documented, basic knowledge of their wintering ecology, a potentially critical period, is sparse. Because many shrubland bird populations are declining and habitat conditions on the breeding grounds seem not to explain population declines, our objective was to identify factors influencing habitat use of wintering shrubland birds. Because food availability for wintering birds varies both spatially and temporally across large spatial extents and is influenced by highly unpredictable monsoon rainfall, we predicted that monsoon rainfall patterns influence where shrubland birds winter. We surveyed birds during winters of 2005/06, 2006/07, and 2007/08 on 142 1-km transects randomly placed between southeastern California and southwestern New Mexico. We used count-based models, adjusted for imperfect detection, and an information-theoretic approach to determine which factors best predicted densities of wintering birds. Preliminary results indicated that the distribution of Brewer's Sparrows (*Spizella breweri*) was highly influenced by monsoon rainfall whereas the distribution of Sagebrush Sparrows (*Artemisiospiza nevadensis*) was not. Preliminary analyses also revealed differences in habitat use between breeding and wintering grounds for some but not all species. The results of our study will provide important information to develop conservation strategies across the annual cycle of declining shrubland species.

Phenotypic manipulation of male barn swallows: A social network experiment

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Morphological and physiological traits are often predictive of reproductive performance, and researchers make inferences about how behavior operates to shape those relationships. However, it is rare that we understand exactly how morphological and physiological traits translate to reproductive success, as this involves detailed information about individual behavior, and its physiological basis, that can be difficult to obtain. We deployed proximity loggers on breeding barn swallows (*Hirundo rustica* erythrogaster) to test how experimentally manipulating male ventral plumage color affects social network position, reproductive

success, and aspects of physiology including testosterone, corticosterone, oxidative stress, and antioxidants. First clutch eggs were collected for a record of paternity pre-manipulation and adult swallows (n=55) were tagged with Encounternet proximity loggers. Tags recorded close proximity interactions for two days both before and after half of the males in the network had their ventral plumage experimentally darkened. Physiological data were collected pre- and post-manipulation for nearly all individuals. We have previously shown that ventral color, a known sexual signal in North American barn swallows, correlates with male interactivity with females. Our experimental data show that a male's interactivity with females changed proportionally to his change in plumage color: darkened males experienced both an increase in interactions with their social mates and with females outside of the pair bond. Interestingly, changes in male-male interactions and changes in physiology were not directly related to the phenotype manipulation.

Changes in Gut Microbiota of Migratory Passerines during Stopover along the Northern Gulf Coast

Lewis, William - University of Southern Mississippi; Frank Moore - University of Southern Mississippi; Shiao Wang - University of Southern Mississippi

The gut microbiota is a large and diverse community of microorganisms which provides many beneficial functions to the animal hosts; however any change in the host's external or internal environment can affect microbiota composition. Migratory passerines arriving at stopover sites show highly variable microbiota, which is likely reflective of the widely different habitats and foods utilized by migrants prior to arrival. If the previous environmental conditions led to the observed initial variability, then the microbiota of birds should become more similar throughout stopover when migrants are in the same habitat and able to utilize similar resources. During spring 2014, migratory Swainson's Thrushes, Wood Thrushes, and Gray Catbirds were captured at a stopover site in southwest Louisiana both upon arrival after crossing the Gulf of Mexico and at least one day later during stopover. Fecal samples were collected and bacterial communities were analyzed using next-generation sequencing. The microbiota of the majority of birds showed distinct shifts in community composition and became more similar during stopover, with birds stopping at the site for longer periods showing more pronounced changes in their microbiota. Individual experiences at the site likely influenced the observed shifts in microbiota composition, as changes in microbiota seemed to be dependent upon a bird's ability to gain mass during stopover. Overall these results are consistent with the hypothesis that environmental factors heavily influence the gut microbiota of passerines, though the influence of similar anatomical rebuilding of the gut environment during stopover may have also played a role.

Lineage age explains speciation rates in hummingbirds

Lim, Marisa - Stony Brook University; Danny Rojas - University of Aveiro; Liliana Davalos - Stony Brook University; Catherine Graham - Stony Brook University

Explaining how large disparities in species diversity and distribution are generated is a central challenge for evolutionary ecologists. The hummingbird family (Trochilidae) comprises 338 species, with major lineages varying in species richness, speciation rate, geography, and morphology. We investigate how lineage age, range area, climatic niche space occupation, and morphological traits influence their speciation rate. From findings in the diversification analysis literature, we expected speciation rates to be: 1) Slower in older versus younger lineages (e.g., as niche space fills over time), 2) Faster in lineages with larger versus smaller geographic ranges (e.g., as more barriers form resulting in

divergence by isolation), and 3) Faster in lineages with higher versus lower rates of change in climatic niche occupation or morphological evolution (e.g., as novel conditions arise leading to divergence by niche partitioning). To test these predictions, we used newly developed methods to calculate rates of speciation and rates of evolution for climate niche (volume, marginality, breadth, position) and morphological (body mass, exposed culmen length) variables for 265 hummingbird species. We also quantified lineage age and species range area. We then used Bayesian phylogenetic mixed models to test whether speciation rate is predicted by these variables. Contrary to expectations based on biogeographic models of diversification, speciation rate and range area are not correlated. Instead, our results show that a negative relationship with lineage age best predicts speciation rate. These results suggest that hummingbird speciation rates depend on time not ecology or morphology at the phylogenetic scale of the entire hummingbird family.

Analyzing BBS data: Hierarchical models and model selection
Link, William - USGS Patuxent Wildlife Research Center; John Sauer - US Geological Survey; Daniel Niven - USGS Patuxent Wildlife Research Center

The BBS dataset is highly structured, temporally and geographically. For the >400 species surveyed, sample sizes, magnitudes of counts, and data quality vary substantially. Observer effects on counts are evident, with variation within and among observers exhibiting temporal patterns of change. Bayesian hierarchical models have thus been a boon to analysis of BBS data. Numerical fitting has been facilitated by the wide availability and accessibility of software for Markov chain simulation. It is easy to propose and fit many models; perhaps too easy. We consider it important to consider alternative models for population trajectories and effects of changing phenology on counts, and to further elaborate effects of observer aging. But while we need models of sufficient complexity to adequately describe population change, it is also important that models not be larded with extraneous factors which confuse interpretation of results and decrease precision. Selection and evaluation of hierarchical models is challenging; simple tools have not been developed. In this talk we describe highly computational cross-validation techniques and promising short-cut alternatives based on the Watanabe-Akaike information criterion (WAIC). Since 2008, the BBS website has provided data analyses based on a single model, an overdispersed Poisson regression model. The model is flexible and produces reliable summaries for distinct species at various geographic scales. We propose replacing this omnibus model with an omnibus model set, with model selection based on WAIC.

Climate Change Correlates of Breeding Phenology and Reproductive Performance in Flammulated Owls
Linkhart, Brian - Colorado College

A growing body of evidence has linked changes in climate to alterations in phenology, distribution, and demographic performance of birds across taxa and geographic regions. While the past decade has witnessed an increased focus on effects of climate change on raptors throughout the world, relatively few studies have focused on raptors compared to other taxa in North America, and how climate change may affect their demographic performance. I examined the long-term patterns in breeding phenology and reproductive performance of Flammulated Owls (*Psiloscops flammeolus*) in central Colorado from 1981-2015, in an attempt to elucidate the relationship between breeding parameters and climate change. Data from 180 nests revealed that Julian dates of incubation onset, which decreased by 0.15 d/yr, were negatively correlated with mean temperature for the month of May, a

time period coinciding with the onset of territory defense, courtship, and incubation in the owls. Number of fledglings/brood also was negatively correlated with onset of incubation, and with January-to-June precipitation, which declined by nearly half over the study period. The mean number of fledglings/brood declined by more than 35% in years when January-to-June precipitation fell below 10 cm (2.1 + 0.1 (SE) fledglings/brood vs 1.3 + 0.3 fledglings/brood), and this decline in productivity was associated with increased nest predation by Red Squirrels (*Tamiasciurus hudsonicus*). No changes in density of breeding pairs were detected. Further studies are needed to more fully understand how climate change may affect demographic parameters of raptors and may mediate complex interactions across trophic levels in ecosystems.

Differential aggression between hybridizing, sex-role reversed species
Lipshutz, Sara - Tulane University; Elizabeth Derryberry - Tulane University

Aggression is a complex behavioral trait important for the acquisition and defense of mates and resources. Sex-role reversed systems in species such as jacanas, where females compete for mates, are typically examined to explore competition from a female perspective. Previous studies found that female jacanas are behaviorally dominant to males in aggressive interactions. We compared aggression in females of two hybridizing species, Northern Jacanas (*Jacana spinosa*) and Wattled Jacanas (*J. jacana*) in Panama. Using the first aggression assay in a shorebird, we simulated territorial intrusions with conspecific female mounts and vocalizations. We measured number of pecks, flyovers, swoops, threats, and vocalizations directed at the mount, as well as distance to the mount. We found that *J. spinosa* females responded more aggressively than *J. jacana* females. Unexpectedly, males also responded, and *J. spinosa* males were more aggressive than *J. jacana* males. Furthermore, *J. spinosa* males responded more strongly than female counterparts, but there were no differences between *J. jacana* males and females. Male jacanas are the first to respond to intruders on a territory, potentially explaining why females were less aggressive toward the mounts. Previous work in the hybrid zone demonstrated asymmetric introgression – hybrids share mtDNA haplotypes with *J. spinosa*, but not *J. jacana*. Higher aggression could allow *J. spinosa* females to outcompete *J. jacana* females for territories where they come into contact, but it is unclear how higher male aggression could mediate hybridization. Future work will test the hypothesis that female competition drives asymmetrical introgression in the hybrid zone.

Using targeted-sequence approaches to test for positive selection in reproductive proteins of Agelaius blackbirds
Liu, Irene - Duke University; Matthew Johnson - Chicago Botanic Garden; Steve Nowicki - Duke University

Multiple mating by females can intensify selection on male traits, such as seminal fluid proteins (Sfps), that maximize sperm competitive ability. Though these proteins have been documented in many species, they remain poorly characterized in birds, a taxon known for its polyandry but only recently studied at the molecular level. We investigated the link between mating system and Sfp evolution in three Agelaius blackbird species to understand how differences in sexual selection shape DNA sequence evolution. First, we identified each species' genetic mating system by empirically measuring extra-pair paternity (EPP). On the basis of behavior and morphology, we predicted variation in sperm competition but found no interspecific difference in the percentage of extra-pair young. Second, because Sfps may be under stronger selection than non-reproductive proteins regardless of mating system, we sequenced

and annotated the transcriptomes of two reproductive and two control tissues to produce the first catalog of seminal fluid proteins in birds. We identified 195 functionally significant candidate genes that are over-expressed in red-winged blackbird reproductive tissues, and we designed targeted-sequencing baits to capture these and 88 control genes identified from the Flock of Genomes data. Characterizing patterns of molecular evolution (positive selection or correlated evolutionary rates) in reproductive proteins will help determine whether avian Sfps evolve similarly to mammals and insects. Alternatively, the slower tempo of molecular evolution in birds may contribute to a unique regime of relaxed post-mating, pre-zygotic selection.

Peregrine Falcon Migration in Cabo de San Antonio, Pinar del Rio province Cuba
Llanes Sosa, Alejandro - Instituto de Ecología y Sistemática, Ministerio de Ciencia de Investigaciones Tecnología y Medio Ambiente; Arturo Hernadez Marrero - Instituto de Ecologia y Sistematica; Alina Perez Hernández - Centro de Servicios Ambientales ECOVIDA, Pinar del Rio; Jaakko J. Finne - Birds Studies Canada; Anjela Blanco - Birds Studies Canada

We present the data collected during 3 years (2008, 2009 and 2009), banding Peregrine Falcon (*Falco peregrinus*) in Cabo de San Antonio, Guanahacabibes peninsula, the western tip of Cuba. This place constitutes a stopover site in the migration route toward South America of many Nearctic migrants. We captured and banding 32 individuals of *F. peregrinus* using mist nets with Rock Pigeons as bait. Birds were banded Canadian Wildlife Service bands. We measured wing chord, tail, bill from cera and weight for all the birds captured to determine subspecies. All birds were juvenile of. *F. peregrinus tundrius*. We also recaptured one individuals previously banded in Ranquin Inlet, Nunavut Territories, Canada. This record constitutes a link between Canada and Cuban territories. We also present count data of this species from the project “Monitoring the raptor migration in Cabo de San Antonio” between 2012 -2015. We made counts from 6:00 to 18:00 and registered all birds that were passing from the west to the east over, north or south to the observer’s site during all fall migration between July 15 to November 15. Count data were compared to wind speed and direction, cloud cover and air temperature to examine the relationship with peregrine abundance.

Patterns of seasonal movement and space use among Mangrove Cuckoos
Lloyd, John - Vermont Center for Ecostudies

Mangrove Cuckoo (*Coccyzus minor*) is a poorly known species that reaches the northern edge of its range in the mangrove forests of southern Florida. It is of conservation concern regionally due to its narrow distribution and small population size. However, because the species’ natural history is mostly undescribed, specific threats to the population and conservation measures to address them have never been identified. I used radio-telemetry to follow 32 individual Mangrove Cuckoos in southwest Florida during 2012-2015 to provide basic information on natural history that could inform future conservation efforts. Mangrove Cuckoos were year-round residents in the study area but exhibited complex patterns of seasonal movement, apparently occupying multiple home ranges over the course of a year and showing little site fidelity among years. At all times of the year Mangrove Cuckoos used exceptionally large home ranges, often in excess of 40 ha, and showed a propensity to wander widely. Home ranges consisted of a variety of mangrove forest types and occasionally incorporated small patches of tropical hardwood trees. I never detected Mangrove Cuckoos in any other vegetation type. They did not avoid hard, anthropogenic edges, and many home ranges abutted residential and commercial developments. This first look at movement

patterns and the use of space by Mangrove Cuckoos suggests that conservation of the North American population should focus on protecting large patches of mangrove forest, even if those patches occur within a matrix of developed land.

Conservation Action Plan for Bicknell's Thrush: outcomes and next actions in both breeding and wintering grounds.
Lloyd, John - Vermont Center for Ecostudies; **Eduardo Inigo-Elias** - Cornell Lab of Ornithology; Kent McFarland - Vermont Center for Ecostudies; Christopher Rimmer - Vermont Center for Ecostudies; Juan Carlos Martinez-Sanchez - Vermont Center for Ecostudies; Yves Aubry - Environment and Climate change Canada

In 2010 a Conservation Action Plan for Bicknell's Thrush was produced after 20 years of research into the ecology and conservation of the species and many international meetings and workshops. This effort was spearheaded by the International Bicknell's Thrush Conservation Group (IBTCG), which is composed of partners from multiple nations in both breeding and non-breeding grounds. The goals of the plan were to increase the global population of Bicknell's Thrush (*Catharus bicknelli*) by 25% by 2060 and prevent any further decline in breeding distribution. After 5 years and remarkable efforts on both the breeding and non-breeding grounds, the Plan has achieved some success and encountered many problems in implementation. In 2016, an updated and revised Plan will be released by the IBTCG. To succeed, it will require unparalleled levels of coordination among partners, especially on Hispaniola, where most Bicknell's Thrush winter and we have experience the highest deforestation rates recently in the Caribbean. In particular, four major areas need special consideration: 1) foster institutional and individual capacities for partners in the non-breeding grounds to conduct scientifically defensible conservation projects; 2) reduce habitat loss and restore degraded native forests on which the species depends; 3) implement at a local scale climate-change mitigation projects; and 4) reduce mortality rates during migration and predation on the wintering grounds by feral and invasive species.

Organization of College-Level Research Groups for the Long-Term Study of Birds
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The participation of college groups have made significant contributions to the study of birds. However, once the academic period has finished or the program of study has been completed, students leave the project—and often the academic field—at an elevated rate. This paper is motivated by one question: How can we integrate research teams with college students for long-term projects? We seek to take advantage of the 'captive' college student population to develop an ornithological research teams aimed at long-term projects. Our main activities are: (a) The formulation of collective projects, (b) Carrying out field work,(c) Review and discussion of scientific papers, (d) The curation of field data and metadata, (e) Obtaining field equipment and financial resources, (f) Training and recruitment of new students, and (g) Active participation in education activities. Based on our experience, we propose a six-step mechanism to integrate effective work teams: (1) Selection and recruitment of new members,(2) Induction and training of recruits, (3) Formulation of collective mid- to long-term projects, (4) Writing scientific publications, reports, and dissemination of results, (5) Obtaining academic credits to reward student participation, (6) Institutionalization of project activities. The research potential of these work teams is

enormous, with implications for our understanding local ecological processes, long-term research, training of future ornithologists, and education activities for the general public. Organized college-level work teams offer a possibility to effectively sustain research and education over many years, activities otherwise unfeasible.

Within-day improvement in a behavioural display: wild birds 'warm up'
Logue, David - University of Lethbridge; Hannes Schraft - UC Davis; Orlando Medina - US Fish and Wildlife Service; Daniel Pereira - Universidad del Valle; Jesse McClure - University of Massachusetts Medical School

Motor performance describes the vigour or skill required to perform a display. It is a behaviourally salient variable in birdsong and other animal displays, but little is known about natural variation in performance over short time scales. A novel parameter called frequency excursion (FEX) quantifies birdsong performance by estimating frequency modulation per unit time. We measured FEX in a large sample of recordings from free-living male Adelaide's warblers (*Setophaga adelaidae*). Our objectives were to quantify natural variation in performance, and test the hypotheses that performance (1) improves as a function of recent practice, (2) decreases over consecutive repetitions of a single song-type, (3) improves with rest between songs, and (4) varies by singing mode. We found significant variation in performance among individuals and song-types. Consecutive repetition of a song-type, rest between songs, and singing mode did not strongly affect performance. Performance consistently increased with song order, however, indicating that males warm up during morning singing. This is the first demonstration of a warm up effect in an animal display. This finding may explain the prevalence of intense dawn singing in birds (the dawn chorus), if rivals engage in an arms race to warm up.

Vocal errors and inferences about the song learning process in songbirds.
Lohr, Bernard - University of Maryland Baltimore County; Samuel Hulse - UMBC

Grasshopper Sparrows learn their song through improvisation or invention rather than through imitation, as is the case in most songbirds studied to date. We examined several cases of vocal errors produced by Grasshopper Sparrows (*Ammodramus savannarum*) that provide insights into the song learning process. In one example a bird of the critically endangered Florida subspecies produced a song that was intermediate between conspecific song and that of another emberizid in its habitat, the Bachman's Sparrow (*Peuacea aestivalis*). In a second example, a male of the Eastern subspecies in Maryland produced an atypical song structurally very distinct from normal adult song, though its duration and bandwidth were species-typical. The song resembled some elements of vocalizations produced during the plastic song phase of vocal motor development. These examples shed light on the types of learning errors that can occur under natural circumstances, and that may contribute to Allee effects in a species with small and declining populations. We tested the impact of such learning errors on song function in the Maryland example by performing a song playback test with the atypical song. Results suggest that natural song learning errors may be more detrimental in intersexual contexts than in intrasexual contexts.

Age-related patterns of sexual dimorphism in Tree Swallows
Lombardo, Michael - Grand Valley State University; Nicole Lyon - Grand Valley State University; Patrick Thorpe - Grand Valley State University

Tree Swallows are common birds that feed on aerial insects and readily accept nest boxes for breeding. We used data collected from swallows that bred in nest boxes on the

GVSU campus during four consecutive breeding seasons between 1992-2015 to study age-related patterns of sexual dimorphism in mass, right wing length, and right tail fork length. Overall, males had longer wings and more deeply forked tails than did females but there was no significant difference between the sexes in mass. Repeated measures ANOVA revealed that across years (a) there were no significant differences in mass and right tail fork length for individuals of both sexes, and (b) there were no significant differences in right wing length for individual females. However, male right wing length increased as males aged across breeding years one-three, then decreased in breeding year four. These patterns of sexual dimorphism suggest that there are different causes of selection affecting wing and tail fork length in male and female Tree Swallows. Because there is no evidence for sex differences in flying behavior while foraging or migrating in Tree Swallows the longer wings and tail forks of males are likely related to male-male aerial competition for nest sites, mates, and the feathers for which males compete fiercely and use to line their nests.

Increased strength of Shiny and Brown-headed Cowbird eggshells prevents damage during laying

Lopez, Analia - Universidad de Buenos Aires; Vanina Fiorini - Faculty of Exact & Natural Sciences, University of Buenos Aires; Kevin Ellison - World Wildlife Fund; Stephanie Allers - Western Illinois University; Rob Porter - Western Illinois University; **Brian Peer** - Western Illinois University

Brood parasites lay eggs with shells that are thicker than expected, which resists host puncture-ejection. These strong eggshells may also benefit the parasite by resisting damage when (1) the parasitic egg is laid onto another egg from an elevated position, (2) when the parasitic egg has an egg land on it during host laying, and (3) when the egg is jostled while a host attacks the parasite during laying. We tested these three possibilities using the eggs of the parasitic Shiny Cowbird (*Molothrus bonariensis*) and its hosts the House Wren (*Troglodytes aedon*) and Chalk-browed Mockingbird (*Mimus saturninus*) in South America and the eggs of the parasitic Brown-headed Cowbird (*M. ater*) and its hosts the House Wren and Red-winged Blackbird (*Agelaius phoeniceus*) in North America. We experimentally dropped parasite eggs onto host eggs to simulate laying by the parasite, host eggs onto parasite eggs to simulate host laying, and stirred eggs in the nest to simulate the jostling that occurs when a host attacks the parasite during laying. In general, we found that small and large host eggs were significantly more likely to be damaged when struck by a parasitic egg compared to when a host egg struck the parasite egg. There was minimal damage to eggs during the jostling experiments. These findings indicate that thick-shelled cowbird eggs are resistant to damage when laid from an elevated position and that these eggs damage host eggs in the process of being laid.

Atmospheric, Temporal, and Demographic Factors Influence Exposure of Common Terns to Offshore Wind Energy Areas in the Western North Atlantic Ocean

Loring, Pamela - U.S. Fish and Wildlife Service, Division of Migratory Birds; Paul Sievert - University of Massachusetts; Curt Griffin - University of Massachusetts; Ramakrishna Janaswamy - Univ of Massachusetts; Hua Bai - University of Massachusetts; Peter Paton - Univ of Rhode Island

Individual-based tracking studies are critical for assessing potential effects of offshore wind energy facilities on target bird populations, particularly when inclement weather limits visibility and leads to elevated collision risks. In 2014, we attached digital VHF transmitters (1.2 g with a 163 d battery life) to 116 adult Common Terns (*Sterna hirundo*) from two major nesting colonies:

Monomoy Island, MA and Great Gull Island, NY. We tracked their fine-scale movements every 5 sec using twelve 12-m automated towers erected at strategically-placed coastal and offshore sites from Cape Cod, MA, to Long Island, NY. Post-breeding long-distance (>50 km) flights occurred predominately at night or during the early-morning hours. Adult females with failed nesting attempts undertook more frequent, long distance movements across the study area than adult males and successful breeders. After dispersing from breeding colonies, terns from Great Gull traveled significantly farther than terns from the Monomoy colony. Eastern Nantucket Sound was an important pre-migratory staging area for terns from both colonies. Up to 97% of tagged individuals from Monomoy and 58% from Great Gull were detected by towers on or near Cape Cod, MA for up to two months before emigrating from the study area from mid-July through early-September. We developed a logistic regression model to relate offshore movements of Common Terns to atmospheric covariates (i.e., wind speed, wind direction, barometric pressure, precipitation rate, and visibility) that could be used to assess potential collision risk with offshore wind turbines.

Boats, buoys, and beyond: extending coverage of nanotag tracking stations into offshore environments

Loring, Pamela - U.S. Fish and Wildlife Service, Division of Migratory Birds; Scott Johnston - U.S. Fish and Wildlife Service, Division of Migratory Birds; Caleb Spiegel - U.S. Fish and Wildlife Service, Division of Migratory Birds

Information on avian movements in offshore areas is important for marine spatial planning efforts, and new advances and coordination of nanotag tracking technology are expanding opportunities to track a variety of small-bodied taxa remotely. We discuss present and future efforts to site automated radio telemetry stations on a variety of offshore platforms, including various types of ships (e.g. research vessels, whale watching boats, passenger ferries, cruise and cargo ships), buoys, and offshore platforms. We will present an overview of various equipment specifications and modifications for offshore environments, and discuss ways that information collected by present studies on federally endangered Roseate Terns (*Sterna dougallii*), and federally-threatened Piping Plovers (*Charadrius melodus*) and Red Knots (*Calidris canutus*) contributes to siting and monitoring offshore wind energy areas along the U.S. Atlantic Outer Continental Shelf.

The State of the Science on Cat Predation of Birds

Loss, Scott - Oklahoma State University, Department of Natural Resource Ecology and Management

Apart from global climate change and habitat loss, predation by free-ranging domestic cats is the single greatest source of human-caused bird mortality in North America. Since the 2013 U.S. and Canadian studies that reached this starling conclusion, there has been a flurry of research, policy, and management attention—as well as substantial public interest—directed at this controversial anthropogenic issue. I will review the state of the science on cat predation on birds with a focus on key findings since 2013 that are directly relevant to bird conservation in practice. I will also outline future research directions that will help clarify how cat predation affects avian populations, information that is crucial for efficiently and successfully implementing conservation management. For example, further research is needed to assess variation in predation vulnerability among different bird species, age classes, seasons, and regions. Estimates of cat population abundance, especially for feral and semi-feral cats, which cause the greatest bird mortality, are needed to help prioritize cat management and bird conservation activities. Collaboration between conservation scientists and resource

practitioners at all stages of research will be crucial to bridging the research-implementation gap for this complicated conservation problem. Furthermore, engaging citizen scientists will not only help address large-scale research questions that inform on-the-ground conservation, but will also be crucial to engendering public support and trust for a highly polarized anthropogenic issue.

Beyond the Treaty: Bird Conservation in Light of New Anthropogenic Threats
Loss, Scott - Oklahoma State University, Department of Natural Resource Ecology and Management

The international treaties launched 100 years ago to conserve, protect, and manage migratory birds have been immensely successful in reducing the unregulated harvest of avian species. However, a large and growing variety of human activities are causing a new type of incidental harvest that affects bird species from the most common to the most critically endangered. Most significant among these threats are global climate change and habitat loss, threats that act from landscape to global scales to determine the amount of inhabitable space for birds. Numerous other human-related threats directly kill birds and are likely to strongly limit bird populations. For example, birds are killed by collisions with manmade structures (buildings, towers, wind turbines, etc.), poisoning by agricultural, industrial, and household chemicals, predation by domestic pets, among many other mortality sources. In concert with escalating climate change and habitat loss, many of these mortality sources are increasing as human populations and associated recreational, commercial, and industrial activities expand. Successful conservation of birds in light of these new threats will require not only managing critically endangered species but also keeping common species common. Policies such as the U.S. Migratory Bird Treaty Act could continue to provide an important trigger for preventing and managing the incidental take of a wide variety of birds, including still-common species. Cooperation and collaboration among scientists, policymakers, and citizens will be crucial to documenting, understanding, and successfully reducing the impacts of these new human-caused threats in the next 100 years.

Is hatching asynchrony adaptive? Latitudinal gradients in breeding behavior of Burrowing Owls.
Lundblad, Carl - Idaho Cooperative Fish and Wildlife Research Unit; Courtney Conway - U.S. Geological Survey, Idaho Cooperative Fish & Wildlife Research Unit

Many birds begin incubation prior to clutch completion resulting in asynchronous hatching, size hierarchies within broods, and frequent death of the youngest offspring. Over 20 hypotheses have been proposed to explain these behaviors, and many of these hypotheses predict latitudinal variation in one or more of the following parameters: the timing of the onset of incubation, the degree of asynchrony within clutches, or the frequency of hatching failure. However, these predictions have never been tested along a latitudinal gradient within a single species. We placed motion-activated video cameras inside Burrowing Owl nest boxes in southeastern California, north-central Utah, and northeastern Oregon and quantified latitudinal variation in breeding behavior, incubation, and hatching patterns. Incubation typically began with partial incubation, but we estimated the onset of full incubation by quantifying both the absolute number and proportion of viable eggs that hatched during the first 24 hours of hatching. We used the average time elapsed between the hatching of subsequent eggs in a clutch as a measure of asynchrony for each clutch. Both measures of the onset of incubation were positively correlated with latitude: the absolute number of eggs that hatched during the first 24 hours ($R=0.48$, $P=0.049$) and the proportion of the clutch that hatched during the first 24 hours

(R=0.29, P=0.167). The time elapsed between hatching of eggs in a clutch (R=-0.59, P=0.022) and the proportion of eggs that failed to hatch (R=-0.33, P=0.128) were negatively correlated with latitude. Collectively, These results suggest limits to egg viability may promote early incubation.

Comparison of call types between subspecies of Marsh Wren (*Citothorus palustris*) suggests variation in behavior, not acoustics

Luttrell, Sarah - University of Maryland Baltimore County; Bernard Lohr - University of Maryland Baltimore County

Calls serve a variety of important functions in bird communication, and cases such as alarm calls or agonistic calls likely play an important role in the immediate survival and social behavior of an individual. Call structure and function may be subject to multiple selection pressures including selection for intraspecific recognition, natural selection via adaptations to various acoustic environments, or acoustic constraints based on physiological or mechanical limits. We studied calling behavior in the Marsh Wren (*Cistothorus palustris*), a highly vocal, gregarious songbird with many subspecies endemic to both freshwater and tidal wetlands. We have identified six distinct call types in five eastern subspecies of the Marsh Wren (both freshwater and tidal endemics), described the behavioral context of each call type, and measured several acoustic parameters including: duration, frequency, note length, and note spacing. Although the acoustic parameters of each call type are similar among subspecies, we found different probabilities of occurrence for several call types among the five subspecies. Future work will examine additional acoustic properties of these calls to determine whether more subtle differences exist in call structure among subspecies. Variation in the probability of occurrence of certain call types in the absence of marked differences in acoustic properties or behavioral contexts could be indicative of differences in social behavior among subspecies.

Autumn migration ecology and biogeography of Red Knots at the Altamaha River Delta, Georgia, USA

Lyons, James - USGS Patuxent Wildlife Research Center; Tim Keyes - Georgia DNR; Bradford Winn - Manomet; Kevin Kalasz - Delaware DFW

Effective conservation and recovery of Red Knots (*C.c. rufa*) will require knowledge of population structure, abundance, and distribution throughout the annual cycle. We conducted a stopover population and biogeographic assessment of knots at the Altamaha River Delta, an important stopover area in Georgia. We estimated autumn stopover population size and stopover duration using mark-resight data and we inferred wintering regions for this stopover population using two types of data: stable isotope ratio of carbon and nitrogen in flight feathers, and 2) observations (captures and sightings) during winter from across the hemisphere. We made observations of marked individuals over 14 weeks from early August to early November 2011 and detected 814 individual birds. We used the Jolly-Seber mark-recapture model and estimated the passage population in autumn 2011 at approximately 22,900 knots and we estimate that knots remained in the study area for approximately 31 days, long enough to complete flight-feather molt. We located at least one sighting or capture record for 659 of the 814 knots detected in our study, and isotope data for 175. Isotope signatures and winter records indicate that the vast majority, 82-96%, of the birds that stopped in Georgia would spend the winter in the southeastern U.S., Caribbean, or northern South America. Combining estimated stopover population size and estimated proportion that winters in northern region, we provide a preliminary estimate of 20,360 knots for the number of knots that winter in the southeastern U.S., Caribbean, and northern South America.

A Cooperative Approach to Automated Radio Telemetry - The Motus Wildlife Tracking System

Mackenzie, Stuart - Bird Studies Canada; Philip Taylor - Acadia University; John Brzustowski - Acadia University; Tara Crewe - Western University - Bird Studies Canada; Denis Lepage - Bird Studies Canada

Avian research using radio telemetry has traditionally been limited by the spatial range of tags and the number of animals that can realistically be tracked using manual tracking devices. The recent development of automated radio telemetry systems, in particular when used with digitally encoded tags, has allowed the simultaneous and continual tracking of multiple individuals at the scale of the entire receiver array. The Motus Wildlife Tracking System (Motus l www.motus.org) is a cooperative research platform for automated radio-telemetry studies. By using a single radio frequency across the Americas, Motus is considerably expanding the potential scope and scale of this technology by harnessing the collective power and coordinated effort of individual research projects over a broad spatial scale, thus optimizing often scarce project-specific resources. There are currently over 150 Motus collaborators working on more than 100 projects with a coordinated network of more than 350 automated receiving stations. The Motus database currently contains over 150 million detections from more than 7,000 animals of 72 species (86% birds) tracked throughout various stages of their annual cycle. Collaborators from various disciplines are working together to investigate complex problems such as how individual traits (e.g. age, physiological condition) influence migratory and stopover behaviours, patterns, and routes, and other aspects of movement ecology across a wide range of species, scales (local, regional, hemispheric), land, air, and seascapes. We will summarize results from across the network, with a focus on the broad range of applications for automated telemetry systems in avian ecology and conservation.

Urbanization and water availability drive avian community composition in the California Central Valley

MacLean, Sarah - UC Berkeley; Andrea Rios Dominguez - UC Berkeley; Steven Beissinger - UC Berkeley

Anthropogenic land-use change can cause homogenization and reduced richness of avian communities both directly through habitat conversion and indirectly through drivers of habitat structure, such as reduced water availability. We studied current and early 20th century bird community composition in the California Central Valley, a region that has undergone rapid urban development and severe drought. Our objectives were to (i) determine whether biotic homogenization is occurring in the valley, and (ii) test the relative contributions of urban cover, water availability, and vegetation structure to community richness and similarity. We paired historic (1911-1929) bird surveys conducted by Joseph Grinnell and colleagues with contemporary (2015-2016) resurveys of avian diversity at 45 sites. At each site we measured percent urban cover, water, trees, shrubs, herbaceous plants, and exotic plants. For contemporary bird surveys we calculated species richness at each site and two indices of community similarity (Jaccard and Bray-Curtis). For historic surveys we calculated only Jaccard similarity, as abundance data was not uniformly recorded. Mean Jaccard similarity among all sites increased significantly between the historic and contemporary surveys. However, similarity increased within both urban and nonurban sites, suggesting that homogenization in the Central Valley is driven by processes in addition to urbanization. Contemporary Bray-Curtis similarity was greater among urban than nonurban sites, and percent urban cover explained similarity between sites better than other habitat covariates tested. Contemporary species

richness was driven overwhelmingly by water availability, highlighting the danger of increased severity and frequency of drought driven by climate change.

History Leading to the Migratory Bird Treaty: The Battle for Birds, a Century of Bird Destruction Prior to 1916.
Madison, Mark - U.S. Fish and Wildlife Service

The 1916 Migratory Bird Treaty was a pivot point in the history of bird conservation. Prior to the Treaty, North American birds were at the mercy of the whims of individual states and the scattered bird reservations across the continent. This piecemeal construction of bird protection was insufficient in the face of increasing economic demands on birds in the late 19th century. This era saw tremendous pressure on migratory birds both for the market hunting for urban tables and the feather trade for women's fashion. The result of these demands and the resultant decline in migratory bird numbers gave birth to the early American Conservation Movement. The creation of the American Ornithologists Union in 1883 and the first Audubon Society in 1886 signaled an increasing interest in birds and their protection. Lobbying pushed forward some initial legislative victories including the AOU Model Law for state bird protection and the Lacey Act (1900) which banned market hunting at the federal level. However, the limits of this protection were made evident by the early 20th C. The Weeks-McLean Migratory Bird Act sought to ban spring shooting and market hunting while putting birds under federal protection, but 2 district courts soon ruled it unconstitutional. The extinction of the most ubiquitous avian species ever, the passenger pigeon, in 1914 highlighted the weakness of existing protections. The Migratory Bird Treaty was the turning point in what till then had been a losing battle for birds.

Baseline corticosterone levels do not reflect environmental quality and fitness simultaneously in a declining aerial insectivore: implications for conservation applications
Madliger, Christine - University of Windsor; Oliver Love - University of Windsor

Glucocorticoids (GCs) are often considered to be indicators of habitat quality, disturbance, and fitness in wild populations. However, few investigations have validated this supposition due to difficulties in measuring habitat variability, GC levels, and fitness metrics simultaneously in the wild. We used a quantitative assessment of two habitat types, a manipulation of foraging ability (feather-clipping), repeated baseline plasma GC measurements, and longitudinal reproductive monitoring to examine the link between habitat quality, GCs, and fitness in female tree swallows (*Tachycineta bicolor*). Control females nesting in inland-pasture habitats, which are characterized by higher early-season food resources, laid larger clutches while fledging an equal number of lower mass offspring compared to females in riparian-cropland habitats. However, females nesting in the two habitat types did not differ in baseline GC levels at the early- or late-breeding stage. While feather-clipping just prior to the onset of nestling rearing reduced provisioning rates across habitats, baseline GCs changed in a habitat-specific way with only individuals in inland-pasture habitats showing an increase. Despite this difference in GC levels, feather-clipping did not affect reproductive output, offspring mass, inter-annual survival, or reproductive success in the following year. Our results illustrate that: 1) environmental changes (e.g., foraging conditions) can impact behaviour, body condition, and current and future baseline GC levels without concomitant influences on fitness; 2) differences in fitness components between habitats may not be reflected in baseline GC levels. Overall, baseline GCs may not reflect environmental quality and fitness simultaneously, potentially limiting

their ecological and conservation applications.

Crude oil on feathers impairs takeoff performance and increases endurance flight energy costs in the Western Sandpiper (*Calidris mauri*)
Maggini, Ivan - Western University; Lisa Kennedy - Western University; Alexander Macmillan - Western University; Kyle Elliott - Western University; Robert MacCurdy - Massachussets Institute of Technology; Chris Pritsos - University of Nevada; Karen Dean - Abt Associates; **Christopher Guglielmo** - Western University

In the aftermath of major oil spills, such as the 2010 Deepwater Horizon (DWH) spill in the Gulf of Mexico heavily-oiled dead birds can be counted, but understanding the fitness costs of exposure to small amounts of crude oil is difficult and often ignored. We studied the effects of DWH oil applied to wing, tail and body feathers on the flight of the Western Sandpipers. Flight energetics and biomechanics were measured using quantitative magnetic resonance, high-speed video, and accelerometry. Takeoff speed was reduced by over 30 %, and takeoff angle was reduced in trace-oiled birds compared to controls. Oiled birds require twice the time to reach cruising speed, and fly lower to the ground, potentially making them more vulnerable to aerial predators. Wind tunnel flights showed that oiling increased flight energy costs by up to 45%. Oiled birds also had decreased flight ability and decreased voluntary duration of flight. Thus, migration would be slower and/or more costly for an oiled bird. Our results suggest that trace to moderate amounts of crude oil negatively affect takeoff and endurance flight performance with associated fitness consequences.

Comparing grassland bird population trends between native prairie and regional BBS – is it all about agriculture?
Mahony, Nancy - Environment and Climate Change Canada; Brenda Dale - Environment and Climate Change Canada

The steep, on-going decline of North American grassland bird populations is of conservation concern. Recent work using BBS trends suggests that declines are driven by breeding ground pesticide use or agricultural intensification. While the conversion of native grasslands to crops on the breeding grounds is undoubtedly a major factor, it is unclear whether factors in migration and wintering areas or recent changes in climate and weather patterns are contributing. One way to explore these varied influences is to compare population trends between areas that have become dominated by intensive agriculture over time with those that remain in native prairie condition. We compared grassland bird population trends from 1994-2016 between regional BBS routes and a large, intact native mixed-grass prairie site at the Suffield National Wildlife Area near Medicine Hat, Alberta. Suffield (459 km2) is one of the largest remaining intact mixed-grass prairie sites in Canada and is situated in a region dominated by cropped agriculture. We predict that if on-going agricultural intensification and pesticide use are driving trends, then BBS data will show steeper and more persistent declines compared to Suffield. Conversely, if trends are similar to BBS at Suffield, then other factors may be contributing. Using point count data collected at Suffield in 2015 and 2016 at the same locations as surveys done from 1994-2006 we develop trend estimates for Chestnut-collared Longspur, Baird's Sparrow, Grasshopper Sparrow, Savannah Sparrow, Western Meadowlark, Sprague's Pipit, and Vesper Sparrow. We then compare these trends to regional BBS trends for these species.

Morphological, genetic, and ecological variation in Stripe-headed Sparrows
Maley, James - Moore Laboratory of Zoology, Occidental College; Caitlyn Lara - Moore Lab of Zoology - Occidental College; Whitney Tsai - Moore Laboratory of Zoology, Occidental College; Amanda Zellmer McCormack - Occidental College; John McCormack - Moore Laboratory of Zoology, Occidental College

Biodiversity research in Mexico and Central America often focuses on organisms distributed in highland habitats across mountain ranges. However, there are many lowland organisms with populations isolated by these same mountain ranges. Stripe-headed Sparrows (*Peucaea ruficauda*) occur in three allopatric populations distributed from western Mexico down through Costa Rica. The subspecies found from Nayarit to Oaxaca (acuminata) has long been considered very distinct from all other populations. Another subspecies, isolated in the southern Isthmus of Tehuantepec (*lawrencii*), is considered subtly distinct from the birds further south. Three subspecies are found from Guatemala to Costa Rica, and subspecies limits within this continuous population are unclear. We measured 344 specimens from throughout the range and used sequence capture of ultraconserved elements to sequence over 4,000 loci for 15 Stripe-headed Sparrows and two outgroups. We analyzed 19 climate variables extracted from occurrence points downloaded from GBIF and conducted niche divergence tests between populations. The morphological results (without any plumage analyses) suggest two main groups: the birds in west Mexico and all others to the south. The genetic results are concordant with allopatric population differentiation, with three strongly supported clades. The phenotypically distinct birds in west Mexico are deeply divergent from the other two clades. We also found that birds in west Mexico have a significantly different niche from other populations. These results support revision of species limits within Stripe-headed Sparrows and further demonstrate that biogeographic barriers have been important to lowland as well as highland Mexican birds.

Stopover behavior of soaring birds is driven by weather
Mallon, Julie - University of Maryland

Stopovers are crucial periods of rest and refuel for avian migrants. Stopovers also serve other purposes for avian migrants, such as respite from inclement weather. Cold fronts produce weather conditions that inhibit migration of soaring birds because cold fronts prevent updrafts from forming, which soaring birds require. To determine if soaring birds use stopovers to avoid inclement weather, I investigated if changes in weather were associated with the timing of stopovers by turkey vultures (*Cathartes aura*), which are long distance, soaring migrants. I found that stopovers began when weather conditions en route changed from good soaring weather (i.e. high thermal updraft velocity and temperature) to inclement weather (i.e. high precipitation, relative humidity, and cloud cover; and low air pressure). Stopovers ended when good soaring weather conditions returned. This study shows that soaring migrants use stopovers when weather conditions hinder migration progress and resume migration when conditions promote the development of thermal updrafts.

Conserving our urban birds: Lessons from the OSU Yard Birds Project
Malpass, Jennifer - The Ohio State University; Amanda Rodewald - Cornell University; Stephen Matthews - The Ohio State University

Human activities can strongly influence urban birds, but the nature and extent of these effects remains poorly understood. We tested how anthropogenic subsidies and habitat modification affected nest survival and predator-prey interactions. During April-

August 2011-2014, we examined resource availability, and nest predators, and nest survival of two common birds (American robin, *Turdus migratorius*; and northern cardinal, *Cardinalis cardinalis*) in seven suburban neighborhoods in Columbus, Ohio, USA. Daily nest survival rates of both species were similar in residential yards and forest parks, but the nest predators differed markedly. Most notably, cats (*Felis catus*) were over 5x more likely to depredate nests in yards versus forest parks. Although two nest predators were positively associated with bird feeders, the relationship among birdfeeders, nest predators, and nest survival was complex. Robin nest survival declined with increasing number of bird feeders but only where American crows (*Corvus brachyrhynchos*) were most frequently detected on diurnal surveys. Cardinal nest survival was unrelated to either feeder availability or predator activity. We found that vegetation surrounding nests and features unique to the urban environment (i.e. roads, buildings, and anthropogenic foods) failed to predict nest survival for cardinals, and only height predicted survival of robin nests. We suggest that nest fate may not be strongly related to vegetation in systems with diverse predator communities, such as the suburban matrix, where no nest site is predictably safe for breeding birds.

The Energetic Importance of Apalachicola Bay Barrier Islands for Transient Birds during Spring Migration
Mancuso, Melanie - Delaware State University; Armando Aispuro - Delaware State University; Devin Mendez - Delaware State University; Christopher Heckscher - Delaware State University

In 2013, the Heckscher Lab at Delaware State University initiated the first empirical investigation of spring Nearctic-Neotropical migrant use of barrier islands in Apalachicola Bay, Florida. Many of these migrant species have experienced declining numbers in recent decades, and conserving stopover habitats is considered a research priority. For many of these birds, barrier islands are critical stopover habitats, providing them with a place to rest and refuel before continuing their northward migration. This study examines the energetic importance of two Gulf Coast barrier islands in the Apalachicola National Estuarine Research Reserve for transient birds during spring migration. Passive mist-netting was employed to capture migrant songbirds stopping over during spring migration from 2013-2016. Using an analysis of body mass, physical condition, and plasma metabolite concentrations of birds captured, I will provide information about the use of St. George and St. Vincent islands as it relates to transient birds. Understanding the energetic importance of these islands for migratory species will allow conservationists to better manage these vulnerable lands, especially as they are altered due to climate change and sea-level rise.

Egg crypsis within host nests by the parasitic Brown-headed Cowbird
Mandru, Michael - Western Illinois University; Brian Peer - Western Illinois University

Obligate avian brood parasitism is an alternative breeding strategy used by Brown-headed Cowbirds (*Molothrus ater*). Because brood parasitism is costly to host reproductive success, hosts often evolve defenses to parasitism, and in turn, brood parasites evolve adaptations to counter host defenses. Despite the benefits of egg ejection behavior, only 10% of cowbird hosts are considered “rejecter” species. One way in which brood parasites circumvent host egg rejection is by laying eggs that resemble the nest environment. Our research investigated whether cowbird eggs mimicked the visual and ultraviolet (UV) spectrum of eggs and nest linings of grassland hosts who accept cowbird eggs. Just Noticeable Differences (JNDs) were used to measure the differences that hosts perceive when comparing objects in the nest environment. This analysis

showed differences within the chromatic (color) and achromatic (brightness) spectra. Our results show that cowbird eggs do not mimic host eggs, but match the nest substrate as well or better than host eggs. Because Brown-headed Cowbirds are generalist brood parasites, it may be more beneficial to blend in with nest substrate than to directly match host eggs that vary significantly between host species. This nest blending may increase rejection errors by hosts. By replacing a more noticeable host egg with a less conspicuous cowbird egg that better matches the nest lining, parasitism by cowbirds may also decrease the likelihood of depredation.

City life and chickadees: effects of urbanization on reproductive success and dawn chorus behaviour in mountain chickadees (*Poecile gambeli*)
Marini, Kristen - Thompson Rivers University; Ken Otter - University of Northern British Columbia; Matthew Reudink - Thompson Rivers University

Worldwide urbanization causes large-scale changes in landscapes, reducing the availability of natural habitat, and resulting in some species living and breeding in urban landscapes. How a species fares in urban habitats is largely dependent on its life history, yet predicting the response of individual species to urbanization remains a challenge. Mountain chickadees (*Poecile gambeli*) are found in coniferous forests and residential areas, making them an ideal study species for examining the effects of urbanization. We monitored chickadees nesting in urban and rural habitats in Kamloops, BC, Canada to determine if the degree of urbanization was associated with variation in condition, clutch size, nestling growth rates, or dawn chorus output. We found that urban females weighed more and initiated clutches earlier than those in rural areas, but found no other differences in nesting success. Nestling feather growth rate increased with later first egg dates, and the magnitude of this increase was greater in urban habitats. Urban males had higher vocal output during the dawn chorus, with longer stretches of song. Our results indicate that pairs nesting in urban and rural habitats have similar reproductive success, and in fact urban nesting may be advantageous to both males and females, as early nesting and female body size are generally positively associated with reproductive success, and increased song output is an indicator of male quality. Contrary to our expectations, urban environments and the associated increased food may provide higher-quality habitat than surrounding natural areas in arid regions, such as the interior of British Columbia.

Ornithological studies using Coupled Human and Natural Systems in the Americas: summary and synthesis of opportunities and challenges
Martin, Kathy - University of British Columbia; Elsie Krebs - Science and Technology, Environment Canada; Lael Parrott - University of British Columbia, Okanagan Campus

By examining the positive and negative feedbacks between human activities and natural ecosystems, the coupled human and natural systems (CHANS) framework provides a lens to better understand, predict and manage human-impacted landscapes for both human interests and wildlife persistence. Avian ecology, despite the many bird-human linkages in ecosystems globally, has lagged behind other disciplines in adopting socio-ecological approaches to manage and conserve biodiversity. In this symposium, speakers introduce studies from the Arctic to the Andes that highlight the use of CHANS approaches involving scientific and traditional knowledge and citizen science data to examine the maintenance or restoration of human-bird linkages ranging from habitat degradation to sustainable resource use in urban, wetland, agricultural and forest ecosystems. We highlight potential future applications of this approach such as

developing effective strategies for recovery planning for Species at Risk, many of which occur on private lands or in highly developed landscapes. Understanding the relative strength of linkages within systems and how they vary over space and time is a key challenge to adopting CHANS approaches to manage trade-offs between resource use and biodiversity conservation. CHANS studies also require the integration of inter-disciplinary teams (social, ecological and economic sciences, policies and politicians), with methodologies that use both quantitative and qualitative parameters. The benefits of succeeding in this integration are the identification of the most effective management actions and the creation of more stable and responsive solutions for the conservation and management of human-altered and natural ecosystems.

Causes and considerations of variation in nestling growth strategies among temperate and tropical songbirds
Martin, Thomas - USGS - University of Montana

Nestling growth has been measured in hundreds of bird species, and measurements often include multiple traits, whereas analyses have focused almost solely on mass. Mass is problematic because it reflects both structural and fat components. Yet, the relative contribution of these two components to estimated growth rates is unknown. Moreover, estimates of growth have focused on K, which is a point estimate of maximum growth rate that can be a misleading indicator of overall growth rates, especially among latitudes. More importantly, prioritization of growth of body size versus other traits like wings and legs can vary among species and among latitudes, as a function of variation in parental investment and nest types. Relative size (proportion of adult size) of wings at fledging is influenced by length of the nestling period and the energy available to offspring. Energy available to offspring is influenced by parental investment (food delivery per offspring) and nest structure. Enclosed nests potentially provide thermoregulatory savings, and are used more frequently in tropical environments and by small species that are most sensitive to heat loss. Tropical species in enclosed nests produce longer wings at fledging than open-nesters for the same nestling period. Relative size of wings at fledging have strong influences on flight ability at fledging based on high speed videography. An experimental test shows that variation in flight ability strongly influences fledgling survival. Future work needs to separate fat vs structural size growth and consider growth over the entire nestling period and a broader suite of traits.

Effects of predation on the acquisition of flight ability during ontogeny in altricial birds
Martin, Thomas - USGS - University of Montana; Bret Tobalske - The University of Montana; **Ken Dial** - University of Montana

Locomotor development among species is remarkably diverse, and we sought to improve understanding of the selective pressures driving this diversification. Herein we demonstrate relationships between the onset of flight capacity at the end of the post-natal stage of development and the daily predation rate during this phase of ontogeny. Focusing on passerines, we studied 11 species in a temperate forest in Arizona, USA (average predation rate 0.028/day), and 15 species in a tropical forest in Malaysia (average predation rate 0.050/day). We measured flight capacity using video recordings (120 Hz) from drop tests, which we digitized and analyzed for rate of whole-body acceleration. In both study areas, species experiencing higher predation rates developed more rapidly and spent less time in the nestling phase. In the temperate forest, flight capacity at fledging was negatively related to predation rate. For example, gray-headed juncos, an open-cup nesting species, fledge 11 days post hatching (d.p.h) but can only support 24% of their body weight using

their wings, while mountain chickadees (cavity nesters) fledge at 20 d.p.h. and are fully capable of flight. In tropical forest, higher predation rates were associated with more rapid development of flight capacity, but most of the species (73%) could fly or support at least 81% of their body weight (w) at fledging, and all could support > 50% w. In sum, flight capacity was negatively related to predation rate in temperate forest and positively related in tropical forest. Comparing non-cavity nesting species, flight ability to improve avoidance of predation after fledglings leave the nest seems to be of greater priority in tropical forests. Overall, our results provide novel insight into the role of predation in promoting diversity of locomotor performance during ontogeny.

Evaluating the influence of an alarm-calling bird on the cohesion and habitat use of mixed species flocks in a neotropical rainforest

Martinez, Ari - San Francisco State University; Oliver Muellerklein - U.C. Berkeley; Vance Vredenburg - San Francisco State University

Predation risk influences decisions by prey to avoid predators and is hypothesized as one of the main drivers in the evolution of mixed-species societies. For example, birds that eavesdrop on alarm calling heterospecifics have been widely documented in many forest ecosystems. In these forests, alarm calling birds are thought to maintain flock cohesion and enable the flock to forage in high predation risk areas. To test this idea, we conducted a short-term removal experiment in a multispecies flock system. Using replicate flocks, we removed the alarm calling bird, *Thamnomanes ardesiacus*, the Dusky-throated Antshrike and quantified the percent occurrence of other flocking species, their foraging heights and the vegetation profile of the forest used by the flocks both before and after removal. We found that when alarm calling antshrikes were removed, the majority of main flock members decreased the percent of time they spend in the flock, and that flock microhabitat used changed to more safe habitat suggesting they were more vulnerable to predation risk. Interestingly, the flocks did not completely dissolve, and thus these data may also support a flock dilution effect as a secondary mechanism driving flock formation. Thus dual mechanisms may operate simultaneously (alarm calling birds and the dilution effect) to maintain flock cohesion and microhabitat use in lowland Amazonian rainforest birds.

Conservation practices induce dialect formation in the endangered Puerto Rican amazon (*Amazona vittata*)

Martinez, Tanya - University of Puerto Rico Mayaguez; David Logue - University of Lethbridge

Captive breeding is a conservation strategy that often results in behavioral changes in animals born and reared in captivity. Culturally transmitted behaviors, such as learned vocal signals, are particularly prone to change because captive animals have limited opportunities to learn behaviors from wild animals. Changes in learned behavior could affect the success of reintroduction programs once captive animals are released into the wild. We tested for the presence of vocal divergence of learned calls in the repertoires of geographically separated populations of Puerto Rican amazons (*Amazona vittata*). We recorded parrots from two captive and two wild populations representing the entire global population of this species. We also recorded parrots that had been translocated between populations and evaluated their vocal changes over time. Using Luscinia software, we compare calls from different populations using a dynamic time warping algorithm. Discriminant function analysis was used to test for differences between populations. We found evidence of acoustic differences in all four populations and considered these differences to be discrete enough to be classified as separate dialects. Captive parrots that had regular

vocal interaction with wild parrots produced calls that were similar to those produced by wild parrots. Parrots that had been translocated between populations were able to adopt the dialect of the foreign population. The emergence of dialects likely resulted from a combination of historical rearing practices, cultural drift, and geographic separation. We recommend that managers employ strategies that will facilitate parrots' abilities to acquire foreign vocal signals prior to release.

The Role of Zoological Park Collections in Pathogen Surveillance and Study
Martinsen, Ellen - Smithsonian Conservation Biology Institute; Heidi Brightman - Smithsonian Conservation Biology Institute; Timothy Walsh - National Zoological Park; Suzan Murray - Smithsonian Wildlife Health Program; Bruce Rideout - San Diego Zoo Institute for Conservation Research; A. Marm Kilpatrick - University of California at Santa Cruz; Robert Fleischer - Smithsonian Institution

Although host shifts play a large role in the emergence of infectious diseases, we still poorly understand which pathogens are able to switch hosts and why. Zoo collections present a unique opportunity to study pathogen host switching as they house exotic species that can act as sentinels. Here, we investigate characteristics of avian malaria parasites (genus Plasmodium) capable of infecting collection birds at two major zoos: National Zoo in Washington, D.C., and San Diego Zoo and Safari Park in California. We also assessed the parasites of thousands of wild birds at and around these zoos. Birds were PCR-screened for infection and infections sequenced and identified to lineage. We used a database of host-parasite records (MalAvi) to estimate native geographic and host range of each lineage. We document 28 native New World avian Plasmodium parasite lineages in wild birds at both zoos, with 13 in Old World host species. We also found four Old World Plasmodium lineages infecting Old and New World collection, and wild birds. Phylogenetic analyses revealed host switching parasite lineages widely distributed across the Plasmodium clade, indicating that parasites switch into novel hosts across large phylogenetic gaps. Host range and prevalence were associated with a parasite's ability to host switch. Repeated host switching by parasites makes them potential agents of infectious disease. Thus our findings are relevant to conservation of naïve bird populations and highlight the importance of zoological parks in surveillance of wildlife pathogens.

Endemism in the Pacific lowlands of Mexico: Phylogeography of the White-collared Seedeater (*Sporophila torqueola*)
Mason, Nicholas - Cornell University; Arturo Olvera-Vital - Universidad Nacional Autonoma de Mexico; Adolfo Navarro-Sigüenza - Universidad Nacional Autónoma de México

Resolving the evolutionary and ecological factors that generate and maintain avian biodiversity is a central goal of ornithology. The Pacific lowlands of Mexico are biodiverse but understudied with respect to spatial patterns of genealogical and phenotypic diversity. We examine genetic and phenotypic variation of the widespread White-collared Seedeater (*Sporophila torqueola*), a granivorous songbird. We use high-throughput sequencing of ultraconserved elements to reconstruct the evolutionary history of populations from the Pacific and Atlantic lowlands of Mexico and Central America. Leveraging over 1000 nuclear loci and whole mitochondrial genomes from 72 individuals sampled throughout the species' range, we report that the Pacific lowlands populations (*S. t. torqueola* group) are genetically differentiated from the remaining populations (*S. t. morelletti* group). The two lineages are reciprocally monophyletic with ~7.5% divergence in mitochondrial DNA. Using coalescent models, we find little

evidence of gene flow between the two lineages, while ecological niche models suggest multiple glacial refugia during the last glacial maximum. Additionally, there is extensive phenotypic differentiation within the complex: the western *S. t. torqueola* group has a cinnamon rump and crissum with no wing bars, while the eastern *S. t. morelletti* group has wing bars combined with a white rump and crissum. Our study provides evidence of strong phenotypic and genetic differentiation within the *S. torqueola* complex, suggesting a possible taxonomic split. These findings highlight the Pacific lowlands of Mexico as a biodiverse—yet understudied—region of avian endemism.

New insights into the ecology of a species at the edge of its range

Mathewson, Heather - Tarleton State University; Jordan Giese - Tarleton State University; Thomas Enright - .Missouri Department of Conservation; Jared Hall - Tarleton State University; Cullom Simpson - Tarleton State University; Kelton Mote - Tarleton State University; Shaun Oldenburger - Texas Parks and Wildlife Department; Jeff Breeden - Tarleton State University; T. Wayne Schwertner - Tarleton State University

The White-tipped Dove (*Leptotila verreauxi angelica*) is an elusive Columbid that reaches its northernmost distribution in south Texas in the Lower Rio Grande Valley (LRGV). Designated a gamebird in 1984, little is known about the species and management is assumed to be consistent with that for the common white-winged dove. In the LRGV, agricultural and urban development has destroyed 95% of the native vegetation. In 2014, we initiated a study on White-tipped Doves focused on obtaining knowledge of the species' ecology and population demographics. The objectives of this research were to evaluate survey methods and the efficacy of using GPS transmitters, model detection probability and habitat-based occupancy, evaluate factors influencing nest survival, identify nest predators, obtain information on nesting behavior, assess habitat use, examine within-season movement patterns, and increase banding efforts. I will provide a brief overview of new and updated information on this species. We have determined that White-tipped Doves differ considerably from White-winged Doves. White-tipped Dove occupancy is greatest in native riparian areas and in citrus groves. Citrus groves could be providing an important alternative habitat for the doves, as we have not detected any negative influence on reproduction or behavior. Recaptures of banded birds and data from our GPS transmitters suggest that White-tipped Doves might remain within a small geographic area during the breeding season and that site fidelity is high. Our research provides new or updated information on the species that will help inform management and conservation efforts in the LRGV for these doves.

Feather mite abundance varies by ecological context, but symbiotic nature of mite-host relationship does not differ in two warbler species

Matthews, Alix - Arkansas State University; Jeffery Larkin - Indiana University of Pennsylvania; Douglas Raybuck - Arkansas State University; Morgan Slevin - Arkansas State University; Scott Stoleson - USDA Forest Service Northern Research Station; Than Boves - Arkansas State University

Feather mites are obligatory ectosymbionts that inhabit spaces between feather barbules and primarily feed on the oily secretions from the uropygial gland. Feather mites may influence individual host condition and fitness, but little is known about the nature and variability of this symbiotic system: is it parasitic, mutualistic, or commensal? Previous studies have reported mixed results, and no clear pattern of the relationship has emerged. To further our understanding of this system, we tested two hypotheses related to within-species and among-species abundance and effects of mites. We hypothesized that sex and age within species

and ecological context among species would explain variation in both 1) mite abundance, and 2) effects of mites on host fitness (reproduction and survival). We focused on two closely related (Parulidae), but ecologically distinct, species: Cerulean Warblers (*Setophaga cerulea*), open-cup canopy nesters, and Prothonotary Warblers (*Protonotaria citrea*), understory cavity nesters. During the 2015 breeding season, we captured and color-banded individuals, recorded morphometrics, and quantified feather mite abundance. We then monitored individuals and their nests to determine reproductive output and annual survival. Feather mite abundance differed by species and *P. citrea* age, but was not related to host sex. Mite abundance did not relate to body condition, fledglings produced, or nest survival. Relationships between mite abundance and annual survival are pending the 2016 breeding season. These results suggest that although feather mite abundance may vary by ecological context, this pattern does not seem to result in differential effects on host condition or reproduction within a single season.

Regional changes in breeding bird distributions: a strong proximate signal of landcover shifts in the face of growing climate pressure

Matthews, Stephen - The Ohio State University; **Matthew Shumar** - The Ohio State University; Paul Rodewald - Cornell Lab of Ornithology; Katharine Batdorf - na

Distributional shifts in apparent response to climate or land use change are well documented, particularly in avian species. However, few studies have examined their combined effects to determine the relative influence on bird distributions aligned in time and space. We examined distributional data for 17 songbird species from two breeding bird atlas projects in Ohio (1982-1987 and 2006-2011) along with climate and landcover data for each time period. Species distributions during the second atlas were modeled using randomForests, incorporating both climate and landcover data separately and in combination to compare relative model performance. Models were then back-projected with environmental data from the first atlas to compare to actual gains and losses of species. Models that included both climate and landcover were most supported in predicting current avian distributions, with consistently higher AUC values and overall model performance. Forest and agriculture were most important in characterizing current distributions for 13 of 17 species and changes in these landcover conditions were the main determinants of local species turnover events. Models using only landcover variables explained the majority of variation in species gains and losses. While climate factors (mean spring, summer maximum, and winter minimum temperatures) were important predictors of current distributions for some species, they were not strong predictors of turnover and likely reflect the limited amount of observed climate change to date in Ohio. Our results suggest the importance of landscape-scale habitat management in climate change adaptation planning in order to potentially increase resilience to future climate pressures.

Phylogenomics of Lories and Lorikeets (Order: Psittaciformes)

Mauck, William - American Museum of Natural History; Michael Andersen - University of New Mexico; Brett Benz - American Museum of Natural History; Brian Smith - American Museum of Natural History

Lories and Lorikeets (Loriini) are nectarivorous parrots that occur from Indonesia throughout New Guinea, Australia, and Polynesia. The clade exhibits a wide variation in body size and plumage diversity that is characterized by 12 genera, 53 species, and 78 subspecies. Previous phylogenetic work has suggested relationships among several species are unclear or unknown, and that nearly half of the genera may not be monophyletic. To infer

phylogenetic relationships among the lories and lorikeets, we sequenced ultraconserved elements (UCEs) from > 95 of the described taxa (species and subspecies) and collected thousands of loci from modern and historical DNA samples. We performed phylogenetic analyses and obtained resolved relationships throughout the tree and confirmed the non-monophyly of several genera. We will present a time-calibrated phylogeny for Loriini and discuss the challenges of estimating phylogenetic relationships from historical and modern DNA samples.

The influence of wind selectivity on migratory behavioral stratagies
McCabe, Jennifer - University of Wisconsin-Madison; Brian Olsen - The University of Maine; Bipush Osti - University of Maine

Weather impacts a migratory animal's decision to initiate migration. Wind has a very strong effect on the timing and energy expenditures of animals and therefore selection of favorable winds for departure is of foremost importance for optimal migratory performance. However, there is also a cost of waiting for favorable winds. Here we conduct an optimality analysis to determine how wind selectivity affects three optimized migratory behaviors: time (total migration time), energy (total time spent in flight), and risk (whether or not migration was completed). To describe variation in these metrics under varying degrees of wind selectivity, we constructed an individual-based model (IBM) to simulate fall passerine migration along the Atlantic Flyway using different thresholds of wind profit, the distance per second the wind carries the bird towards its goal. A gradient of wind profit values were tested, from initiating flights only on nights when winds were directed in their preferred direction (highly selective), to flying under most wind conditions (low selectivity). Our analysis indicated that relative mortality risk was lowest at intermediate selectivity and increased at both high and low wind-profit values. Birds with increasing selectivity used less energy for migratory flight; however, there was an upper threshold beyond which no wind conditions ever met the criteria for take off. Of those who successfully completed migration, those with the lowest selectivity spent less time on migration. With this analysis, we showed that variation in departure wind selectivity can produce behaviors that mimic the classic "time-minimizer" and "energy-minimizer" strategies.

Diet and prey selection of the Barn Swallow, a declining aerial insectivore
McClenaghan, Beverly - Trent University; Erica Nol - Trent University; Kevin Kerr - Toronto Zoo

Aerial insectivores in North America have experienced serious population declines in the past 30 years. This guild represents birds from a wide taxonomic breadth that occupy diverse habitats, suggesting population declines may be related to their common food source: flying insects. To investigate insect populations as a potential cause for the decline, we first need to know the diet of aerial insectivores, of which little is known. We studied the diet of an aerial insectivore, the Barn Swallow (*Hirundo rustica*), and compared this to the insect prey available at nesting sites. Based on research from outside of North America, we hypothesized that Barn Swallows are taxonomic generalists and select prey based on size and not on taxonomy. To survey insect diversity in Barn Swallow habitat, we operated Malaise traps at ten nesting sites in Ontario throughout the breeding season and identified the insects via DNA barcoding. To reveal species consumed by Barn Swallows, we paired DNA barcoding with next-generation sequencing to identify insect remains found in fecal samples. We found that while insect diversity in the habitat changed from the first to the second brood, Barn Swallow diet stayed consistent throughout the breeding season. Barn Swallows consumed large Dipterans most often, with Calliphoridae and Tipulidae being the main prey items (found in 86% and 84%

of fecal samples, respectively). These findings will fill a gap in our knowledge of Barn Swallow biology in North America and will help inform decisions for the protection and recovery of Barn Swallows in Ontario.

Impacts of shale gas development on breeding bird populations in the eastern United States

McClung, Maureen - Hendrix College; Kevin Kracjir - Hendrix College; Annie Meek - Hendrix College; Matthew Moran - Hendrix College

The development of horizontal drilling and hydraulic fracturing in shale formations has made available vast new deposits of oil and natural gas throughout many parts of the United States, including large areas of eastern deciduous forest that have had less major energy industry activity in the past. In order to access these fossil fuel deposits, this technology requires substantial land-use changes that are likely to have negative impacts on many species, particularly birds. Using the Breeding Bird Survey, we examined the population trends of 131 bird species that are common in eastern deciduous forests of North America. We measured bird population changes from 2000-2013 in areas with recent oil and gas development compared to adjacent areas that have not experienced this activity. We found that 10 species experienced population changes in gas zones that are significantly different from population changes in non-gas zones. Among the different habitat guilds, open species appeared most affected, while the other habitat guilds (forest, wetland, developed, and generalist) showed no significant effects. Within the open habitat guild, some species declined and some increased relative to non-gas areas. Our results indicate that recent developments in the energy industry are having an impact on community structure of bird populations, with some species benefitting and others declining. The shale gas industry is considered by many analysts to be in its infancy and future land-use changes are likely to continue, which could further modify habitats leading to further changes in bird communities.

Estimating Northern Bobwhite Recruitment Using Integrated Population Models

McConnell, Mark - Warnell School of Forestry and Natural Resources, University of Georgia; Richard Chandler - University of Georgia; Adrian Monroe - Colorado State University; William Palmer - Tall Timbers Research Station and Land Conservancy; Shane Wellendorf - Tall Timbers Research Station and Land Conservancy; L. Wes Burger - Mississippi Agricultural and Forestry Experiment Station, Forest and Wildlife Research Center; James Martin - Warness School of Forestry and Natural Resources, University of Georgia

Understanding game bird recruitment is essential for determining harvest regulations because density-dependent recruitment and survival are cornerstones of sustainable yield theory. However, density-dependent recruitment is rarely quantified or incorporated into gamebird population models. Similarly, the effects of environmental factors on recruitment remain largely unexplored. We hypothesized that a combination of density-dependent and density-independent factors influence bobwhite recruitment and investigated this using integrated population models (IPMs). We used a combination of capture-recapture and harvest information and used an IPM to estimate population abundance, annual survival, and per-capita recruitment. We modeled the effects of population abundance, breeding season rainfall, and temperature as covariates of per-capita recruitment. Model selection results indicate a time-varying recruitment model was most-supported by deviance information criteria (DIC). Per-capita recruitment averaged 1.66 over the 42-year time series and ranged from 0.01-7.43. Our best supported covariate model showed a

negative effect of population abundance on recruitment (β1 = -0.12; 95% CRI [-0.15, -0.09]). Our results support the density-dependent hypothesis for bobwhite recruitment. We found no support for the effects of breeding season temperature or rainfall on recruitment as evidenced by DIC. Therefore, our results do not suggest that density-independent factors alone impact bobwhite recruitment. IPM's represent a powerful and novel approach to ecological investigation and unparalleled opportunity for modeling population dynamics.

Molecular identification of the wood thrush diet and validation of a protocol for studies of avian diets

McCoskey, Dana - George Mason University; Rebecca Forkner - George Mason University; Masoumeh Sikaroodi - Microbiome Analysis Center George Mason University; Patrick Gillevete - George Mason University

DNA barcoding and next-generation sequencing (NGS) show great promise in applications to avian diet studies. We tested the efficacy of molecular methods with three COI (animal DNA barcoding gene) mini-barcode markers, to quantify diet richness for a declining migratory bird, the wood thrush (*Hylocichla mustelina*), and compared molecular results to those obtained by a traditional morphological method to validate techniques at sample and marker levels. Samples were dissected and partially digested prey was identified by morphology. Prey DNA was extracted from wood thrush scats and stomach contents. Polymerase chain reaction and NGS were used to obtain prey sequences that were identified with public reference databases. Overall the molecular method provided the most and finest scale information on diet and reliably identified numerous soft-bodied prey that were not detected by morphology. The use of additional markers provided an added benefit of detecting more unique information. However, ants an abundant prey item, were best detected by morphology. Detection of beetles was reliable with morphology, but molecular methods provided better family level information. Moreover, certain arthropod families were only detectable by one COI marker. Results indicate DNA barcoding avian diet can overcome some limitations of traditional methodologies but interpretation of species presence and absence information should proceed with caution. Protocols for describing generalist bird diets should include morphological screening and include multiple COI markers to increase the breadth of prey detected. Best practices for detecting focal species in generalist diets are informed by variation in detachability of prey between the methodologies.

Long-term impacts of climate change on breeding bird phenology and productivity in the Laurel Highlands of Pennsylvania

McDermott, Molly - Powdermill Nature Reserve - Carnegie Museum of Natural History; Luke DeGroote - Powdermill Nature Reserve - Carnegie Museum of Natural History

Using 53 years of banding data from Powdermill Nature Reserve, we investigated how climate change has influenced breeding bird phenology, productivity, and linkages with spring arrival. We found evidence of sensitivity of reproductive phenology to climate change for 21 locally breeding passerines. Regardless of broodedness or migration distance, 13 species showed an earlier appearance of young over time with most advancing >3 days per decade. Warmer springs were associated with earlier juvenile captures for 14 species, with 1.5-3 days advancement for every 1°C. Four of 19 species reproduced earlier in years when migrants arrived earlier. The interval between adult spring arrival and appearance of juveniles shortened with warmer spring temperatures for 14 species, suggesting some migratory passerines adapt to climate change by laying more quickly after arrival or by reducing the time from laying to fledging. We found more support for the former: that

the rate of reproductive advancement was higher than that for arrival in warm years. Timing of spring arrival and breeding were poor predictors of local productivity; climate explained more variation, with varying effects of both spring and summer temperature and precipitation. Given that temperatures are projected to increase significantly by 2100, our results indicate that climate change could have profound effects on long-term fitness. Species-specific responses to climate that we observed provide novel insights into phenological flexibility in songbirds. Our research underscores the value of long-term monitoring programs and the importance of continuing constant efforts to improve our ability to predict future responses to climate change.

The breakdown of male-male cooperation in a manakin lek network
McDonald, David - University of Wyoming; Sara Decker - University of Wyoming

In the entire animal kingdom, only lek-mating Long-tailed Manakins (*Chiroxiphia linearis*, Pipridae) engage in obligate dual-male song (unison toledos) and dance (backwards leapfrog) involving unrelated males. Males form orderly networks and move – normally – in orderly fashion, up a dominance hierarchy, to attain the alpha roles that are their only chance for mating success. After a demographic collapse (rapid loss of all the top males) at one very successful lek, a power vacuum drew in males from neighboring leks. Some of the males contending for the alpha role had no prior history of network interactions, and therefore no established dominance relations. For the first and only time in a twenty-year study, males engaged in physical combat. The consequences were drastic and long-lasting. Female visitation and copulation rates dropped. Female preference for orderly dual-male display forces males into working, cooperatively, toward long-delayed benefits derived from establishing reputations for their leks. The evolution and maintenance of cooperative courtship depends on predictable lifelong relations in the male social network. In the face of rapid turnover of top-ranking males, that framework disappeared. The breakdown of cooperation exposes the many preconditions that make this form of non-kin cooperative display unique, and sheds light on forces driving less exaggerated forms of cooperative courtship in other species of the family Pipridae. Social network tools, including triad motifs and algorithms for assessing variance in edge weights, were useful in quantitative assessment of the conditions favoring cooperation and its breakdown.

Landscape composition influences area sensitivity by songbirds in Manitoba's endangered tall-grass prairie ecosystem
McDonald, Laurel - University of Manitoba; Nicola Koper - Natural Resources Institute, University of Manitoba

The ongoing loss, degradation, and fragmentation of grasslands across North America is believed to be the primary cause of precipitous declines in grassland bird populations. In Manitoba, Canada, over 99% of our tall-grass prairie has been lost, and most remnant patches are small. The conservation value of these patches may be compromised by area sensitivity - a behaviour whereby many species of grassland birds avoid nesting in smaller patches. Landscape composition is known to influence area sensitivity; however, its importance relative to that of patch size remains unclear. I used point count data collected in 2007, 2008, 2010, 2011, and 2014 from 20 tall-grass prairie patches in Southern Manitoba to assess the relative importance of patch size and landscape composition on the densities of six grassland passerines. I found that the degree to which the landscape surrounding point count plots was open, as opposed to forested or urban, had a strong positive effect on five of six species. While four of six species were more abundant in larger patches, patch size

remained important for only one species once landscape composition was taken into account. My results suggest that area sensitivity may in fact be a response to the openness of the surrounding landscape, which is usually positively correlated with patch size. Small grassland patches surrounded by open landscapes are likely, therefore, less susceptible to area sensitivity, and may provide high quality habitat for grassland birds.

The conservation of behavioral traits, and their roles as selective regimes for female plumage conspicuousness, in the Passeriformes

McEntee, Jay - University of Florida; Zoe Zelazny - University of Florida; J. Gordon Burleigh - University of Florida

Many evolutionary biologists have viewed behavior as especially labile. If behavior is generally subject to rapid evolutionary change, behavioral traits may be seen merely as responding to rather than setting selective regimes. Here we examine the hypothesis that conserved behavioral states set selective regimes for the evolution of female plumage conspicuousness. First, we test whether two behavioral traits, nesting behavior and sociality (defined as group-living), are conserved in the Passeriformes by reconstructing their evolution on a densely sampled, species-level phylogeny. We find that nesting behavior has strong phylogenetic conservatism within the Passeriformes. Counter to Wallace's assertion that transitions should be most frequent between cavity and dome nests, in which incubating birds are 'hidden', we show that such transitions are relatively rare. Further, we find that sociality also has substantial phylogenetic conservatism. As these traits have been hypothesized to influence female plumage conspicuousness, we use phylogenetic linear and logistic models to examine their influence on dorsal female plumage scores across the passerines, while controlling for body size. According to Wallace's classic hypothesis, 'hidden' nests (cavities and domes) should permit the evolution of conspicuous female plumage, whereas 'open' (cup) nests should result in dull female plumage, with selection from predation risk. We find evidence for more complex relationships, where sociality interacts with nesting behavior. An intriguing result is that non-social cavity-nesters have lower plumage conspicuousness scores than non-social cup- and dome-nesters, opposite Wallace's predictions. Our evidence is consistent with the hypothesis that conserved behaviors can set selective regimes on other traits.

New geospatial and sensor technologies for quantifying bird behavior

McGann, Andrew - Cellular Tracking Technologies; Michael Lanzone - Cellular Tracking Technologies; Sheldon Blackshire - Cellular Tracking Technologies

New technologies from the realm of smartphones and "wearable" fitness devices are now being incorporated into wildlife telemetry devices allowing for groundbreaking research in movement ecology and animal behavior. GPS telemetry with cellular Internet connectivity (GSM or CDMA) solved three major limitations of satellite telemetry: limited bandwidth, high power requirements, and high costs of transmitting mere kilobytes of data. Cellular telemetry devices transmit megabytes of data at substantially lower power and costs. Additionally, 2-way communication between the user and device via the Internet allows for changing duty cycles and updating firmware, even on deployed devices. Two new modes of GPS sampling, GPS burst mode and activity-based dynamic GPS sampling, maximize the behavior-quantifying power of geospatial data. New sensors go beyond simple GPS information and allow detailed quantification of animal movements and behavior between GPS locations. A triaxial accelerometer (ACC) provides g-force measurements in three axes at rates of 8-100

Hz (8 – 100 times per sec). ACC data can also be summarized into an easy-to-use "Activity Rate", which provides minute-by-minute continuous sampling of activity. These technological advancements open doors for ornithologists to address new and longstanding questions about animal movement and behavior. Here we present how these data can be collected and how they can be used to answer a variety of research questions.

Decision analysis for habitat management of migratory waterfowl using a full annual cycle model.
McGowan, Conor - U.S. Geological Survey; Orin Robinson - Auburn University; Pat Devers - US Fish and Wildlife Service

Full annual cycle models are increasingly important and popular for describing population dynamics and assessing the status and viability of migratory bird populations. These models typically connect the breeding grounds and wintering grounds of migratory bird species and allow researchers and managers to estimate the sensitivity of population viability metrics to model parameters such as seasonal survival to inter-annual connectivity. However, few of these modeling efforts have actively been employed for population management and conservation decision making. We used a full annual cycle model for migratory American Black Ducks to assess habitat management actions and effort allocation at spatially large scales. We set population objectives for black ducks to match the National Waterfowl Management Plan (NWMP) population targets for the species and used the simulation model to estimate the probability of achieving those population objectives under different habitat management portfolios. We incorporated costs of management actions as the expected relative expense of managing habitat in different portions of the annual cycle and locations in the flyways. Our decision analysis, selected the management portfolios that maximized the probability of achieving our population objectives while minimizing cost, and we tested the sensitivity of the decision analysis to differing weights on objectives. Our work shows the potential tremendous benefit of full annual cycle models to inform management and conservation decisions for migratory populations.

Phylogenetic variation in heat tolerance and evaporative cooling capacity among Kalahari Desert birds
McKechnie, Andrew - Department of Zoology and Entomology, University of Pretoria; Ben Smit - Nelson Mandela Metropolitan University; Maxine Whitfield - Department of Zoology and Entomology, University of Pretoria; Blair Wolf - Biology Department, University of New Mexico

Birds inhabiting hot environments rely heavily on evaporative cooling to avoid hyperthermia, but little is known about the upper limits to avian heat tolerance. During the last four years, we have investigated body temperatures, evaporative water loss and metabolic rates during acute heat stress in phylogenetically diverse taxa in southern Africa's Kalahari Desert. Among three ploceid passerines, heat tolerance was positively related to body mass, with larger species tolerating higher air temperatures. In contrast, among three columbids heat tolerance scaled negatively with body mass, with smaller species tolerating higher temperatures. All three columbids showed only small increases in metabolic rate at high air temperatures. Moreover, Namaqua Doves (*Oena capensis*) showed an exceptionally pronounced evaporative cooling capacity, with nearly 500 % of metabolic heat production being dissipated evaporatively. Unexpectedly, evaporative cooling in Burchell's Sandgrouse (*Pterocles burchelli*), a member of the arid-adapted order Pterocliformes, was far less efficient than in columbids, and involved substantial increases in metabolic rate at high air temperatures. We have also investigated intraspecific variation in heat tolerance

among populations of White-browed Sparrow-weavers (*Plocepasser mahali*) across a ~10 °C gradient in maximum summer air temperatures. Individuals at a hot desert site showed significantly greater heat tolerance in summer compared to populations at cooler sites, but this difference was not evident in winter. These data provide the first evidence for seasonal acclimatization in avian heat tolerance and evaporative cooling capacity, and raise a number of questions regarding the roles of phenotypic plasticity versus local adaptation as determinants of physiological variation.

Seasonal metabolic acclimatization in southern African birds: inter- and intraspecific variation

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Phylogenetic variation in seasonal metabolic flexibility remains poorly studied in birds from subtropical latitudes, as do the ecological correlates of within-individual metabolic adjustments. Data on seasonal changes in basal metabolic rate (BMR) and summit metabolism (Msum) in three southern African passerines suggest that the direction and magnitude of seasonal metabolic adjustments in are highly variable. In White-browed Sparrow-weavers (*Plocepasser mahali*; ~40 g), populations at four sites varying by ~ 7 °C in winter minimum air temperature showed differing patterns of seasonal metabolic acclimatization, ranging from BMR ~ 52 % higher in winter to no significant seasonal difference. Enhanced winter cold tolerance occurred in a population at a colder, desert site, manifested as higher Msum (~ 25 % above summer values) and lower helox temperature at cold limit compared to conspecifics at a milder, more mesic site. More recently, we have begun examining inter-annual variation in metabolic acclimatization in White-browed Sparrow-weavers and Scaly-feathered Weavers (*Sporopipes squamifrons*; ~10 g) at a desert site. The sparrow-weavers showed consistently higher BMR in winter over a two-year period, with winter BMR 36-67 % above summer values. There was no significant seasonal variation in Msum within years, but Msum in the winter of 2014 was significantly (24%) higher than during the following summer, suggesting that patterns of seasonal metabolic acclimatization may be modulated in response to short-term environmental fluctuations. In contrast, Scaly-feathered Weavers at the same site showed no significant seasonal variation in BMR or Msum over the period for which we have data so far.

Should they stay or should they go? An automated telemetry system provides insight into nomadic winter movements of Snow Buntings

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Temperate winters are changing rapidly, and models predict less snow and warmer winter temperatures in many parts of North America. Snow Buntings (*Plectrophenax nivalis*), like many species overwintering in North America, are nomadic, presumably following food resources throughout their winter range. New tracking technologies are helping to shed light on nomadic movements. We applied digitally-coded radio tags to Snow Buntings within an automated tracking array (Motus Wildlife Tracking System) in southern Ontario, Canada in 2016. Birds were captured in baited ground traps and fitted with a backpack-style radio tag. Unique tag frequencies were then detected by telemetry stations across southern Ontario. We combined these tracking data with band-recapture data from Snow Buntings (Canadian Snow Bunting Banding Network,

2010-2015) in southern Ontario and Quebec. Availability of food for the ground-foraging Snow Buntings can be assessed indirectly by using snow depth – higher snow depth results in less accessible food. Snow Buntings also show variability in cold tolerance, thus minimum temperature should be an important predictor of movements. We first describe Snow Bunting movements by modelling distance and bearing between detections as a function of date, age, and sex. To account for the non-random distribution of radio-towers and banding sites, we compared the environmental conditions at the site where each bunting was detected with concurrent conditions at the site each bunting was detected previously. Our model results will provide information on environmental correlates of Snow Bunting presence and allow for predictions about winter detectability and population trends for this cold-adapted temperate-wintering species.

Assessing Shorebird Vulnerability to Potential Climate-Induced Changes in Food Availability

McKinnon, Laura - York University Glendon Campus

One of the hypothesized effects of climate change on arctic-nesting shorebirds is a reduction in the growth and survival of chicks due to climate-induced changes in the phenology of their prey (i.e. mismatch hypothesis). We have evidence that growth rates of chicks can be hindered by asynchrony between chick hatch and food resource peaks, however results are not consistent across species and/or latitudes. In addition, our recent research has revealed that the temperature increases that may drive asynchrony between chick hatch and food resource peaks, may decrease energetic requirements of chicks via reduced thermoregulation costs, and thus compensate for the potential negative effects of reduced food availability (mismatch trade-off hypothesis). To test the latter hypothesis, we experimentally measured resting metabolic rates (RMR) of shorebird chicks (Dunlin and Least Sandpiper) in Churchill, Manitoba (59°N, 94°W) across a range of temperatures during the summer of 2014 and 2015. Preliminary analyses of the 2014 data indicate that for Dunlin chicks, RMR was not affected by growth rate or ambient temperature, however it did increase marginally with age. For Least Sandpiper chicks, RMR decreased as temperatures increased, but was not affected by age or growth rate. Combined, these results emphasize the need for more detailed physiological and ecological data to test hypotheses regarding the direct and indirect effects of climate change for multiple species across a latitudinal gradient in order to build comprehensive models of climate change vulnerabilities.

Agent-based modeling of Clark's Nutcracker foraging behavior to determine thresholds for whitebark pine restoration

McLane, Adam - University of Calgary; Diana Tomback - Department of Integrative Biology, University of Colorado Denver; Greg McDermid - Department of Geography, University of Calgary; Christina Semeniuk - Great Lakes Institute for Environmental Research, University of Windsor; Danielle Marceau - Department of Geomatics Engineering, University of Calgary

Clark's Nutcrackers (*Nucifraga columbiana*) provide obligate seed dispersal services for whitebark pine (WBP, *Pinus albicaulis*) across its very broad range. However, if seed production is not adequate, Clark's Nutcrackers appear to employ hierarchical heuristics to decide whether to remain within a region or emigrate, likely assessing energy availability over multiple scales, including the local forest scale. We used an agent-based modeling (ABM) approach that embraces a bottom-up hierarchical habitat selection process of individual foraging ecology and energetics to elucidate the stay-or-leave decision-making process to aid WBP

management, given that WBP is declining from introduced disease in the South Cascades, Washington, USA. Our ABM incorporates nutcracker movement and emigration behavior, combined with landscapes varying in energy configuration (WBP and ponderosa pine, *Pinus ponderosa*) and in nutcracker population levels (competition) to evaluate the relative contribution of these proximate factors to emigration. We found the most important proximate factor is landscape energy availability, and future energetic landscapes that minimize nutcracker emigration will maintain mutualism and nutcracker seed dispersal services. Using our ABM to evaluate the adaptive behaviors of nutcrackers to possible future energetic landscapes and considering current rates of decline, we suggest that WBP will not recover on its own in this region and that randomly planting WBP patches at a density of five percent of existing WBP will maintain the mutualism while minimizing the cost and scope of work. Our modelling strategy is both flexible and applicable to other geographic regions and could provide an evaluation tool for managers in other regions.

Open-water flights by Nearctic-Neotropical landbird migrants: assessing orientation behavior, reaction to wind and storm effects

McLaren, James - University of Delaware; Jeffrey Buler - University of Delaware; Deanna Dawson - USGS Patuxent Wildlife Research Center; Andrew Farnsworth - Cornell Lab of Ornithology; Marshall Iliff - Information Science, Cornell Laboratory of Ornithology

Many nocturnally migrating landbirds undertake extensive open-water flights. The impact of winds including storm effects on these mostly small migrants is unclear, including the robustness of putative orientation strategies to wind drift given the absence of landmarks. We assessed the speed and reliability of open-ocean flights by fall Nearctic-Neotropical passerine migrants from the Atlantic coast to the Caribbean using individual-based models together with dynamic wind data. We here focus on selection of departure nights based on wind conditions, frequency of re-orientation using navigational cues, and storm-induced mortality and vagrancy to the northeastern U.S. Simulated broad-front migration of migrants from the southeastern U.S. to the Caribbean was robust to wind conditions and many orientation strategies, but faster when migrants simply re-oriented at dawn as opposed to re-orienting continually through the night. Simulated flights involving infrequent re-orientation were also consistent with unseasonably late eBird records of Neotropical migrants in the northeastern U.S. following Hurricane Sandy's landfall in New Jersey, suggesting these vagrants likely originated post-Sandy, and that many more perished at sea. Simulated endurance flights (~2500 km) of Blackpoll Warblers (*Setophaga striata*) between Atlantic Canada and the Caribbean further emphasized that continual 'map-based' reorientation can be counter-productive, but also the importance of selecting suitable departure winds and maintaining orientation at sea. We suggest that navigational capacity and adaptive reaction to wind may vary strongly between migratory populations, driven by both prevailing winds and extremes in wind phenology.

Effects of Tamarisk Defoliation on Southwestern Willow Flycatchers Along the Virgin River

McLeod, Mary Anne - SWCA Environmental Consultants; Anne Pellegrini - SWCA Environmental Consultants

Tamarisk leaf beetles (*Diorhabda* spp.), released in the western U.S. as biocontrol for tamarisk (*Tamarix* spp.), began defoliating large areas along the Virgin River around St. George, Utah, in 2008. Beetles then expanded their range downstream, affecting multiple breeding sites of the federally

endangered southwestern willow flycatcher (*Empidonax traillii extimus*), which breeds in dense, mesic habitats. Breeding sites vary in their floristic composition and thus have been affected to varying degrees by defoliation and subsequent mortality of tamarisk. Following the initial year of defoliation in St. George, flycatchers moved into nearby sites that consisted primarily of native vegetation. Very little native vegetation is present farther downstream on the Virgin River, and flycatchers in downstream areas continued attempting to breed at sites that contained a significant tamarisk component; however, the number of breeding flycatchers dropped from 14 to 7 pairs in the year following initial defoliation and declined further in subsequent years. In all cases where flycatchers attempted to breed in defoliated areas, reproductive output was poor, with an average of 0.3 young produced annually per female flycatcher. Tamarisk beetles are continuing to expand farther into the flycatcher's breeding range in both Arizona and New Mexico. Beetles are likely to arrive at several large flycatcher sites, some of which consist primarily of monotypic tamarisk, in the next few years. Active restoration of native riparian woodlands in watersheds where flycatchers currently nest primarily in tamarisk is urgently needed to provide flycatchers with alternate nesting sites.

From Touch-down to Take-off: Breeding season habitat needs for Golden-winged Warblers

McNeil, Darin - Cornell Lab of Ornithology, Natural Resources; Amanda Rodewald - Cornell Lab of Ornithology and Cornell University Department of Natural Resources; Cameron Fiss - Indiana University of Pennsylvania, Dep't of Biology; Jeffery Larkin - Indiana University of Pennsylvania

The ability to develop science-based conservation actions and evaluate their effectiveness within an adaptive management framework is important to the successful recovery of at-risk species. Efforts to conserve Golden-winged Warbler (*Vermivora chrysoptera*) illustrate the importance of filling existing knowledge gaps to better inform conservation efforts. This species is declining rapidly throughout much of its breeding range largely due to the loss of shrubland and early successional forest nesting habitat. Over the past decade, much research has focused on gaining a better understand of how breeding season demographics are influenced by micro and macro-scale habitat features. Golden-winged Warblers require expansive landscapes dominated by deciduous forest with adequate amounts early successional communities (ESC) interspersed. Within patches of ESC, vegetative features such as tree basal area, woody cover, Rubus spp., and herbaceous cover predict Golden-winged Warbler occurrence, territory density, nest site selection, and nesting survival. More recently, post-fledging habitat use and movement studies reveal the species uses of a variety of forest conditions (e.g., sapling-pole, shelterwoods, and unmanaged mature forest), than what is typically used for nesting. Forest managers have an excellent opportunity to assist with Golden-winged Warbler recovery by employing standard forest management practices at spatial and temporal scales that are consistent with the species nesting and post-fledging ecology.

Cuckoos attracting mates: Who coos for who?

McNeil, Shannon - Southern Sierra Research Station; Diane Tracy - Southern Sierra Research Station

Female birds are increasingly found to sing; those singing to attract mates appear to do so along with their male counterparts, not as solo singers. However, most current knowledge comes from the study of passerines, just 1 of over 40 bird orders now recognized. Female-driven systems may exist, but the cryptic nature of many species hinders a better understanding of their mating systems. The coo is a mate attraction signal

given by yellow-billed cuckoos (*Coccyzus americanus*) that was previously assumed to be given by unmated males, though evidence suggest that females also coo. We witnessed cooing in a color-banded population of yellow-billed cuckoos sexed from DNA samples. Of 105 males and 80 females, we confirmed 25 cooers, all female. Despite the small sample size, our results are compelling that females and not males coo. This complements our discovery of high rates of multiple maternity within yellow-billed cuckoo clutches, where the nesting male may or may not be the father of extra females' eggs. Females apparently not only coo to attract unmated males with which to nest, but also to locate, potentially mate with, and lay eggs in the nests of already-nesting males.

Galapagos mockingbirds lose tolerance to introduced nest parasites in dry years.
McNew, Sabrina - University of Utah; Graham Goodman - University of Utah; Ashley Saulsberry - University of Utah; Angela Hansen - University of Utah; John Jackson - University of Utah; Dale Clayton - University of Utah

When faced with attack by parasites, animals can defend themselves by resisting or tolerating infection. Resistance mechanisms help the host by reducing the parasite load, and thus parasite damage. Tolerance mechanisms do not reduce parasite load, but instead enable the host to compensate for damage done by the parasite. Although resistance mechanisms have traditionally received more attention, tolerance is increasingly seen as an advantageous and common defense. What remains unclear is what factors affect the ability of a host to tolerate a parasite. We studied variation in tolerance in Galapagos mockingbirds (*Mimus parvulus*) to an introduced nest parasite, *Philornis downsi*. A recent study found that mockingbirds were tolerant to the fly over two years of study (Knutie et al. 2015, Ecology 97(4): 940-950). Parasitized nestling mockingbirds survived by soliciting more food from their parents, thus recovering energy lost to the parasite. However, in two subsequent dry years, mockingbirds were not tolerant and fledging success in parasitized nests was significantly lower than in previous years. Our results suggest that tolerance is environmentally dependent: in years of lower food abundance mockingbirds cannot compensate for parasite damage. Our study highlights the fact that host-parasite interactions are often labile. We discuss implications for evaluation of long-term impacts of this invasive parasite on endemic mockingbirds in the Galapagos.

Habitat use and thermal challenges to breeding in Atlantic coast King Rails
McRae, Susan - East Carolina University; Amanda Clauser - East Carolina University; Jaan Kolts - East Carolina University; Katie Schroeder - East Carolina University

Due to loss of wetland habitat, the King Rail *Rallus elegans* is now largely restricted to the coastal margins of its historical eastern US range. We studied the behavior and ecology of breeding king rails at a coastal wetland managed using prescribed burns. Nesting King Rails experienced a 45ºC-range in ambient temperature during the breeding season. We describe a novel technique for continuously monitoring clutch temperature: embedding an iButton inside of a model egg. Video of parental behavior at the nest was used to investigate how parents maintained their clutches within tolerable limits. We report shading behavior for the first time in a rail. Parents spent proportionately more time shading and less time incubating their eggs at higher ambient temperatures. However, parents took more frequent recesses in hotter conditions, exposing their eggs to direct sunlight. Clutches that attained high temperature for extended periods hatched fewer chicks. Radio-telemetry of parent birds revealed a shift in microhabitat preference between nesting and brood-rearing. Parents

with broods sought areas with shallower water and more edge than preferred nesting habitat, including impounded and wooded marsh. Brood-rearing areas were on average more than 300 m from the nest sites.

What is good quality habitat for migrating songbirds? A nutritional and physiological perspective

McWilliams, Scott - University of Rhode Island; Adam Smith - U.S. Fish & Wildlife Service; Susan Pagano - Rochester Institute of Technology; Lillie Langlois - Pennsylvania State University414 Forest Resources Bldg; Megan Skrip - University of Rhode Island

Just like rest and refueling spots along our long stretches of motorways and autobahns, well provisioned stopover sites are crucial for songbirds during their seasonal peregrinations between breeding and wintering areas. Determining whether a given stopover site is adequately provisioned or ”good quality" requires knowing the nutritional requirements of songbirds while flying a short- to long-duration marathon, and the available quality and quantity of foods at the stopover site in relation to the number of songbirds that stop there to refuel. We review what we know (and need to know) about the requirements of songbirds during migration, and present a few case studies that exemplify how to assess whether your favorite stopover site is of sufficient quality to facilitate a successful migratory trip. Be forewarned, the quality of a given stopover site is in the eyes of our beholders, and depends on the condition and perspectives of the birds that stop there.

Southbound Merlin (*Falco columbarius*) migration in southern New England and the mid-Atlantic

McWilliams, Scott - University of Rhode Island; Adam Smith - U.S. Fish and Wildlife Service; Rick Gray - Biodiversity Research Institute; Chris DeSorbo - Biodiversity Research Institute; Scott Comings - The Nature Conservancy in Rhode Island

Merlin (*Falco columbarius*) use the Atlantic Coast extensively during southbound migration, particularly immature birds making their first migration. Band recoveries provide some insight into the provenance and destinations of these coastal migrants, but we know little about the migratory strategies of individuals. We used a growing automated digital telemetry network along the New England and mid-Atlantic Coast to explore the migratory routes, rates, and “stopover” for immature Merlins captured on Block Island, RI during the falls of 2014-2015. Detection histories of 64 individuals (of 69 tagged) detected by at least one tower suggest a few general patterns of movement: southbound coastal migration (nearshore and perhaps offshore), localized easterly movements, and northwesterly movements to the mainland. Most Merlins detected in New Jersey or Virginia (n = 23) made the trip from southern New England in less than six days, but occasionally took longer than 10 days. Of 56 Merlin detected on Block Island after release, half stayed for a day or less, 90% remained less than a week, but a few remained more than three weeks. Automated telemetry provided novel insights into the patterns of use of southern New England and the mid-Atlantic by fall southbound Merlin.

Predicting reproductive isolation among passerines from song divergence and climatic niche divergence

Megna, Libby - University of Wyoming; Dianna Brustman - University of Wyoming; Matt Carling - University of Wyoming

One of the most salient questions in evolutionary biology is whether we can predict evolutionary processes. Here we determine if there are repeated patterns of bioclimatic niche divergence and song divergence for 23 pairs of North American oscine passerines, and whether these divergences can predict the degree to which particular pairs are reproductively isolated. These pairs include 10 species pairs that hybridize and 13 species pairs that are at least partially sympatric but do not hybridize. We determined hybridization status by reviewing the literature. We calculated mean sequence divergence using data from the mitochondrial gene cytochrome b for each species pair to control for varying times since divergence. To calculate climatic niche divergence, we extracted Rehfeldt climatic data for species presence locations obtained from eBird. We constructed hypervolumes of mean annual temperature, mean annual precipitation, and frost-free period for each species and calculated a Sorensen Similarity Index between climatic hypervolumes for each species pair. To calculate song divergence, we obtained song recordings from the Macaulay Library of Sound for each species and extracted syllable parameter data using Raven Pro. We constructed hypervolumes of syllable data for each species and calculated a Sorensen Similarity Index between hypervolumes for each species pair. We regressed the similarity indices and sequence divergences against reproductive isolation as a binary response variable. We found that mitochondrial sequence divergence was the only significant predictor of reproductive isolation (multiple logistic regression, $p = 0.04$; song divergence $p = 0.86$; climatic niche divergence $p = 0.36$).

Preliminary analysis of the conservation status of Gulf of Mexico stopover areas

Mehlman, David - The Nature Conservancy

The Gulf of Mexico is well-recognized for its importance to numerous species of North American migratory birds during both spring and fall seasons. Work originally conducted by The Nature Conservancy and partners over a decade ago identified a network of known or hypothesized important stopover sites for the conservation of these species during one or both seasons in both the U.S. and Mexico. Although originally identified as part of the work that helped develop the stopover site conservation framework presented in Mehlman et al. (2005), these results were placed into a spatial database and have been used in various planning efforts, including one recently published by the Partnership for Gulf Coast Land Conservation. This preliminary analysis uses both the older identified stopover sites from a decade ago and more recent work to assess the degree to which important sites are conserved in both countries and how much more work remains to be done to conserve them. Due to the general lack of habitat quality information during the migration seasons over this large geographic area, conserved is defined as those areas which are in some form of conservation status, whether in public or private ownership. Overlap with indicators or correlates of threats (e.g., urban areas, roads, communications towers, wind turbines, sea level rise) is also preliminarily analyzed. Opportunities for synergy with other current efforts at Gulf region-wide conservation are also discussed as are some ideas for improving the accuracy of site identification with new data.

Trade-offs in ecosystem services: damage from black bears in a Douglas fir forest increases forest structural complexity and improves habitat for cavity-nesting birds

Mendia, Shannon - Hoopa Tribal Forestry/Humboldt State University; Matthew Johnson - Humboldt State University; Mark Higley - Hoopa Tribal Forestry

Economic loss due to black bear (*Ursus americanus*) tree damage on managed timberlands has been valued at several million dollars annually in the Pacific Northwest. While bear damage to trees may negatively affect timber production, it also alters forest structure and habitat that may contribute to forest wildlife diversity. I studied the relationship between bear damage to Douglas fir (*Pseudotsuga menziesii*) trees and response of culturally significant cavity nesting birds on the Hoopa Valley Indian Reservation. I measured dis-services from bear damage by calculating current and future timber revenue loss, and ecosystem services by calculating forest structural complexity, abundance and diversity of cavity nesting birds, and of woodpecker activity. Bear damage negatively affected tree growth and estimated lumber recovery. Forest structural complexity was positively correlated with bear damage, and cavity nester abundance and woodpecker foraging activity were positively correlated to forest structural complexity and bear damage. Pileated woodpeckers and red-breasted sapsuckers used bear damage more than it was available, and pileated woodpeckers selected for more structurally complex sample units. To the best of our knowledge, this is the first study to evaluate ecosystem services for multiple species in relation to disservices from another species. Understanding the costs and benefits of bear damage can help guide management decisions vital to forest managers both on and off tribal lands.

The role of conservation areas in maintaning local populations of Magellanic woodpeckers in southern Chile

Meneses, Luis - Universidad de Chile and Laboratorio de Ecologia y conservación Universidad de Santiago; Pablo Vergara - Laboratorio de Ecologia y Conservacion, Universidad de Santiago de Chile; Gerardo Soto - Cornell Lab of Ornithology and Cornell University Department of Natural Resources; Marcelo Saavedra - CONAF IX región - Departamento de Areas Silvestres Protegidas

Large woodpecker species has long generation times, large home-ranges and are sensitive to forest disturbances, which make them prone to population decline and extinction. Therefore, persistence of large woodpecker in human-dominated landscapes requires conservation areas providing them with large amounts of high quality habitat in the long-term. Here, we address temporal changes in local populations of the Magellanic woodpecker (*Campephilus magellanicus*) in three conservation areas located in southern Chile: Conguillio National Park (NP), Nahuelbuta NP, and Tolhuaca NP. We recorded and compared the abundance of woodpeckers between the late 1990s (1995-1998) and the current year (2016). We conducted replicated point-count surveys that combined passive and active-sampling methodologies. Count data were analyzed using N-mixture with Conditional Autoregressive terms Bayesian models. Results indicate that the abundance of Magellanic woodpeckers exhibited no significant variation over the study period for two of the three studied populations (Tolhuaca NP and Nahuelbuta NP). However, woodpeckers in Conguillio NP increased their abundance values in 2016, when compared to the data collected in the 1990s. The detection probability was significantly higher in 2016 for two of the three conservation areas. Finally, woodpecker abundance exhibited no changes after the 2008 volcanic eruption in Conguillio NP, which affected

directly the forest by a lahar flow. These results suggest that these Southern Chilean NP provide local populations of Magellanic woodpeckers with suitable habitat, thus contributing to their persistence.

Vocal learning in wild birds: a four-year playback experiment
Mennill, Daniel - University of Windsor; Stéphanie Doucet - University of Windsor; Heather Williams - Williams College; Amy Newman - University of Guelph; D. Ryan Norris - University of Guelph

In eight groups of animals, including humans and songbirds, juveniles learn to vocalize by listening to adults. Vocal learning has important implications for behavioural ecology – learned vocalizations are critical for defending territories and attracting mates – and for evolutionary biology – learning promotes variation and influences population divergence and speciation. Vocal learning has been studied through many laboratory experiments, but not experimentally in the wild. We present results of a four-year experimental study of vocal learning in a wild population of Savannah Sparrows. We developed an innovative playback technology: weatherproof loudspeakers that simulate vocal tutors and broadcast songs over long time periods. Our island study population exhibits high natal site philopatry, allowing us to tutor young animals from birth, and then study their vocalizations when they return to breed as adults. By varying the seasonal schedule for broadcasting experimental tutor songs, we test hypotheses about the timing of vocal learning in wild birds. By varying the level of interactivity between the experimental tutors, we test hypotheses about the social context of vocal learning in wild birds. We show that multiple factors influence vocal learning, including the timing of when tutor songs are heard, and the context in which tutor songs are broadcast. Our findings underscore the complexity of vocal development in wild birds, and our playback methods present new possibilities for experimental studies of learning in free-living animals.

Investigating factors limiting species distributions at low-latitude range margins
Merker, Sam - University of Georgia

The mechanisms behind recent climate-induced range shifts are poorly understood, making it difficult to forecast the consequences for biodiversity. To understand the causes of range shifts, information is needed about the factors limiting species distributions at low-latitude range margins. Potential limiting factors are myriad but MacArthur (1972) proposed that biotic interactions should exert stronger influence than abiotic effects at low-latitude range margins due to less extreme climate and increased opportunity for competition. We used observational and experimental methods to assess the role of abiotic and biotic interactions on species distributions in the southern Appalachian Mountains, where many species reach their low-latitude range limits. Point-survey data from the 2014-2015 breeding seasons provided some evidence that the distributions of many cool-adapted species, such as Canada Warbler and Veery, were limited by contact with warm-adapted species such as Hooded Warbler and Wood Thrush. However, in each case, the apparent competition effect was greatly diminished after accounting for climate variables. Simulated territory intrusion experiments supported the conclusion that abiotic effects were stronger than biotic interactions. Individuals showed few signs of aggression or other behavioral responses to the presence and song of putative competitors. Together, these results provide preliminary evidence that southern range limits are determined primarily by niche differentiation and abiotic conditions. However, additional research is needed to assess additive and interactive effects of abiotic conditions and biotic interactions on species distributions and range shifts.

Landscape and life history: what factors influence condition in adult and nestling birds?

Merrill, Loren - University of Illinois, Urbana-Champaign; Thomas Benson - Illinois Natural History Survey, University of Illinois; Anne Barger - University of Illinois, Urbana-Champaign

A major hurdle that birds face today is assessing nest-site locations in anthropogenically-altered landscapes. Some species appear to be resilient to these habitat changes, while others are more sensitive and disappear from heavily, and even moderately, impacted areas. Researchers have begun examining the mechanisms linked to avian population changes in human-altered landscapes, and much work has focused on the role of changes in nest predator communities. But the early-life environment is more than just a filter for survival; the conditions a bird experiences during development can shape its phenotype for the remainder of its life. If early-life conditions can program a bird's phenotypic development, landscape-level changes may have population-level consequences for the birds using them. In this study we investigated the relationships between landscape features within 500 and 1000m of each bird's nest, and aspects of condition in the adults and nestlings of five shrubland bird species across a habitat gradient from low to heavy human-impact. Our focal bird species were American robin, northern cardinal, field sparrow, brown thrasher, and grey catbird. We found that landscape features were significantly more important for nestlings than for adults in shaping aspects of condition (e.g., dietary metabolites, size, oxidative stress, white blood cell profiles, bacteria-killing ability). Moreover, we found that life-history patterns influenced the manner in which birds allocated resources during development, and likely play an important role in shaping how different species respond to human-induced changes to the landscape.

Swallow-tailed Kite conservation: Case studies from 28 years of applied research

Meyer, Kenneth - Avian Research and Conservation Institute; Gina Kent - Avian Research and Conservation Institute (ARCI)

Nesting ecology, demography, and migration studies of Swallow-tailed Kites since 1988 demonstrate how long-term research on species of conservation concern identifies actions that sustain populations. 1. Commercial timber companies and public land managers in the southeastern U.S. are applying forest-management recommendations we produced by monitoring >1,200 nesting attempts. These include thinning; retention of mature, emergent trees; expanded best-management practices for wetlands; decoys and artificial nests as attractants, and landscape-scale management prescriptions. These actions increase nesting and foraging opportunities at low cost with silvicultural benefits. 2. Combining a three-state model of nesting and foraging habitat, satellite-tracking results, and land-ownership data has improved acquisition decisions and connectivity for public lands. 3. Since 1989, synchronized, systematic aerial photo-counts of pre-migration communal roosts in Florida, which contain 90% of the national population, have allowed us to monitor trends and identify threats to these critical sites. Results since 2006 have increased the minimum estimate of national abundance by nearly 40%. Daily abundance and mean duration of attendance derived from satellite telemetry from 2012 through 2016 will result in an estimate of annual occupancy of Florida's pre-migration roosts and, thus, the first data-based abundance estimate for the national population. The threats we have documented to these spectacular aggregations and their vital functions include mining contamination, aerial herbicide applications, and disruptive intrusions by irresponsible amateur and professional photographers in aircraft and boats. Compelling data and public outreach build support for land-use and management

policies that will sustain Swallow-tailed Kite populations and their diverse communities.

Sulids, Stable Isotopes and Sexual Ornaments: Links between foraging and carotenoid ornamentation in the Brown booby

Michael, Nathan - University of Akron; Anne Wiley - University of Akron; Roxanna Torres - Universidad Nacional Autonoma de Ecologia; Andreanna Welch - Durham University; Daniel Thomas - Massey University

Sexual ornaments are important drivers of reproductive success and evolution. Carotenoid-based ornaments are common in birds and well studied, with presence and absence of carotenoids shown to alter ornamentation in controlled studies. However, the extent to which diet influences these ornaments in natural settings, and what information is being conveyed is poorly understood. We investigated the link between foraging and gular skin color in the Brown booby using stable isotope analysis. Breast contour feathers, from the non-breeding season, were analyzed from 30 pairs of breeding Brown boobies from Islas Marietas, Mexico. Both d13C and δ15N values were significantly correlated with green chroma (summation of green reflectance divided by total reflectance) of male gular skin, measured using in-situ spectrophotometry (R2=0.46, p=0.015 for δ15N; R2 = 0.43, p= 0.019 for δ13C). This suggests that birds feeding on higher trophic levels and more pelagic prey have more green, attractive carotenoid-rich ornaments. While female δ15N values were correlated with mate's color data (R2=0.43, p=0.052), showing a link between female foraging and their mate's ornamentation, birds don't appear to be mating assortatively with regard to isotope values. We are using GPS tracking and inter-year comparisons to further explore Brown booby foraging and its relationship to carotenoid-based ornaments. Understanding the relationship between diet and ornamentation in natural settings is imperative in discerning what information is communicated and selected for in bird populations, and how environmental change may impact reproductive success.

Interspecies variability in responses of aerial insectivorous birds to agricultural conversion, pesticides, and climate in Canada's Prairie Pothole region

Michel, Nicole - National Audubon Society; Robert Clark - Wildlife Research Division, Environment and Climate Change Canada; Keith Hobson - Environment Canada; Christy Morrissey - University of Saskatchewan

Many aerial insectivorous bird species are experiencing severe population declines across North America. Although they have varied life-histories, this guild is grouped by diet and foraging strategy on the assumption that invertebrate prey availability explains their population declines. Yet aerial insectivorous birds face a variety of threats such as pesticides, habitat loss, and climate change that likely have species-specific effects. Here we evaluate the relative effects of agricultural conversion, pesticides, and climate on a suite of six aerial insectivorous bird species: Purple Martin (*Progne subis*), Tree Swallow (*Tachycineta bicolor*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), Bank Swallow (*Riparia riparia*), Cliff Swallow (*Petrochelidon pyrrhonota*), and Barn Swallow (*Hirundo rustica*). We used boosted regression trees to assess the ability of these variables to predict aerial insectivorous bird relative abundance on 117 Breeding Bird Survey routes across the Prairie Pothole region of Alberta and Saskatchewan over a 31-year period (1981-2011). Relative effects of predictors varied widely between species, with agricultural intensity explaining from 20% to over 90% of the variation. While pesticide use was not the primary driver of population variation for any species analyzed, the coarse scale of available data may have limited our ability to detect effects; moreover the effects of agricultural intensity may be mediated by

pesticides. Our findings have important implications for aerial insectivorous bird conservation and management in Canada's Prairie Pothole Region, and suggest that a variety of factors contribute to population declines among this guild.

Reproductive output, parental and juvenile condition, and life history in Flammulated Owls
Mika, Markus - University of Wisconsin La Crosse; David Oleyar - HawkWatch International; Clayton White - Brigham Young University

While raising young, parents face significant energetic trade-offs. Increased parental provisioning may drain reserves in adult birds while their juveniles experience improvements in individual growth or numbers of successful fledglings. Breeding locations in areas of high quality food resources can offset the need for more food deliveries by parents while still enhancing reproductive output or accelerating juvenile growth rates. Sub-optimal foraging habitat may decrease clutch sizes unless parental efforts are increased during nesting periods. We measured food resource abundance, parental and juvenile condition, and reproductive output in Flammulated Owl over seven breeding seasons across four habitat patches in northern Utah. Special attention was paid to females who returned over multiple seasons. Due to their semi-colonial breeding distribution in relatively small nesting territories, these nocturnal raptors are excellent study organisms to investigate foraging and breeding relationships. High quality nest sites and habitat patches positively impacted reproductive output among breeding females. We did not observe a relationship between weight loss of females and brood sizes during nesting periods. However, juveniles in larger broods grew at slower rates and on flatter growth curves than young in smaller broods.

Views on conservation engagement among dedicated birders: Findings from workshops informing the North American Waterfowl Management Plan
Miller, Holly - U.S. Geological Survey; Colin Leslie - City of Boulder; Earlene Swann - U.S. Geological Survey; Rudy Schuster - U.S. Geological Survey

The 2012 North American Waterfowl Management Plan (NAWMP) outlined new objectives focused on increasing waterfowl conservation support among various constituencies including waterfowl hunters, viewers, and the general public. To meet this goal, NAWMP has begun a multi-year effort to engage waterfowl stakeholders through collaborative processes to better understand their knowledge, preferences, levels of use, and support for waterfowl and wetlands conservation. As part of this effort, a series of workshops were conducted across the United States in the spring of 2015. The 12 viewer workshops focused on birding preferences among relatively experienced birders. The importance of birders contributing to or engaging in conservation was a main theme to emerge from these workshops. Conservation engagement included citizen science efforts and community involvement, as well as mechanisms for funding and recognition of such support. This presentation will report on the preferences expressed by workshop participants for engagement, as well as barriers to engagement.

Proximity to Road Traffic Depresses American Kestrel Reproductive Performance
Miller, Karl - Florida Fish and Wildlife Conservation Commission

The Southeastern American Kestrel (*Falco sparverius paulus*) is a non-migratory, resident falcon listed as Threatened in Florida because of long-term population declines associated with habitat conversion and fire suppression. Currently, nest boxes and other anthropogenic structures provide many of the

remaining kestrel nest sites, and most are located along roads and highways. We assessed the impacts of roads and other environmental variables as predictors of kestrel reproductive performance in large (250 km2) pasture-dominated landscapes provisioned with 142 nest boxes. We used Florida Department of Transportation data to categorize public roads in descending order of traffic volume: principal arterial, minor arterial, major collector roads, and rural and unsurfaced roads. Road class did not significantly influence clutch size, hatching rate, or number of fledglings, but it significantly influenced morphometrics of nestlings measured at 25 days of age. Nest boxes near rural roads with less traffic had less brood reduction and produced heavier broods than nest boxes located near heavily-traveled arterial highways. Availability of "open" land cover types had no influence on any response variable. Nest attendance rates were lowest along arterial highways with narrow shoulders, which suggests that food provisioning rates may have been depressed by proximity to noise and/or traffic. More research is needed in other locations to confirm the effect of roads on kestrel nestling development and to understand mechanisms behind those effects. Implications for management of American Kestrel nest-box programs throughout the U.S. are discussed.

Implementing Landscape-Scale Conservation for Forest-Breeding Birds through Prioritized Habitat Restoration

Mini, Anne - Lower Mississippi Valley Joint Venture; Randy Wilson - U.S. Fish and Wildlife Service; Daniel Twedt - U.S. Geological Survey; Keith McKnight - Lower Mississippi Valley Joint Venture

Bottomland hardwood forest in the Mississippi Alluvial Valley has been dramatically reduced and fragmented, primarily from conversion to agricultural production, with only 30% of the original 10 million hectares remaining. Thus, a primary focus of Lower Mississippi Valley Joint Venture partners has been to protect, manage, and restore forest in ways that build large, contiguous forested areas or "core forest" needed by many landbird species. "Core forest" has a 250-meter buffer against surrounding unsuitable habitats and is the basic building block of priority bird habitat in the Mississippi Alluvial Valley. This key understanding of the birds' biology was incorporated into a landscape-scale Forest Breeding Bird Decision Support Model, which public land management agencies and non-governmental partners use to target acquisition, protection, and reforestation efforts that maximize benefits to priority bird species, such as Swallow-tailed Kite and Prothonotary Warbler. To date approximately 1 million acres of forest have been restored. This model has directly impacted habitat conservation delivery programs. For example, it has been used in ranking applications for funding through the Wetlands Reserve Easements (WRE) by identifying tracts within high priority reforestation areas. As a result, WRE has supported the reforestation of over 700,000 acres within the Mississippi Alluvial Valley—a substantial increase in available habitat for priority bird species — most of which has been strategically placed to help build core forest.

The Harsh Weather Hypothesis: A Proximate Mechanism for Slow Post-Natal Development of High Elevation Birds

Mitchell, Adam - University of Montana; Thomas Martin - USGS - University of Montana

Birds living at high elevations commonly have slower life history traits than those at lower elevations. Thus far, a general consensus has not yet been reached on the causes of slower traits at high elevations. Here we present a novel hypothesis, the harsh weather hypothesis, and test it to help explain global patterns of life histories of high elevation birds. This hypothesis states that

harsh weather conditions at high elevations (namely ambient temperatures far below the developmental optimum) place temporal constraints on parents, who must spend more time warming nestlings, resulting in less time available for provisioning offspring. This reduced provisioning rate may be a proximate mechanism causing delayed post-natal development, a key life history stage. We tested this hypothesis by adding supplemental heat to nests of Mountain Blackeyes (*Chlorocharis emiliae*) at a high elevation field site (3200 m asl) on Mt. Kinabalu, Malaysian Borneo. Our results support the harsh weather hypothesis showing that heated nests cause lower adult brooding and increased nestling provisioning rates. This suggests that low ambient temperatures constrain parental behavior by requiring additional brooding time, thereby reducing provisioning rates, and delaying offspring growth. Thus, our results explain one mechanism by which life history traits of high elevation birds are slower than those of lower elevations. Elevational gradients are one of the major biogeographical gradients in which life history variation commonly occurs. These results will greatly improve our understanding of life history variation across elevations, and the range of abiotic factors causing these differences.

Automated telemetry reveals regular and extensive movements by Bank Swallows to wetland roosting habitat during breeding: implications for conservation

Mitchell, Greg - Wildlife Research Division, Environment and Climate Change Canada; Myles Falconer - Bird Studies Canada; Douglas Tozer - Bird Studies Canada; Kristyn Richardson - Bird Studies Canada; Philip Taylor - Acadia University; Mike Cadman - Canadian Wildlife Service, Environment and Climate Change Canada

Aerial insectivores, including swallows, are showing some of the strongest population declines of all avian guilds in Canada. An important step towards understanding the mechanisms resulting in these declines is identifying habitat requirements. We used a small automated telemetry array in 2012 and the Motus Wildlife Tracking System in 2015 to investigate breeding habitat use of adult Bank Swallows in southwestern Ontario, Canada. Birds were radio tagged at eight lakeshore colonies along the north shore of Lake Erie and at six inland sand and gravel pit colonies within 100 km of the lakeshore. We found that both sexes made extensive and regular movements (10s of km) during the early evening to large wetland complexes around Long Point, Lake Erie, to roost. Males were more likely to roost away from the colony relative to females, and both sexes were more likely to roost away from the colony as the breeding season progressed. We also found that birds were only willing to commute to the large wetland complexes around Long Point if their breeding colony was within 40 km of the wetland complexes; birds from more distant colonies travelled to alternative roosting sites. While swallows are known to regularly roost and stage in wetlands during the pre-migratory and migratory periods, our research demonstrates the importance of wetlands as roosting habitat during the breeding period and illustrates how automated telemetry can be used to capture and infer regional patterns of habitat use.

Combining Breeding Bird Survey data and crop mapping to assess how amount and diversity of agriculture affects avian diversity in central Canada

Mitchell, Greg - Wildlife Research Division, Environment and Climate Change Canada; Scott Wilson - Wildlife Research Division, Environment and Climate Change Canada; Mark McGovern - Landscape Science and Technology Division, Environment and Climate Change Canada; Jon Pasher - Landscape Science and Technology Division, Environment and Climate Change Canada; Marie-Anne Hudson - Canadian Wildlife Service, Environment and Climate Change Canada; Lenore Fahrig - Biology Department, Carleton University

Conversion of natural habitat to agriculture is one of the primary threats to biodiversity and with an increasing need for food production this threat will intensify over the next few decades. Research is therefore needed to understand how we can manage agricultural landscapes to maximize biodiversity. We combined data from the Breeding Bird Survey with remotely sensed agricultural crop mapping to study how avian diversity was impacted by agricultural type (forage crops/pasture vs food crops) and heterogeneity across 131- 16 km2 landscapes in southern Ontario and Quebec. We examined the effects of agriculture on total avian diversity and diversity within forest, shrub-edge, grassland and generalist guilds. Total diversity and diversity of the forest and shrub-edge guilds showed strong, negative responses to amount of food crop but neutral responses to total forage crop while grassland bird diversity was positively affected by both types. We expected that greater food crop diversity would enhance avian diversity because of higher semi-natural habitats along field boundaries, but forest and shrub-edge species showed no response while the grassland guild was negatively affected by crop diversity. We also found that the negative effect of total crop amount on avian diversity was strongest in landscapes with higher crop diversity. Forest and shrub bird diversity was positively affected by total hedge row amount but only in open landscapes (>50% open cover) suggesting hedge rows along field edges can help enhance diversity in landscapes that are otherwise less suitable for species in these guilds.

Migratory connectivity and demographic properties in Semipalmated Sandpipers: implications for conservation

Mizrahi, David - New Jersey Audubon

Since the 1980s, Semipalmated Sandpipers (SESA) have declined by ~80% in their primary wintering region of northeastern South America (Suriname, French Guiana, northern Brazil), which historically supported ~90% of the continent's population. Understanding migratory connectivity is critical to developing effective conservation strategies for this species. Knowledge about demographic properties is also important, as threats can affect population trajectories differently when sex and age classes segregate spatially/temporally during the annual cycle. Sex ratios at northeastern South America wintering sites were skewed, with males accounting for ~65% of adults and ~60% of first-year birds sampled. SESA wintering in this region face significant threats, such as illegal or poorly regulated hunting and habitat loss. On northbound migration, many individuals overfly the Lesser Antilles, make landfall in the southeast US, and then continue to Delaware Bay, the most important staging site for SESA en route to eastern Canadian Arctic breeding grounds. Sex ratios in the Bay are slightly skewed, with females accounting for ~51% of all individuals sampled. Since 2000, SESA have experienced dramatic declines in horseshoe crab egg availability, the primary food resource during the Delaware Bay staging period. Females typically arrive later than males, likely compromising their ability to accumulate energy reserves during a shorter staging period and possibly affecting overall

fitness. Future work will use a full life cycle, migratory network modeling approach to elucidate how threats occurring across the annual cycle, and on different demographic segments, affect SESA population trajectories.

Resolving Sexual Conflict over Biparental Care

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Biparental care is common only in birds. Theoretically, it evolves when investment in offspring pays higher fitness dividends (vs. alternative activities) for both adults. Even then, each should prefer the other to invest more ('sexual conflict'). The premier resolution model for biparental cooperation posits interactive negotiations over division of labor, though cooperation can also result from reciprocity and/or coercion. In Oklahoma house sparrows, parents seemed not to negotiate when provisioning, so we focused on incubation (when parents can monitor partner contributions more easily). Moreover, incubating female sparrows had demonstrated a compensation response when their testosterone-implanted partners reduced incubation. The key question thus became whether males also respond when females alter their contributions? We engineered female increases (food supplements) or decreases (artificial heat only when female present), comparing those males' patterns with control pairs. Male partners did not respond. Without symmetrical negotiation, the question remains: what prevents males from reducing to zero? We identify three countervailing factors as a testable answer. First, incubating males are poorer heat sources, capable of little more than retarding egg heat loss and nest-guarding. Second, the 15 min/h of male attendance frees the female for self-maintenance essential for her to sustain high provisioning effort to boost brood fitness. Third, low Brood Outcomes (= total brood mass at fledgling) often lead to mate-switching, which penalizes only male fitness. After switching, the female pairs again and recovers to the median outcome on her next cycle, but male outcomes fall 25%.

Mechanism for vocal discrimination in nesting calls of the Lilac-Crowned Parrot

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Parrots show variation in composition, syntax and phonology of duet calls, however few studies have tested importance of these attributes in call recognition and discrimination. We recorded response of 6 incubating Lilac-crowned Parrot (*Amazona finschi*) females to playback trials of male nesting call: a natural call, modified note composition, syntax and phonology; and the response to real male nesting call as control. For each trial, we registered 4 behavioral variables and reduced axes for analysis with a Principal Component Analysis. We then used a Friedman ANOVA to determine differences in female response among playback trials, and Wilcoxon test to compare female response to each playback with control. One PC explained 74.6% of variance, and differed significantly among playbacks (Friedman ANOVA $Z3= 9.5$, $P=0.023$). Posthoc comparison showed significant differences between natural and modified syntax and phonology. Paired comparisons of playbacks with control determined that females responded significantly less to modifications of syntax, phonology, and composition, but not differ from natural encounters. Female discriminated among playbacks, where modification of attributes reduced response. This supports an innate auditory template in vocal learning, where modification of attributes changes original message. The fact that modification of attributes affected female response may reflect the importance of call in coordinating reproduction, suggesting a critical communication function. For cavity-nesting birds without visual cues to identity of callers,

acoustics signals could be fine-tuned to reflect individuality and avoid risks to false positive identification.

The peahen is a persnickety shopper
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While female choice and its influence on male traits have been widely documented in birds, we still know very little about the process by which a female chooses a mate. Such information is needed to understand why females make diverse choices and to shed light on the maintenance of variation in male traits. To document the process of mate choice, we observed and followed 35 peahens (Indian Peafowl *Pavo cristatus*) as they visited lekking peacocks in a feral population in Arcadia, California. We recorded male-female interactions, the courtship behaviour (train rattling, orientation) and plumage traits (train size, eyespot number and colours, crown) of all males visited, and all copulations during our observation periods. Individual peahens visited leks repeatedly over several weeks, returning nonrandomly to males they had visited in the past. Different females tended to visit different males with no evidence of copying or being influenced by the visits and choices of other peahens. A peahen's sequence of visits to leks were also structured in time, as they returned to males they had previously visited sooner than expected if visits were randomly allocated. These results point to a potential role for memory in mate choice—by remembering and returning to males with attractive displays, females may be able to assess the consistency of male courtship displays, and thereby reduce uncertainty about the quality of male traits. We did not observe all peahens copulating, but when they did they preferred males whose train eyespots displayed particular iridescent colours.

A Place to Land: Stopover Ecology and Conservation of Migratory Songbirds
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The majority of songbirds that breed in temperate North America move to nonbreeding areas in Mexico, Central and South America and the islands of the Caribbean, and the Gulf of Mexico (GOM) features prominently in this Neotropical-Nearctic migration system. Habitats along the northern gulf coast provide the last stopover before migrants must negotiate this barrier, and the first landfall for birds returning in spring. During stopover, a migrant usually finds herself in unfamiliar surroundings at a time when energy demands are high, often faced with the need to acquire food in a short period of time, while balancing conflicting demands between predator avoidance and food acquisition, competition with other migrants and resident birds for resources, unfavorable weather, exposure to parasites and pathogens, and the need to make accurate orientation decisions upon departure. The decisions made at this juncture depend essentially on a scale-dependent relationship to habitat. The efficacy of her decisions will determine the success of her migration, while success is measured in terms of survival and reproductive performance. Today, the availability of suitable stopover habitat is often at odds with rapid human population growth in coastal landscapes. The GOM will continue to experience significant loss of habitat due to natural disturbances and anthropogenic impacts. Conservation and management of important coastal areas must be informed by data that explain how migratory birds use habitat, document temporal and spatial population trends, and offer capacity to explain those trends and the major stressors driving abundance and distribution of migratory birds during stopover.

Use of stable isotopes (δ13C and δ15N) to determine seasonal variation and shifts in diet composition of the endangered Attwater's prairie chicken (*Tympanuchus cupido attwateri*) in Texas
Mora, Miguel - Texas A&M University; Zaria Torres - Texas A&M University

The Attwater's prairie chicken (APC; *Tympanuchus cupido attwateri*) has been on the endangered species list since 1967. Recovery efforts have been implemented since then, but unfortunately with little success. One recent study suggests that available insect biomass in APC habitat has been significantly reduced in Texas by the invasive red imported fire ant (*Solenopsis invicta*). We used stable isotope techniques to determine seasonal shifts in diets of APCs at the Attwater's Prairie Chicken NWR. We also determined if current diets have switched from those in the past based on analysis of feathers from museum specimens. We analyzed δ13C and δ15N in blood, feces, and feathers from APCs, as well as in vegetation and insect samples collected throughout the year. Using the stable isotope mixing model (MixSIAR) we determined that APCs switched diets over the annual cycle and summer diets consisted mainly of non-legume forbs, and insects from the groups coleoptera, araneae, and hymenoptera. δ15N values in feathers of museum specimens were greater than those in feathers taken from individuals currently in the wild. However, δ13C values in feathers were not different; although, feathers from current specimens had greater variability. Lower δ15N values and a broader range of δ13C values in feathers of current APCs compared to historic values, suggest APCs may currently be utilizing less insects during the period of feather growth perhaps because of lower availability. The current APC population in the wild also may be consuming more grasses and forbs than what they consumed in the past.

Sex differences in the stopover behaviour of Black-throated Blue Warblers during spring migration
Morbey, Yolanda - Western University; Christopher Guglielmo - Western University; Ivan Maggini - Western University; J. Morgan Brown - Acadia University; Stu Mackenzie - Bird Studies Canada

In long distance migrants, the seasonal timing of migration is part of an evolved strategy to deal with spatio-temporal environmental variability and competition for resources. A dominant sex-specific migratory pattern is protandry, whereby males migrate and arrive earlier at breeding areas than females, likely as a strategy to maximize mating opportunities. In a radiotelemetry study using the Motus Wildlife Tracking System, we tested for sex differences in the stopover behaviour and post-departure movement of the sexually-dichromatic Black-throated Blue Warbler at Long Point, Ontario. In the two years of our study, we found no sex differences in the onset or duration of diel foraging activity, the minimum length of stay before departure, the departure time, or the post-departure movement paths.

Agricultural intensification as a driver of precipitous declines of farmland birds in North America
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Over the last 50 years, agriculture has undergone dramatic changes worldwide, with consequences for many farmland-associated birds. The relationship between agricultural intensification and avian declines has been established in Europe, however links for North American species have received less study. We found trends in populations of birds associated with farmlands and grasslands in

North America shows severe declines with 57 of 77 (74%) species exhibiting decreases from 1966 to 2013. The greatest concurrence in multiple species declines occurred during 1960s-1980s, a period with high agrochemical use and widespread conversion of grasslands to cropland. The most severe declines occurred in aerial insectivores (average decline of -38.3% from 1966 to 2013), followed by grassland birds (21.5%) and shrub (-16.0%) species. Evidence exists for direct drivers through loss of natural habitats, interference from farming equipment, direct mortality or sublethal effects from pesticide exposure. Indirect drivers occur through reduced food supplies, pesticide sublethal toxicity, habitat alteration and disturbance often through subtle interference with behaviour or physiology. Mechanistic studies examining indirect effects are rare, though here we present a case study with Tree swallows in the Canadian Prairies. Combined research evidence suggests two leading drivers of North American farmland bird declines are frequency and area of pesticide use and destruction of grassland habitat. We recommend changes to farmland management to reduce pesticide inputs through integrated pest management and maintain uncultivated field margins - both have been shown to positively influence farmland birds without reducing agricultural crop yields.

Clear differentiation between island races of the White-breasted Thrasher (*Ramphocinclus brachyurus*), an endangered Antillean passerine

Mortensen, Jennifer - Tufts University; Jeffrey DaCosta - Harvard University; Matthew Miller - Villanova University; University of Oklahoma; Jean-Raphaël Gros-Désormeaux - University of the French West Indies and Guiana; Thierry Lasales - Cabinet d'Ingénierie Homme Et Nature Conseil Environnemental (CIHENCE); Georges Tayalay - Association Ornithologique de la Martinique (AOMA); Robert Curry - Villanova University; J. Michael Reed - Tufts University; Michael Sorenson - Boston University

This study provides the first description of genetic diversity and population structure of the Red Listed Antillean mimid, *Ramphocinclus brachyurus*. The species is endemic to Saint Lucia and Martinique, where it has subspecies status on each island. We used ddRAD-seq, a reduced representation genomic method, to identify thousands of SNPs across the genome of the Martinique subspecies and the two populations of the Saint Lucia subspecies. Pairwise multilocus fixation indices (ΦST and FST) demonstrated strong differentiation between island populations; values were higher than those reported for the few other avian subspecies pairs, and even species pairs, analyzed with similar molecular methods. Clustering-based methods, run without prior location information, grouped samples unequivocally by subspecies. We also found a low, but significant, degree of genetic differentiation between the Saint Lucia populations, which are separated by only ~3 km. Decreased gene flow across this short geographic distance is likely due to intensive human land-use between ranges, exacerbated by the species' typically short dispersal distance. Measures of genetic diversity were similar among the three Ramphocinclus populations, despite relatively large differences in extant population size and the Martinique population having presumably recovered from very low numbers within the last century. Plumage, biometric, and vocalization differences between subspecies are concordant with genomic differences. All together, these data provide support for recognition of species-level differentiation between the island populations of Ramphocinclus thrashers. Resolution of this taxonomy has important implications beyond avian classification.

Casting a sonic net: deterring birds from food sources using acoustic ecology
Moseley, Dana - William and Mary, Smithsonian MBC; Waverly McClusky - The College of William and Mary; John Swaddle - The College of William and Mary

Despite their conservation importance, birds are often considered pests in socio-economically valued landscapes, such as in the agricultural industry. Each year, birds cause billions of dollars in crop losses. Thus far, techniques to keep birds away from farms have been ineffectual since birds habituate to the scare techniques, and pesticides have environmental consequences. We ask if directional, broadband noise would effectively and sustainably deter birds from food sources. We hypothesized that this "sonic net," which completely masks the range that birds vocalize and hear, would decrease foraging at high-value food sources. Over five months at three sites, we compared foraging at feeders treated with the sonic net to control feeders and recorded the mass of food eaten and bird presence by species. We then limited food access to control feeders, such that birds had only half as much access to control feeders as compared to sonic net-treated feeders. We found that for the sonic net-treated feeders, the mass of seed eaten was reduced by roughly 33% in the first experiment, and 14% in the food-limited experiment despite the fact that twice as much food was accessible at the sonic net feeders. Duration of bird visitation was similarly reduced by 35%, and these patterns held over the course of the noise exposure. These results suggest tapping into birds' acoustic ecology may reveal an application of directional noise to protect both crops from birds and birds from human structures such as wind turbines.

Enemies aren't always dear: Male song sparrows vary the dear enemy effect across different periods of female fertility
Moser-Purdy, Christopher - University of Windsor; Elizabeth MacDougall-Shackleton - Western University; Daniel Mennill - University of Windsor

Across diverse animal taxa, territorial interactions with unfamiliar strangers are more intense than those with familiar neighbours. This phenomenon is called "the dear enemy effect". The dear enemy effect occurs because strangers represent a threat to an animal's territory and paternity, whereas neighbours already hold territories and represent a threat only to paternity. Recent studies have revealed that the strength of the dear enemy effect varies during the breeding season, but the factors responsible for this variation remain unknown. One possible explanation is variation in female fertility; neighbours become an increased threat when they seek extra-pair copulations during female fertile periods. To test this hypothesis, we conducted a playback experiment on male Song Sparrows (*Melospiza melodia*) in Ontario, Canada in 2015 and 2016. We exposed 25 territorial males to playback simulating a stranger and a neighbour, multiple times during the fertile and non-fertile periods of the subjects' social mates. We determined female fertility status by monitoring the nests and behaviour of the playback subjects. We found that males displayed a dear enemy effect when their mates were non-fertile, but they showed equal levels of aggression to playback of neighbours and strangers when females were fertile. This study furthers our understanding of the motivations of songbirds to interact with conspecific individuals, revealing adaptive flexibility in the dear enemy effect according to female reproductive stage.

Genomic insights into speciation in a widespread Pacific island bird lineage
Moyle, Robert - University of Kansas; Joseph Manthey - New York University Abu Dhabi; Michael Andersen - University of New Mexico; Carl Oliveros - Louisiana State University; Chris Filardi - American Museum of Natural History

The archipelagos of the SW Pacific are among the world's great natural laboratories, with diverse island sizes and degrees of isolation that support high species diversity and endemism. Phylogenetic relationships among island bird taxa are being clarified at a rapid pace with DNA sequence data, but aspects about the speciation process, such as the tempo of speciation and occurrence of gene flow, remain unclear. White-eyes (Aves: Zosteropidae) are one of the most rapid radiations among birds and have a complex speciation history in the SW Pacific. We used two methods of reduced-representation genomic sequencing to assess the relationships among species and populations of white-eyes (Aves: Zosteropidae) in the Solomon Islands. Data from both methods reveal two notable patterns: 1) gene flow among well-differentiated species and 2) no discernable genetic difference between morphologically and behaviorally distinct populations. These data support that diversification can be rapid and may occur without complete isolation of incipient species.

Cuban Bird diversity and habitat conservation through the Cuban National System of Protected Areas (SNAP)
Mugica, MSc. Susana - Centro Nacional de Áreas Protegidas (CNAP)

The presentation will show the current state of the National System of Protected Areas (SNAP) of Cuba, as well as the results obtained in bird conservation in the SNAP, through the coordination of National Center of Protected Areas (CNAP). One of the main results have been the Cuban Important Bird Areas Program (IBA), it started in 2000, with the support of other institutions like Habana University, Ecological and Systematic Institute, Natural History Museum and BIOECO. In 2009, 28 Cuban IBAs were identified and we will show the trends and state of Cuban IBAs since 2009 to 2015. In the last years several actions and projects have been done with an increase in legal protection and site conservation. We expose these projects results in the creation of bases for sustainable ecotourism, training, reforestation, erosion control, invasive species control, environmental education and community work and threatened endemic species research. The results of several National Symposium of Cuban Ornithologist with the support of the IBAs Program, Birdlife International, Cornell University and Cuban Zoological Society, will be analyzed. Finally, we will discuss the Waterbird Monitoring Program, organized by the SNAP and Havana University, its results and capacity building.

A unified theory on the use of orientation cues by migratory songbirds
Muheim, Rachel - Lund University; Sissel Sjöberg - Lund University

Migratory birds use multiple compasses for orientation, including a magnetic, star and sun/polarized light compass. They have to regularly update these compasses with respect to a common reference to keep them in register. Cue-conflict studies have resulted in contradictory results on the compass hierarchy, disagreeing about whether celestial or magnetic compass cues are the primary calibration reference. We showed earlier that the geomagnetic field and polarized light cues present at sunrise and sunset play a key role in compass cue integration and proposed that polarized light cues at sunrise and sunset provide the primary calibration reference for the other compass systems. New results with migratory garden warblers and a meta-analysis of the available literature suggest that migratory

songbirds recalibrate their magnetic compass by sunrise/sunset polarized light cues, provided they have access to the vertically aligned band of maximum polarization near the horizon and a view of landmarks. If polarized light information is not available near the horizon at sunrise or sunset, the birds temporarily transfer the previously calibrated magnetic compass information to the available celestial compasses. Once the stars appear in the sky, the birds recalibrate the star compass with respect of the recalibrated magnetic compass. If sunrise and sunset information can be viewed from the same location, the birds average the information to get a true geographic reference. Thus, the type of cue-conflict manipulation and the availability of stars can explain the discrepancies between studies.

Effects of Anthropogenic Noise Exposure on Secondary Cavity Nesters
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Anthropogenic noise is an increasingly prevalent global disturbance. Animals that rely on the acoustical environment, such as songbirds, are especially vulnerable to these sounds. Traffic noise, in particular, overlaps with the frequency range of songbirds, creating masking effects. Here, we investigated the effects of chronic traffic noise on the breeding success of nesting Western Bluebirds (*Sialia mexicana*) and Ash-throated Flycatchers (*Myiarchus cinerascens*). Because anthropogenic noise exposure has the potential to interrupt parent-offspring communication and alter vigilance behaviors, we predicted that traffic noise would negatively influence one or more metrics reflective of reproductive success, such as nest success, clutch size, number of nestlings or number of fledglings. Importantly, we were able to eliminate self-sorting among individuals with respect to noise and other possible effects of traffic, such as collisions and pollution, by experimentally introducing traffic noise into nest boxes after clutch initiation using playback systems. Our results indicate no effect of traffic noise on *S. mexicana* reproductive measures. However, *M. cinerascens* may experience fitness consequences from chronic anthropogenic noise exposure. Despite equal clutch sizes to flycatchers in boxes with no noise exposure, noise-treated flycatcher nests experienced a reduction in hatching success relative to control boxes. We contrast these species-specific responses to recent observational work on both species in New Mexico and other studies that have examined fitness consequences of noise. Lastly, we stress the importance of these findings in addressing current conservation practices of nest box placement with respect to roads.

Simultaneous rectrix molt is associated with uniparental desertion of late-season young in Hooded Warblers
Mumme, Ronald - Allegheny College

North American warblers molt their rectrices simultaneously in late summer, leaving molting birds without a functional tail for several days. Because the tail is an important foraging tool for Hooded Warblers — they use their white tail spots and tail-flicking behavior to startle insect prey — I examined the relationship between tail molt and parental care of late-season nestlings and fledglings in Hooded Warblers of NW Pennsylvania. Hooded Warbler nestlings fledge when 9 days old, but remain dependent on adults until age 35 days. Of 32 adults initiating rectrix molt before the end of parental care, 78% deserted nestlings (n=7) or fledglings (n=18), leaving the other parent responsible for all remaining parental care. Males were the deserting sex in 92% of cases, and generally initiated rectrix molt about two weeks earlier (10 Aug ± 8 d) than females (25 Aug ± 12 d). Although it is not entirely clear why some molting birds do not desert, brood age is certainly a contributing factor; mean age of the dependent young at the start of rectrix molt was significantly

greater for non-deserters (27 ± 7 d old) than for deserters (15 ± 12 d old). My results suggest that the simultaneous rectrix molt of warblers, which begins while birds are also molting primaries, carries significant energetic demands and can compromise late-season parental care, particularly in species where the tail plays an important role in foraging.

The role of facilitation in the structure of tropical bird communities: a case study of mixed-species flocks
Munoz, Jenny - University of British Columbia; Jill Jankowski - University of British Colombia

Understanding the influence of species interactions on community structure is a long-standing goal in ecology. While many studies have focused on negative biotic interactions, the role of other mechanisms has received less attention, in particular, facilitation. In birds, facilitation occurs in mixed species flocks, in which individuals of several different species move and forage as a group to obtain potential benefits from the association. These associations of species in mixed flocks have been described in different habitats during the last century; however, there is still much debate regarding the prevalence of this foraging strategy and the role it plays in Neotropical bird communities. In this study, we investigate how facilitative interactions in mixed-species flocks influence the structure of Neotropical bird communities across an elevational gradient and examine the role of facilitation in reinforcing elevational range limits of birds species. First, we examine how the structure of mixed flocks changes across elevations. Second, we quantify the stability of these multispecies groups over time. Third, we evaluate the association of several key habitat variables with flock diversity. Finally, we examine the co-occurrence and elevational range patterns of flocking species. To address these questions, we integrated data from flock observations, occurrence and elevational ranges of species. Data was collected along a 3000-m elevational gradient on the eastern slope of the Andes in Peru. Our results showed that, like lowlands flocks, mid- and high-elevation flocks are diverse and highly stable multi-species groups suggesting that these flocks are functional subunits of tropical communities.

Understanding the feedback loop between birds and coffee culture in Colombia
Munoz, Jenny - University of British Columbia; Jill Jankowski - University of British Colombia; Gabriel Colorado - Universidad Nacional de Colombia sede Amazonía

Colombia is widely recognized as the global hotspot of bird diversity, as the country supports more than 1800 bird species year-round. This high level of bird species richness is coupled with one of the most extensive deforestation among Neotropical countries. The major causes of deforestation in this country include agricultural intensification, urbanization, and logging. Coffee, one of the main agricultural crops in Colombia, has been cultivated traditionally under shade conditions (i.e. plants grow in the understory of native tree cover). However, the most extensive form of cultivation today is simplified monocultures with full sunlight exposure. In the face of current and projected rates of deforestation, the installation of traditional agroforestry systems such as shade-coffee represents a tremendous opportunity to link high modified landscapes with avian biodiversity conservation. Here we explore the positive feedback between shade-coffee systems and forest bird diversity. Specifically, we examine the role of shade-coffee systems in providing suitable habitat to support resident and migrant bird species. We also review the potential positive effect of avian diversity and coffee productivity (e.g., better coffee attributes), as well as the potential socio-economic benefits obtained from shade coffee production systems. Finally, we provide a conceptual overview of this positive feedback and the importance of reintegrating traditional shade-coffee systems, and in general, sustainable agroecosystems

practices in Colombia's coffee culture for avian conservation.

Seasonal decline of clutch size by a migratory passerine: The relative importance of enviornmental and female quality.
Murphy, Michael - Portland State University

Seasonal declines of clutch size are widespread among single-brooded bird species breeding in seasonal environments but explaining why this is so remains elusive. I address this question using 27 years of data on Eastern Kingbirds (*Tyrannus tyrannus*) from Kansas, New York, and Oregon. Size of initial clutches always declined seasonally, and within sites, mean annual clutch size was smaller in years of delayed breeding, suggesting that factors associated with calendar date had important influences on reproductive "decisions". However, individual variation in clutch size for all years/sites combined exhibited a 50% stronger relationship with relative laying date (laying date in relation to median date) than with median laying date of each clutch's year of study when the two were examined together. Females that replaced failed first clutches also laid larger clutches than contemporaneously produced initial clutches. Position in the laying sequence, likely reflecting female quality, thus had a stronger effect on clutch size than calendar date. Neither the probability that nests fledged young nor the severity of nestling losses to the major sources of mortality (predation, starvation, weather) varied seasonally. By contrast, in Oregon, where recruitment was studied, probability of young returning from migration declined with relative laying date (but not calendar date). Seasonal decline in clutch size thus does not appear to be a response to predictable changes in conditions for rearing young, but appears mainly a product of the ability of the highest quality females that lay the largest clutches and raise the highest quality young to breed first.

Phylogenomic analysis using ultraconserved elements reveals cryptic diversity in the complex Neotropical genus Pachyramphus
Musher, Lukas - American Museum of Natural HIstory; Joel Cracraft - Department of Ornithology, American Museum of Natural History

Phylogeographic studies within the Neotropics continue to uncover cryptic diversity, the extent of which remains unknown. Molecular studies of suboscine birds, in particular are producing evidence that diversity is substantially underestimated. One group of Neotropical suboscine birds, the becards (genus: Pachyramphus), ranges from Argentina through northern Mexico and the Caribbean. Within the 16 currently recognized species, 55 taxa have been described. Their taxonomic relationships have been confusing and controversial. The genus has bounced around a number of suboscine families and been considered incertae sedis repeatedly. Within-genus taxonomy has also been complex, as certain named taxa have been designated to multiple species-groups. Previous analyses (Barber and Rice, 2007) found evidence of paraphyly in one species, *P. castaneus*, but all prior studies have been both taxonomically and phylogeographically under-sampled. We sequenced mitochondrial DNA for 255 individuals of 50 taxa, including all recognized species, in the genus Pachyramphus, and used target capture and massively parallel sequencing of ultraconserved elements for 41 individuals of 29 taxa, resulting in the most densely and completely sampled phylogenetic hypothesis for Pachyramphus to date. While some discordance between gene-trees and species trees for diagnosable taxa may be attributable to incomplete lineage sorting or gene flow at recent timescales, we provide evidence for multiple young, previously undetected evolutionary lineages within Pachyramphus. Deep, well-supported branches, nonmonophyletic taxa, and a high number of reciprocally monophyletic

intraspecific lineages across the tree suggest that diversity is underestimated and the evolutionary history has been misunderstood.

Foraging and Diving Ecology of the Socotra Cormorant in the eastern Arabian Gulf: conservation implications.
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The Socotra Cormorant (*Phalacorocorax nigrogularis*) is a regional endemic seabird restricted to the Arabian Gulf and Gulf of Oman areas. They have been declining since the 1980s and about 700,000 birds exist. The breeding colonies are small islands that are few in numbers and threatened by disturbance and development. Many colonies have become extinct due to oil exploitation in the Arabian Gulf. We studied foraging and diving behavior of breeding Socotra Cormorants on Siniya Island, Umm Al Quwain, United Arab Emirates, one of the largest colonies in the region with a breeding population of 28,000-35,000 pairs. We attached GPS loggers and temperature-depth recorders to quantify foraging ecology. 5,225 dives by 20 birds (2012-2013) were recorded. Dive duration increased with dive depth. Mean dive depth was 6.9 ± 5.0 m and mean dive duration was 24.1 ± 13.2 s, with most dives occurring at 1-2m and 5-11m depths. Dive profiles ranged from parabolic (9.1%), irregular (28.2%), flat-bottomed (35.4%) to V-shape (27.2%). Mean foraging trip duration was 3.82 ± 1.6 h (max. 7.44 h) with a mean trip distance 32.6 ± 20.2 km from colony (max. 63.9 km). Diving and foraging activities were spread across the northeastern shoreline along Ras Al Khaima or westwards along Dubai and Abu Dhabi. Diving areas indicate seasonal abundance of fish stocks (anchovies and sardines). Spatial distribution highlights areas of conservation importance to the species. Socotra Cormorants are Vulnerable and a management plan incorporating breeding colonies and foraging areas is required.

Do exotic plants explain dietary shifts in nestlings of an insectivorous bird?
Narango, Desiree - University of Delaware/Smithsonian Migratory Bird Center; Douglas Tallamy - University of Delaware; Peter Marra - Smithsonian Migratory Bird Center

Exotic plants support lower abundance and richness of insects which can have cascading effects on food webs. For birds, the availability of high quality insect prey can impact nestling provisioning behavior, however the extent that plant origin alters diet, growth and condition of nestling insectivores remains poorly understood. From 2013-2015, we quantified the diet and provisioning behavior of Carolina Chickadees (*Poecile carolinensis*) in residential neighborhoods that varied in the proportion of exotic plants. We identified prey items using continuous video cameras and nestling trophic level using stable isotopes of carbon and nitrogen in blood. We also compared diets with historical records of gut contents. Stable isotopes indicated that nestlings in exotic sites were fed fewer herbivorous insects and more predatory insects, however, isotope values of prey items in urban areas made discrimination between phytophagous insect orders difficult. Video cameras revealed changes in diet were due to the reduction of caterpillar prey in exotic sites and increases in the provisioning of spiders and other prey items. Video cameras also suggested that chickadee prey may be dominated by only a few caterpillar taxa. Moreover, nestling condition was lower in exotic sites, a likely consequence to changes in prey types, however, nestling growth

remained similar. We discuss the benefits and limitations of these techniques for describing bird diets and the consequences of plant-associated diet shifts for food web interactions.

Cerulean Warbler and Associated Species Response to Silvicultural Prescriptions in the Central Appalachian Region

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We quantified cerulean warbler (*Setophaga cerulea*) response to a range of forest management treatments at six sites (WV n=2, PA n=2, KY n=1, VA n=1), between 2013 and 2015. Different silvicultural treatments (e.g., shelterwoods, clearcuts) were implemented at each site. The goal of the study is to recommend ways to improve breeding habitat for cerulean warblers and associated songbird species through operational silviculture. We are using point counts (n=45) from sites in which we have pre- and post-harvest data to evaluate changes in cerulean warbler abundance post-treatment. We used single species, multi-season N-mixture models to estimate abundance while accounting for detection biases inherent in point count methods. Abundance was affected by mean post-harvest basal area, aspect, slope position, and point location (harvest interior or edge). Detectability was influenced by observer experience. We used Akaike's information criterion (AIC) to select the best model(s) describing abundance at point counts. The top models predicted that during pre-harvest conditions, ceruleans were more abundant on middle slopes than ridges and negatively associated with S- to NW-facing slopes. Cerulean warblers are typically most abundant on upper slopes and ridges. Post-harvest, abundance increased as mean basal area decreased. We are sampling additional post-harvest sites in the 2016 field season. With an increase in sample size, we expect to further understand what is influencing cerulean breeding habitat selection, pre- and post-harvest. Information presented at the conference will incorporate 2016 data, including abundance from 10 sites and approximately 160 point count stations with pre- and post-harvest data.

Birds of a Feather Don't Always Flock Together: Migration patterns of San Francisco Bay Area Hermit Thrushes differ across a fine spatial scale

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Effective conservation of short-distance migrants requires an understanding of intraspecific variation in migratory patterns across small spatial scales. Until the advent of ultra-light geolocation devices, our knowledge of the migratory connectivity of songbirds was limited. For the Hermit Thrush (*Catharus guttatus*), subspecies delineations and connectivity patterns have been particularly unclear in the portion of their range spanning from the San Francisco Bay in California to southeastern Alaska, USA. To determine breeding locations of the San Francisco Bay Area's wintering Hermit Thrushes, we deployed geolocators at sites located north and south of the Bay. We collected morphometrics to identify regional differences. Hermit Thrushes that wintered in the North Bay had a wider and more southerly breeding distribution from the British Columbia coast to northwestern Washington, whereas South Bay thrushes migrated to southeastern Alaska and the British Columbia coast. Regional morphology differed only in bill length. In a separate study, we deployed geolocators on Hermit Thrushes breeding in the Santa Cruz

Mountains of coastal California, approximately 40 km southwest of our wintering-bird deployment site in the South Bay. Preliminary results indicate that Hermit Thrushes breeding in the Santa Cruz Mountains winter in western Mexico, and their morphology differs substantially from Hermit Thrushes that winter in the Bay Area.

Red List status of forest endemic birds in the Caribbean

Nelson, Howard - University of Chester; Eleanor Devenish-Nelson - University of Chester; Doug Weidemann - BirdsCaribbean Journal of Ornithology; Jason Townsend - BirdsCaribbean Journal of Ornithology

Endemic forest-dependent island species are particularly vulnerable to extinction. The insular Caribbean hosts 171 extant endemic forest bird species, of which 45 are threatened with extinction according to the IUCN. In spite of this diversity and endangerment, published data from field surveys on the status of these island endemics remains limited. With regional governments coping with limited human and financial resources, the accelerating loss and degradation of natural habitats from development, as well as the threat of climate change, the conservation of these island species requires a robust science base. Phylogenetic generalized linear mixed models using intrinsic life history traits and extrinsic anthropogenic predictors, were used to determine predictors of extinction risk and population trends in Caribbean forest endemic bird species. In the absence of detailed population data, these analyses provide a mechanism with which to prioritise endemic species most threatened by extinction. However, long-term monitoring is urgently needed to inform management and conservation actions for specific species and their habitats, to ensure persistence of viable populations.

Microhabitat use by Cerulean Warblers (*Setophaga cerulea*) in an experimentally-managed forest in Indiana

Nemes, Claire - Ball State University; Kamal Islam - Ball State University

The Cerulean Warbler (*Setophaga cerulea*) is a small canopy-nesting songbird that breeds in mature deciduous forests in the eastern US and Canada. Populations of this Neotropical migrant have declined at a rate of nearly 3% per year between 1966 and 2010, and the species is classified as state endangered in Indiana. This research is part of the Hardwood Ecosystem Experiment (HEE), a long-term ecological research project investigating the impacts of different forest management strategies, including experimental timber harvests, on Indiana state forests. Between 2011 and 2015, we searched intensively for Cerulean Warbler nests within the HEE's experimental units. At each nest location, we measured microhabitat variables and compared these values with paired non-nest points nearby in order to determine which features birds used for selection of the nest patch. Because nest success is comparatively low at this study site, we also examined which variables contributed to nest success. In addition, we sampled microhabitat variables at the center of male territories and compared them with randomly sampled points to examine which features are associated with Cerulean Warbler territory placement. While nest patches and territories shared several of the same attributes, Cerulean Warbler nest patches tended to have characteristics of more even-aged forest stands, while male territories had more uneven-aged stand characteristics. Features associated with nest success were not necessarily preferred for nest selection. Here we present the results of these analyses and discuss their potential implications for management of this imperiled species.

Cognitive, behavioral and physiological responses to disturbance and novelty vary with life history in a songbird

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Organisms are increasingly exposed to rapid and often unpredictable changes in their environment. These changes may lead to disturbed or degraded habitats and exposure to unfamiliar predators, competitors, pathogens and resources. How well individuals cope with unpredictable and novel conditions will determine their survival and reproductive success in the new environments. Migratory birds are considered to be ecologically less flexible than resident species thus it may be hypothesized they are more vulnerable to altered conditions. If so, we predict that migrants may be less able to cope with challenges in the environment than resident congeners. To test this prediction, we examined migratory and resident subspecies of the White-crowned Sparrow (*Zonotrichia leucophrys*) in cognitive, behavioral and physiological tests, and the following variables were measured: risk tolerance (i.e. flight initiation distance), problem-solving ability, object neophobia, spatial exploratory tendency and adrenocortical stress response. All tests, except the exploratory test, were conducted in the non-breeding season. Giving support to our prediction, migrants were found to be more risk-averse and less innovative in opening a novel feeder but did not differ in their responses to novel objects, novel space or capture and restraint stress. These results suggest that migrants may be more constrained in their ability to cope with human disturbance and exploit emerging novel resources.

Seasonal Variation in Yolk Carotenoid Concentrations and Egg Metrics in Eastern Bluebirds

Newbrey, Jennifer - Columbus State University; Renata Paiva - Columbus State University; Michael Newbrey - Columbus State University

Carotenoids are biologically-active, yellow, orange, and red pigments that are synthesized by plants and photosynthetic microorganisms. Birds are unable to synthesize carotenoids, and therefore they obtain all of their carotenoid resources from their diets. Female birds allocate high concentrations of carotenoids to their egg yolks, and eggs with higher concentrations of carotenoids are more likely to hatch and produce healthy chicks than eggs with lower concentrations. Despite this critical role that yolk carotenoids play in avian reproduction, surprisingly little research has focused on the yolk carotenoids of North American songbirds. Therefore, we studied seasonal variation in yolk carotenoid concentrations and egg metrics in Eastern Bluebirds (*Sialia sialis*) breeding in nest boxes at two locations in west-central Georgia; Columbus State University (CSU) in Columbus, GA, and Callaway Gardens in Pine Mountain, GA. The third-laid-egg was collected from each study nest and carotenoids were extracted and quantified in the laboratory using high performance liquid chromatography. We found a positive correlation between Julian Day and concentrations of yolk carotenoids, which suggests that carotenoid-rich foods likely became more abundant later in the breeding season. We also found that later breeding female bluebirds produced eggs with larger yolks than females that bred earlier in the season. To better understand the trends that we found, future research will focus on the link between seasonal changes in diet, and the allocation of carotenoids and other resources to the eggs of bluebirds.

Parental Behavior of Chestnut-collared Longspurs at Nests in Response to Oil and Gas Infrastructure

Ng, Christoph - Natural Resources Institute, University of Manitoba; Nicola Koper - Natural Resources Institute, University of Manitoba

Grassland birds have been in severe decline over the past few decades, and the threatened chestnut-collared longspur (*Calcarius ornatus*) is no exception. This ground-nesting songbird only breeds in mixed- and short-grass prairies, and its reliance on native prairie habitat means it is sensitive to disturbance, fragmentation and destruction of the prairies, all factors that are linked to energy infrastructure and associated roads. Heightened perceived risk from proximity to infrastructure and roads can affect the quality of parental care songbirds provide, and therefore reproductive success. To examine how key parental behaviors at nests are affected by proximity to oil and gas infrastructure and roads, we deployed surveillance cameras at control sites and sites centred on oil wells in southern Alberta. We recorded activity at nests during both egg and nestling stage until fledging or depredation. We quantified effects of distance to oil wells and roads on nest attentiveness, length of incubation and brooding/shading bouts, length of incubation recesses, and visitation and provisioning rates by both parents. Parents showed decreased activity around nests and increased nocturnal vigilance with proximity to infrastructure and roads during the incubation stage, supporting the heightened perceived risk hypothesis. Males brooded and shaded nestlings longer near infrastructure. The insights gained by examining the parental behavior of chestnut-collared longspurs nesting in areas of dense anthropogenic infrastructure can help us determine the best way to minimize disturbance to the species during their critical breeding season throughout their range.

Identifying current and future conflict risk between wind energy development and Ferruginous Hawk nesting habitat

Ng, Janet - University of Alberta; Troy Wellicome - Environment and Climate Change Canada, University of Alberta; Erin Bayne - University of Alberta / Department of Biological Sciences

Wind energy development has potentially large implications for wildlife. Siting wind energy projects to avoid high-conflict areas can reduce risk. Identifying landscapes where wind energy could conflict with species at risk, such as the Ferruginous Hawk (*Buteo regalis*), may reduce potential direct and indirect impacts. Our objectives are to 1) develop predictive maps of habitat selection by Ferruginous Hawks and 2) identify areas with potentially high and low conflict risk with wind energy development in Canada. We developed a home range habitat selection model and a relative abundance model to predict habitat use and nest abundance in southern Alberta and Saskatchewan. We examined the influence of landscape variables including landcover, industrial development, climate, and soil characteristics. We used these models to generate maps that predicted Ferruginous Hawk home range habitat selection and nest abundance across their Canadian range. Predictive maps were overlaid onto maps of existing wind infrastructure and wind development potential to spatially identify potential conflict. High conflict landscapes where probability of habitat selection and wind potential is high can inform wildlife managers about risk. Low conflict landscapes where wind potential is high and probability of habitat selection is low would have lower liability for industry. Landscapes with high probability of habitat selection and low wind potential could be conserved or used for habitat offsets. This risk assessment can help with prioritizing conservation, reducing risk to a species at risk, and balancing economic objectives.

Bird-Building Collision Risk: An Assessment of Phylogenic and Behavioral Factors Using Two Citizen-Science Data Sets

Nichols, K. Sami - University of Minnesota

Bird collisions with buildings are the second largest anthropogenic source of direct mortality for birds (365-988 million birds killed annually in the United States). Recent research suggests that this mortality is selective across species. However, previous work had relied on regional and annual measures or relative species abundance. My research identifies which species experience higher or lower collision rates than expected from local abundances using two sets of citizen science data: Minnesota Project BirdSafe and the Mississippi River Important Bird Area Landbird Monitoring Program. My analysis uses a measure of relative species abundance that spatially overlaps the area monitored for building collisions and is measured weekly, allowing for a more accurate and temporally specific analysis. Abundance and collision data were used to model phylogenetic and behavioral traits associated with increased collision risk. Behavioral traits considered include diurnal/nocturnal migration timing, length of migration, and foraging strategies. My analysis shows that birds that predominately migrate during the day have a decreased risk of building collisions despite peak collision numbers occurring during early morning; this result suggests that more nuanced behavioral of physiological differences between diurnal and nocturnal migrants could contribute to bird-building collision risk. Additionally, for many species, abundance is the predominant determining factor for collision risk. However, for about 20% of species studied, the family, genus, and species of a bird may affect the collision risk.

State of science and recommendations for bird electrocution and collision risks with power lines

Nielsen, Lori - Western EcoSystems Technology (WEST)

Power lines are the common denominator for electric generation, transmission, and distribution, whether it involves renewable or conventional energy development and use. Bird interactions with power lines are multi-dimensional, and the science in assessing bird fatalities from power line electrocutions and collisions has progressed significantly in the last 10 years. However, current approaches in discerning between these risks are inconsistent in the U.S. and recommended mitigation can be flawed. Bird electrocution risks are dictated by voltage, structure configuration, and potential at-risk species. Bird collision risk applies to a range of voltage classes, typically reflecting site-specific ecological factors combined with infrastructure design. Understanding these variables is integral to the ever-evolving state-of-the-art science relative to birds, power line infrastructure, and regulatory requirements. Minimizing long-term risks to birds requires balancing regulatory requirements, engineering considerations, management goals, environmental due diligence, and associated costs. Estimated bird mortality rates from power line electrocution and collision in the U.S. are wide ranging and relatively unknown. Internationally, birds and power lines have varying levels of protection and economic limitations, sometimes resulting in high electrocution or collision risks on power lines in areas that support essential populations of susceptible bird species. We will cover current issues, communication challenges, the tools and resources currently available to minimize avian electrocution and collision risks with power lines, and recommended resolutions moving forward.

Genetic fitness returns for brown-headed nuthatches (*Sitta pusilla*) are impacted by group size and heterospecific competition.
Niemasik, Esther - Cornell University; Mark Stanback - Davidson College; Janis Dickinson - Cornell University

Studies of cooperative breeding have focused mainly on intraspecific competition for breeding opportunities, only rarely considering a potential role of inter-specific competition. In this study, we asked whether heterospecific competition selects for cooperative breeding through increases in per captita fitness returns. In a box-nesting population of brown-headed nuthatches, we manipulated competition with other bird species and used microsatellite analysis to examine individual fitness returns for helper and breeder brown-headed nuthatches. We found that mean inclusive fitness increased with group size for female helpers and breeders. Males fitness was insensitive to group size and competition pressure. Female's however, suffered fitness losses when facing high competition pressures except when breeding in large groups. This study provides the first support on an individual fitness basis for the role of heterospecific competition in driving social behavior.

Migratory bird conservation planning in the Northern Plains using spatial models developed from stop-level BBS data
Niemuth, Neal - USFWS HAPET; Mike Estey - USFWS HAPET; Sean Fields - USFWS PPJV; Andy Bishop - USFWS RWBJV; Brian Wangler - U.S. Fish and Wildlife Service, Habitat and Population Evaluation Team; Pam Moore - USFWS HAPET; Adam Ryba - USFWS HAPET; Roger Grosse - USFWS RWBJV

Bird conservation efforts in the Prairie Pothole, Rainwater Basin, and Northern Great Plains joint ventures make extensive use of spatially explicit occurrence and count models developed from BBS data to target areas for conservation treatments and assess conservation actions. We analyze data at the stop level, which is consistent with the scale of conservation treatments we apply and avoids information loss caused by pooling of data along routes. By accounting for observer effects, nesting of stops within routes, and sequence of stops, we were able to accommodate BBS survey design, refine estimates for important habitat predictors, improve model fit, and reduce or eliminate positive spatial autocorrelation in model residuals. Predictive power of models was greatly increased by inclusion of variables characterizing annual and long-term precipitation, as well as landcover attributes not available from satellite-derived landcover data. Results of models predicting occurrence of grassland birds in the Northern Plains demonstrated that analyses using stop-level BBS data and environmental data with high thematic resolution were able to describe habitat relationships often associated with fine-grained, local studies but across broad spatial extents and at scales relevant to local conservation actions. Predicted occurrence was strongly correlated with observed numbers, suggesting that occurrence models may be useful predictors of density. We used relationships derived from models to develop spatially explicit decision support tools, which are used to guide and assess conservation in the region.

Heterozygosity is heritable, affects fitness, and correlates with song complexity in song sparrows
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Inbreeding and heterozygosity (i.e. individual genetic diversity) commonly affect the fitness of populations and individuals. Individuals

may profit from choosing mates with increased heterozygosity for example to gain direct fitness benefits in the form of increased paternal care and territory quality. Furthermore, choosing heterozygous mates may under special conditions provide indirect fitness benefits through increased offspring heterozygosity. Indeed, despite the fact that heterozygosity has previously been shown to be heritable whenever allele frequencies are unequal, this mathematical inevitability remains largely unknown. Here we use newly developed theory for multi-allelic loci, as well as a long-term individual-based dataset and 160 short tandem repeat markers for an island population of song sparrows (*Melospiza melodia*) to show that the empirically estimated heritability of heterozygosity of 0.31 closely matches theoretical predictions. We further show that heterozygosity explained variation in lifetime reproductive success (Pearson's correlation coefficient r = 0.06, p-value = 0.02), a trait that is rarely measured in nature. Finally, we found that heterozygosity correlated with the number of song types and syllable types in the repertoire of a male, and thereby show that song complexity may serve as a sexually selected indicator of heterozygosity. Hence, female song sparrows have the possibility to gain information about a male's heterozygosity through the diversity of a male's song repertoire, which could allow them to gain direct fitness benefits for example in the form of increased paternal care and territory quality, and possibly under some conditions also indirect fitness benefits through increased offspring heterozygosity.

Retraction of the range of a sub-arctic breeding shorebird: are the causes always clear?

Nol, Erica - Trent University; Walter Wehjte - Trent University; Ken Abraham - Ontario Ministry of Natural Resources and Forestry; Rod Brook - Ontario Ministry of Natural Resources and Forestry

Semipalmated Plovers (*Charadrius semipalmatus*) are common breeders across the North American sub-arctic. As this region is the epicentre for both northern development activities such as mining, and rapid, climate-induced transitions from open to treed environments, the region is where we might expect the first retractions of geographic ranges towards more northerly latitudes. We studied breeding Semipalmated Plovers over a 12-y period on Akimiski Island, Nunavut. We document severe declines of nesting birds on Akimiski Island while, over the same period, Killdeer (C. vociferus), a temperate breeding shorebird, is increasing. Does the inverse correlation between numbers of these two plovers represent cause and effect? Killdeer arrive earlier than Semipalmated Plovers and their territories are closer to trees, and at higher elevations further from water, than nests of Semipalmated Plovers. Thus, their is significant niche differentiation of the two species which may preclude direct competition for nesting locations. Semipalmated Plover nests, however, have become more frequently inundated by high tide events. Dispersal as a result of poor reproduction, rather than direct competition, appears to explain the retraction of Semipalmated Plovers. Is climate warming vindicated? The answer is no, as flooding events are linked to earlier ice out from a warming climate. Warm winters make low elevation nests highly susceptible to high tide events. The survival of the predator, red fox (*Vulpes vulpes*), may also be improving. That Killdeer are increasing in the north may offset declines in other portions of their range whereas the geographic extent of Semipalmated Plover decline is unknown.

Ecotoxicological Impacts of Run-Of-River Dams on American Dippers and Mountain Stream Food Webs

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Run-of-river (RoR) dams are an increasingly common alternate energy source on mountain streams. Despite reductions in size and greenhouse gas emissions compared to conventional impoundments, RoR hydro may have ecotoxicological impacts through disruption of the natural flow regime. The American Dipper (*Cinclus mexicanus*) is a river bird that occupies mountain streams year-round and is a well-described indicator of stream health; thus, it is an ideal species to study impacts of RoR hydropower on river food webs. From fall 2014 to fall 2015, we conducted seasonal river bird surveys and sampled food webs at 7 regulated and 7 unregulated streams in coastal BC. Regulated streams supported higher densities of dippers during breeding and non-breeding seasons, suggesting year-round residency occurs at high elevation streams stabilized by RoR-regulation. Analyses of dipper whole blood revealed significantly different blood isospace between stream types ($p=0.032$), driven by 34S-depleted blood at regulated streams. The bacteria responsible for 34S-depleted food webs also methylate inorganic mercury into its toxic and bioavailable form, methylmercury (MeHg). MeHg levels in dipper tissues were comparable across stream types, with the exception of one of the more recently regulated sites, which supported dippers with MeHg levels of potential toxicity concern (up to 8.5µg/g dw in feathers and 1.8µg/g ww in whole blood). Our data suggest that stabilized flow habitats associated with RoR dams create year-round habitat for dippers. We have demonstrated, however, the potential for MeHg production in RoR headponds, raising the question of whether these habitats are ecological traps for river bird specialists.

Revive & Restore's 'The Great Passenger Pigeon Comeback': predicting conservation gains of de-extinction through researching natural history

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Explaining the extinction of passenger pigeons to this day leaves scientists arguing. The announcement of the "The Great Passenger Pigeon Comeback", a de-extinction effort by non-profit organization Revive & Restore, likewise elicited polarized debate from scientific and conservation communities, traceable to the many untested assumptions and unsettled disputes about the species' history. Pursuing de-extinction for whole-ecosystem benefits atop a foundation of empirical investigations of natural history can serve as a model for responsible application of de-extinction in conservation. Toward this end investment in addressing assumptions and questions about the passenger pigeon's history and role in its former habitat has been made to answer one big question: is there a place for passenger pigeons today? Research modeling gape size and testing seed dispersal with living pigeons reveals that passenger pigeons' impacts on forests were much more complex than previously assumed. Population genetic modeling using 42 mitochondrial genomes reveals long-term stable abundance over the past 20,000 years through drastic changes in forest range, structure, and composition, indicating that passenger pigeons were ecologically resilient. Relating these new insights to knowledge from historic accounts and decades of forestry management

suggest that passenger pigeons were ecosystem engineers of forest patch dynamics, which are virtually non-existent today, that so many extant threatened species depend upon. This early research illuminates ecological assessment parameters needed for successful low-risk reintroduction of the species. More significantly, this clarified natural history elevates the importance of the species' restoration for long-term, large-scale sustainable conservation of eastern North America's disturbance dependent forest communities.

Evaporative cooling capacity and heat tolerance in two southern African Caprimulgids

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Nightjars represent a model taxon for investigating heat tolerance because of their habits of roosting and breeding in exposed microsites during the day. We investigated the relationships between body temperature (Tb), resting metabolic rate (RMR) and total evaporative water loss (TEWL) at air temperatures (Ta) of 10 – 56 °C in Rufous-cheeked Nightjars (*Caprimulgus rufigena*) and Freckled Nightjars (*Caprimulgus tristigma*); for the latter species, we obtained data from two sites, and examined seasonal differences at one site. At high Ta both species thermoregulated precisely, maintaining Tb 10 – 15 °C below Ta. Lower critical limits of thermoneutrality occurred at Ta = 35 – 37 °C, whereas we detected no clear upper critical limits of thermoneutrality. At the highest Ta values, TEWL was equivalent to 484 – 892% of values at Ta ≈ 38 °C, reaching maximum rates of 2.49 g h-1 and 2.32 g h-1 in *C. rufigena* and *C. tristigma*, respectively. Evaporative heat dissipation incurred only small metabolic costs; at no time did the RMR of either species increase by more than 20% above thermoneutral values at Ta ≈ 38 °C. TEWL in *C. tristigma* was 30% lower in an arid-zone population compared to mesic conspecifics, and mass-specific RMR was 16% higher in summer than winter at a mesic site. At the highest Ta reached, nightjars were dissipating the equivalent of 309 – 515% of metabolic heat produced. Our data are consistent with previous data, and reveal that caprimulgids possess extremely efficient evaporative cooling mechanisms compared to most birds.

On the Visual Ecology of Woodpeckers

O'Daniels, Sean - University of Missouri; Dylan Kesler - The Institute for Bird Populations; Jeanne Mihail - University of Missouri; Elisabeth Webb - USGS Missouri Cooperative Fish & Wildlife Unit; Scott Werner - USDA/APHIS/Wildlife Services National Wildlife Research Center

Woodpeckers are considered keystone taxa because their cavities are utilized by dozens of other bird, mammal, and reptile species. Additionally, woodpeckers are responsible for millions of dollars in damage to anthropogenic structures annually. Altering the ultraviolet (UV) reflectance of wood substrates has been proposed as a means of deterring woodpecker damage, but little work on woodpecker visual systems has been published. We developed a novel foraging-based behavioral assay to evaluate UV sensitivity in the Pileated Woodpecker (*Dryocopus pileatus*). We acclimated 21 wild-caught *D. pileatus* to foraging for frozen mealworms within 1.2 m sections of peeled cedar (*Thuja spp.*) poles. We then tested the functional significance of multiple UV-reflective cues by placing frozen mealworms behind increased UV covers, decreased UV covers, or decayed red pine substrates within the same 1.2 m poles in independent experiments. After ten trials, behavioral responses were greater toward treatment substrates than control substrates in all

experiments, but cue-naïve woodpeckers (first trial results) demonstrated a preference towards decreased UV substrates. Our behavioral results suggest that Pileated Woodpeckers can be conditioned with UV cues, but that decreased UV reflectance may be a foraging cue similar to UV-absorbing signals found in plant-pollinator mutualisms. We further investigated visually perceptible differences between decayed substrates using a perceptual model. This analysis revealed that decayed substrates appear visually different to a hypothetical woodpecker based on the species of fungi responsible for the decay, providing evidence for a visual mechanism that allows selection of trees decayed by specific fungi for cavity placements.

Differences in female and male duetting behavior in a tropical breeding songbird
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Females and males of many animals possess elaborate ornaments or displays. Elaborate traits in males are often studied in the context of sexual selection to attract or gain access to mates. Elaborate traits in females, however, may be selected for by broader selection pressures that function in ways that benefit overall fitness, such as defense of a multi-purpose, year-round territory. We used Bayesian hierarchical analyses to evaluate multiple functions of solos and duets in female and male troupials (*Icterus icterus*), a tropical breeding songbird, during the breeding and non-breeding season. We found that females answered their mate's songs to form duets and that both sexes soloed when there were more other troupials present compared to when males answered their mate's songs to form duets. Male troupials were more active after they soloed or formed duets than females; males were more likely to fly toward their mate or other troupials after they sang. However, both male and female troupials frequently formed duets after duets by other troupials occurred. These results suggest that females solo and both sexes duet to defend territories, but that males may also form duets to guard their mate. Both sexes also often moved closer to their mate after they answered their mate, indicating that troupials also duet to maintain contact, supporting multiple functions for duetting that may independently benefit females and males.

Genomic insights into neutral and adaptive variation in sage-grouse: implications for ecology and conservation
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Understanding the relative influence of neutral versus adaptive processes to genetic variation within and between species is a central problem in evolutionary biology, and has become an increasingly important consideration for conservation practices. Advances in sequencing technologies have now made it possible to evaluate patterns of neutral and adaptive genetic variation at the whole-genome level with unprecedented resolution for non-model systems. Greater Sage-Grouse (*Centrocercus urophasianus*) and Gunnison Sage-Grouse (*C. minimus*) are two closely-related galliform species of considerable interest for behavioral ecology, evolution, and conservation. Historically distributed broadly across the North American West, sage-grouse have undergone dramatic range contraction over the past century, contributing to the current complete geographic isolation of many populations. Previous studies have reported significant genetic differentiation between some of these populations, but these analyses were mostly based on anonymous genetic markers, and thus the potential adaptive significance of such differences has been unresolved. We

recently completed de novo genome assemblies for both species, which were utilized here along with whole-genome resequencing from seven sites representing the core populations of both species, along with five isolated satellite populations. These data were used to perform genomic scans for neutral and putative adaptive variation within and between species. We also evaluated candidate loci underlying metabolic counter-adaptations to toxic defenses in sagebrush, to which sage-grouse are dietary specialists. We discuss potential implications of these results for the sage-grouse ecology as well as future conservation practices. USGS: This information is preliminary and subject to revision.

Acute Toxicity of Gossypol on Northern Bobwhites

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Gossypol is a toxic secondary plant compound found in cotton (*Gossypium ssp.*). Because of gossypol's toxicity to many animals, particularly monogastric mammals, cottonseed-based feeds are currently under investigation as a possible control agent for feral swine. However, concerns have arisen regarding the effects of gossypol ingestion on non-target wild animals. A species of particular concern is northern bobwhite (*Colinus virginianus*), a species of significant economic and cultural value. We determined the oral LD50 of gossypol in northern bobwhites following the EPA's OCSPP 850.2100 Guideline: Avian Acute Toxicity Test. Through a range-finding test, we estimated that the LD50 was between 200 mg/kg and 1,000 mg/kg body weight [BW]. Following the range-finding test, we administered a single oral dose of refined gossypol to quail at 262 mg/kg, 342 mg/kg, 447 mg/kg, 585 mg/kg, and 765 mg/kg BW. We observed quail daily for mortality or any signs of intoxication throughout a 28-day observation period. We measured feed consumption daily and body weight intermittently. We monitored sublethal effects, including: gross appearance, behavior, gross pathology, and histopathological and physiological changes. Using probit analysis, we determined that the oral LD50 of gossypol in northern bobwhites is 651 mg/kg BW (95% CI, $579 \leq x \geq 731$). Results suggest that the level of gossypol found in cottonseed is insufficient to cause direct mortality in northern bobwhites. Further research will investigate the long-term effects of gossypol ingestion on northern bobwhite health and reproductive parameters.

Tectonic collision and uplift of Wallacea triggered the global songbird radiation

Oliveros, Carl - Louisiana State University; Robert Moyle- University of Kansas; Michael Andersen - University of New Mexico; Peter Hosner - University of Florida, Gainesville; Brett Benz - American Museum of Natural History; Joseph Manthey - New York University Abu Dhabi; Scott Travers - University of Kansas; Rafe Brown - University of Kansas; Brant Faircloth - Louisiana State University

Songbirds (oscine passerines) are the most species rich and cosmopolitan bird group, comprising almost half of global avian diversity. Songbirds originated in Australia, but the evolutionary trajectory from a single species in an isolated continent to worldwide proliferation is poorly understood. Here, we combine the first comprehensive genome-scale DNA sequence data set for songbirds, fossil-based time calibrations, and geologically informed biogeographic reconstructions to provide the first well-supported evolutionary hypothesis for the group. We show that songbird diversification began in the Oligocene, but accelerated in the early Miocene, at approximately half the age of most previous estimates. This burst of diversification occurred coincident with extensive island formation in Wallacea, which

provided the first dispersal corridor out of Australia, and resulted in independent waves of songbird expansion through Asia to the rest of the globe. Our results reconcile songbird evolution with Earth history and link a major radiation of terrestrial biodiversity to early diversification within an isolated Australian continent.

Matryoshka niches: Niche correlates of hypothesized time since colonization of a novel ecosystem

Olsen, Brian - The University of Maine; Katharine Ruskin - University of Connecticut; Rebecca Longenecker - US Fish & Wildlife; Alison Kocek - State University of New York, College of Environmental Science & Forestry; Jonathan Cohen - SUNY College of Environmental Science and Forestry; Chris Elphick - The University of Connecticut; Adrienne Kovach - University of New Hampshire; W. Gregory Shriver - The University of Delaware

Biological communities and climatological characteristics are in flux through paleo-ecological time scales, forming and dissolving ephemeral sets of correlated conditions. Selection from various sources can thus vary through time and influence the dimensions of a species' niche. Therfore, modern niches, like other phenotypic traits, can reflect historical changes in selection from available niche space. The importance of historical legacies for modern niches, however, is unknown. Tidal marshes are an example of ephemeral conditions at paleo-ecological time-scales. Large estuarine marshes, like those along the Atlantic and Gulf coasts of North America today, can only accumulate when during periods of relatively constant sea levels, like those during inter-glacial events. During the present inter-glacial period, the estuarine marshes of eastern North America formed and were colonized largely by non-tidal-marsh bird species. Genetic divergence among extant tidal-marsh taxa also suggests this process may have occurred during at least the last two inter-glacial events. Despite the recent colonization history of most tidal-marsh taxa, many exhibit parallel adaptations to tidal marshes, indicating the evolution of specialism. To understand the evolutionary and ecological consequences of novel ecosystem colonization in this cyclically colonized environment, we compared the nesting niche dimensions of multiple bird species that varied in their hypothesized time of tidal marsh colonization. Older colonists generally exhibited larger niches within the tidal marsh relative to more recent colonists. We discuss the implications of these findings for niche evolution, ecosystem colonization, and the evolution of organismal specialism.

Threatened birds in Mexico: switching in a climate change time

Ortiz-Pulido, Raúl - Universidad Autónoma del Estado de Hidalgo, CIPAMEX

The number of bird species considered as threatened in a country depends on the group of experts consulted. Mexico is not the exception. There are suggested between 63 and 735 threatened bird species. Which is the correct number? Here I show an integration of three bibliographic sources that are proposing threatened species, I suggest coincidences between them and I show how many people are developing conservation activities in the country on such species. As it is known, 392 bird taxa are protected by the law in Mexico, however 271 taxa has been classified as of high concern by national experts, but many of the are not protected by law; besides 420 bird taxa have populations that are reported as declining and 104 taxa do not have data to determine their population tendency. I conclude that the Mexican laws related to bird conservation must be revised and updated. Even when Mexico is confronting a bird conservation crisis, there are signs that allow be a little optimist; by example, 175 ornithologists and conservationist reported that they are doing conservation activities with 282 bird taxa inhabiting Mexico.

Birds as potential vectors of *Borrelia burgdorferi*

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Lyme Disease is the most prevalent vector borne disease in North America. It is caused by the bacterium *Borrelia burgdorferi s.l.*, which has a complex life history involving tick vectors and vertebrate hosts. Recent work on the population genetics of the tick vector *Ixodes scapularis* and bacterium *Borrelia burgdorferi* indicates that their genetic population structures do not match. *Ixodes scapularis* has structured populations, indicating little movement across geographic space, whereas *Borrelia burgdorferi* has little structure indicating greater movement, suggesting that the ticks are not the primary dispersers of the pathogen across geography. We analyzed birds as potential long distance dispersal agents for *Borrelia*. During migration many bird species travel thousands of miles and are known to host larval and nymphal *Ixodes* ticks. We screened approximately 500individuals with tissue and blood samples collected from migrant birds in Chicago, Illinois and Chester and Bucks counties, Pennsylvania. We extracted DNA from these tissues and used a nested PCR protocol to screen for DNA from the 5S-23S intergenic spacer region of the *Borrelia* genome. We sequenced the products of all positive samples to identify the specific strains of *Borrelia burgdorferi* present. Preliminary results with approximately 200 Pennsylvania birds suggest that there is a high prevalence of *Borrelia* infecting birds in this region compared to other published results. In-depth analyses with these data will help us to understand variation in pathogen prevalence across regions (NE versus Midwestern US), across seasons (fall versus spring migration), and between host species.

Asymmetric gene flow during the protracted diversification of dry-forest-bird assemblages in northwest Peru

Oswald, Jessica - Louisiana State University; Isaac Overcast - City College of New York; William Mauck - American Museum of Natural History; Michael Andersen - University of New Mexico; **Brian Smith** - American Museum of Natural History

Arid-adapted bird faunas in the Neotropics are often fragmented by intervening mountains and rainforests giving rise to high local endemism. We tested hypotheses on the origins of avian diversity in two Neotropical dry forests, the Tumbes and Marañón dry forests in northwestern Peru, by modeling the population history of six taxon pairs distributed across the western cordillera of the Andes. To obtain genome-wide genetic variation, we employed a reduced-representation genome sequencing technique, Double Digest Restriction Associated DNA (ddRAD). We then used both full and composite likelihood approaches to estimate population genetic parameters and identify the best-fit demographic model. Our results indicate asymmetric gene flow from the Tumbes into the Marañón valley across multiple species, and that the diversification between these areas was a protracted process.

Willet be one species or two?: A genomic view of the evolutionary history of *Tringa semipalmata*

Oswald, Jessica - Louisiana State University; Michael Harvey - University of Michigan; Rosalind Remsen - Louisiana State University; DePaul Foxworth - Louisiana State University; Steven Cardiff - Louisiana State University; Donna Dittmann - Louisiana State University; Libby Megna - University of Wyoming; Matt Carling - University of Wyoming; Robb Brumfield - Louisiana State University

The Willet (*Tringa semipalmata*; Scolopacidae) is composed of two morphologically and vocally distinct subspecies with broadly disjunct breeding distributions in North America. Nominate *T. s. semipalmata* breeds in coastal salt and brackish marshes along the Atlantic and Gulf coasts of eastern North America and the West Indies, and *T. s. inornata* breeds in wet grasslands and prairies in the northwestern interior of North America. To assess divergence and test for hybridization between the two subspecies, we sampled breeding and wintering populations and collected morphological data, mitochondrial DNA sequences from the ND2 locus, and nuclear DNA sequences from genomic libraries enriched for ultraconserved elements (UCEs). Mitochondrial haplotypes were reciprocally monophyletic between the two subspecies and indicated a divergence approximately 700,000 years ago. The UCE dataset included 4,635 loci containing 19,322 SNPs, and based on these data individuals clustered by subspecies with no evidence of admixture between them and no sub-structure within subspecies. We identified 42 nuclear loci that contained SNPs fixed for alternate alleles between the two subspecies. Of the 42 loci with fixed differences, a statistically disproportional 17 were Z-linked, indicating a role for sexual selection in the divergence of the two subspecies. Genetic, morphological, ecological, and behavioral differences suggest the two Willet subspecies may merit treatment as separate species. Further studies are needed to determine the presence of pre-or post-mating reproductive isolation.

Threats of climate change to a Fynbos-endemic bird: physiological responses show low heat tolerance thresholds irrespective of season in the Cape rockjumper (*Chaetops frenatus*)

Oswald, Krista - Nelson Mandela Metropolitan University; Alan Lee - Percy Fitzpatrick Institute of Ornithology, University of Cape Town; Climate Change Adaptation Division, South Africa National Biodiversity Institute; Ben Smit - Nelson Mandela Metropolitan University

The Fynbos biome, south-western South Africa, is a biodiversity hotspot of conservation priority vulnerable to anthropogenic disturbance and climate change. Recent studies have shown that a Fynbos endemic, the Cape rockjumper (*Chaetops frenatus*), is at risk from increases in temperature, with greatest population declines observed in regions that experienced warming over the last two decades. Moreover, Cape rockjumpers show low air temperature thresholds for evaporative cooling, suggesting a direct link between high thermoregulatory costs during hot temperatures and population declines. In this study we determine if Cape rockjumpers show seasonal flexibility in thermoregulatory costs at high temperatures. We collected data on resting metabolic rate, evaporative water loss and body temperature at high temperatures in a wild population of Cape rockjumpers during winter and summer (n = 11 July/August 2015, 4 females and 7 males; n = 11 January 2016, 6 females and 5 males). We found no evidence that Cape rockjumpers reduce the physiological costs of thermoregulation at high temperatures during warm summer periods. During summer, Cape rockjumpers showed elevated resting metabolic rates (at whole-animal and mass-specific level), and did not improve their

evaporative efficiency or heat loss rates, compared to winter. This study provides further evidence of a physiological basis for the Cape rockjumpers' cool climate niche and population declines reported in parts of the Fynbos region that experienced significant warming. Cape rockjumper habitat will become both hotter and drier, and a better understanding of their physiological and behavioural mechanisms in dealing with high temperatures is urgently needed.

Adult survival probability explains parental risk-taking behavior in tropical and temperate songbirds.
Oteyza, Juan - University of Montana; James C. Mouton - University of Montana; Thomas Martin - USGS - University of Montana

Should parents prioritize their own survival or that of their young when facing a predator? Life history theory predicts that variation in parental risk-taking behavior can be explained by adult survival probability. Species with low adult survival probability are expected to tolerate greater risk to themselves, but not their young, because the fitness value of their brood is high and chances of future reproduction are low (low residual reproductive value). Conversely, when risk is high, species with high adult survival are expected to prioritize their own survival over that of their young. Empirical evidence for this theory are largely correlative or have not used direct measures of adult survival probability. We experimentally tested if adult survival probability explained parental risk-taking behavior in 21 songbird species in north-temperate Arizona and tropical Malaysia. We flushed incubating adults from their nest, and manipulated their perception of adult-predation risk by presenting a model (robotic taxidermic mount) of a predator for one hour near the nest. We measured the parents' latency to return to incubate eggs as a measure of risk-taking behavior and compared it to controls. Consistent with classic life history theory, we found that species with high adult survival probability favored their own survival over that of their young more than species with low adult survival. Our study represent the first direct test of the influence of adult survival probability on risk-taking behavior, giving support to general life history theory and offering insight into factors influencing parental care strategies within and across latitudes.

San Antonio 100 years later: Bird Extinctions and Climate Change
Palacio, Ruben Dario - Fundacion Ecotonos; Gustavo Kattan - Pontificia Universidad Javeriana Seccional Cali

With maximal elevations of 2200 m, San Antonio is a cloud forest on a truncated mountain summit in the Colombian Andes, for which multiple avian surveys dating back to 1911 are available, a rare scenario for a tropical site. We document changes in this bird community over a 100-year period and provide a first assessment of its vulnerability to climate change. In 2015-2016 we surveyed birds with point counts and complemented our list with data from eBird. During the first 80 years forest fragmentation caused the extirpation of 32 species from an original avifauna of 175 forest birds. Thanks to conservation programs, at least 11 species have reestablished populations in the last 20 years and there are no further extinctions. The original core avifauna has remained relatively intact at a control site in a nearby protected area with continuous forest in higher elevations. In the face of ongoing global warming, we found that even in a worst-case scenario of a temperature increase of 3°C for the area, no mountaintop extinctions are expected for San Antonio, because there are few highland birds near their lower elevational limit. However, 52 species have narrow elevational ranges (≤1500m) and are mountain specialists with low abundances, thus being vulnerable to climate change. Our study provides long-term baseline information for a single montane tropical community that will allow future

assessments and the evaluation and calibration of models made at larger spatial operating scales.

The role of conservation breeding in the recovery of threatened avian species
Palfrey, Katy - Conservation Centers for Species Survival (C2S2)

Research and breeding at conservation centers have been instrumental to the successful return of endangered species including the black-footed ferret, California Condor, and oryx to the wild through reintroduction. A collaborative in situ / ex situ approach is now being developed to address the needs of the Loggerhead Shrike, a passerine species that has experienced one of the most drastic declines among North American landbirds since the inception of the Breeding Bird Survey in the mid-1960s. The highest priority need, as outlined in the Loggerhead Shrike Conservation Action Plan developed by the North American Loggerhead Shrike (LOSH) Working Group, is to identify the limiting factors, with a focus on wintering ecology, which work to date suggests is the key to the bird's decline. The breeding flock of loggerhead shrike at the Smithsonian Conservation Biology Institute (SCBI) is providing birds for reintroduction through Wildlife Preservation Canada in Ontario and for unique opportunities to contribute to understanding the limiting factors of this grassland bird population. The ability to house a captive population of loggerhead shrike and to develop working partnerships with State colleagues enables collection of biomaterials for comparison of wild and captive populations, including health status, nutrition, genomics, etc. The analysis of this data can provide much needed answers to questions regarding the shrike's range, ideal habitat, and mortality factors affecting these birds that will help inform and support on the ground efforts for the species.

Avian Conservation Assessment highlights diversity and vulnerability in Central American Forests
Panjabi, Arvind; Oliver Komar - Zamorano University; Luis Sandoval - Universidad de Costa Rica; Alejandra Martinez - Centro Agronómico Tropical de Investigación y Enseñanza (CATIE); Viviana Ruiz Gutierrez - Cornell Lab of Ornithology; Humberto Berlanga - CONABIO; Greg Levandoski - Bird Conservancy of the Rockies; Karla Lara - Zamorano University

For the first time, ornithologists have assessed the conservation status of every bird species in Central America. Using the Partners in Flight species assessment process that has been successfully applied in Canada, the USA and Mexico, 49 ornithologists and wildlife professionals from Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica and Panama, as well as Mexico and the USA, evaluated Population Size and Trend, Threats, Distribution, and major habitat associations for 1,161 regularly-occurring bird species in Central America. Preliminary results of the assessment indicate 484 species (42% of the Central American avifauna) are of high conservation concern and warrant Watch List status. Of these, 166 species (14%) qualify as "Red" Watch List. These species have multiple causes of concern, are highly vulnerable and in urgent need of special attention to avoid extinction in the next 30-50 years. The remaining 318 species (27%) qualify as "Yellow" Watch List, of which 186 species(16%) are undergoing steep population declines, have high threats and require immediate action to stabilize trends and reduce threats. The remaining 132 Yellow Watch List species (11%) are range restricted or have small populations and are in need of constant care. Tropical Lowland and Montane Evergreen Forests harbor more than 70% of Watch List species in Central America, highlighting the biological importance of humid tropical forests and the

ongoing threats to these ecosystems from clearing of forests for alternate land uses.

Differences in species diversity and abundance between ARU-based roadside and forest-edge avian point count surveys: implications for the North American Breeding Bird Survey

Pankratz, Rhiannon - Canadian Wildlife Service / Environment and Climate Change Canada / Government of Canada; **Samuel Haché** - Canadian Wildlife Service / Environment and Climate Change Canada / Government of Canada; Peter Solymos - Alberta Biodiversity Monitoring Institute, Alberta Innovates Technology Futures and University of Alberta / Department of Biological Science; Erin Bayne - University of Alberta / Department of Biological Sciences

The North American Breeding Bird Survey (BBS) provides the primary source of breeding bird population data, but has limited coverage in boreal regions and a sampling design that results in roadside bias in species detection. These are some of the concerns highlighting the need to evaluate the potential of new technologies to improve the efficiency of this important long-term monitoring program. Autonomous recording units (ARUs) may help address these issues by improving data quality. Units can record sounds over multiple periods, within and among days. They can be deployed at forest edges along secondary or winter roads by volunteers without strong bird identification skills to increase geographic coverage. However, studies have shown differences in detectability between human- and recording-based surveys. There could also be important differences in detectability between ARU-based roadside and forest edge surveys. We quantified the difference in species diversity and total number of detections between ARU-based roadside and forest edge surveys at BBS stops along three routes in the Northwest Territories, Canada. We also tested for an effect of day (surveys conducted a week apart) and time of day (traditional BBS surveys, sunrise, and sunset surveys) on detectability. Preliminary results suggest that species diversity and number of detections were higher for roadside than forest edge surveys, but there was little evidence for an effect of day and difference between BBS and sunrise surveys. Results from species-specific analyses will also be presented. We will discuss how ARUs can be used to enhance existing avian monitoring programs.

Efficacy of Clark's nutcracker dispersal varies with community type and geographic region

Pansing, Elizabeth - University of Colorado Denver; Diana Tomback - Department of Integrative Biology, University of Colorado Denver; Michael Wunder - Department of Integrative Biology, University of Colorado Denver; Joshua French - University of Colorado Denver; Aaron Wagner - University of Colorado Denver

Seed dispersal is a key ecosystem service provided by birds, influencing biodiversity, community structure, and demographic processes. To investigate whether community type (upper subalpine vs. treeline) and microsite type (near rocks, trees, or unprotected) influences dispersal efficacy or spatial concordance of recruitment over time, we simulated the caching behavior of Clark's nutcracker (*Nucifraga columbiana*), principal seed disperser for whitebark pine (*Pinus albicaulis*), in two Rocky Mountain locations. After monitoring caches for three years, we documented spatiotemporal shifts in dispersion during early recruitment, and whether specific microsite types and ecological characteristics were associated with cache pilferage, germination, and survival. Odds of pilferage were similar between locations, but odds of germination and survival were more than twice as high at one location relative to the other. Pilferage was not associated with microsite type, but was spatially clustered at one location. Where recruitment was high, microsite effects varied

by community type, indicating discordance. In the subalpine, odds of pilferage were higher near objects, and odds of germination were higher near rocks than trees. At treeline, odds of germination were higher near rocks than trees, and odds of survival were higher near rocks and trees than in unprotected sites. In contrast, where recruitment was low, seedling dispersion was concordant with seed dispersion. Although geographic location and community specific variation illustrate the importance of biogeographical context when assessing nutcracker dispersal efficiency, Clark's nutcrackers act as efficient dispersers of whitebark pine even where recruitment is low.

Bringing Back the Forest Birds: Challenges and Opportunities
Parr, Michael - American Bird Conservancy

The presenter will explore synergies between bird conservation and forest management goals for a variety of forested bird habitats across bird life-cycles, and discuss the identification of "sweet spots" where management goals overlap.

Alliance for Zero Extinction
Parr, Michael - American Bird Conservancy

The presenter will discuss how a global conservation standard for site prioritization, the Alliance for Zero Extinction (AZE), has used biodiversity data to influence conservation decisions at governmental levels globally. The talk will cover both scientific and policy-related methodologies.

Assessing nearshore and offshore movements of Piping Plovers in southern New England
Paton, Peter - Univ of Rhode Island; Pamela Loring - U.S. Fish and Wildlife Service, Division of Migratory Birds; Ramakrishna Janaswamy - Univ of Massachusetts; Hua Bai - University of Massachusetts; Curt Griffin - University of Massachusetts; Paul Sievert - University of Massachusetts

There is considerable interest in local and regional movements of federally-threatened Piping Plovers (*Charadrius melodus*) due to ongoing and proposed offshore wind energy developments. We attached digital VHF transmitters to 50 adult Piping Plovers in Rhode Island (n = 25) and Monomoy NWR, Massachusetts (n = 25) during the 2015 nesting season, and monitored their movements using an an array of 20 automated telemetry stations extending from Cape Cod, Massachusetts to eastern Long Island. Nanotags did not affect the behavior or productivity of Piping Plovers compared to a non-tagged control group. Nanotags were retained for an average of 46 days (range = 3 to 98 days).We developed fine-scale spatial models of the outflight departures of 33 individuals and documented variation in timing of departure by age class: Second-year (SY) individuals departed first, followed by After-Second- Year (ASY) individuals, with ASY males departing last. Piping Plovers that successfully fledged young departed earlier than unsuccessful breeders. Individuals generally initiated outflights in the early evening between 16:00 to 22:00 hrs (EST) and flew at speeds of 60 to 80 km per hr. The majority (88%) of individuals from Monomoy NWR departed on an offshore trajectory, while individuals from Rhode Island departed either coastally (75%) or offshore (25%). During the 2016 field season, an additional 50 Piping Plovers will be tagged to further assess movements utilizing an expanded network of automated telemetry stations ranging from Cape Cod through the mid-Atlantic.

Seasonal physiological and behavioural characteristics of a small bird in an unpredictable, arid habitat

Pattinson, Nicholas - Nelson Mandela Metropolitan University; Ben Smit - Nelson Mandela Metropolitan University

In arid-zones organisms have to deal with large seasonal shifts and/or extremes in temperature and/or moisture levels. We assessed the physiological and behavioural adjustments of an arid-zone endemic passerine, the rufous-eared warbler (*Malcorus pectoralis*; mass = 9 – 11 g), to seasonal air temperature (Ta) changes in the Karoo semi-desert of South Africa. We found that the whole-animal evaporative water loss (EWL) correlated with Ta in both seasons, but was significantly lower at high Tas in summer compared to winter (182.1 mg.hr-1 vs. 293.1 mg.hr-1 respectively at Ta = 41 °C). The thermoneutral zone (TNZ) of the warblers occurred at a higher, wider range of Tas in summer (32 °C – 36 °C) compared to winter (28 °C – 31 °C). Body temperatures (Tb) showed dependence on Ta, and within the TNZ birds had a significantly higher Tb in summer compared to winter (39.3 °C vs. 38.1 °C, respectively). Free-living rufous-eared warblers exhibited considerable temperature-dependence in their behaviour. At high Tas in summer birds significantly reduced overall activity levels and time spent foraging, as well as sought out shaded microsites and allocated a significant amount of time to heat dissipation behaviours. These results emphasise the plastic responses these warblers are capable of in order to balance energy and water demands in an arid environment that exhibits extreme seasonality in Ta. The inherent sensitivity of arid-zone species to even small increases in temperature underscore their suitability as model taxa for developing conceptual frameworks for predicting avian responses to climate change.

What does the Ovenbird say? Flight song structure varies within and among individuals

Paul, Nadine - Algoma University; Jennifer Foote - Algoma University

The Ovenbird (*Seiurus aurocapilla*) is a prolific singer common in North American forest communities. The Ovenbird is best known for its primary song consisting of a single repeated syllable. The flight song, however, is sporadically sung and less well studied with respect to both structure and function. We present the first detailed study of the complexity of the Ovenbird flight song from a season long study using automated bioacoustics recorders. We examined 100 flight songs from ten different male Ovenbirds to characterize the syllable repertoire of this song type. We identified 34 syllables in the flight songs of ten males. Each male had a repertoire size of 23.5±4.6 syllables and any given flight song includes 14.7±0.6 syllables. Several syllables were common to all 10 males, while others were sung by fewer males or only a single male. We show that both song length and versatility varied significantly among males and that song versatility decreases with increasing song length. Longer songs do not contain more note types despite the availability of note types in the repertoire, suggesting there is a trade-off between these two traits. Thus, our results suggest that flight songs may contain useful information for mates and rivals to assess male quality or motivation. Unlike primary songs, variation in note repertoires among males (this study) and between locations (this study and previous work) suggests the possibility of dialects in flight songs. Understanding flight song variation will lead to a better understanding of the function(s) of this elusive song type.

Can grazing management for the Lesser Prairie-chicken serve as an umbrella for the conservation of the grassland avifauna in the southern Great Plains?
Pavlacky, David - Bird Conservancy of the Rockies; Anne Bartuszevige - Playa Lakes Joint Venture; Kristen Nasman - Western EcoSystems Technology, Incorporated; Fawn Hornsby - Western EcoSystems Technology, Incorporated; Christian Hagen - Oregon State University

Because a large percentage of the southern Great Plains are privately owned, the recovery of grassland bird populations will depend on conservation initiatives with strong partnerships between private landowners and resource professionals. Our research objectives were to evaluate the effects of the Lesser Prairie-chicken Initiative (LPCI) prescribed grazing practice on the Lesser Prairie-chicken (*Tympanuchus pallidicinctus*) and grassland bird species of conservation concern. We used 2015 range-wide monitoring data for the Lesser Prairie-chicken to establish occupancy responses to landscape and prescribed grazing covariates. We used distance sampling data from the Integrated Monitoring in Bird Conservation Regions program to compare avian density on LPCI grazing lands relative to density on reference grasslands within the historical range of the Lesser Prairie-chicken. In an exploratory analysis of possible covariates, the highest ranking occupancy model for the Lesser Prairie-chicken included the positive effects of mean patch size of native vegetation and land cover of prescribed grazing. Long-billed Curlew (*Numenius americanus*) density was six times lower in LPCI rangelands than in reference grasslands and Burrowing Owl (*Athene cunicularia*) density was similar in LPCI and reference grasslands. Cassin's Sparrow (*Peucaea cassinii*) density was three times greater and Lark Bunting (*Calamospiza melanocorys*) density was four times greater in LPCI rangelands than in reference grasslands. Our results suggested grazing management for the Lesser Prairie-chicken confers umbrella species conservation to songbirds such as the Cassin's Sparrow and Lark Bunting, but species requiring disturbance or keystone features, such as the Long-billed Curlew and Burrowing Owl may need additional conservation measures.

Collapsing avian community on a Hawaiian island
Paxton, Eben - Pacific Islands Ecosystem Research Center, U.S. Geological Survey; Richard Camp - University of Hawai'i at Hilo; Marcos Gorresen - University of Hawaii; Lisa Crampton - Kauaii Forest Bird Recovery project; David Leonard - US Fish and Wildlife Service; Eric VanderWerf - Pacific Rim Conservation

The Hawaiian Honeycreepers, famous for their spectacular adaptive radiation, are predicted to experience negative responses to climate change given their susceptibility to introduced disease, the strong linkage of disease distribution to climatic conditions, and their current distribution. Here we document the rapid collapse of the native avifauna on the Island of Kaua‘i that corresponds to changes in climate and disease prevalence. Declines in the six native Kaua‘i Honeycreepers averaged -68% over a 25 year period in the core regions of their range, and -94% across their peripheral range. Two species, Akikiki and Akeke‘e, have declined precipitously with 2012 population estimates of 468 and 945 individuals, respectively, and still declining. Although multiple factors may be pressuring the community, we suggest that a tipping point has been crossed where temperatures in forest habitat at high elevations have reached a threshold that facilitates the development of avian malaria and its vector throughout their range. Continued incursion of invasive weeds and non-native avian competitors may be facilitated by climate change and could also be contributing to declines. If current rates of decline continue, we predict multiple extinctions in the coming decades. Kaua‘i

represents an early warning for the forest bird communities on Maui and Hawai'i Islands, as well as numerous species around the world that are trapped within a climatic space that is rapidly disappearing.

Comparative Transcriptomics of Hawaiian Amakihi (genus *Hemignathus*) Populations Experimentally Infected with Avian Malaria

Paxton, Kristina - University of Hawaii Hilo; Loren Cassin Sackett - Center for Conservation & Evolutionary Genetics, Smithsonian Institution; Carter Atkinson - USGS Pacific Island Ecosystems Research Center; Robert Fleischer - Smithsonian Institution

The Hawaiian avian malaria system is an exceptional model for studying the adaptive responses of birds to invasive pathogens. Amakihi (genus Hemignathus), a Hawaiian honeycreeper complex composed of three species, are the only native birds found in high densities throughout their range, including low elevation areas where malaria is prevalent. Recent experimental work indicates some amakihi populations in low elevations are evolving resistance or tolerance to malaria while high elevation populations remain highly susceptible. While these experimental studies highlight how rapid evolution can occur under the strong selective forces of avian malaria mortality, they shed little light on the mechanisms and genes associated with the evolved response. We examined transcriptome-wide gene expression throughout a bird's immunological response to experimental infection with malaria in populations of high elevation amakihi. Fifteen amakihi were experimentally infected with P. relictum by mosquito bite while five amakihi served as controls. Blood for RNA analysis was sampled prior to infection and spanned the rising, acute, and chronic phases of infection. We examined differential gene expression at different stages of infection between individuals that died and those that recovered from infection to identify candidate genes that correlate with a bird's ability to recover from infection. Candidate genes were mapped to the Hawaii amakihi reference genome to identify the gene ontologies of differentially expressed genes, providing critical information on the genetic basis of immunological adaptations to an invasive, vectored disease.

Single-visit dynamic occupancy models: An approach to account for imperfect detection with Atlas data

Peach, Michelle - SUNY College of Environmental Science and Forestry; Jonathan Cohen - SUNY College of Environmental Science and Forestry; Jacqueline Frair - SUNY College of Environmental Science and Forestry

Breeding Bird Atlas data provide biodiversity information at a relatively fine spatial grain over a broad spatial extent and, increasingly, at multiple points in time, which make them invaluable for understanding processes that affect species distributions over time. The effect of survey effort on species detection has long been appreciated and Atlases typically include records of effort, but challenges remain in analyzing Atlas data that has not been collected using a sampling protocol designed to correct for imperfect detection. We developed a single-visit dynamic occupancy model in a Bayesian framework using covariates to account for imperfect detection in Atlas data and evaluated its performance using both simulations and *Cardellina canadensis* data from the New York Breeding Bird Atlas. At sample sizes that are realistic for many Atlases, a single-visit dynamic occupancy modeling approach can produce unbiased estimates for detection, occupancy, colonization and extinction parameters. Estimates of population parameters (occupancy, colonization and extinction probabilities) are more stable than those for regression coefficients. Incorporating effort hours into the detection model as a power term rather than a linear covariate maintains

parameter estimate accuracy and precision while making the model more realistic and flexible. The single-visit dynamic occupancy approach can correct for imperfect detection in Atlas data and thereby improve understanding of species distributions and the factors that shape them, which is essential for effective conservation and management.

Integrating data to study large-scale population responses to climate change
Pearce-Higgins, James - British Trust for Ornithology

In the UK, an array of large-scale datasets exist to help detect and identify the causes of long-term population changes, ranging from structured surveys, periodic atlases, the collection of birdwatchers records through BirdTrack, ringing (banding) and nest recording schemes. Using a range of examples, I show how analyses of these citizen science datasets, either in isolation or in combination, are providing an increasingly comprehensive picture of the impacts of climate change upon the UK avifauna. Large-scale population trends show a strong impact of climate change. Populations of resident and short-distance migrants have generally increased in abundance as a result of warmer winter and breeding season conditions improving overwinter survival and breeding success. The effects of warming upon long-distance migrants has been more mixed, or even negative, and analyses of both survey and ringing data shows that their populations are strongly affected by precipitation in their wintering grounds, which affects survival. Warming has affected the timing of spring arrival of these migrants, and there is increasing evidence that these changes in phenology may have affected the breeding success and population trends of migrants, at least in some habitats. Consistent negative effects of summer drought conditions are also apparent. The impacts of these processes upon demographic rates and populations have led to significant shifts in the distribution of species, and in the composition of bird communities. Finally, I consider what analyses of these data tell us about the potential for birds to adapt to what may be a warmer future.

Variation in climate change impacts
Pearce-Higgins, James - British Trust for Ornithology

Climate change is regarded as an increasing threat to global biodiversity. Whilst the magnitude of future climate change is projected to be much greater than that experienced already, we can learn much from the already observed responses of populations to variation in climatological variables, to help inform our assessment of the future. Drawing heavily from the wealth of long-term studies, particularly from North America and Europe, I show how climate change is already affecting bird populations around the world, and present evidence about the different mechanisms underpinning those impacts. Variation in the response of different species to temperature and precipitation at different times of the year is summarised, and used to identify taxa which are most likely to be sensitive to future warming and changes in rainfall. Further analysis then shows how the impact of temperature and precipitation upon bird populations varies with latitude. Finally, I consider the main ecological mechanisms likely to underpin the response of populations to climate change, demonstrating the importance of biotic mechanisms associated with altered species interactions, rather than direct abiotic impacts. These results are used to identify the sorts of species which are most likely to be vulnerable to the future impacts of climate change and where those impacts may be greatest. In combination, these results also provide important evidence to inform climate change adaptation.

The role of species traits in driving variation in population trends between habitats

Pearce-Higgins, James - British Trust for Ornithology; Martin Sullivan - University of Leeds; Stuart Newson - British Trust for Ornithology

There has been considerable research undertaken into the traits associated with species' population trend. So far, this has largely ignored the fact that population trends may also vary between habitats. Here, we analyse population trends from the UK Breeding Bird Survey to address this. Trends varied significantly between habitats, with significantly negative trends apparent in woodland and urban habitats. Population trend was largely a function of species identity, and the interaction between species identity and habitat, rather than just habitat alone, and was strongly affected by species traits. In particular, species wintering in the Humid Zone of Africa had more negative population trends than other species, as did ground-nesting species, whilst there were additional effects of diet. Although the effect of these traits did not vary strongly between habitats, declines in long-distant migrant populations were reduced in less seasonal and cooler habitat-types such as coniferous woodland and upland. Variation in population trends between habitats also appeared affected by density-dependent processes operating through the buffer effect. These results provide some explanation for recently observed spatial variation in bird population trends across the country. To conclude, it appears that in the UK, bird population trends are more strongly driven by large-scale processes operating at the scale of species, than by finer-scale processes operating within specific habitats, although habitat-specific processes may ameliorate or exacerbate the impact of drivers operating at these larger-scales. The causes of generally negative population trends in woodland and urban habitats, and in south-east England, requires further investigation.

To go or not? Investigating cues determining timing of songbird migration

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To optimally tune their migration in response to their surroundings, migrating animals rely on an ensemble of internal and external cues. These cues may vary across sites and temporal scale and can work in consort to shape migratory movement patterns. However, our knowledge about the relative importance of these cues in facilitating shifts in behavior is still limited. Here, we present the results of a project using geolocator tracks of a long-distance migrant the Red-backed shrike (*Lanius collurio*), to investigate how migratory songbirds move in response to the environmental cues they encounter throughout the annual cycle. First, we developed a state-space movement model within a Bayesian framework to estimate the probability of switching between moving and stationary stages in response to weather conditions, photoperiod and estimated food availability based upon the Normalized Difference Vegetation Index (NDVI) on a daily basis throughout the annual cycle. Secondly, relying on optimal bird migration theory, we developed a mechanistic stochastic dynamic model to evaluate the importance of different staging areas and predict the decision to move or stay at each of these sites throughout the annual cycle to optimize lifetime reproductive outcome. The results of this model will enable us to gain a better understanding of the actual mechanisms driving timing of migration and movement decisions in migratory songbirds.

Furthermore, our overall modelling framework can ultimately be tested across multiple species and flyways, leading us closer towards predicting how migratory songbirds are responding to global changes.

Unexpected post-fledging site visitation in Tree Swallows: new insights in a well-studied system

Pegan, Teresa - Cornell University, Ecology and Evolutionary Biology; David Winkler - Cornell University

Tree Swallows (*Tachycineta bicolor*) are used as a model system for many aspects of avian biology. However, little is known about their behavior between breeding and migration, which may be critical time periods influencing the birds' dispersal decisions. We used solar-powered radio tags to investigate the movements of young Tree Swallows in Ithaca, New York. Without batteries to die, these tags have a theoretical lifespan longer than that of the bird; thus, we can monitor individuals across their entire annual cycle. Unexpectedly, many of the fledglings returned to the breeding site throughout the late summer, up to 102 days after fledging. By contrast, no tagged adult returned to the site after the completion of its nesting attempt. We deployed tags on nestlings involved with an experimental manipulation of Corticosterone, a stress hormone. Variation in stress response may be an important link between the physical state of an individual and its movement patterns and eventual dispersal behavior. We hypothesized that elevated Cort levels would be correlated with lower philopatry, but early results indicate that Cort levels do not significantly affect the immediate post-fledging behavior of the fledglings. We will also present data resulting from exhaustive road surveys within 10 km radius of the natal site, using directional receivers to locate the individuals that have dispersed. With this dispersal data, we will present for the first time an integrated look at post-fledging behavior and dispersal in this well-studied bird.

Hawaii's introduced birds: ecological replacements for native species?

Pejchar, Liba - Colorado State University

Non-native species may or may not functionally replace the role of native birds in ecological processes. Although most Hawaiian plants rely on bird-mediated seed dispersal, only one common native frugivore persists on Hawaii Island. Omao (Hawaiian Thrush) occupy less than 50% of their original range, but two introduced frugivores are abundant and widespread throughout the island. To assess seed dispersal by native and introduced birds, seed rain and bird diet were measured at three sites with and without Omao (n=6). The diet of native and introduced birds overlapped substantially, but Omao dispersed many native species evenly. In contrast, over 90% of seeds dispersed by introduced birds were from two ubiquitous small-seeded species. Seed rain was also significantly greater and more species rich at sites with Omao. These findings suggest that patterns of seed dispersal are altered following the local extinction of a native frugivore, and that introduced birds incompletely replace the seed dispersal services that Omao provide. To evaluate the effects of refaunation on seed dispersal, future studies could include reintroducing Omao to suitable habitat within its historic range, or novel introductions to nearby islands where similar thrush species are now extinct.

Mercury exposure in Arctic-breeding shorebirds

Perkins, Marie - McGill University; Iain Stenhouse - Biodiversity Research Institute; Niladri Basu - McGill University; Joël Bêty - Département de biologie et Centre d'études nordiques, Université du Québec à Rimouski,; Rebecca Bentzen - Wildlife Conservation Society; H. River Gates - ABR, Inc. Environmental Research and Services; Marie-Andrée Giroux - Département de biologie et Centre d'études nordiques, Université du Québec à Rimouski,; Jean-François Lamarre - Département de biologie et Centre d'études nordiques, Université du Québec à Rimouski,; Richard Lanctot - U.S. Fish and Wildlife Service; Nicolas Lecomte - Département de biologie, Université de Moncton

Many shorebird species are declining. Causes for these declines are unknown, but exposure to contaminants, such as mercury, can have sub-lethal effects in birds that may result in population declines. Arctic-breeding shorebirds may be at greater risk of mercury contamination due to increased mercury deposition in the Arctic. However, it is unknown whether mercury exposure reaches concentrations that may cause adverse effects for Arctic-breeding shorebirds. Here we analyzed 2,477 blood and feather samples collected from 11 Arctic-breeding shorebird species during 2012 and 2013. Sampling locations included five sites in Alaska and four sites in Canada. Blood mercury concentrations in individual shorebirds ranged from 0.014-3.53 µg/g (mean = 0.30 µg/g). Mean blood mercury concentrations differed among species at the same site, among species across sites, and were greater in 2013 for most species. Feather mercury concentrations were generally higher than blood mercury concentrations, ranging from 0.067-12.14 µg/g (mean = 1.14 µg/g). In general, mean blood and feather mercury concentrations were below the threshold associated with a 10% reduction in nest success found in a similarly-sized invertivore, the Carolina Wren (0.7 and 3.0 µg/g, respectively). However, mercury concentrations varied among individuals, with 8% of shorebirds sampled exhibiting blood concentrations greater than 0.7 µg/g and 5% exhibiting feather concentrations greater than 3.0 µg/g. Overall, this study indicates that some individuals may exceed concentrations that reduce reproductive success, particularly those breeding at Barrow, Alaska. The large variation in exposures among individuals poses an additional challenge for deciphering conservation measures for shorebird populations.

Integrating morphology, phylogeography, and ecological niche modeling to explore population differentiation in North African Common Chaffinches

Perktas, Utku - Hacettepe University; A. Townsend Peterson - University of Kansas; Dale Dyer - American Museum of Natural History

Diagnosing discrete evolutionary taxa requires careful assessment of genetic, morphological, ecological, and behavioral variation within and among populations. In this study, data on phenotype (mensural and coloration characters) and genotype [mitochondrial DNA (mtDNA) control-region sequences], and distributional projections derived from ecological niche models (ENMs), were used to investigate population differentiation of North African Common Chaffinches. Results showed substantial genetic variation among populations, mostly (~56%) distributed between Libyan populations and other North African populations, rather than within populations. Isolation-by-distance analyses, together with spatial genetic structure analyses, indicated severely restricted gene flow between populations. Historical demographic analyses indicate that population expansion began before the Last Glacial Maximum (LGM), which is concordant with ecological niche model paleoprojections; interestingly, the

differentiation of the Libyan population apparently did not take place under the last glacial conditions. Hence, although its taxonomic status must await robust testing using multilocus DNA data, this population is an important element in the conservation of bird diversity in North Africa.

First year survival and natal philopatry in migratory grassland songbirds
Perlut, Noah - University of New England; Allan Strong - University of Vermont; Jenna Cava - University of New England; Steven Travis - University of New England

Long-distance natal dispersal generally limits our ability to assess parameters like first-year survival (ϕ1st). Likewise, natal philopatry, and the factors that influence variation in it, is poorly understood. From 2002-2014, we studied ϕ1st and natal philopatry in two migratory songbird species—Savannah Sparrows and Bobolinks—breeding in an agricultural region of Vermont, including 140,000 ha of managed grassland. We detected 90 and 129 locally hatched Savannah Sparrows and Bobolinks, respectively, breeding as adults (mean±SD dispersal distances: Savannah Sparrows 917±851m; Bobolinks 1251±839m). Across ten yearly estimates, ϕ1st averaged 0.41 (range 0.32-0.58). The interaction between fledge date and body mass best explained variation in ϕ1st. Lighter nestlings had greater ϕ1st than heavier nestlings; average or heavy nestlings had greater ϕ1st when they fledged earlier in the summer. For both species, natal dispersal distance increased with increasing annual productivity of the natal field. The probability a Savannah Sparrow was philopatric to its natal field increased if it fledged later in the season; furthermore, this probability decreased if there was an opposite-sex parent or sibling present on the natal field, or the field was under a late-hay management scheme. None of the variables considered explained variation in Bobolink natal philopatry. Overall, first-year survival and natal dispersal distance, including the factors explaining variation in both parameters, were similar between species; the species only differed in the factors that explained fidelity to the natal field itself.

Speciation with gene flow in *Anas* ducks
Peters, Jeffrey - Wright State University; Kevin Hawkins - Wright State University; Joel Nelson - Wright State University; Philip Lavretsky - Wright State University

Mitochondrial DNA (mtDNA), nuclear DNA, and phenotype often yield discordant inferences about the progression of speciation between pairs of avian sister species/subspecies. Specifically, studies have revealed several cases of weakly differentiated mtDNA despite prominent phenotypic differences, or strongly differentiated mtDNA coupled with weak nuclear differentiation. Most explanations of this mito-nuclear-phenotypic discord include some form of genetic exchange and selection during speciation, and in many cases, speciation-with-gene-flow models might apply. Under this model, high heterogeneity within nuclear DNA is expected for species pairs exhibiting prominent discordance among marker types. To test this hypothesis, genomic differentiation at >3,000 loci was examined for 14 pairs of Anas ducks that vary in their degree of marker discordance. We found that FST distributions for species exhibiting mito-nuclear-phenotypic discord were characterized by a strong peak at low values of FST and a long tail extending into higher values. Indeed, distributions for these species were more strongly skewed (mean skewness = –3.71) than distributions for pairs that did not exhibit a prominent discord (mean skewness = –0.75). Mapping loci to the Mallard (*Anas platyrhynchos*) genome revealed that loci from the Z sex-chromosome were over-represented in the tails of the distributions for all pairs. Thus, species exhibiting mito-nuclear-phenotypic discord also exhibited elevated Z-differentiation—e.g., between the Mallard and

American Black Duck (*A. rubripes*), the Z-chromosome was five times more differentiated than autosomes. These results support speciation with gene flow and suggest an important role for the Z-chromosome.

Measuring rather than Predicting: Before-and-after Comparisons of Avifaunas to Detect Climate Change Effects
Peterson, A. Townsend - University of Kansas; Adolfo Navarro-Sigüenza - Universidad Nacional Autónoma de México; Enrique Martinez-Meyer - UNAM

An important step in strategizing for conservation response to climate change was the development of ecological niche modeling approaches that allow anticipation of the future distributional potential of species in the face of future climate conditions and rising sea levels. Those prospective approaches have provided views of how distributions of species and overall species diversity will likely respond to changing climates, but generally remain without empirical testing. Here, we focus on assembling before-and-after tests of how avifaunas have reorganized in recent decades, and what environmental factors have acted as drivers of these changes. In view of the valuable information that emerges from such analyses, we assess data gaps that limit their development for various regions worldwide.

Repeat Inventories of Sites to Detect Avifaunal Change
Peterson, A. Townsend - University of Kansas; Adolfo Navarro-Sigüenza - Universidad Nacional Autónoma de México; Enrique Martinez-Meyer - UNAM

Faunal change is a basic and fundamental element in ecology, biogeography, and conservation biology, yet vanishingly few detailed studies have documented such changes rigorously over decadal time scales. This study responds to that gap in knowledge, providing a detailed analysis of Digital Accessible Knowledge of the birds of Mexico, designed to marshal DAK to identify sites that were sampled and inventoried rigorously prior to the beginning of major global climate change (1980). We identified 100 individual 0.05° pixels and 20 broader 'hotspots' of sampling that were demonstrably well-inventoried prior to 1980; we summarize these sites to promote and enable resurvey efforts that can document events of avifaunal change (and non-change) across the country on decadal time scales. Development of such repeat surveys would pay off richly in information about distributional dynamics of Mexican birds.

Changes in spring arrival dates of 117 bird species over 127 years in West Virginia
Petrauski, Lori - West Virginia University; James Anderson - West Virginia University; George Constantz - Canaan Valley Institute; Sheldon Owen - West Virginia University

Global climate change is affecting many facets of avian ecology, such as shifts in breeding phenology and patterns of migration. Migratory bird species are responding to changes in climate by shifting their temporal patterns of migration. Understanding the magnitude and the contributing factors of these shifts, as well as the variation in species' responses is important when considering conservation plans for vulnerable species. This study examined the spring arrival dates of 117 migrating species over a span of 127 years (1889–2015) using archival sources in West Virginia. West Virginia is in the center of the Atlantic Flyway, is home to the threatened Cerulean Warbler, and has provided rich historical datasets with which to examine changes in spring migration. Of the 117 taxa, 107 showed negative slopes of spring arrival dates (arriving earlier in the spring) plotted against year, whereas only 10 species showed positive slopes (arriving later in the spring). The mean slope of arrival date against year is -0.17, which is equivalent to

an average change in migration of 1.7 days earlier every decade. There is also variation in first arrival dates among groups of migrating birds. All of the 12 orders indicated earlier spring arrival. Accipitriformes displayed the strongest shift in arrival dates (4.1 days earlier each decade, n=88), and Cuculiformes displayed the weakest shift (0.9 days earlier every decade n=103). Differences between long and short distance migrants, preferred habitat, and climatic influences are important factors in understanding changes in spring arrival over the last 127 years.

First to Flush: How are songbird flight initiation distances influenced by ambient sound?

Petrelli, Alissa - Cal Poly San Luis Obispo; Clinton D. Francis - Cal Poly San Luis Obispo

Anthropogenic noise is rapidly encroaching on natural landscapes. A growing body of research indicates that noise can detrimentally affect wildlife and has the potential to negatively feedback on humans experiencing nature and their overall support for nature conservation. In the context of the increasingly popular recreation of bird watching, the ability to approach birds in the wild may be important in ensuring a positive encounter with wildlife. A previous study proposed the “distracted prey hypothesis,” which predicts that individuals receiving multiple modes of sensory stimuli are distracted and respond more slowly to approaching threats. If this hypothesis applies to wild birds, we expect birds to be distracted by noise and that observers can approach to a closer distance. Here, we tested this hypothesis by measuring the flight initiation distances of several species of free-living songbirds exposed to varying background sound levels. For most species, we did not observe a relationship between sound levels and flight initiation distances; however, for Black Phoebes (*Sayornis nigricans*), flight initiation distance increased with background sound levels. This trend might be explained by increased visual vigilance in loud conditions where acoustic surveillance is compromised. Additionally, the biology of this species may drive the trend, and we plan to expand the project to include other species that also exhibit hawking behavior. This study provides evidence that birds may be more resilient to noise pollution than previously thought. However, contrary to the “distracted prey hypothesis,” bird-watchers may find certain species difficult to approach under loud conditions.

The Relationship between Fledging Age and Nest Temperature in Western Bluebirds

Phillips, Emily - Los Alamos National Laboratory; Charles Hathcock - Los Alamos National Laboratory

Extensive research has been done on temperature during the incubation periods of birds, but little has been done during nestling development, and none with the Western Bluebird (*Sialia mexicanus*). In this study, dataloggers were used to monitor nest temperatures during the nestling development phase of Western Bluebirds to determine if there was a relationship between nest temperatures and the age at fledging. The study was conducted in an existing nestbox network at Los Alamos National Laboratory and surrounding area in north-central New Mexico. Based on the age of the nestlings at fledge, the nestboxes were split into three groups: early (fledged at or before 18 days old), average (fledged at or between 19 and 21 days old), and late (fledged at or after 22 days old). Dataloggers were placed underneath the nest and an ambient control was placed on the outside bottom of the box. Temperatures from 22 nestboxes were used in the analysis. An average 4 degree Celsius difference (Temperatures taken every 25 minutes from 0300 to 0600 hours) was found between the nests in the early (n=6) and late (n=5) fledgers throughout their nestling phase ($t=18.73$, $p < 0.001$). The early and average (n=11) fledgers did not have this difference in

temperature during the nestling phase (t=-1.33, p=0.184) Ambient temperatures were similar among all groups. These results suggest that higher temperature nests during the nestling stage tend to fledge earlier. Data is still being collected and will be added to this study in the coming seasons.

Natural and sexual selection on performance of songs in urban white-crowned sparrows
Phillips, Jennifer - Tulane University; Elizabeth Derryberry - Tulane University

Anthropogenic noise is a part of most soundscapes and affects acoustic communication. Many bird species increase song minimum frequency to avoid masking by low frequency, high amplitude anthropogenic noise. An increase in song minimum frequency can reduce song bandwidth if maximum frequency is not increased; however, few studies examine variation in song bandwidth in anthropogenic noise or the behavioral consequences of this variation. Nuttall's white crowned sparrow (*Zonotrichia leucophrys nuttalli*) is known to have narrow bandwidth songs with fast trills in noisier areas of San Francisco, California, yet it is unknown whether these patterns hold up in other cultural populations or in natural soundscapes. I measured variation in song bandwidth, trill rate, and vocal performance across soundscapes in the bay area of California, and male and female response to variation in those three features of song. I tested males with territorial playback experiments across soundscapes, and found that they respond more to high performance, wide bandwidth songs than to low performance, narrow bandwidth songs. I also examined the response of naïve, captive females to bandwidth in the context of low and high city-like noise levels, to assess how ambient noise effects female preference. Results suggest that although natural selection favors signals with reduced bandwidth to avoid masking, sexual selection appears to favor increased bandwidth. My research investigating the interaction between natural and sexual selection on song provides new insight into the evolutionary processes shaping song variation across soundscapes.

Rising novelty and homogenization of bird communities in the U.S.
Pidgeon, Anna - University of Wisconsin-Madison; Rose Graves - University of Wisconsin-Madison; Christopher Latimer - University of Wisconsin-Madison; Jessica Gorzo - University of Wisconsin-Madison; **Max Henschell** - University of Wisconsin-Madison; Paul Schilke - University of Wisconsin-Madison; Martina Hobi - University of Wisconsin-Madison; Marty Pfeiffer - U.S. Forest Service; Amy Shipley - Department of Forest and Wildlife Ecology, University of Wisconsin-Madison; Ashley Hannah - University of Wisconsin-Madison; Benjamin Zuckerberg - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison; Volker Radeloff - University of Wisconsin-Madison

In many regions, bird communities are increasingly similar to each other, possibly due to the proliferation of urban and exurban areas. Exurban areas provide novel abiotic conditions (e.g., temperature, noise, light) that differ greatly from historic ranges of variability of conditions in ecoregions in which they are embedded. We asked: are bird communities in exurban areas novel, or merely simplified, relative to their eco-regional pool? We analyzed dissimilarity among breeding bird communities in the conterminous U.S., grouped in nine ecoregions, using data spanning 2010-2014 from the North American Breeding Bird Survey (BBS) and eBird. While BBS data suggested that, within ecoregions, species richness on exurban routes was either not different than or higher than species richness on routes with greatest natural land cover, eBird data strongly indicated that species richness was higher at exurban sites as compared to sites with high natural land

cover. Using both data sets, the turnover among bird communities was positively related to dissimilarity in housing density and natural vegetation cover among routes/sites. We found that drivers of novelty of exurban bird communities (i.e., high turnover) varied regionally, with housing accounting for 3% (dry western mountains & deserts) to 31% (northwest rainforests) of variance explained, and natural land cover accounting for 2 % (central grasslands) to 33% (central hardwoods). In conclusion, at the national scale, urban and exurban area turnover is beginning to result in the early formation of novel urban communities, but the magnitude and drivers of these changes varied regionally.

How land ownership, land use, and the potential for a trophic cascade impact conservation models for Mountain Plover.
Pierce, Allison - University of Colorado Denver; Colin Woolley - University of Colorado Denver; Ryan Parker - University of Colorado Denver; Tyler Michels - University of Colorado Denver; Angela Dwyer - Bird Conservancy of the Rockies; Michael Wunder - Department of Integrative Biology, University of Colorado Denver

Mountain Plover (*Charadrius montanus*) is a ground-nesting migratory shorebird species that breeds in the grasslands of central North America and winters in the desert grasslands of southwestern North America. Populations have been declining in number for several decades, and the species is one of conservation concern in the US States and Canadian Provinces where it nests. Native grasslands have been replaced with dryland crop farming throughout much of the breeding range. Plovers readily nest on crop fields. In the late 1990s and early 2000s, the prevailing hypothesis for population declines was that tilling practices were destroying nests, and therefore crop fields were ecological traps. A five-year study determined that nest survival rates were comparable on crops and native prairie, but that the causes were different; most nest loss on crop fields was due to tilling, whereas most nest loss on native prairie was from predation. A conservation incentive program facilitated communication with farmers willing to modify tilling practices to mitigate nest loss, and nest abandonment is now the major cause of nest loss in crop fields where farmers participate. Most remaining habitat on native prairie is created and maintained by black-tailed prairie dogs (*Cynomys ludovicianus*). We suspect that these habitats have now become ecological traps, owing to a trophic cascade involving plovers, Burrowing Owls (*Athene cunicularia*) and swift fox (*Vulpes velox*). Here, we describe patterns from long-term monitoring data for these three species from the Pawnee and Thunder Basin National Grasslands.

The impact of land use on Bobolink occurrence, abundance, and reproductive outcome in a shallow soil alvar in Ontario, Canada
Pintaric, Alice - Trent University; Erica Nol - Trent University; Ron Reid - The Couchiching Conservancy

Rapidly declining Bobolink populations have prompted much research into the relationship between agricultural profitability and breeding bird sustainability. This study investigates (1) the effects of agricultural land use change on the occurrence of Bobolink in the alvar region of Carden, Ontario and (2) the influence of continuously grazed pasture management on Bobolink reproductive success. We used historical 2001-2005 Ontario Breeding Bird Atlas (OBBA) and recent (2015) surveys where Bobolink had previously been present to investigate cause of declines in occupancy at 67 survey sites. A total of 66% of historical sites no longer contained Bobolink. The sites where Bobolink disappeared were more likely to have changed land use from pasture or grassland to row crops than those where Bobolink have persisted. Given previous research on impacts of grazing on Bobolink reproduction, we predicted that there would be poor reproductive success in continuously

grazed fields. However, fields in which cattle were continuous grazed at stocking densities of 0.15-1.00head/acre resulted in only slightly lower hatching and fledgling success than in nearby hay fields, which were all under conservation agreements that delayed haying until July 15th. Bobolink nests in low density continuously grazed pastures experienced a trampling rate of 8%. Thus, continuously grazed fields in regions where soil properties dictate low cattle stocking densities can serve as refuges for successful Bobolink reproduction.

Patterns of variation in thermal sensitivity within and between a tropical and temperate bird assemblage

Pollock, Henry - University of Illinois at Urbana-Champaign; Jeffrey Brawn - University of Illinois at Urbana-Champaign; Zachary Cheviron - University of Montana

Understanding animals' physiological responses to ambient temperature is becoming increasingly imperative due to global climate change. Theory predicts that thermal tolerance breadth will increase with temperature variability, yet few studies have tested this prediction in endotherms. Furthermore, most previous studies have used indirect metrics (e.g. the breadth of the thermoneutral zone) as proxies of thermal tolerance rather than testing the absolute limits of the thermal tolerance. For endotherms like birds, which maintain constant, high internal body temperatures, thermoregulation in hot environments poses a twofold challenge: 1) a metabolic cost and 2) a water-balance cost (i.e. evaporative water loss is the primary mode of heat dissipation outside of the thermoneutral zone). We measured metabolic rates, heat-strain coefficients (i.e. the slope of the relationship between ambient temperature and metabolic rate above the thermoneutral zone), evaporative water losses, and body temperatures (collectively, 'thermal sensitivity') of birds to assess variation in physiological responses to acute heat-stress between temperate and tropical species. We found that tropical species had greater thermal sensitivities than temperate species, as indicated by their higher heat-strain coefficients, greater evaporative water losses, and becoming hyperthermic at lower ambient temperatures. Furthermore, within temperate species, we found that habitat was a strong predictor of variation in thermal sensitivity – temperate forest species had greater thermal sensitivities than open or edge species. Our results indicate that ambient temperature regime influences patterns of avian thermal sensitivity on local (within a geographic locality) and regional (between geographic localities) scales.

Projecting Desert Wintering Capacity for Grassland Birds Under a Changing Climate

Pool, Duane - Bird Conservancy of the Rockies; Alberto Macías Duarte - Sonora State University; Robin Reich - Colorado State University; Arvind Panjabi - Bird Conservancy of the Rockies

The winter ecology of grassland birds is a high research priority, especially in terms of understanding potential impacts from climate change. We explored the spatio-temporal changes in grassland bird abundance throughout their wintering grounds in the Chihuahuan Desert by modeling species density using precipitation and Normalized Difference Vegetation Indices (NDVI) in a hierarchical model. We used climate data to identify climate zones in the region and modeled NDVI as a function of climate zones and monthly climate averages to map future shifts in climate zones that support grasslands. We projected species distribution and density for 11 species using climate zones and NDVI though a hierarchical model. Our results demonstrate variable responses to climate change from grassland birds. Six species are predicted to experience < 20% change in wintering capacity; four species are expected to experience < 50% change and one is projected to experience a >50%

change in expected capacity. Eight of the eleven species are projected to experience a decline over the time frame. These results demonstrate that most of the capacity estimates change only modestly relative to the overall population size, with a few exceptions; however, loss of functional grasslands may concentrate birds into smaller areas which may have other consequences. The results emphasize the need to conserve existing grasslands that are predicted to remain viable in the future. The results also provide guidance regarding the condition of grasslands indicated by NDVI as a guide for land managers.

Collecting the Sounds of Nature: Building an Online Archive of Bird Song Records
Pope, Jackson - University of Oklahoma

In 2013 Cornell's Macaulay Library completed the digitization process of their repository of natural sounds, making them available to the public. What was neglected in this digitization process were the records that had been created from the recordings housed in the library. Collaborating with various departments of the University of Oklahoma, I have spent much of the last year digitizing bird song records and creating an online archive using Omeka, a platform which allows for the collection and curation of digital materials. The project itself is based upon the model of the Biodiversity Heritage Library, which has made primary source documents in the history of ornithology freely available online. The BHL, however, has no audio component of its historical collection. The core of the archive are the record series produced by the Cornell Laboratory of Ornithology from the 1930s to the 1960s as a part of the recording activities of Allen, Kellogg and the network of sound recorders who donated their recordings to the Library of Natural Sounds. However, the archive encompasses a diversity of material reaching back to 1900. The digitization includes not just the audio, but images of the physical records, the record sleeves, and associated text all of which is intended to be fully open access and available for download by anyone who wishes to use them. These records have played an important role in the history of ornithology and are worthy of conservation for future appreciation of birds—and of the people who studied them.

When maternal strategies are maternal effects: an example with cooperative breeding in a passerine bird
Potticary, Ahva - University of Arizona; Renee Duckworth - University of Arizona

Cooperative breeding is thought to evolve in response to resource limitation and dispersal costs, yet these problems are common and cooperative breeding is relatively rare. Reconciling rarity with the ubiquity of these constraints requires an understanding of the mechanistic bases promoting expression. A critical assumption is that all individuals evaluate the decision to breed cooperatively equally. However, maternal effects often have permanent impacts on offspring behavior that may alter individual propensity to breed cooperatively, yet the role of maternal strategies in production of helpers is unknown. One possibility is that females produce helpers when they anticipate needing help. Alternatively, helpers may result from a mismatch between the maternal environment of induction and offspring environment of breeding. While maternal strategies require cues that are predictive of subsequent conditions to evolve, every natural system has some stochasticity that can undermine this link. We investigated these possibilities in the facultatively cooperative western bluebird, a species in which male aggression and dispersal propensity are determined by mothers during egg-laying. Our results support the mismatch hypothesis, as helpers appear when there is an increase in population density across seasons, undermining the efficacy of the maternal strategy. Moreover, there is selection on the maternal effect to reduce

mismatch as females have lower fitness when they have helpers and helpers have lower lifetime fitness than other philopatric males. Together, these data indicate that rarity of cooperative breeding in this system reflects the rarity of mismatch and provides a mechanism for maintenance of this strategy despite its costs.

Interspecific competition between resident and wintering warblers: Evidence from a 3D removal experiment

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Every autumn, billions of migratory songbirds depart North America for the Neotropics, which paradoxically coincides with the Caribbean's driest, most arthropod poor time of year. Though many suspect that migrants and residents compete during winter, the mechanisms behind competition and coexistence of ecologically similar species remain unclear. To determine whether resident Yellow Warblers compete with wintering American Redstarts at Font Hill Nature Preserve, Jamaica, we estimated interspecific 2D territory overlap and used point counts and 3D mapping to track birds during natural and experimental removals. Redstarts showed an age/sex hierarchy in interspecific 2D overlap, with dominant adult males overlapping least with Yellow Warblers and subordinate young females overlapping most. Accordingly, 14 of 19 restarts that returned between years decreased their 2D overlap with Yellow Warbler territories (mean = -28%), suggesting that returning birds avoid settling near Yellow Warblers. In the natural experiment, we detected 3.3 times more redstarts with Yellow Warblers absent, suggesting that redstarts constantly avoid Yellow Warblers. During 3D removal experiments, male redstarts moved into the (vacated) core areas of removed Yellow Warblers, providing strong evidence for interspecific competition for space. Curiously, young female redstarts moved away from vacated core areas—probably due to intraspecific competition with dominant males. The constant presence of Yellow Warblers may create a niche for female redstarts that may otherwise be excluded from high quality mangrove habitat by males. Redstarts and Yellow Warblers clearly compete for space, with differences in foraging and diet niche likely allowing coexistence.

Will Climate Change Limit Hovering in Hummingbirds?

Powers, Donald - George Fox University; Kathleen Langland - George Fox University; Susan Wethington - Hummingbird Monitoring Network; Bret Tobalske - The University of Montana; Sean Powers - George Fox University; Catherine Graham - Stony Brook University

Flying animals generate large amounts of heat, which must be dissipated to avoid overheating. In birds, heat dissipation during flight is complicated by feathers, which cover most body surfaces and retard heat loss. Heat dissipation is critical for hummingbirds who generate enormous mass-specific power during sustained hovering. At moderate environmental temperature (21 °C) the thermal gradient allows hummingbirds to dissipate excess heat using heat dissipation areas around the eye, shoulder, and legs where feather density is reduced. However, predicted increases in environmental temperature resulting from climate change could decrease the thermal gradient needed for passive heat loss leaving evaporation as the only avenue for heat dissipation. In this study we used infrared thermography to measure surface temperature in hummingbirds at environmental temperatures ranging from 15-48 °C to test how high environmental temperature impacts passive heat dissipation during hovering. Average body surface temperature positively

correlated with environmental temperature from 15-38 °C (environmentally controlled), but became constant at > 38 °C suggesting behavioral thermoregulation. Mean surface temperature of heat dissipation areas remained constant (~33 °C) between 15-42 °C suggesting integration with the body core. Thus, as environmental temperature increases, the thermal gradient for passive heat transfer decreases. When environmental temperature exceeds body temperature (~42 °C) the thermal gradient was reversed, causing an increase in a hummingbird's thermal load during hovering. Predicted higher temperatures in hummingbird habitat due to climate change could increase the risk of overheating during flight, thereby causing changes in foraging behavior and important social activities.

Using Science to Inform Coastal Cactus Wren Management in Southern California
Preston, Kristine - U.S. Geological Survey Western Ecological Research Center; Dana Kamada - Self Employed; Karly Moore - Self Employed; Trish Smith - The Nature Conservancy; Milan Mitrovich - Natural Community Coalition; Barbara Kus - U.S. Geological Survey Western Ecological Research Center

Since the 1980s Cactus Wren populations have significantly declined in coastal southern California due to habitat loss and fragmentation, wildfires, and drought. Consequently, the species is a focus of regional conservation and research to inform management to recover populations. Fecundity was relatively low in Orange County over five years of monitoring. There are indications that food limits reproduction, especially during drought and in poor quality habitat. Fecundity was highest for early nesters and positively associated with late winter to early spring precipitation and late winter minimum temperatures. Initial egg laying was delayed at higher wren densities and corvid (nest predator) abundances and accelerated for pairs with older males and warmer March maximum temperatures. About 22% of color-banded nestlings survived to the next breeding season and 80% of these individuals attempted breeding in their second year. Wrens were sedentary in the fragmented landscape, with only 20% dispersing away from natal sites and maximal straight-line dispersals of 11 km. Sites with fewer than five pairs of wrens were most vulnerable to local extinction. Cooper's hawks appeared to be the major predator of adults and fledglings. The management strategy is to restore and expand cactus scrub near existing wren populations and then to enhance connectivity with large stepping stone patches that can support at least five territories within several km of existing populations. Research is ongoing to determine plant species that provide optimal food resources and to tailor habitat restoration palettes and choose planting microhabitats that can sustain wren populations during prolonged drought.

***Pelicanus occidentalis*' nesting disturbance on a small island in the Guadeloupe archipelago.**
Priam, Judith - Servicios Cientificos y Tecnicos

OBJECTIVES The purpose of this presentation is to discuss the impact of tourism on the nesting of *Pelicanus occidentalis* on a small island of the Guadeloupe archipelago (see Picture 1 and Map 1) Picture 1: The small islands of Les Saintes located in Southern Guadeloupe Archipelago. Map 1: The Small islands of the Southern Guadeloupe archipelago. Terre-de-Haut and Terre-de-Bas are the biggest and inhabited islands of Les Saintes Archipelago. METHODS We conduct a two year study of the population of *Pelicanus occidentalis* during the breeding season, including vegetation alteration due to tourism activities along the coast by going near and under trees used by the birds for breeding. We have taken GPS points to quantify the displacement of the birds. RESULTS The

vegetation disruption due to walking ways for tourism generated a small displacement of the colony towards the North. We discuss the risk for the juveniles regarding the new environment when they leave the nests. SCIENTIFIC SIGNIFICANCE The study allows understanding small scale equilibrium dynamics as the island considered is around 5 km². In fact around 900 inhabitants are located on only two villages. Birds were in other areas of the archipelago for many years. Many moved from small islets to this bigger inhabited island. The equilibrium between humans and birds is then of paramount importance to maintain such colonies in the Caribbean.

Nest evolution in the earliest passerines
Price, Jordan - St. Mary's College of Maryland; Simon Griffith - Macquarie University

The architectural diversity of nests in the passerine birds (order Passeriformes) is thought to have played a major role in the adaptive radiation of this group, which now comprises more than half of avian species and occupies nearly all terrestrial ecosystems. Here we present an extensive survey and ancestral state reconstruction of nest design across nearly all passerine taxa including 124 families. Most passerines construct open cup-shaped nests, whereas a minority build roofed structures or nest in cavities or burrows. We provide strong evidence that, despite being relatively uncommon today, roofed nests were constructed by the common ancestor of all modern passerines. Open cup nests evolved from enclosed nests at least four times independently: in the bowerbirds, the honeyeaters, the New World suboscines, and in a worldwide radiation including most extant oscine passerine species. Our results show that the familiar cup-shaped nests of these birds were convergently evolved, suggesting adaptive benefits over earlier roofed designs. The next challenge will be to identify what those benefits are.

Context- and behavior- dependent effects of male testosterone treatment on long-term pair-maintenance behavior in zebra finches
Prior, Nora - University of Maryland, College Park; Kang Nian Yap - Simon Fraser University, Burnaby BC, Canada; David Liu - Psychology Department, University of British Columbia, Canada; Clementine Vignal - Université de Lyon / Saint-Etienne; Kiran Soma - Psychology Department, University of British Columbia, Canada

The neuroendocrine mechanisms regulating pair-maintenance behaviors are largely unknown, yet fundamental to our understanding of monogamy. Furthermore, the expression and regulation of pair maintenance behavior is likely to be greatly influenced by social and environmental contexts. Here, we examined whether testosterone administration to males had context-dependent effects on pair-maintenance in zebra finches. We compared two contexts: un-manipulated (baseline) and following a brief chase (post stressor). Pairs were randomly assigned to either control (N = 8) or testosterone (N = 7) conditions. Only the male partner was manipulated (either an empty or a testosterone-filled Silastic implant). We quantified both physical and acoustic behaviors. Interestingly, we found that while male testosterone treatment had no effect on behavior during baseline, it significantly affected behavior post stressor. Specifically, testosterone-treated males spent less time in close proximity to their partner and sang more. To our knowledge, this is one of the first reports of a context- and behavior-dependent effect in the neuroendocrine regulation of pair maintenance behavior, as well as the first report of an inhibitory effect of testosterone on zebra finch pairing behaviors. These results raise interesting questions about the function of affiliative behaviors in established pair bonds.

Review of Avian Influenza and Global Perspective
Prosser, Diann - US Geological Survey, Patuxent Wildlife Research Center; John Takekawa - National Audubon Society

This introductory presentation will provide a summary of avian influenza viruses, risks to wildlife, poultry, and people, and important ecological and sociological factors that will be addressed in detail by the subject experts comprising our symposium. Topics covered by the speakers will include: What are avian influenza viruses? Where do they come from? What is the global history of AIVs and the current situation in the United States? What's the relevance of wild birds, poultry, and humans to AIV transmission? How do we study AIVs? How will global change affect risks of avian influenza spread? The rapidly changing interface between wild birds, agriculture, and humans is poorly understood, yet a serious potential risk to worldwide health. We are fortunate to have a wide range of interdisciplinary specialists at NAOC, so come join us in learning about the challenge of avian influenza from some of the top experts in their fields.

Genetic and behavioral divergence among Northern Cardinal populations: testing the permeability of a biogeographic barrier
Provost, Kaiya - Columbia University/American Museum of Natural History; William Mauck - American Museum of Natural History; Brian Smith - American Museum of Natural History

Biogeographic barriers often play an important role in initiating the first step of allopatric speciation by genetically isolating bird populations. However, biogeographic barriers serve as filters in that some species exhibit rapid divergence and others maintain high gene flow across the barrier. Because these biogeographic filters preferentially allow populations with certain traits or ecologies to pass through them and exchange genes, allopatry only occurs between populations missing those traits. Understanding which traits modulate a filter barrier would elucidate how allopatric speciation is initiated or prevented. We tested whether behavioral isolation via song recognition can maintain genetic isolation across the Cochise Filter Barrier, which separates the Sonoran and Chihuahuan deserts. To quantify genetic structure and the degree of gene flow across the barrier, we collected mitochondrial and genomic SNP-based genetic variation of the Northern Cardinal (*Cardinalis cardinalis*). We evaluated song recognition via playback experiments to quantify Sonoran males' responses to familiar vs. novel songs. To determine if reproductive signaling mismatches can maintain isolation in this system, we used differences in recognition between desert populations. Mitochondrial data showed reciprocal monophyly between desert populations, but genomic data suggest that gene flow may occur. Differential responses to playbacks suggested that males recognized songs from geographically close populations, but not distant populations, as conspecific. We posit that the permeability of the filter barrier is directly linked to mating behavior in Northern Cardinals. As songs diverge among populations, the filter barrier will become less permeable, leading to the onset of speciation.

Living in a Neighborhood: Comparative Marauding Behavior in Bowerbirds
Pruett-Jones, Stephen - University of Chicago

In bowerbirds, males often maraud and/or attempt to steal the decorations at the bowers of their neighbors. Game theory models have suggested that 1: Marauding behavior is evolutionary stable compared to guarding behavior, and 2. Males should either always maraud or always guard. I examine marauding behavior across all species of bowerbirds based on published studies to test the predictions of theoretical models. Rates of bower marauding and theft behavior vary significantly across species, and these behaviors exhibit a negative relationship to

each other and to the relative complexity of the bower. In species that build relatively simple bowers that are easily destroyed, males display further apart. Further, most aspects of marauding and theft behavior vary with relative spacing of males (nearest neighbor distance). As males display closer to each other, all types of marauding behavior increases. Further, males invest less in bower components as display strategies when spacing between bowerbirdsdavid decreases and in these cases, females appear to focus less on bower components in their choice of mates. In contrast, in species in which males display further apart from each other, they accumulate more decorations, and female use decorations more in their choice of mates. Aspects of ecology (body mass and diet) explained some aspects of behavior such as bower attendance time, but not bower marauding. I suggest that the dynamics of marauding and theft behavior affect social organization in bowerbirds as much as traditionally important aspects of ecology.

Identification and Conservation of Landbird Molting Grounds in North America

Pyle, Peter - The Institute for Bird Populations; **James Saracco** - The Institute for Bird Populations; David DeSante - The Institute for Bird Populations

It has largely been assumed that the definitive prebasic molt of most North American landbirds occurs in late summer on or near breeding territories. However, locations of molting sites relative to breeding territories and habitat requirements for molting remain virtually unstudied for most species. We analyzed data from ~ 75,000 individual adult birds of 143 species captured as part of the Monitoring Avian Productivity and Survivorship program (MAPS) to assess variability among individuals, regions (east v. west), and species in the probability of capturing molting birds at their breeding sites (only birds captured multiple times, at least once in breeding condition were considered). Although molt-migration has been thought to be more common in western North America, we found similar molt probabilities in late summer (1 Aug) for birds at their breeding sites for eastern (0.44; 95%CI: 0.35-0.54) and western (0.49; 95% CI:0.40-0.59) regions. Molt probabilities largely reflected migratory status and molt locations of species reported in the literature. However, there were exceptions, and we found a wide range of variation among migratory species generally thought to molt on breeding grounds. Distributions of breeding and molting sites and spatial models of breeding and molting probabilities suggested a range of movements between breeding and molting locations, including latitudinal, longitudinal, elevational, or stochastic shifts. We encourage consideration of potential molt strategies in the design and interpretation of full annual cycle population studies, such that molting habitat requirements for North American landbirds can be identified and incorporated into conservation and management strategies.

Genetic characterization of Cuban colonies of American flamingos: impacts on its management and conservation.

Quevedo, Alexander Llanes - University of Havana, Cuba; Roberto Frías Soler - University of Heidelberg, Germany; Georgina Espinosa López - University of Havana, Cuba

The American Flamingo (*Phoenicopterus ruber*; Aves: Phoenicopteridae) is widely distributed throughout the Caribbean, with a significant presence in Cuba, where can be found more than a half of the species individuals. Flamingos can move long distances looking for suitable conditions for feeding and breeding, so the knowledge of the genetic diversity and connectivity of its colonies and populations is essential in order to preserve and manage these birds. Molecular markers are very useful tools to assess the genetic structure among populations. In this work we used six

microsatellite loci to estimate the genetic composition, diversity and structure of the three largest breeding colonies in Cuba and a small isolated one from Galapagos Island. All analyzed loci were in Hardy-Weinberg equilibrium and polymorphic, with the exception of Pruμ5 in Galapagos. Diversity indexes and Fst values showed no statistical differences among Cuban colonies, what can be explained due to the high mobility of the species. However, there are significant differences in the genetic composition and frequencies between Cuba and Galapagos, where diversity indexes such as total and private number of alleles, observed and expected heterocigozity and allelic richness were lower than those found in the Cuban colonies.

The tight fit of refueling and staging time: bar-tailed godwits need more worms at temperate migratory site to cope with climate change in the Arctic
Rakhimberdiev, Eldar - NIOZ Royal Netherlands Institute for Sea Research; Theinis Piersma - NIOZ Royal Netherlands Institute for Sea Research

The Taimyrensis subspecies of Bart-tailed godwit winters in subtropical Mauritania, West Africa, and in spring migrates to the breeding site on Taimyr, Russian Arctic, in two nonstop flights. For refueling godwits stage in the Wadden Sea, Northwestern Europe. Here, godwits work hard to accumulate up to 10 g of fat per day, which is close to the maximum rate predicted for animals of this size. We integrated independent long-term data on arrival time in the Netherlands from a citizen science project, captures of lean birds on arrival, capture-resight data while fueling, food abundance in the Wadden Sea, and arrival and breeding observations on the breeding grounds in the joint Bayesian framework. We show that individual and population average godwits' survival strongly depends on weight accumulated during fueling, which is a product of time spent at the staging site and food abundance. During the last two decades godwits advanced breeding time with about 12 days, thus precisely following advances in snowmelt dates. This caused shortening of staging time at the Wadden Sea. Compensation of shortened fueling time increased dependency on the food at the staging site. Such a compensation mechanism between the Arctic breeding and the temperate staging areas may shield population from hard selection at a specific place, but can also provide a cumulative mismatch in case of negative simultaneous negative changes in both places.

A direct investigation of the role of competition in Hawaiian forest birds
Ralph, C John - US Forest Service, Redwood Sciences Laboratory; Jared Wolfe - USFS Pacific Southwest Research Station - Klamath Bird Observatory

Individual bird species numbers and community composition are regulated through several processes, and while the primary role that competition for seasonal resources played has been long been acknowledged and investigated direct measures have been relatively few. When faced with limited resources, in effect, a species has few choices. It can decrease in numbers, it can exclude other species from these resources, or it can shift to other resources. While the literature has many indirect studies involving correlational analyses, direct measurements of trophic linkages and role of competition in bird communities to demonstrate these processes are exceedingly rare. Hawaiian bird communities are excellent to study these processes because they are relatively species poor, and have easily measureable trophic linkages (including obligate nectarivores and frugivores, endangered specialists, and generalists), as well as introduced and native species. We collected intensive data on 15 bird species in the 1970s and 1980s at several study sites where the population and behavioral dynamics and associated food resources, were assessed at monthly intervals. With analytical power

unavailable when these data were gathered, we have investigated the direct and indirect effects of exogenous and endogenous variables on these species. We have found that they use different life history strategies to structure their life-cycle events around climatically-induced food availability, as well as trophic interspecies interactions.

Population trends influence climate niche breathe and the ability to track climate change for North American birds
Ralston, Joel - Saint Mary's College; **William DeLuca** - Northeast Climate Science Center, University of Massachusetts; Richard Feldman - Centro de Investigación Científica de Yucatán; David King - USDA Forest Service Northern Research Station / University of Massachusetts, Amherst

Ecological niche theory states that realized niche breadth should increase with increasing population trends, yet previous studies have not investigated the relationship between population trend and climate niche breadth. Furthermore, little is known about how population trends influence a species' ability to track their realized climate niche. This information is imperative to not only understand the potential consequences of climate change, but understand implications on predictive species distribution models. We analyzed BBS data between 1980 and 2012 for 46 species of North American birds and found that changes in realized climate niche breadth were significantly and positively associated with BBS trend in abundance. We show that 40.6% of the variation in change in niche breadth can be explained by population trend, and that 20.0% of this is independent of the influence of changes in distribution. We found that increasingly abundant species tended to show greater levels of niche expansion compared to declining species and that declining species had significantly greater niche unfilling due to an inability to colonize new sites beyond their range peripheries after climate had changed at sites of occurrence. Our results indicate that species with increasing trends are better able to geographically track climate change compared to declining species, which exhibited lags relative to changes in climate. These findings have important implications for understanding past changes in distribution and for modeling future species shifts.

Taxonomic status and habitat associations of the declining Newfoundland Gray-cheeked Thrush (*Catharus minimus minimus*)
Ralston, Joel - Saint Mary's College; Alyssa FitzGerald - University at Albany; Jeremy Kirchman - New York State Museum; Ian Warkentin - Memorial University of Newfoundland Grenfell; Darroch Whitaker - Parks Canada

The once common Newfoundland subspecies of Gray-cheeked Thrush (*Catharus minimus minimus*) has declined precipitously in recent decades, and has been recommended for both provincial and federal imperiled species protection. In contrast, the Northern subspecies (*C. m. aliciae*) is still common in Labrador, suggesting local factors are driving the population decline on Newfoundland. In 2014 and 2015 we collected mtDNA and morphometric data from Gray-cheeked Thrushes captured in Newfoundland and Labrador to assess the validity and geographic distributions of the currently recognized subspecies. We found Newfoundland thrushes (*C. m. minimus*) were smaller, had less extensive black in the lower mandible, and were genetically distinguishable from mainland thrushes (*C. m. aliciae*), but with genetic intermixing of subspecies in southern Labrador. These results support the currently recognized subspecies boundary north of the Forteau Barrens ecoregion in southern Labrador. To determine whether habitat characteristics could explain recent changes in distribution and abundance we conducted point counts and habitat measurements at historically occupied Gray-cheeked Thrush sites in Newfoundland and Labrador. We found no

significant difference in forest structure or composition at sites where Gray-cheeked Thrush have disappeared compared to those where they have persisted. This suggests that factors unrelated to availability of suitable habitat are responsible for population declines. It has been suggested that nest predation by introduced red squirrels (*Tamiasciurus hudsonicus*) could be driving declines in Newfoundland. We found Gray-cheeked Thrushes were three times more likely to be detected at survey points where red squirrels were not observed.

Where the Wild Birds are: Spatial Mismatch and Range Contractions of the Western Ghats Avifauna

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Global declines in biodiversity are occurring at an unprecedented rate due in part to extensive loss of habitats, including forests. Since 1994, the International Union for Conservation of Nature (IUCN) has maintained a Red List of threatened species to inform conservation action. One criterion used by IUCN to assess threat is the geographic range of a species. However, range maps used to assess threat often contain large areas of unsuitable habitat, thereby overestimating range and underestimating threat. In this study, we assessed 11 of the 25 endemic birds of the Western Ghats biodiversity hotspot to test the hypothesis that the majority of the geographic ranges that IUCN uses for threat assessment are largely inaccurate. Using expert reviewed data from the world's largest citizen science database (eBird) within a species distribution modeling framework, our results show that: (a) geographic ranges have been greatly overestimated by IUCN for 10 of the 11 endemic bird species examined; (b) range maps used by IUCN contain large areas of unsuitable habitat, and (c) ranges estimated in this study require provisional upgrading of IUCN threat status for at least 6 of the 11 species. Data quality and improving uncertainty in species range estimation are critical to assessing threat and informing species conservation. The use of high resolution and freely available geo-referenced data to estimate species ranges provides a platform for conservation planning at minimal cost. The significantly revised range estimates provided here have important conservation management implications for endemic birds in the Western Ghats, and elsewhere.

in relative abundance of H7 subtype influenza A virus in blue-winged teal (*Anas discors*) along the United States Gulf Coast and potential implications to poultry production

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H5 and H7 hemagglutinin (HA) subtype influenza A viruses (IAVs) may develop high pathogenicity in poultry production systems and are therefore frequent targets for wild bird surveillance programs. As part of research efforts to assess the role of blue-winged teal (*Anas discors*) in the dispersal of IAVs, we sampled these long-distance migrants along the United States Gulf Coast

annually during spring (February–March) and autumn (July–September) 2012–2015. Viral prevalence in blue-winged teal sampled in Texas and Louisiana during spring has been lower as compared to autumn. IAVs detected in blue-winged teal in spring have been predominately of the H7 HA subtype, including six of seven collections made in Texas and Louisiana during 2012–2015 and two collections made in Texas in 2001–2002. In contrast, IAVs detected during autumn have predominately been of the H4 HA subtype, including six of seven collections made in Texas and Louisiana during 2012–2015 and most collections from 1986–2011. Genetic analyses using sequences for H7 HA subtype IAVs recovered from wild birds and those isolated in poultry provide support for relatively recent shared common ancestry. This suggests that waterfowl-origin H7 subtype IAVs are occasionally introduced into agricultural production systems where they may lead to economic losses. Additional research would be useful to quantify the frequency at which wild bird-origin H7 subtype IAVs enter poultry production systems, identify mechanisms by which viruses cross the wild bird-poultry interface, and assess how biosecurity practices could be improved to limit the introduction of viruses into poultry.

Does blue-green eggshell color influence provisioning strategies of male mountain bluebirds (*Sialia currucoides*)?

Randall, Jeannine A. - University of Northern British Columbia; Russell D. Dawson - University of Northern British Columbia

Clarifying the function of elaborate ornamental traits has been a key objective in evolutionary ecology. However, despite the common occurrence of such ornaments in females, the influence of female traits on male behavior is still poorly understood. Blue-green eggshell color is produced by female birds in many species, and has been proposed to have evolved through sexual selection by advertising quality and pre-hatch maternal investment to males, and eliciting increased paternal care. Previous tests of this hypothesis have been inconclusive and have not accounted for avian visual capabilities. We quantified eggshell color using reflectance spectrometry and perceptual color models, and examined the relationship between eggshell color (achieved r, theta, phi) and male provisioning behavior in mountain bluebirds (*Sialia currucoides*). Because eggshell color and nestling phenotypes may be related, we used a cross-fostering design to separate these effects, and compared eggshell color to parental provisioning rates at three stages during brood-rearing (early/mid/late). Contrary to predictions if eggshell color was sexually selected, achieved r (saturation) of eggs was negatively related to male feeding rates during mid brood-rearing. Furthermore, eggshell color was not related to male feeding rates in early and late brood-rearing. Our results suggest that eggshell color may be assessed by male birds, and may influence their provisioning behavior at some stages of brood rearing, but it does not elicit increased parental care as predicted. Instead, these findings indicate that under some circumstances males provide increased care to young hatched from eggshells with less saturated color.

Reproductive consequences of climate variability: evidence for species-specific responses to spring phenology and cross-seasonal effects

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Climate change is expected to alter temperature and precipitation regimes across North America, and the ability of species to respond to these changes could have serious

implications for population dynamics. Flexible species may better respond to advances in spring phenology by altering breeding chronologies. In migratory bird species, conditions experienced during winter may have cross-seasonal effects during the subsequent breeding season. We evaluated species-specific responses to antecedent winter and current spring conditions. We used a dataset composed of 21,230 duck nests from 164 sites to determine how these factors influenced timing of nesting and subsequent reproductive success in eight duck species representing distinct life-histories. Data were collected during the period 1993-2011. With general and generalized linear mixed effects models we tested how species responded in timing and nest survival, respectively, to El Nino Southern Oscillation (ENSO) conditions experienced during the preceding winter (Dec-Feb), spring temperature as a proxy for spring phenology (Mar-Jun), and spring moisture anomaly (Mar-Jun) indicating conditions on the breeding grounds, while accounting for random effects of site-year and habitat. Overall, species responded differently to the combined effects of winter and spring climate. Species tended to nest earlier following warmer, wetter winters and in warmer springs; however, Lesser Scaup, a late nesting species, showed little response to climatic conditions and therefore may be more sensitive to future climate change. Reproductive consequences of phenological response were also detected, such that early-nesting female Mallards and American Wigeons had greater nest survival. Results provide new insights into mechanisms for cross-seasonal effects.

The impact of elevated temperatures on social networks of a communal passerine, the Sociable Weaver *Philetairus socius*

Rat, Margaux - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Andrew McKechnie - University of Pretoria; Cedric Sueur - Institut Pluridisciplinaire Hubert Curien; Susan Cunningham - Percy FitzPatrick Institute of African Ornithology, University of Cape Town

Individuals living in hot and arid environments face important risks associated with hyperthermia (e.g. dehydration), risks which are expected to increase with climate change. In order to cope with heat stress, individuals can adjust their behaviour, for example by finding cooler locations within thermal landscapes and/or by reducing activity. These behavioural modifications coupled with alterations of resource availability induced by climate change, may have important impacts on how individuals interact with their conspecifics. Group social structure typically regulates information flow, cooperation and conflict between individuals. Modifications of social structure may undermine the way a group functions. We tested whether the social structure of year-round communal passerines, sociable weavers *Philetairus socius*, was modified when temperatures increased. We spent 30 days monitoring three colonies in the Kalahari. We collected the interactions observed at artificial feeders and the air temperatures birds were experiencing in order to establish their dominance and their association networks under different thermal conditions. We additionally conducted focal observations to assess whether heat stress behaviour (i.e. time spent panting) was related to social behaviour. We found that individuals interacted less (i.e. lower network density) and with less social partners (i.e. lower network degree) under high temperatures. We also found that the time an individual spent panting was associated with its social behaviour during the focal suggesting that being social under hot temperatures may be costly. Taken together our results indicate that social interactions between individuals are affected by heat, suggesting climate change may alter the way societies function.

Radio-tracking reveals survival, movements, and habitat selection of post-fledging Cerulean Warblers in a managed forest landscape

Raybuck, Douglas - Arkansas State University; Scott Stoleson - USDA Forest Service Northern Research Station; Jeffery Larkin - Indiana University of Pennsylvania; Than Boves - Arkansas State University

The Cerulean Warbler is a declining Nearctic-Neotropical migrant species of concern. While much knowledge has been gained about the nesting period of this canopy species of the eastern hardwood forests, little is known about the post-fledging period, which is likely another critical life stage. After locating nests within a matrix of habitat conditions created by various forest management strategies in NW PA, we captured fledglings and used radio telemetry to estimate survival, track movements, and examine habitat selection during their dependent stage. Mortality occurred in 11 of 21 fledglings (52%) during this period, with nine deaths occurring within three days post-fledging. Most birds left the parental territory within a week of fledging and the maximum distance moved from the nest after 5 d was 462 m; after 14 d it was 1.3 km; and after 24 d it was, somewhat unexpectedly, 4.4 km. Fledglings used a diversity of habitat and management types, including clear-cut patches, 25-yr-old regenerating clear-cuts, shelterwood cuts, and mature undisturbed forest. Over the entire tracking period (up to 35 d), fledglings selected for habitats with greater midstory cover, lower basal area, and lesser sapling cover (when compared with paired, random locations). However, lesser sapling cover may also be correlated with decreased survival for birds that come down from the canopy immediately upon fledging. Our results suggest that a diversity of management types, including some quite different from those that produce habitat typically selected by adults, and maintaining large blocks of contiguous forest would benefit fledgling Cerulean Warblers.

Ecological Determinants of Nestbox Occupancy and Reproductive Success in the Western Bluebird (*Sialia mexicana*)

Reader, Lindsey - University of Utah; Anne Jacobs - Allegheny College; Jeanne Fair - Los Alamos National Laboratory

The past forty years have seen a large body of literature on nest-site selection and its consequences for fitness – particularly in secondary cavity nesters. However, explanatory power is often limited by short study duration and lack of suitable variation in predictor variables. The Avian Nestbox Network at Los Alamos National Laboratory, a long-term study area initially established for ecoimmunololgy studies, is ideally poised to circumvent these limitations. We used 16 years of data on seasonally-arriving bluebirds to analyze the effects of several course-grained and box-level characteristics on occupancy rates and reproductive success. Overall, we found highly significant effects of habitat type, altitude, and nestbox orientation on occupancy rates, as well as lesser-magnitude effects of landcover that depended on variable combinations. Habitat type and altitude remained strong predictors of all measures of reproductive success, while orientation and landcover had no effect. We examine additional relationships between variables and within geographically distinct areas, and discuss what the discrepancies between occupancy patterns and fitness outcomes may mean for this species.

The impact of taxon sampling and data type on difficult problems in phylogenomics: Birds in a bush revisited?
Reddy, Sushma - Loyola University Chicago; Rebecca Kimball - Department of Biology, University of Florida; Akanksha Pandey - University of Florida; Peter Hosner - University of Florida; Mike Braun - Smithsonian National Museum of Natural History; Kin-Lan Han - University of Florida; John Harshman - -; Shannon Hackett - Field Museum of Natural History; Christopher Huddleston - National Museum of Natural History; Sarah Kingston - Bowdoin College; Ben Marks - Field Museum of Natural History; Kathleen Miglia - Duke University; William Moore - -; Frederick Sheldon - Louisiana State University; Christopher Witt - University of New Mexico; Tamaki Yuri - Sam Noble Museum, University of Oklahoma; Edward Braun - University of Florida

Resolving deep relationships of modern birds has challenged avian systematics and despite enormous efforts, much conflict remains across studies. Recent phylogenomic analyses using different strategies – whole genome sequencing for a limited taxon set (Jarvis et al. 2014. Science 346: 1320-31) or sequence capture with more extensive taxonomic coverage (Prum et al. 2015. Nature 526: 569-73) – have resulted in very different topologies. Using an independent data set with coverage comparable to Prum et al. (235 taxa and 54 loci, mainly introns), we tested whether this incongruence is due to biases such as taxon sampling, signal in data, or analytical methods. Our analyses show that taxon sampling improves support for a set of interordinal relationships that are recovered across most analyses. However, in comparing our data to published analyses, conflict in the deep internodes of birds appears to depend more upon differences in data type (coding versus non-coding). Some biases in data–type, such as base compositional biases that violate the assumptions of existing substitution models, are more problematic in coding regions than non-coding sequences, indicating that these coding regions may not be ideal to use with existing models. Although the avian tree of life has made tremendous advances in the last 10 years in reaching consilience in several relationships, some deeper nodes may be unresolvable given limitation of the analytical tools and the inherent signal in avian genomes.

Abundance and body condition of a Neotropical migratory bird overwintering in mangrove forests in Colombia
Reese, Jessie - Virginia Commonwealth University; Lesley Bulluck - Virginia Commonwealth University

Understanding nonbreeding season abundance and body condition of birds across habitats can be useful for determining relative habitat quality and identifying areas of conservation priority. Here, we present some of the first abundance estimates for overwintering Neotropical migratory birds. We estimated abundance and body condition for Prothonotary Warblers (*Protonotaria citrea*) overwintering at four coastal mangrove forests and one forested freshwater lagoon on the Caribbean coast of Colombia in January 2016. The sites varied in dominant canopy species, were on average 125 km apart, and spanned a precipitation gradient from humid lowland forest in the west to dry tropical scrub in the east. Point counts were conducted using a time removal model and abundance was estimated using a multinomial N-mixture model. Birds were captured via mist nets and body condition was estimated by calculating the residuals of a regression of body mass and wing chord. Abundance varied between 0 and 0.641 birds per hectare, with lowest density occurring at the historically driest site. Abundance increased with increasing canopy height, suggesting that more mature forests supported higher densities of birds. There was no difference in abundance when dominant canopy species was red versus

black mangrove. Body condition varied significantly across the sites, and decreased with increasing canopy height, suggesting that Prothonotary Warblers may adhere to the adaptive body mass theory. Together, these results indicate that mature tracts of forest, regardless of mangrove species composition, should be prioritized for protection in order to benefit the greatest number of overwintering Prothonotary Warblers.

The Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources

Regan, Ron - Association of Fish & Wildlife Agencies; Mark Humpert - Association of Fish & Wildlife Agencies

Inadequate funding to conserve the broad array of species in a state fish and wildlife agency conservation portfolio is a serious challenge. In the early 1990's the Association of Fish Wildlife Agencies launched a fish and wildlife diversity funding initiative. The initial focus was on a dedicated funding stream from excise taxes on outdoor recreation products to fund nongame conservation and later on offshore energy royalties via the Conservation and Reinvestment Act (CARA). The State and Tribal Wildlife Grants program was created in 2000 by the U.S. Congress after CARA failed to pass. This program has provided each state, territory, and the District of Columbia with an average of about $1 million annually to develop and implement State Wildlife Action Plans. Although these funds and the Plans have made a meaningful difference in state agency capacity and conservation delivery, the need is still great. In 2015, the Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources was launched to recommend a solution to the continuing funding problem. The Panel has recommended that $1.3 billion annually from existing royalties and fees from energy and mineral development on federal lands and waters be dedicated to state fish and wildlife agencies. The Panel's work also offers a jumping off point for new partnerships with the business community, for telling the state conservation story, and for making the case for state agency relevancy to the lives of all Americans. The support of the birding community will be vital on all fronts.

Female Dark-eyed Juncos produce male-like song in a territorial context during the early breeding season

Reichard, Dustin - Ohio Wesleyan University; Daniel Brothers - Ohio Wesleyan University; Serena George - Ohio Wesleyan University; Jonathan Atwell - Indiana University; Ellen Ketterson - Indiana University

The occurrence of female song, once considered a rarity, has become increasingly recognized across a variety of avian taxa. Females of many species can be induced to produce male-like song with exogenous testosterone, but observations of female song in free-living birds remain limited by both male sampling biases and incomplete sampling of females. Here, we report multiple observations of female dark-eyed juncos (*Junco hyemalis*) producing a male-like song during the early breeding season (i.e. post-territory establishment; pre-nesting) in a recently established non-migratory population. To elicit this behavior, we presented free-living junco pairs with a live, caged female conspecific. Three unique females responded to our trials by diving at the intruding female, chasing their mate, fanning their tail feathers, and singing a trilled song similar to male broadcast song. We compared male and female songs quantitatively and found that the two sexes were statistically similar in many spectral and temporal characteristics, but female songs had significantly lower minimum and peak frequencies than males. This result is particularly surprising, as males in this urban population are known to sing at a significantly higher minimum frequency than males in a nearby montane population. We will discuss potential proximate and ultimate explanations for the occurrence of female song in dark-eyed juncos. Whether female song is

common in all juncos during the early breeding season or if it is restricted to this particular non-migratory population remains an important question for future research.

Can private-land habitat restoration be used to meet population goals for conservation priority species?
Reiley, Bryan - Illinois Natural History Survey, Prairie Research institute, Univ. of Illinois at Urbana-Champaign; Thomas Benson - Illinois Natural History Survey, University of Illinois

Agricultural intensification has negatively affected biodiversity throughout the world. In the U.S., population declines of many early successional bird species have been linked with habitat loss due to agriculture. In light of this, recent efforts have attempted to prioritize conservation actions at continental scales. Importantly, these efforts have used existing data to estimate the global population size for declining species and set future population goals. Though these efforts consider broad scales for conservation efforts and provide population targets, they lack explicit plans to achieve those goals. One way to achieve these goals is through the process of habitat restoration. In particular, voluntary private-land programs that restore habitat in agricultural landscapes may be implemented at a sufficiently large scale to achieve population goals. In order to understand how private-land restoration programs could be used to achieve population goals for declining species we examined the population-level impacts of the Conservation Reserve Enhancement Program, which has created more than 57,000 hectares of habitat in Illinois, for two conservation priority species, the Bell's Vireo and the Field Sparrow. We surveyed 201 randomly chosen restored fields in 10 counties in central and west-central Illinois during the 2012-2015 breeding seasons. We found that current restoration efforts in Illinois may be achieving state population goals for the Bell's Vireo, but more than 10 times the current amount of restored habitat would be required to achieve the Field Sparrow population goal. Our results suggest that population goals for some species may be unrealistically high.

Winter diet derived from stable isotopes across the breeding range of a long-distance migratory grassland songbird
Renfrew, Rosalind - Vermont Center for Ecostudies; Jason Hill - Vermont Center for Ecostudies; Christopher Romanek - Furman University

Full life cycle conservation of migratory birds requires an understanding of non-breeding ecology that is still lacking for many species. Bobolink (*Dolichonyx oryzivorus*) is a grassland obligate species that breeds across North America and migrates to South America. Although the Bobolink is often regarded as a pest in cultivated rice fields of South America, the relative importance of rice in its non-breeding diet is unknown. Bobolinks undergo two complete molts each year, and feathers grown on the wintering grounds are retained through the subsequent breeding period. We examined the timing and contribution of rice consumption in the diet of Bobolinks during winter molt for three populations in different regions of the breeding range using stable isotopes in feathers. Using mixing models, we compared d13C of feathers to grass and sorghum (C4) and rice (C3) seeds consumed by 105 Bobolinks during early, middle, and late winter molt. Across all three breeding populations, Bobolinks relied on rice for nearly one-third (95% CRI: 0.25, 0.34) of their diet during winter molt. The proportion of rice consumed was highest during late molt (95% CRI: 0.33, 0.46), and Bobolinks breeding in Vermont and North Dakota relied more on rice during late molt compared to Bobolinks in Nebraska. Our results demonstrate that across the breeding range, rice is an important but not dominant component of the Bobolink diet during the winter prealternate molt. Potential impacts of pesticides used in rice are greatest during late molt, when Bobolinks are staging for spring migration.

Resilience of food and cavity nest-site resources for canopy birds to low-level hurricane disturbance: impacts of Hurricanes Jove and Patricia in tropical dry forest

Renton, Katherine - Universidad Nacional Autonoma de Mexico; Alejandro Salinas-Melgoza - Universidad Michoacana de San Nicolás de Hidalgo; Rafael Rueda-Hernandez - Instituto Nacional de Ecologia A.C.

Large canopy trees are susceptible to hurricane damage, with consequences for food and nest-site resources for canopy birds. We determined flowering and fruiting phenology, and availability of tree-cavities and snags for cavity-nesting birds in distinct vegetation types of tropical dry forest from 2009-2016, prior-to and following landfall by hurricanes Jove (category 2) in 2011 and Patricia (category 5) in 2015. We also evaluated reproductive output of the threatened Lilac-crowned Parrot (*Amazona finschi*) prior-to and following hurricane impacts. Flowering and fruiting phenology declined throughout the first year post-Hurricane Jove, but deciduous forest recovered phenological patterns in the second year post-hurricane, and semi-deciduous forest began to recover phenological patterns three years after hurricane impact. Tree-cavity and snag resources were reduced by half post-hurricane Jove, with a loss of 34% of nest-sites for the Lilac-crowned Parrot. Reproductive output of the Lilac-crowned Parrot declined markedly the first year post-hurricane Jove, but recovered by the second-year post-hurricane. The recovery of tree phenological patterns and parrot reproductive output indicates a greater resilience to low-level hurricane impacts of food resource availability for nectarivorous and frugivorous/granivorous bird communities of tropical dry forest. By comparison, Hurricane Patricia had a catastrophic impact on forest dynamics with an almost total decline in food resources of semi-deciduous forest, and loss of 60% of parrot nest-sites. The impact of this major hurricane may have long-term implications for the availability of food resources for canopy birds, particularly during the dry season, and reproduction of large-bodied cavity-nesting species, such as the Lilac-crowned Parrot.

Conditions in the Mexican monsoon region affect feather carotenoid content and composition in a western moult-migrant, the Bullock's oriole (*Icterus bullockii*)

Reudink, Matthew - Thompson Rivers University; Katie Sparrow - Thompson Rivers University; Andrew Pillar - Thompson Rivers University; Peter Marra - Smithsonian Migratory Bird Center; Nancy Flood - Thompson Rivers University; Kingsley Donkor - Thompson Rivers University

After breeding in western North America, several species, including Bullock's orioles (*Icterus bullockii*), travel to the Mexican monsoon region and stopover for an extended period to moult prior to migrating further south to overwinter. Using geolocators and hydrogen stable isotope analysis, we previously confirmed that all age/sex classes of a northern population of Bullock's orioles complete moult during this time. Here, we asked whether diet and habitat quality during moult (inferred by stable isotopes) are associated with feather carotenoid content and composition. We analyzed adult male breast feathers for carotenoid content and composition using liquid chromatography mass spectrometry (LC-MS) and used carbon (δ13C) and nitrogen (δ15N) stable isotope analysis to infer habitat conditions during moult. We found a positive relationship between δ15N and feather lutein concentration, as well as a negative relationship between δ15N and the proportion of canthaxanthin. These results suggest that a greater trophic level during moult, perhaps from a diet high in insects, is associated with a greater lutein deposition. However, an insect-rich diet may reduce the availability of β-carotene or dietary canthaxanthin, or the

ability to effectively metabolize β-carotene to canthaxanthin due to individual condition. This study highlights the importance of moult environment for obtaining carotenoids required for producing ornamental plumage colouration. Our results are also consistent with the idea that a moult migration strategy may have evolved to take advantage of superior moult conditions in the Mexican monsoon region, which can directly influence the ability to obtain bright colouration critical for inter- and intra-sexual interactions.

Using Big Data to Drive Conservation of the Pacific Flyway in California
Reynolds, Mark - The Nature Conservancy

Bird migration is one of the greatest challenges for conservation in changing world. Ancient flyways extending thousands of miles, some across entire hemispheres, depend on high quality habitat for breeding, molting, stop-over and wintering. The challenge is made greater by poor information about movements of species and habitat availability, a lack of efficient and adaptable conservation tools, and the high cost of implementation at meaningful scales. The recent availability of large-scale data from citizen science to remote sensing is improving our ability to develop effective conservation strategies for bird migrations. Working in partnership with Cornell Lab's eBird program, The Nature Conservancy has developed precision science tools to create temporary bird habitat on farmland in California when and where birds need it most. Using reverse auctions, we have partnered with over 200 farmers creating over 35,000 acres of high quality bird habitat, demonstrating a cost-effective way for farmers to help protect the Pacific Flyway.

Proactive Management of Kirtland's Warbler under Changing Environmental and Management Conditions
Ribic, Christine - US Geological Survey, Wisconsin Cooperative Wildlife Research Unit; Donald Brown - West Virginia University; Deahn Donner - USDA Forest Service, Northern Research Station; Carol Bocetti - California University of Pennsylvania; Christie Deloria-Sheffield - US Fish and Wildlife Service

The Kirtland's Warbler is an endangered migratory songbird that breeds primarily in Michigan and winters in the Bahamian Archipelago. The species is an extreme habitat specialist on the breeding grounds, showing a strong preference for large, dense patches of young jack pine and well-drained sandy soils. Due to intensive collaborative management, the species has recovered from ca. 200 breeding males in 1971 to ca. 2,000 breeding males today, and is now a candidate for federal delisting. However, potential post-delisting management changes and climate change on both the breeding and wintering grounds could impact the long-term viability of the species. We developed a full annual cycle model to investigate impacts of potential management and environmental changes on the Kirtland's Warbler. Scenarios included changes in production of breeding habitat and Brown-headed Cowbird control, and impacts of climate change on breeding and wintering grounds habitat quality and quantity on the long-term viability of Kirtland's Warbler. We found that moderate reductions in breeding habitat suitability did not impact the species, but reduced Brown-headed Cowbird control had substantial negative impacts on abundance. Climate change impacts include the potential for jack pine habitat suitable for Kirtland's Warbler to shift north, which might require shifting locations of Kirtland's Warbler Management Areas to maintain suitable breeding habitat conditions. Our studies will assist managers with understanding the importance and influence of different Kirtland's Warbler management

strategies on population stability, and provide spatially-explicit information that will assist with facilitating adaptation of the species to climate change-induced habitat changes.

Climate impacts on grassland bird demography are mediated by patch size
Ribic, Christine - US Geological Survey, Wisconsin Cooperative Wildlife Research Unit; Lisa McCauley - The Nature Conservancy Center for Science and Public Policy; Benjamin Zuckerberg - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison

Grassland ecosystems originally dominated central North America but have been extensively altered by agriculture and urbanization. As a result, grassland bird management has focused almost exclusively on maintaining extensive grassland patches. However, many grasslands are experiencing disproportionally rapid changes in temperature and precipitation. Land use and climate change represent critical threats to grassland birds, but little is known as to how these forces interact to influence demographic sensitivity across multiple species. We conducted an analysis of nest success for a dozen grassland birds across North America to quantify sensitivity to climate variability and its interaction with grassland patch size. We modeled the effects of a suite of bioclimatic variables on nest survival from 211 studies comprising 15,000 nests. We found that higher amounts of precipitation in the preceding year (bioyear) and warmer spring temperatures were associated with higher rates of nest success. These relationships were moderated by grassland patch size such that the influence of bioyear precipitation on nest success was strongest in grasslands greater than 15 ha. Conversely, warmer spring temperatures promoted higher nest success rates in grassland patches less than 15 ha, lowered success in grasslands between 15-300 ha, and no effect in grasslands larger than 400 ha. Understanding the broader context of past and future climate change will be important for successful grassland management. Although the biological mechanisms leading to these results remain to be elucidated, it is clear that managing for larger grassland patches would serve to reduce the deleterious consequences of future warming.

Pinyon and Juniper Encroachment into Sagebrush Ecosystems Impacts Distribution and Survival of Greater Sage-Grouse
Ricca, Mark - U.S. Geological Survey-Western Ecological Research Center; Peter Coates - U.S. Geological Survey-Western Ecological Research Center; Brian Prochazka - U.S. Geological Survey-Western Ecological Research Center; Benjamin Gustafspon - U.S. Geological Survey-Western Ecological Research Center; Pilar Ziegler - Bureau of Land Management; Michael Casazza - U.S. Geological Survey-Western Ecological Research Center

Population dynamics of greater sage-grouse can be affected adversely by even low-densities of singleleaf pinyon and Utah juniper (hereafter pinyon-juniper) in sagebrush habitat, yet behavioral and ecological linkages behind this pattern have not been identified fully. We employed a novel two-stage Bayesian model that linked avoidance across different levels of pinyon-juniper cover within phases of encroachment to individual survival probabilities of greater sage-grouse within the Bi-State Distinct Population Segment. The first stage identified evidence of avoidance for all canopy cover classes (which indexed phases of encroachment), but strongest for those with the greatest cover (phases II and III). The second stage linked increased survival rates for individuals that exhibited avoidance of scattered isolated trees (phase I). A post hoc survival analysis revealed the greatest increase in mortality risk occurred in mesic and productive areas with scattered and isolated trees. Collectively, these results

indicated that local sage-grouse distributions are shaped strongly by avoidance of pinyon-juniper. Areas with high productivity but relatively low (and seemingly benign) pinyon-juniper cover may also function as ecological traps that convey attractive resources but can adversely affect population vital rates. Model predictions support reducing actual pinyon-juniper cover to values as low as 2%, especially in productive areas with phase I, which is lower than the published recommended target of 4%.

Meeting bird conservation needs through better public policy in the United States
Rich, Terrell - Boise State University

The public interest in birds and the needs for bird conservation on the one hand, and bird conservation policy among state and federal natural resource agencies in the U.S. on the other hand, are surprisingly disconnected. At no time in history have we had a better scientific foundation for bird conservation. Scientific ornithology, vulnerability assessments, land use planning, strategic conservation, and public-private partnerships for bird conservation all continue to advance through unprecedented levels of data collection, data analysis, thinking, understanding, and collaboration. At the same time, the number of birders in the United States continues to increase to an estimated 47,000,000. However, public funding for bird and bird habitat conservation through public resource agencies such as the U.S. Fish and Wildlife Service and the 50 state wildlife agencies, as indicated by the budgets allocated to major bird conservation programs, e.g., the Neotropical Migratory Bird Conservation Act, State Wildlife Grants, and Joint Ventures, is flat or declining. So the question is, why is there this huge disconnect between the needs, what people value, and the policies? To answer this question, we need to know what birders value, what actions they currently take for bird conservation, and what actions they might take. We need to know how birders are currently organized for conservation action and how they might become better organized. Speakers in this symposium will examine these issues, and offer insight into how we might become much more effective in influencing public policy, and, hence, public budgeting for bird conservation.

Partners in Flight Species Vulnerability Assessment: A Long-term Foundation for Prioritizing Conservation Action
Rich, Terrell - Boise State University

Wise action in this age of conservation triage requires large-scale and long-term perspectives. It is no longer defensible to work on an ad hoc list of favorite species at a scale that's simply convenient. For 25 years, Partners in Flight has been using its Species Assessment Process to evaluate the future vulnerability of landbirds. Published assessments have evaluated 448 species in the U.S. and Canada (2004), and 882 species with the addition of Mexico (2010). Another 399 species are currently being evaluated in Central America. The Species Assessment Process scores each species at the continental or global scale on six factors – Population Size, Population Trend, size of the Breeding Distribution, size of the Non-breeding Distribution, Threats to Breeding, and Threats to Non-breeding. The first four factors are based on data, while the threats scores are produced via consensus among hundreds of ornithologists and conservationists with expertise on particular species, habitats, and issues. The resulting species scores can then be used in a variety of ways. Groups can be created based on habitat selection, taxonomy, behavior, ecological attributes, or geographic range, and the mean vulnerability calculated. This allows for the objective arraying of conservation priority based on a number of different lenses from among an otherwise bewildering array of possibilities. This process has persisted and succeeded due to its robust design and due to a group of

ornithologists dedicated to the big picture and the long run.

What do we know about unifying factors for bird vulnerability to anthropogenic collisions?

Riding, Corey - Oklahoma State University; Scott Loss - Oklahoma State University, Department of Natural Resource Ecology and Management

Anthropogenic collisions (i.e., collisions with vehicles and manmade structures) and other human-related mortality sources are increasingly recognized as conservation issues for birds. An emerging goal of conservation science, policy, and management is determining whether such collision mortality is causing significant impacts to avian populations and whether avian life history traits and/or taxonomy can be used to predict population vulnerability. Although we are a long way from understanding how various anthropogenic threats contribute to regulating populations of affected species, there appear to be rough patterns of avian vulnerability. Results from our on-going research of bird-window collisions in Oklahoma, as well as other studies of collision mortality throughout North America, suggest that there are unifying traits that affect collision risk at buildings and communication towers (e.g., migratory strategy and habitat association). However, based on the available data, predictors of mortality may not be consistent across all geographic locations and collision types. Furthermore, correlates of collision risk do not necessarily translate into correlates of population vulnerability. Much future field work and modeling development is needed to clarify how populations of different bird species respond to various anthropogenic mortality sources and to identify the unifying factors that dictate these population-level responses.

Long-term effects of nest predation on future reproductive investment

Riecke, Thomas - University of Nevada Reno; Alan Leach - University of Nevada Reno; James Sedinger - University of Nevada, Reno

The black brant (*Brant bernicla nigricans*) is a small, arctic nesting goose, occurring in coastal estuaries and wetlands along the Pacific coast. Brant populations on the Yukon-Kuskokwim Delta have declined substantially since the 1980's, and populations remains significantly below historic levels. Demographic research began at the Tutakoke River Brant Colony in 1984, where researchers have documented multiple major reproductive failure events. To better understand the effects of these events, which occurred in 2001, 2003, and 2008, on future reproductive investment, we developed novel hierarchical Bayesian robust-design models to estimate the effects of previous reproductive investment and success on future breeding probability. Breeding probability exhibited a Markovian structure, where successful breeders returned to breed at much higher rates (0.9) than non-breeders (0.45). However, unsuccessful breeders bred at extremely low rates (0.2) in the following year. These findings indicate that major reproductive failure events may reduce colony reproductive potential into the future, where individuals may choose to skip future reproductive attempts in response to predation. Brant are also highly gregarious during the non-breeding season, where adults with goslings are known to be dominant over singletons and unsuccessful or non-breeding pairs. We suggest that a combination of prior information, and social status as a result of previous breeding effort, influences future reproductive investment.

Evaluating performance of bird abundance estimators: a simulation including variability in detection
Rigby, Elizabeth - University of Minnesota; Douglas Johnson - USGS Northern Prairie Wildlife Research Center

Point count surveys are commonly used to estimate bird abundance. Counts (C) can be used as an index to abundance (N), assuming that detection probability (p) describes the relationship between them (C = pN). Double-observer, distance sampling, removal, and replicated counts analysis methods have been developed to estimate both abundance and detection probability, but there is little information available for how these methods perform in various biological situations or if they improve inference compared to indices. We assessed abundance estimator performance by building a stochastic model to simulate survey counts and incorporating variation in detection. We modeled bird movements within elliptical territories, modeled bird song production (availability) using Markov chains at 2 scales, and modeled the detection of songs by observers (perceptibility) using a logit function, with detection declining with increased distance from the observer. We investigated 3 biological comparisons: species with high vs. low availability, species with high vs. low perceptibility, and conditions where perceptibility was confounded with abundance or not. Indices were negatively biased, but were strongly correlated with abundance. Of the 3 biological comparisons, low availability had the strongest effect (indices were more negatively biased, with weaker correlation). Distance sampling estimators had less bias but lower correlation with abundance. For low availability simulations, removal estimators were less biased than indices but had weaker correlation with abundance. Double-observer estimators were virtually unchanged from indices. Replicated counts estimators were often severe inflated due to low estimated detection. Overall, estimators incorporating detection did not substantially outperform indices.

Dispersal and Morphometrics of the Hawaiian Coot, *Fulica alai*, in the Fragmented Wetland Landscape of Oahu
Riggs, Randi - University of Hawaii at Manoa Zoology Department, Ecology, Evolution & Conservation Biology Program

The aim of this study was to determine if the Hawaiian Coot, *Fulica alai*, exhibits sexual dimorphism or sex biased dispersal. The Hawaiian Coot is an endangered species and one of only four extant waterbird species remaining in the Islands. It is similar in appearance to the American Coot, but with a large white shield above the bill, although about ten percent of the population has a red shield. In other coot species shield size may differ between the sexes and at different times of year. Some species are also sexually dimorphic in body size. Sixty coots were captured at five locations on the island of Oahu. Standard morphometric measurements and bloods samples were taken. Locations were resurveyed to gather re-sight data over two years. Fifty-eight individuals were genetically sexed. There was no evidence for sexual dimorphism in any morphological character except that in white-shielded coots, females had significantly wider shields than males. However, shield size varied significantly among months, possibly because shields appeared more engorged during the pre-breeding season (January-April). There was no evidence of sex biased dispersal. Despite estimated wetland habitat loss of 65 % on Oahu and fragmentation of the wetland landscape, both sexes can disperse between the remaining wetlands as well as between islands.

Hispaniolan Forest Endemics — Rare, Vulnerable and Understudied
Rimmer, Christopher - Vermont Center for Ecostudies; John Lloyd - Vermont Center for Ecostudies

Among Hispaniola's 31 endemic bird species, 18 are mostly or entirely restricted to wet, high-elevation broadleaf or mixed pine-broadleaf forests. Another 4 species occupy dry forests at low and mid-elevations, while the island's rarest and most endangered species, Ridgway's Hawk, occurs in only one region of low-lying, wet karst forests. While data on population trends and conservation status of Hispaniolan endemics are generally sparse, many species are rare, assumed or known to be declining, and of high conservation concern. This talk will provide an overview of endemic Hispaniolan forest specialists, focusing on their distribution, ecology, population status, and conservation needs. Research and monitoring priorities will be highlighted.

Narrowing the Search for Overwintering Bicknell's Thrush in the Caribbean
Rimmer, Christopher - Vermont Center for Ecostudies; John Lloyd - Vermont Center for Ecostudies; Jose Salguero - Puerto Rico Department of Natural and Environmental Resources

The overwinter distribution of Bicknell's Thrush is restricted to four Greater Antillean islands, of which Hispaniola is believed to support 80-90% of the species' global population. A recent predictive model of winter habitat indicated several areas in Puerto Rico, Jamaica, and Cuba that might support populations but that have not been adequately surveyed. We conducted surveys on Puerto Rico during the winters of 2015 and 2016 to clarify the distribution, abundance, and habitat use of Bicknell's Thrush on the island. The species was locally rare, with only 14 individuals detected, all in high-elevation wet forests of the Cordillera Central. We conclude that Puerto Rico does not represent a significant wintering area for Bicknell's Thrush. Targeted surveys for this globally rare, vulnerable migrant are planned for Cuba (15% of modeled winter habitat) in winter 2016-17 and Jamaica (14%) in 2017-18. Although Bicknell's Thrush has been confirmed to overwinter in montane forests on both islands, its status is poorly known. Given the results of our surveys on Puerto Rico, however, we caution that the discovery of large, heretofore-unknown populations is unlikely. Conservation of cloud forests on Hispaniola, which are known to support large numbers of individuals, is therefore critical to the survival of the species.

Intrinsic and extrinsic factors influencing parental provisioning rates of a migratory songbird, Purple Martin (*Progne subis*)
Ritchie, Alisha - University of Manitoba; Kevin Fraser - University of Manitoba; Jason Fischer - Disney's Animals, Science, and Environment

Lower recruitment of juvenile migratory songbirds can be a result of the constraints of migratory and overwintering periods; however, it can also be influenced by events during the previous nesting cycle. The timing of breeding and the quality of parental care, such as provisioning rate, can have important impacts on the condition of an individual and thus its ability to complete migration and overwintering. Factors that have been shown to influence provisioning rates include the age of young and the presence of predators. However, the way in which environmental conditions, timing of breeding, and breeding latitude influence provisioning rates remains largely understudied. We examined factors influencing parental provisioning rates of Purple Martins (*Progne subis*); a colonial, cavity nesting migratory songbird. We used a newly modified form of radio frequency identification (RFID) technology to automate the recording of cavity entrance rates for male and female martins, a proxy of parental provisioning rate. The influence of clutch size, hatch date, breeding latitude, and

environmental variables on provisioning rates was examined. We also tested for within-day patterns of provisioning by using a frequency-domain spectral analysis and found a cyclic pattern of parental provisioning through the nesting period. Overall, this research will provide new insight into factors influencing variation in parental provisioning in a migratory songbird.

Foresters for the Birds: Realizing Habitat Management Objectives for Birds in Northeastern Forests
Ritterson, Jeffrey - Massachusetts Audubon Society; Joan Walsh - Massachusetts Audubon Society

The Foresters for the Birds program of Massachusetts provides a novel strategy for promoting diverse vertical structure interspersed with canopy gaps that Wood Thrushes need for nesting and postfledging habitat. Although creating these structural conditions with silviculture treatments is relatively straightforward, habitat managers in the Northeast are challenged by a number of demographic and ownership conditions that hinder active management. A relatively small proportion of forest in the region is publicly owned, so public-land managers have a limited ability to shape landscape-scale habitat conditions. Foresters for the Birds engages private forest landowners to highlight good forestry that promotes compositional and structural characteristics beneficial to forest birds. This is key, because cutting practices in the region are driving forests towards a homogeneous condition that limits regional forest bird diversity. This program harnesses the keen interest many private landowners have in wildlife, and provides technical assistance for active management on private lands. Another impediment is parcelization; forested properties in much of the region are too small (averaging < 10 ha) to accommodate the full range of habitat conditions needed for this species. Current research is directed at characterizing habitat management opportunities across diverse landscapes that tailor prescriptions not only to stand conditions, but context within the working landscape.

Does song-learning play a role in acoustic adaptation to urban environments?
Rivera-Gutierrez, Hector - Grupo Ecología y Evolución de Vertebrados, Universidad de Antioquia; Vannesa Jaramillo-Calle - Grupo Ecología y Evolución de Vertebrados, Universidad de Antioquia; Dariel Martinez-Alvarado - Grupo Ecología y Evolución de Vertebrados, Universidad de Antioquia; Andrea Lopera-Salazar - Grupo Ecología y Evolución de Vertebrados, Universidad de Antioquia

City birds may face limitations for communicating in noisy environments. Urban birds can avoid the masking effect of urban noise by increasing the song amplitude, singing at higher pitch or changing the timing of singing during noise exposure. Whereas the strategies for noise avoidance are well known for oscine species that learn their song, little is known on the adaptations of Passerine species that do not learn to sing (Suboscines). Given that many suboscine species inhabit and are common in the cities, we tested whether song learning plays a role in the acoustic adaptation of passerine species to urban environments. We hypothesized that suboscine species may face limitations for rapid changes in acoustic or temporal patterns of their song (song plasticity), and therefore, they may have developed different strategies, compared to oscine species. Using a correlational study in a paired design (urban-rural) we tested whether song activity and spectral parameters of the song were different between suboscines and oscines living in both environments. In addition, using a comparative phylogenetic analysis, we tested whether song structure in suboscines that inhabit urban environments is a preadaptation for effectively communicating in noisy places. Our results suggest that suboscine species

lack plasticity in spectral parameters and show larger song activity, even when noise may mask acoustic communication. On the other hand, song characteristics of suboscines seem to confer an advantage for communicating in noisy places. Our study tests for first time the adaptations in both oscine and suboscine species for communicating in urban environments.

Sustainability Assessment of Plain Pigeons (*Patagioenas inornata wetmorei*) Illegally Hunted in Puerto Rico.
Rivera-Milán, Frank - United States Fish and Wildlife Service, Division of Migratory Bird Management, Branch of Population and Habitat Assessments

The Plain Pigeon is hunted illegally, despite being protected in Puerto Rico. Data are lacking to estimate how many pigeons are hunted illegally each year. For this reason, we used abundance estimates derived from distance sampling surveys conducted in 1986–2014 to (1) fit a Bayesian state-space model, (2) estimate posterior distributions for population and harvest management parameters, and (3) predict abundance in 2025 as a function of potential illegal hunting in 2015–2024. The median of intrinsic rate of population growth was 0.351 (95% BCI = 0.086-0.737), population carrying capacity was 55,840 individuals (29,649-96,505), maximum sustainable harvest rate was 0.176 (0.043-0.369), and predicted abundance was 20,536 individuals (8,167-89,040) in 2025. The population increased from low numbers in the 1980s, recovered after hurricanes in 1989 and 1998, surpassed carrying capacity in 1996–1998, and decreased at the same time that legal hunting increased in 2008–2014. Our monitoring and modeling results suggest that an increase of illegal hunting might be responsible for some of the abundance decline in 2008-2014, and that population sustainability might be affected by illegal hunting in 2015-2025. Therefore, data collection and the control of illegal hunting should be management priorities. Because we are updating model-based abundance predictions with monitoring data annually, we can inform management decisions, evaluate the results of conservation actions taken to maintain the population fluctuating around carrying capacity, and learn from the comparison of estimated and predicted abundance. Our monitoring and modeling scheme is applicable to other Caribbean birds.

Population Assessment of the Grenada Dove (*Leptotila wellsi*) and Hook-Billed Kite (*Chondrohierax uncinatus mirus*) using Distance Sampling and Repeated Count Methods
Rivera-Milán, Frank - United States Fish and Wildlife Service, Division of Migratory Bird Management, Branch of Population and Habitat Assessments

The Grenada Dove and Hook-billed Kite are island endemics at the verge of extinction. Previous counts, not corrected for detection probability, ranged from 68 to 91 calling doves in 1987–2007 (or 136–182 breeders, assuming a census of paired territorial males), and 50–75 kites in 2000–2006 (assuming a census of breeders, floaters, and juveniles). However, dove and kite detection is imperfect (incomplete count) in xeric and mesic forests. Unpaired male doves can have higher calling rates and be more available for detection than paired male doves, and territorial breeding kites can have higher detection rates than nonbreeding adults and juveniles. Moreover, sex ratio can favor males in small bird populations. For this reason, I conducted a population assessment in July 2013, using a systematic sampling scheme of survey points and distance sampling and repeated count methods to estimate detection, density, and population size, accounting for survey and site specific covariates (e.g., forest type, time of day, and detection mode). Dove detection was 0.166 (95% CI = 0.114–0.242) within 320 m of point centers, and kite detection was 0.219 (0.146–0.327) within 800 m of point centers.

Distance sampling and repeated counts generated similar abundance estimates, with densities of 0.021 doves/ha (0.014–0.030) and 0.006 kites/ha (0.004–0.009), and population sizes of 160 doves (107–229) and 38 kites (25–58) in a survey region covering 7,621 ha. Therefore, both island endemics are highly endangered and should be considered conservation priorities by local and international organizations.

Breeding bird response to pine-savanna and woodland restoration in the Ozark-Ouachita Interior Highlands

Roach, Melissa - University of Missouri; Frank Thompson - Forest Service Northern Research Station; Elisabeth Webb - USGS Missouri Cooperative Fish & Wildlife Unit; John Kabrick - Forest Service Northern Research Station; Todd Jones-Farrand - Gulf Coastal Plains & Ozarks Landscape Conservation Cooperative

Pine-savannas and woodlands represent a gradient from very open to nearly-closed canopy forest with a dense ground layer. These vegetation communities nearly disappeared from the landscape from excessive timber harvest and fire suppression. There is active management to restore large tracts of pine-savanna and woodland, but its effects on the breeding bird community are unknown. We determined relationships between species densities and vegetation characteristics and management activities to examine the effects of restoration on select breeding birds. We surveyed 352 points once per breeding season for 3 years (2013–2015). Points were located in the Mark Twain National Forest in Missouri (n=251) and the Ouachita National Forest in Arkansas and Oklahoma (n=101). We conducted 10-minute, unlimited-radius point counts recording the distance and time of detection for 19 focal species. We fit two-stage hierarchical distance-based models to estimate detection probability and species density using the GDISTSAMP procedure in the R package unmarked. We used multi-stage model selection based on a priori models to examine vegetation and management covariates at the point and landscape level. We ranked models based on Akaike Information Criterion and conducted a Freeman-Tukey goodness of fit test on each top model. Eleven species responded positively to management activities and the resulting vegetation. Four species responded negatively to management, while one species had mixed results. Our results suggest that current management activities are effectively restoring the open communities of pine-savanna and woodland in the Ozark-Ouachita Highlands.

Unraveling the migratory pathways of the Canada Warbler across the Americas

Roberto-Charron, Amelie - University of Manitoba; Kevin Fraser - University of Manitoba

To effectively conserve declining populations of Neotropical migratory songbirds, their entire geographical range needs to be considered. The Canada Warbler (*Cardellina canadensis*) has declined by an average of 2.3% per year from 1966 to 2012. Conservation efforts have been limited by a number of factors, including a poor understanding of migration routes. Based on observational data during migration, Canada Warblers were inferred to migrate overland from breeding sites in North America, through Central America, to overwintering sites in South America. New light-level geolocators (< 1 g) provide the opportunity to elucidate start-to-finish migratory routes for small (< 15 g) songbirds. We used geolocators to track individual Canada Warblers from a breeding site at the northern edge of their range (Slave Lake, Alberta), to determine fall migratory routes and overwintering locations. We show the first direct tracking data for Canada Warblers, based on four recovered units. Routes and destinations varied with three birds taking an eastward fall route, including a trans-Atlantic migration between the eastern U.S. and the Antilles, a route previously

unknown for this species. The fourth individual took a more westward route down the Mississippi flyway crossing the Gulf of Mexico to the Yucatan. This study is the first to identify the migratory pathways and the overwintering sites of Canada Warblers by using direct tracking and represents a critical step toward understanding migration and year-round habitat use for this imperilled species.

Estimating the persistence of Seaside and Saltmarsh Sparrow populations in Forsythe National Wildlife Refuge, New Jersey

Roberts, Samuel - University of Delaware; Rebecca Longenecker - US Fish & Wildlife; W. Gregory Shriver - The University of Delaware

Globally limited to 45,000 km2, salt marshes are threatened by a myriad of anthropogenic influences. Among the most prominent is sea-level rise, which is projected to continue at accelerated rates and reduce global salt marsh area 20 – 45% by 2100. Endemic salt marsh inhabitants are particularly vulnerable to salt marsh loss and degradation and may be unable to adapt to rapidly changing conditions. Along the Atlantic coast, Seaside (*Ammodramus maritimus*) and Saltmarsh (*A. caudacutus*) sparrows are year-round endemic salt marsh species with declining breeding populations from Maine to Virginia. Because the vital rates and factors affecting population persistence vary regionally for both species, localized assessments are required to best predict individual population persistence. We used a metapopulation model to estimate the population viability of the breeding Seaside and Saltmarsh sparrow populations in Forsythe National Wildlife Refuge, New Jersey over a 42-year period. In our models we incorporated empirical data on the vital rates and abundances of these populations and simulated the effect of low (0.35m) and high (0.75m) levels of sea-level rise through habitat loss. We found that the Seaside Sparrow population persists under both sea-level rise scenarios. The Saltmarsh Sparrow population reaches a quasi-extinction threshold within eight years under the 0.35m sea-level rise scenario. Using the same modeling framework we modeled potential management scenarios for the Saltmarsh Sparrow population and found that fecundity and survival rates will require dramatic increases for the population to persist beyond the next 10 – 30 years.

Come rain or no water, I will survive: nonbreeding lesser prairie-chicken survival and space use

Robinson, Samantha - Virginia Tech; Reid Plumb - California Department of Fish and Wildlife; David Haukos - U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, Department of Biology, Kansas State University; Christian Hagen - Oregon State University; Jim Pitman - Western Association of Fish and Wildlife Agencies; Brett Sandercock - Kansas State University

Prioritization of vital rates and times in which species of conservation concern are most vulnerable should be a priority. The lesser prairie-chicken (*Tympanuchus pallidicinctus*), a species of concern with uncertain regulatory status, is one such species having experienced population declines and consistently low population numbers for several decades. The majority of research for lesser prairie-chickens has focused on the breeding season, however, the nonbreeding season also has the potential to contribute to annual mortality. Lesser prairie-chickens were trapped on leks using walk-in drift traps, and marked with either a Satellite or VHF transmitter. Following the breeding seasons of 2013, 2014 and 2015, we monitored marked prairie-chickens in three study areas in Kansas from September 16-March 14. We estimated survival using known-fate models, home-range size using Brownian Bridge movement models and habitat use by marked lesser prairie-chickens (N = 100). Survival was high (0.73), although home ranges ($\bar{x}$ = 997 ha)

increased by 181% relative to the breeding season. Home range size was smaller in the 2013-2014 season than the following two (2014-2015 and 2015-2016), corresponding with drought conditions of 2013, which were alleviated in following years. Habitat use varied among the study sites, with prairie-chickens using more Conservation Reserve Program (CRP) land in northwestern Kansas, and more crop and CRP as the season progressed, in south-central Kansas. Future management for lesser prairie-chickens could remain focused on the breeding season, as nonbreeding survival remains high despite increased space use, drought response, and varying habitat use relative to the breeding season.

Cormorants and threatened salmon in the Columbia River Estuary: a management conundrum

Roby, Daniel - US Geological Survey-Oregon Cooperative Fish and Wildlife Research Unit; Donald Lyons - Department of Fisheries and Wildlife / Oregon State University; Yasuko Suzuki - Department of Fisheries and Wildlife / Oregon State University; Jessica Adkins - Department of Fisheries and Wildlife / Oregon State University; Adam Peck-Richardson - Department of Fisheries and Wildlife / Oregon State University; Peter Loschl - Department of Fisheries and Wildlife / Oregon State University; Kirsten Bixler - Department of Fisheries and Wildlife / Oregon State University

The Double-crested Cormorant (*Phalacrocorax auritus*) breeding colony on East Sand Island (ESI) near the mouth of the Columbia River is the largest-known colony of its kind. Approximately 14,000 breeding pairs (40% of the Pacific Flyway population) nest at ESI. While juvenile salmonids (*Oncorhynchus* spp.) constitute just 2%-20% of the diet (% biomass) of cormorants at ESI, in some years cormorants consume approximately 20 million salmonids, ca. 15% of all salmonids out-migrating from the Columbia Basin. Because 13 of 20 Columbia Basin salmonid populations are listed under the U.S. Endangered Species Act, fisheries managers have targeted ESI cormorants for management to enhance salmonid recovery. We developed non-lethal methods aimed at reducing the ESI cormorant colony to a size acceptable to fisheries managers, using privacy fencing and hazing of birds that attempted to nest outside the fencing, while demonstrating conspecific attraction techniques to draw displaced cormorants to alternative colony sites with acceptable risks to fisheries of conservation concern. Managers nevertheless selected a lethal management approach that includes a targeted cull of 11,000 cormorants and destroying the contents of 26,000 nests, thereby reducing the size of the Pacific Flyway population by about 15%. This highly controversial large-scale cull, the first in the western U.S., was selected as the preferred alternative because it minimized manager-perceived risk of cormorant emigration to other unsuitable sites, was perceived to be expedient, and mimicked the widespread practice of culling cormorants in the eastern and central U.S., where cormorant numbers are ca. 10x greater than in the West.

Habitat selection of riparian songbirds at restoration sites along the Trinity River, CA, and the effect of invasive Himalayan blackberry

Rockwell, Sarah - Klamath Bird Observatory; Jaime Stephens - Klamath Bird Observatory; John Alexander - Klamath Bird Observatory

Invasive plant species are common features of many North American landscapes, but are novel to native bird populations and can affect them by offering attractive nest sites with lower probabilities of success. We studied habitat selection preferences and nest success of focal bird species in riparian areas along the Trinity River, CA, where invasive Himalayan blackberry (*Rubus discolor*) is a prevalent understory plant. We surveyed six study sites that have undergone restoration via berm removal and replanting

of native vegetation, and four unmanipulated reference sites. We tested for departure from random use of available habitat by comparing vegetation composition and structure at random points across each study site vs. random points within bird territories, and at territory vs. nest points. Focal bird species exhibited general preferences for features of more mature riparian forest, such as greater canopy cover, canopy height, number of large alders, and tree species richness. Riparian birds tended to select territory and nest sites with greater shrub cover, but less shrub richness than expected, which was associated with selection for greater cover by invasive Himalayan blackberry. Nest success of these species was similar between nests placed in Himalayan blackberry vs. native vegetation. Therefore, blackberry does not appear to act as an ecological trap in this system. The function of nonnative plant species should be considered during restoration planning. If removal of Himalayan blackberry is prioritized, replacement by native shrub species with similar structure and function would be important to mitigate for the potential habitat loss.

Causes & consequences of the urban phenotype.
Rodewald, Amanda - Cornell Lab of Ornithology and Cornell University Department of Natural Resources

Urbanization provokes tremendous changes in biological, physical, chemical and ecological factors that can strongly influence the selective environment for phenotypic traits in birds. In this talk, I synthesize 14 years of research on the demographic and behavioral responses of birds to altered species interactions, invasive species, and anthropogenic resources associated with urban development. From 2001-2014, my students and I studied density, demography, habitat selection, predator-prey interactions, morphology, coloration, song, and a wide suite of behaviors of Northern cardinals (*Cardinalis cardinalis*) breeding in forests located along a rural-to-urban gradient in central Ohio. Urban cardinals were smaller, had different bill morphology, bred earlier, sang faster and longer songs at higher frequencies, and displayed bolder behavior than rural birds. Interestingly, urban-associated phenotypic traits were not consistently associated with positive fitness outcomes for individuals, with some even reducing reproductive performance. Understanding the interplay between ecological and evolutionary processes is critical if we are to conserve biodiversity in an urbanizing world.

Socioecological drivers of urban bird communities: trait and density-mediated consequences of human inputs.
Rodewald, Amanda - Cornell Lab of Ornithology and Cornell University Department of Natural Resources

As the expanding footprint of cities envelops natural areas and brings humans in closer contact with wildlife, there is increased need to understand the socioecological feedbacks that operate within human-dominated landscapes. Among the defining characteristics of many urban ecosystems are introduced predators (i.e., cats) and a rich assortment of anthropogenic resources, whether in the form of exotic fruiting trees, bird-feeders, food dishes for free-ranging cats, or human refuse. The consequences of these inputs are profound and include cross-edge spillover of subsidized species from urban to natural areas, changes in population densities, and functional responses of predators. However, relatively little attention has been paid to identifying the mechanisms underlying these impacts and the extent to which they stem from changes in animal density or behavioral traits. From 2001-2014, my students and I studied the consequences of human inputs on plant, bird, and predator communities inputs in urbanizing landscapes of Ohio, USA. Human inputs fundamentally altered species interactions in ways that affected bird-plant networks, changed the

nature of predator-prey relationships, and resulted in ecological traps. Despite the common perception that consequences of urbanization are density-mediated in nature, several lines of evidence suggest that most outcomes are trait-mediated and involve sometimes nuanced behavioral responses of non-human species to human inputs.

Filling the gaps: BBS in Mexico

Rodriguez-Contreras, Vicente - CONABIO; Humberto Berlanga - CONABIO; **Keith Pardieck** - USGS Patuxent Wildlife Research Center

The North American Breeding Bird Survey (BBS) in Mexico will complete its eighth year of data collection in 2016. The BBS expanded into Northern Mexico to provide data useful for bird population assessments and to help inform conservation decisions in regions where little or no quantitative data existed. Despite the unexpected challenges of recession periods and increased border violence during its formative years, a dedicated cadre of citizen scientists supported by the Mexican National Commission for the Knowledge and Use of Biodiversity (CONABIO) in collaboration with the United States Geological Survey (USGS) managed to grow the program from a few routes in 2008 to over forty routes sampled in recent years, providing data on >280 species (>122,072 birds counted). Nevertheless, challenges continue. For example, CONABIO must often reimburse travel expenses to facilitate participation, and safety considerations and participant availability often dictate which routes are sampled, limiting geographic representation. As the first data analyses are being produced, BCR x State lists are being defined in order to establish state and local filters to expedite data review. This will not only allow timely annual review, public release, and analyses of Mexican BBS data, which is the goal of the program but will also provide additional feedback to volunteers helping to improve participation as well.

National strategy for monitoring and conservation of the Golden Eagle in Mexico

Rodríguez-Estrella, Ricardo - Centro de Investigaciones Biológicas del Noroeste S.C.; Alberto Lafon - PROFAUNA, México; Leonardo Chapa-Vargas - Instituto Potosino de Investigación Científica y Tecnológica; Jorge Nocedal - PH Consultores Ambientales; Laura Scott Morales - Universidad Autónoma de Nuevo León; José Ojeda Orranti - Universidad de Guanajuato; Patricio Tavizón - Universidad Autónoma de Zacatecas; Gonzalo De Leon G - Centro de Investigaciones Biológicas del Noroeste; Alejandro Lozano - Universidad Autonoma Agraria Antonio Narro

The Golden Eagle (*Aquila chrysaetos*) is one of the most studied raptors around the world because of conservation problems detected mainly during the 70´s to 90´s. The Golden Eagle is still considered a species of special concern in many places because of negative population trends. In Mexico, it is listed as a Threatened species and has a Special Conservation Program for vulnerable species. However, a good conservation strategy has failed because of a lack of studies on ecology and population trends, and on the movements of Golden Eagles in Mexico. From 2012, we started a National Strategy for monitoring and the conservation of the Golden Eagle in most of its actual distribution in Mexico. Here, we present our results of the Golden Eagle monitoring, ecology and threats in Chihuahua, Coahuila, Nuevo León, Zacatecas, Jalisco, San Luis Potosí, Guanajuato, Sonora and the Baja California peninsula and some conservation proposals.

Hummingbird-plant interaction network: Exploring the pattern from an evolutionary and morphological perspective

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Mutualistic interactions are considered powerful drivers of biodiversity on earth, because they build complex interaction networks that vary in connection pattern and intensity. We conducted an exhaustive search of journals, theses, reports, and personal communications with researchers about unpublished data, that document which hummingbird species visit which plant species for nectar resources. Using the information gathered from4532 interactions between 292 hummingbird species and 1287 plant species, we built an interaction network between hummingbird clades and the plant families used by them as nectar resources. We found that network architecture was related with biogeographical origin of hummingbird clades, hummingbird morphology (beak size and weight) and flower pollination syndrome. The connection pattern of the network was consistent with hummingbird and plant evolutionary history across the Western hemisphere.

Using phylogenomic markers to test the taxonomy and evolution of Atthis hummingbirds spanning the Isthmus of Tehuantepec in Mexico

Rodríguez-Gómez, Flor - Universidad Autonoma de Mexico; Eugenia Zarza - Moore Laboratory of Zoology, Occidental College; Whitney Tsai - Moore Laboratory of Zoology, Occidental College; John McCormack - Moore Laboratory of Zoology, Occidental College

The Isthmus of Tehuantepec (IT) is one of the major biogeographic barriers of Mexico, with many sister species found in highlands on either side of this lowland area. In the case of Atthis hummingbirds, however, divergence between forms on either side of the IT appears weak, with evidence for ongoing gene flow and misidentifications. Our aim was to clarify the phylogenetic relationships between the currently described species, the Bumblebee Hummingbird (*A. heloisa*) with populations in the west of IT and Wine-throated Hummingbird(*A. ellioti*)with population in the east of IT and to associate divergence processes with past geological and climatic fluctuations in Mesoamerica. We used ultraconserved elements (UCEs) from museum specimens to collect a set of loci and informative single nucleotide polymorphisms for phylogenetic and population genetic analysis. Phylogenies based on UCEs and those from mtDNA collected as “by-catch” show two weakly supported clades on either side of the IT. With regard to phenotype, the two species lacked clear morphological differences. Analysis of their niches using niche models based on climate data and habitat variables suggest little evidence for ecological divergence and a pattern more in keeping with niche conservatism, as has been demonstrated for other sister groups that span the IT. In sum, the IT does not appear to be a strong barrier to genetic exchange between the two species. Further research is needed to determine their taxonomic status and quantification of the level of current gene flow.

Management and conservation of cavity nesting birds in Monte Cabaniguan Wildlife Refuge, Las Tunas, Cuba

Rodríguez, Aryamne Serrano - Empresa Nacional de Flora y Fauna.; Yusneida Alarcón Jorge - Empresa Nacional de Flora y Fauna

The availability of nesting sites for birds that nest in cavities can be influenced by the specific characteristics of habitat, human

influence or dominance patterns within species assemblages. We ask the following questions for the Monte Cabaniguan Wildlife Refuge: 1. Do the structure of the guild or the characteristics of each species determine a differential use of the substrates or habitats? 2. Are the cavities or the substrates the limiting factors in reproduction? We found that between 2010 and 2015 the *Melanerpes superciliaris* was the dominant species in terms of abundance and number of nests (142); while *Colaptes fernandinae* is the least common. This dominance can be explained by morphological and behavioral characteristics *of M. superciliaris* because it has harder bill ($U = 98.00$, $p > 0.05$) and more aggressive behavior (nine nests predated during the 2015 season). There is no differential use of the substrate for nesting, as the seven species studied use mostly a single palm species (*Copernicia gigas*) to build their nests (94%). The density of this substrate determines a differential habitat use for nesting in Savannah (774 nests) and forest (334). Density of cavities by itinerary is not related with occurrence frequency ($r = 0.525$; $p = 0.037$ for excavators and $r = 0.504$; $p = 0.046$ for secondary cavity nesters). The availability of cavities is not related to the habitat use for secondary cavity nesters species, which allows us to presume that this is not a limiting resource in the area.

Distribution of the Honduran Emerald (*Amazilia luciae*) in tropical dry forests of the Agalta Valley, Honduras

Rodríguez, Fabiola - Indiana University of Pennsylvania, Indiana University of Pennsylvania Research Institute; Joseph Duchamp - Indiana University of Pennsylvania; Dorian Escoto - Indiana University of Pennsylvania Research Institute; Thelma Mejía Ordoñez - Universidad Nacional Autonoma de Honduras; Lilian Ferrufino Acosta - Universidad Nacional Autonoma de Honduras; Josiah Townsend - Indiana University of Pennsylvania; Jeffery Larkin - Indiana University of Pennsylvania

The Honduran Emerald (*Amazilia luciae*) is Honduras´ only endemic bird species. This imperiled hummingbird's population is considered endangered and it inhabits one of the most threatened ecosystems in the American continent, the tropical dry forest. During 2014-2015, we conducted Honduran Emerald surveys within 35 dry forest remnants in the Agalta Valley. We used survey data to construct a species distribution model (SDM) using the maximum entropy method to identify areas that are important to the species persistence. Honduran Emeralds were detected at 179 point count locations that were surveyed three times each during the study period. The SDM was constructed with nine climactic and environmental variables. The metric, area under the receiver operating characteristic curve (AUC), was used to assess our model's performance. Results based on the testing data (0.917 ± 0.015 SE, CI95% 0.889-0.948) suggest that our model adequately predicted suitability. Variables that contributed the most to the prediction of distribution were precipitation seasonality (66.5%) and distance to the main highway (21%). The species distribution model output indicates there is a core area of approximately 730 hectares that is classified as highly suitable for Honduran Emeralds. We recommend that conservation efforts focus on the development of incentive programs that promote 1) the conservation of existing dry forest remnants and 2) the restoration of dry forest communities in strategically located areas that improve connectivity between the core area and surrounding dry forest remnants.

The Role of Hybridization in Shaping Habitat Selection Patterns and Population Dynamics in Golden-winged Warblers
Rohrbaugh, Ron - Cornell Lab of Ornithology; Sara Barker Swarthout - Cornell Lab of Ornithology; Viviana Ruiz Gutierrez - Cornell Lab of Ornithology; Scott Taylor - Fuller Evolutionary Biology Program, Cornell Lab of Ornithology; David Toews - Fuller Evolutionary Biology Program, Cornell Lab of Ornithology; Eric Wood - California State University, Los Angeles

As a consequence of long-term, steep population declines, the Golden-winged Warbler has been the subject of research and conservation efforts for decades. This work has revealed a consistent pattern of habitat selection during the breeding period. Similar knowledge, however, is lacking for hybrid individuals that result from mating between phenotypic Golden-winged and Blue-winged warblers. Widespread hybridization has been cited in causing Golden-winged Warbler population declines, thus habitat selection by hybrids might influence settlement patterns, hybridization rates, and ultimately Golden-winged Warbler population dynamics. We captured phenotypic male Golden-winged Warblers, Blue-winged Warblers, and hybrids on their breeding territories in New York State. Using blood samples from these birds, we then determined the genotype for each individual by either examining mitochondrial DNA or six nuclear loci that differ between parental phenotypes. Using habitat data collected within territories and remotely, we compared the habitat conditions across genotyped birds at multiple geographic scales to determine if those conditions differed by genotype and degree of genetic introgression. Initial results suggest that phenotypic and genotypic hybrids have somewhat different habitat association patterns from each other and from their “parent types.” Such patterns are likely to perpetuate a cycle of hybridization between phenotypically different individuals. Results of this work are being used in an adaptive framework to inform future policy and conservation action for the Golden-winged Warbler.

Trade-offs between plumage quality and time spent in the nest in baby birds
Rohwer, Vanya - Cornell University; Lea Callan - Cornell University

Nestling birds carry a remarkably distinct plumage with body feathers that are generally duller in color and loftier, almost down like relative to adults. While differences between nestling and adult plumages are readily observed, our understanding of these differences remains poor. We explore variation in the quality of the body plumage of nestlings using a diversity of temperate and topical birds. Preliminary data suggest a trade-off between the time spent in the nest and the quality of the plumage produced, with species that spend less time in the nest producing lower quality plumage. One factor we predict to drive this trade-off is nest predation. Nest predation is the leading cause of nest failure in birds, so nestlings may sacrifice growing high quality plumage in order to leave the nest quickly. If predation favors rapid fledging at the expense of plumage quality, then nestlings in relatively safe nest sites should have higher quality plumage compared to those in more dangerous locations. We explore this hypothesis in two ways: (i) by comparing nestling plumages between temperate and tropical congeners and (ii) by comparing nestling plumages from low (cavity nesters) and high (open cup nesters) predation nest sites. We predict that nestlings of both tropical species and open cup nesters will have lower quality plumage compared to temperate and cavity nesting species, consistent with patterns of nest predation.

Long-term effects of four silvicultural treatments on spruce-fir avian communities

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Several migratory bird species associated with conifer-dominated forests show declining populations in northern New England, which is primarily comprised of commercial forests. However, effects of current forest management practices on bird communities are poorly understood in this region, where harvesting patterns and extent have changed dramatically during recent decades. We surveyed birds and vegetation at 657 points in 117 stands during 2013-2015 in commercial forests and at four National Wildlife Refuges in Maine, New Hampshire, and Vermont. We used multivariate analysis and generalized additive models to test for the avian response (abundance and richness) to four common silvicultural treatments regenerating clearcuts, pre-commercially thinned, selection, shelterwood, and compared relative to mature reference stands. Abundance of declining species, such as Bay-breasted Warbler (*Setophaga castanea*) and Cape May Warbler (*S. tigrina*), were associated with mid-successional, regenerating clearcuts and pre-commercially thinned treatments with abundant spruce-fir trees. Silvicultural treatment was an important predictor (R2=0.29) for bird abundance; however, treatments overlapped. Vegetative attributes that were important predictors of bird abundance included mature forest structure (measured by quadratic mean diameter; R2=0.63), canopy cover (R2=0.50), proportion spruce-fir trees (R2=0.41), ground cover (R2=0.30), midstory cover (R2=0.28), and shrub cover (R2=0.26). Mature forest structure, ultimately influenced by silvicultural treatment, is an important determinant for bird communities. Additional analyses to be included in the presentation will compare species richness of spruce-fir obligates, spruce-fir associates, species of concern, and total species richness among our five silvicultural treatments.

Mimicking the sounds of oil extraction: A playback experiment assessing effects of oil development noises on nesting success and abundance of grassland songbirds

Rosa, Patricia - Natural Resources Institute, University of Manitoba; Nicola Koper - Natural Resources Institute, University of Manitoba

As anthropogenic noise becomes more prevalent across habitats, its impacts on wildlife remains difficult to assess. Noise from oil development may contribute to grassland bird population declines in western Canada. To disentangle effects of noise from confounding factors of oil development, we used a solar-powered broadcasting system that reproduces sound with a high degree of source fidelity. During three field seasons, we surveyed bird abundance on transects and monitored nesting success at continuous pumpjack playback sites, intermittent drill playback sites, silent playback site, and control sites without any infrastructure. This study design allowed us to decouple effects provoked by anthropogenic noise from effects driven by the presence of infrastructure. We found negative effects of noise on nesting success for chestnut-collared longspurs, Savannah sparrows and Sprague's pipits at sites with continuous noise exposure. While Savannah sparrows and Sprague's pipits were not less abundant at noise-producing sites, chestnut-collared longspurs avoided the loudest pumpjack playbacks and the even louder drill playbacks. Vesper sparrows had a higher nesting success at control sites

compared to silent playback sites, suggesting that effects were driven by the presence of infrastructure and not of the noise itself for this species. Compared to control sites, vesper sparrows had in fact lower nesting success at all site types with infrastructure present (i.e. pumpjack, drill and silent playbacks). In our system, assessing noise-related impacts by only examining differences in abundance would not have revealed fitness-related consequences endured by residing species. The management implications are not straightforward; species-specific mitigation must be considered.

Conservation Status of the North American Avifauna

Rosenberg, Kenneth - Cornell Lab of Ornithology; Arvind Panjabi - Bird Conservancy of the Rockies; Adam Smith - Environment and Climate Change Canada; John Sauer - USGS Patuxent Wildlife Research Center; Peter Blancher - Environment and Climate Change Canada; Humberto Berlanga - CONABIO; Vicente Rodriguez - CONABIO; Randy Dettmers - U.S. Fish and Wildlife Service; Judith Kennedy - Canadian Wildlife Service

As 2016 marks the centennial of the Migratory Bird Convention between the U.S. and Canada, two major reports summarize the conservation status of the North American avifauna— Partners in Flight's (PIF) Landbird Conservation Plan for the U.S. and Canada, and The State of North America's Birds report produced by the North American Bird Conservation Initiative in these two countries and Mexico. Using a consistent and standardized species assessment process (see Rich et al., this symposium), we assessed the conservation vulnerability of 1,154 native bird species, considering six factors including population size, trend, size of breeding and nonbreeding distributions, and threats. Across all major terrestrial and aquatic habitats, birds dependent on oceans (54 species) and tropical forests (478 species) are of highest conservation concern, with more than 50% of species in these habitats on the North American Watch List. Birds in grassland and aridland habitats, as well as long-distance migratory shorebirds are undergoing steep, consistent population declines, based on long-term monitoring data, whereas temperate and boreal forest birds represent a mix of high-concern and lower-concern species. Widespread species in wetland habitats, and especially waterfowl, show overall stable or increasing populations, reflecting significant conservation investment in recent decades. New metrics derived from year-round distribution and abundance models highlight the connections across habitats and countries for migratory species and the imperative of coordinated and collaborative international conservation efforts. Continuing and replicating the success of wetland and waterfowl conservation across other major habitats is the highest priority for continental bird conservation.

Use of Breeding Bird Survey Data in Avian Conservation Assessments

Rosenberg, Kenneth - Cornell Lab of Ornithology; Peter Blancher - Environment and Climate Change Canada; Arvind Panjabi - Bird Conservancy of the Rockies

Conservation status assessments for birds frequently rely on multiple factors and data sources to determine the relative vulnerability of species to regional extirpation or extinction. Information on current population size, population trend, current and historic distribution, and current and future threats are most often incorporated into species assessments, although availability of consistent and reliable data is often a severe limitation. In the U.S. and Canada, the North American Breeding Bird Survey (BBS) has been an invaluable source of data for conservation assessments, and in particular Partners in Flight's (PIF) widely used Avian Conservation Assessment Database relies heavily on BBS results. Strengths of the BBS for this process include broad geographic

coverage, long time-series (50 yrs), stratified random design, standardized protocol, and continued improvement and transparency of analysis and results. PIF uses BBS to directly assess population trend (286 of 460 landbird species adequately covered) and relative population size (338 species), and incorporates BBS data into models to estimate global population size and to project future trends as a metric of conservation urgency. Other, more targeted, assessments of endangered species status in the U.S. and Canada also have relied on BBS results, when appropriate, or on PIF population estimates derived from BBS data. Current limitations of the BBS as a continent-wide assessment tool—namely incomplete geographic coverage, as well as roadside, habitat, and seasonal biases—may be addressed by integrating the analysis of BBS with other data sources, such as regional monitoring data and eBird.

Combining multiple data sources to determine drought and land-use impacts on Lesser Prairie-Chickens

Ross, Beth - USGS South Carolina Cooperative Unit, Clemson University; David Haukos - U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, Department of Biology, Kansas State University; Christian Hagen - Oregon State University; Jim Pitman - Western Association of Fish and Wildlife Agencies

The Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) is a species of conservation concern, yet studies quantifying factors affecting population abundance over broad spatial and long temporal scales are lacking, making conservation decisions difficult. Quantifying the drivers of the Lesser Prairie-Chicken is especially important, as climate and land-use change are predicted to disproportionately impact the Great Plains region where it occurs. Our objectives were to combine long-term data sets of lek counts, telemetry locations, nest success, climate, and land use to quantify changes in Lesser Prairie-Chicken population growth rates in Kansas from 1997-2012 and understand the effects of climate and land-use change on adult survival and nest success. We used integrated population models to combine population-level data sets with environmental data to determine how climate and land-use change affect Lesser Prairie-Chicken populations. The population growth rate in 2002 and 2011 was less than one, and greater than one in 1997, 2000, 2003, and 2009, but was not significantly different than one in other years. Neither variation in climate (Palmer Drought Severity Index) nor land-use change (conversion of grassland to agriculture) had a significant effect on Lesser Prairie-Chicken adult survival or nest success. While past research indicated that changes in Lesser Prairie-Chicken abundance was related to drought, our new approach allowed us to identify which portions of the life cycle are most affected by drought and land-use change. Combining broad-scale count data with localized, intensive field efforts in integrated population models can result in better inference and understanding of avian population drivers.

Severe weather ecology: Global insights from localized chaos

Ross, Jeremy - University of Oklahoma

Population limitations are often reached during extremes of environmental fluctuations. Depending upon the severity, frequency, and spread of such perturbations, these transient events can limit the distribution of species or even biological communities. Severe weather events increasingly present local or even global extinction risks for fragmented and depleted populations. Yet, localized catastrophes have too often been treated as an unquantifiable variable because of their relative spatiotemporal unpredictability. In line with assessments of anthropogenic disasters (e.g., oil spills) there do exist many possible ways to quantify severe weather impacts among birds and other species if field

observers are prepared to gather scientifically-robust data after disaster strikes. A coordinated network of such observers can expand our global understanding of macrosystemic ecological pressures associated with severe weather events. Those insights will allow better parameterization of environmental stochasticity in ecological models, providing clearer perspective on possible macroscale outcomes under proposed meteorological shifts during climate change.

Phenological mismatch and density-dependent nutrition: explaining decadel declines in gosling production by Ross's and lesser snow geese in Canada's central arctic

Ross, Megan - University of Saskatchewan; Ray Alisauskas - Environment and Climate Change Canada; Dana Kellett - Environment and Climate Change Canada

Animal populations fluctuate due to the interplay between the probability of persistence, or survival, of adults and the per capita rate at which dead adults are replaced, also known as the recruitment rate. Recruitment is more complex than is annual adult survival because it is an outcome of various states and transition probabilities between the life stages. In migratory species, several of these components may influence reproductive success via responses to proximate factors before or during arrival to the breeding grounds. Using a 23-year dataset (1992-2014), we evaluated whether (i) density-dependence on northern spring staging grounds, leading to nutritional deficiencies of pre-breeding females, and (ii) phenological mismatch between peak gosling hatch and peak forage quality on brood-rearing areas might be key factors associated with a long-term decline in the per-capita production of Ross's and lesser snow goose goslings at Karrak Lake, Nunavut. We found that gosling production was reduced in years when females arrived to the nesting grounds with diminished protein and lipid reserves. Delayed nesting and later hatch dates relative to forage phenology were also strongly associated with reductions in productivity and increasing mismatch over the course of our study was the result of a long-term advance in plant phenology without a corresponding advance in hatching dates by geese. Sustained declines in gosling production at our study site imply reduced potential for subsequent recruitment. A reduction in recruitment may alter the population age distribution toward older individuals with possible senescent effects on reproduction and momentum effects on population trajectories.

Coastal Areas are a Population Source for eastern Painted Bunting

Rotenberg, James - University of North Carolina, Wilmington; Evan Adams - Biodiversity Research Institute

The eastern populations of Painted Bunting (*Passerina ciris*) have been a conservation concern over the past 30+ years because of changes to breeding habitat and adverse effects of the pet trade. Unfortunately, little is known about population limitation or dynamics in this species, so it can be difficult to determine the causes of their population decline. To determine how adult survival varied among sites in North and South Carolina, we employed a robust design mark-capture study. The 45 study sites were divided into two different strata: (1) coastal vs. inland and (2) high, medium, and low bunting density sites based on prior survey data. Estimates of adult survival, emigration/immigration rates, and capture/recapture probability were determined by using a Huggins robust design model in Program MARK 7.0. Over the six-year banding period (2007-2012), we found coastal adult survival was 0.558 (95%CI: 0.509-0.606) while inland adult survival was 0.330 (95%CI: 0.276-0.389). Bunting density was not important for predicting adult survival. The reasons for higher coastal survival are not clear. Habitat differs

significantly between the two areas, and therefore habitat quality could be better in the coastal areas. Agricultural practices common at inland sites may be adversely affecting the birds by clearing preferred scrub brush and forest-edges, as well as the use of pesticides or other agricultural chemicals. Disturbance is not absent on the coast, but protected wetland, forest edge and shrub-scrub habitats could increase the survival of adults and make these areas likely population sources for eastern Painted Buntings.

Myoglobin concentration in flight muscle predicts flight endurance in Neotropical birds: implications for ecology and evolution

Rourke, Bryan - California State University - Long Beach; Kelsey Condell - California Fish and Wildlife; W. Douglas Robinson - Oregon State University; Jeffrey Stratford - Wilkes Univeristy

The flight muscle of birds serves a wide variety of flight modes, from infrequently powered flight to highly demanding hover. Powered flight has many performance envelopes, and may extend to hours or even days of sustained duration. Aspects of avian muscle physiology, and flight muscle in particular, lag in understanding compared to other taxa. This is especially true in the description of muscle fiber-types, and the presumed myosin heavy-chain isoform expression of flight muscle motor proteins. We present a reassessment of these fiber-types, using a range of Neotropical species that were presented with a short-distance flight challenge. Some birds were unable to maintain powered flight even over these relatively modest distances, which raises questions of flight muscle fatigue, or overall aerobic performance. A potential influence on performance is the myoglobin content of muscle, which may serve as an oxygen store for aerobic activities, and colors “red” muscle. Myoglobin protein content of cardiac muscle was not predictive, but concentration in flight muscle was well correlated with flight ability. We describe the variety of muscle fiber-types present in birds, and discuss implications for the distribution of birds across fragmented landscapes and population barriers.

Large scale migration patterns of Rufous Hummingbirds

Rousseau, Josée - Oregon State University and Klamath Bird Observatory; John Alexander - Klamath Bird Observatory

Effective conservation of Rufous Hummingbirds (*Selasphorus Rufous*) requires a better understanding of its distribution, movement, and demographics. Our goal is to quantify large scale demographic movements from banding data to inform management priorities. We obtained banding data from the Avian Knowledge Network, Institute of Bird Populations and USGS Bird Banding Lab. Using GIS, we created two-standard deviation ellipses (n = 141) encompassing locations from each combination of age, sex, and week of capture (e.g. adult-female-week 1). Each ellipse thus represent the spatial distribution of an age-sex category in time. We used cluster analysis to evaluate demographic similarities and differences in annual cycle movement patterns represented by the ellipses. The results for the southbound migration demonstrate that adult males migrate first, followed by adult females, then young hummingbirds. These results also expose a lesser known southbound migration route through California, and possible movements to and within the southeastern USA. Lastly, the data reveal a yearly bias in the age-sex ratios favoring adult females ($x^2 = 246.1$, $df = 1$, $p < 0.001$). The needs for international partnerships, and the benefits and limitations associated with banding data are discussed.

Planting hope: Restoring the ecological function of our communities and supporting bird conservation by landscaping with native plants

Rowden, John - National Audubon Society

Native plant species are better at supporting North America's native birds and research is demonstrating that even small patches of habitat planted with natives – down to the yard and neighborhood scale – can benefit birds. With that in mind, the National Audubon Society investigated whether birders and bird-loving gardeners are willing to modify their own yards to benefit birds. In 2015, Audubon asked our members and supporters about their interest in planting native species, receiving 14,000 responses. The results showed broad support for the concept: 94% of respondents indicated that they were interested to extremely interested in supporting growing more native plants in their community; more than 50% said they would be willing to dedicate at least half of their own outdoor space to native plants; and more than 50% said they would be willing to volunteer to help others in their communities install native plants. With regard to support they would need, respondents prioritized information on local bird-friendly native plants, and nurseries or growers that carry native bird-friendly plants. Armed with this information, Audubon is introducing a nationwide Plants for Birds initiative that will provide resources and support suggested by our research, with a five-year target of helping people put one million appropriate native plants in the ground in gardens, yards, and community spaces.

Phenological Overlap & Asynchrony in Migratory Birds as a Consequence of Climate Change

Rubenstein, Madeleine - USGS National Climate Change and Wildlife Science Center; Jherime Kellermann - Oregon Institute of Technology, Natural Sciences Department

Climate change is expected to alter the phenology of bird migration, potentially resulting in desynchronization between spring migration and peak resource availability on stopover sites and breeding grounds. Despite a large body of research on migratory bird phenology in a changing climate, much of the literature emphasizes shifts in bird migration phenology without an associated analysis of phenological trends in lower trophic levels. The empirical evidence to date for phenological asynchrony is variable, with important differences between biogeographic regions, migration distance, and life history traits, and much remains unknown about the extent, occurrence, and impact of phenological asynchrony. This study uses historical citizen science data on the timing of bird migration (eBird) and breaking leaf buds (National Phenology Network) to assess climate-driven changes in phenological synchrony between migratory birds and food availability (as indicated by breaking leaf buds of deciduous trees). We calculate two metrics of co-occurrence (synchrony and overlap) for multiple species and guilds of North American migratory birds in multiple regions. We evaluate the generalized relationship between phenological changes in vegetation and migratory birds, and analyze differences in trends between various guilds (i.e., long- vs. short-distance migrants; resource specialists vs. generalists). By calculating both synchrony and overlap, we investigate the limitations of traditional phenological metrics (e.g., first arrival date). Using empirical data, this study aims to shed light on both the occurrence of phenological asynchrony and the ecological mechanisms driving this phenomenon.

Metrics of Neotropical Bird Wings: Ecological and Evolutionary Correlates
Ruelas Inzunza, Ernesto - Universidad Veracruzana

The wings of birds and other flying animals are shaped by characteristics of their flight. Here, I compare the morphometrics of 71 species of Neotropical birds to a series of variables that could be drivers of wing dimensions in sedentary birds. I calculated the wing-loading (WL) and aspect ratio (AR) of birds captured in mist nets in five localities in Costa Rica, and compared them to six factors and their interactions. My comparisons of the ecological and evolutionary variables that could influence the WL and AR of these birds showed effects of different magnitude. Elevation, vegetation type, sensitivity to habitat disturbance, and range size had no effect on either of the two metrics used. However, single factors foraging guild and taxonomic family showed strong effects that are highly significant. All the two-factor interactions that involve taxonomic family are also highly significant. The two different metrics of wing shape used in this investigation support the predictions of Seebohm's Rules, and the results of a handful of published papers, that show the wings of sedentary, Neotropical birds are more rounded and carry more weight than any other bird with published data. The higher WL and lower AR of sedentary species found in this study suggest that these birds are less constrained by long-distance movements than their migratory counterparts and that they can pay the cost of an increased wing-loading and aspect ratio.

A Model-Based Approach to Estimating Nest Detection Probability
Ruff, Zack - Iowa State University; Stephen Dinsmore - Iowa State University

Nest detection probability is defined as the probability that a nest will be located during a survey, given that it is active and available to be detected. There is no single accepted method for estimating nest detection probability; here we demonstrate a model-based approach. Using data from >1,600 nesting attempts across a 19-year period, we constructed closed-capture models to examine factors influencing initial nest detection in the Mountain Plover (*Charadrius montanus*), a cryptic, ground-nesting shorebird with an unusual uniparental incubation system. Nest detection probability was primarily influenced by survey date, nest initiation date, nest age at discovery, survey area size, and year. Nest detection decreased throughout the nesting season and showed a non-linear relationship with nest initiation date; detection was lowest for nests initiated around 1 June. Nest detection decreased non-linearly with nest age, with the effect being slightly weaker in very old nests. Nests were easier to find when surveying small areas of nesting habitat than large ones. The best model also included tending adult sex and observer skill level, but these effects were only marginally significant. Single-visit detection probability ranged from < 0.10 to >0.80, clearly demonstrating the need for a model-based approach that accounts for individual heterogeneity. Our methodology can be applied to many different taxa and has the potential to greatly improve estimates of breeding activity by providing a robust modeling approach to estimate the probability of initially finding a nest.

Nursery or Buffet: To what Extent are Worm-eating Warblers Using Early Successional Habitat on Summer Breeding Grounds?
Ruhl, Patrick - Purdue University; John B. Dunning Jr. - Purdue University

Worm-eating Warblers (*Helmitheros vermivorum*) are classified as forest interior specialists, requiring large contiguous tracts of mature forest for breeding and nesting habitat. Although described as a mature forest species, our recent findings suggest that Worm-eating Warblers may not depend entirely upon mature forest habitat during the

breeding season. In the summer of 2015 (May 21 – August 14) we mist-netted and banded birds in six 7-year-old clearcuts in southern Indiana. Throughout the field season we caught 257 individual Worm-eating Warblers in the clearcuts, making it the most frequently captured species in our study. Of these 257 individuals, 75 adults in breeding condition were captured during the month of June when the majority of Indiana breeding takes place. Our results suggest that Worm-eating Warblers might be using southern Indiana clearcuts as breeding habitat. Although they are known to utilize early successional habitat during the post-fledging period, this association during the breeding season has not been previously described for the species. In the summer of 2016, we initiated a study of Worm-eating Warbler breeding demography using radio-telemetry and traditional nest-searching to locate nest-sites. In this talk we present our research findings from the 2016 field season and implications for Worm-eating Warbler conservation.

A Vision for an Integrated Monitoring Framework for the Western Hemisphere
Ruiz-Gutierrez, Viviana - Cornell Lab of Ornithology

Implementing full life-cycle conservation strategies for migratory birds requires knowledge on where and when populations are most at risk. To achieve this, scientific information is needed to estimate and link seasonal components of population vital rates, abundance, and distribution through time and across space (e.g., migratory connectivity). Recent model developments and technological advances are providing unique opportunities to combine multiple sources of bird monitoring information at scales that match the temporal and spatial dynamics of migratory bird populations. This class of integrated population models (IPMs) allows for predictions on how management decisions aimed at increasing survival and reproduction on the breeding grounds might impact populations in the context of factors influencing overwintering survival. The goal of this talk is to provide an overview of the different information components that feed into IPMs (e.g., banding data, point-count surveys), and highlight ways that demographic and count-based monitoring information can be generated at relevant geographical and temporal scales through international partnerships in the Western Hemisphere.

Using integrated population models to estimate seasonal survival and full-annual-cycle drivers of population dynamics in migratory birds
Rushing, Clark - Smithsonian Institute Migratory Bird Center

The primary challenge to quantifying the limiting factors of migratory birds is that these species can experience limiting factors at any stage of their annual cycle. To further complicate matters, demographic and environmental processes operating across the annual cycle often interact such that no single period can be understood outside the context of the entire cycle. Although researchers have long recognized these complexities, traditional population modeling approaches cannot easily account for demographic processes occurring across the full annual cycle. Integrated population models (IPMs) provide a natural and potentially powerful method for estimating demographic rates across the entire annual cycle and quantifying their influence on observed population dynamics. In particular, IPMs offer the ability to: 1) combine demographic data from different periods of annual cycle in a unified framework; and 2) estimate demographic rates for which there is no explicit data (e.g. migration survival). In this talk, I outline recent advances in the development of full annual cycle IPMs, in particular the ability to estimate seasonal survival rates during both the stationary (breeding and wintering) and migration (fall and spring) periods. To illustrate the utility of

these methods, I highlight recent applications of these methods to quantify the environmental drivers of migration survival in Black-throated Blue Warblers and the influence of non-breeding survival on breeding population dynamics of Wood Thrush. The results from these case studies underscores the power of full annual cycle IPMs to address both fundamental and applied issues related to migratory bird ecology and conservation.

Advances in full-annual-cycle modeling to inform bird conservation

Rushing, Clark - Smithsonian Institute Migratory Bird Center

One of the central impediments to improving conservation of common but declining birds is that information about limiting factors is currently unavailable for the vast majority of species, especially long-distance migrants. The primary challenge to quantifying the limiting factors of long-distance migrants is that these species can experience limiting factors at any stage of their annual cycle. To further complicate matters, demographic and environmental processes operating across the annual cycle often interact such that no single period can be understood outside the context of the entire cycle. Given these complexities, empirical attempts to quantify limiting factors have been hindered by the lack of large-scale demographic monitoring data, missing information on migratory connectivity, and the absence of population models that can incorporate data from across the entire annual cycle. Fortunately, rapid technological advances are providing unprecedented opportunities to advance our understanding of when and where bird species experience limiting factors. In particular, novel “full-annual-cycle” population models are giving scientists and managers rigorous methods to bring together demographic monitoring data, remote sensing data, and information about migratory connectivity to shed light on the processes limiting migratory bird populations. In this talk, I will provide a brief overview of recent advances in the development of full-annual-cycle population models, highlighting several cases where these models are helping to identify limiting factors and inform conservation planning for one species of conservation concern, the Wood Thrush.

Abundance and demographic rates are not correlated across the global range of a species

Ruskin, Katharine - University of Connecticut; Alyssa Borowske - University of Connecticut; Maureen Correll - Bird Conservancy of the Rockies; Christopher Field - The University of Connecticut; Whitney Wiest - USFWS; Jonathan Cohen - SUNY College of Environmental Science and Forestry; Thomas Hodgman - The Saltmarsh Habitat and Avian Research Program; Adrienne Kovach - University of New Hampshire; Brian Olsen - The University of Maine; W. Gregory Shriver - The University of Delaware

Population growth rates are widely hypothesized to be greatest at the geographic center of the species range, but direct empirical support is limited because demographic data are difficult to collect over a large spatial scale. Indirect empirical support for this pattern using abundance data forms a deep body of literature, but the results have been mixed. Therefore, the texture of how demographic rates of a species vary over its range remains an open question, and one of growing importance for conservation in the face of climate change. We quantified abundance, a number of demographic rates (seasonal fecundity, adult annual survival, and annual population growth rate), and adult condition as an index of population growth rate across 59% of the global breeding range of a single species, the saltmarsh sparrow (*Ammodramus caudacutus*). We used data collected across 5 years that included >800 nests and >6,000 captures sampled at 20 demographic plots which span 575 km. Saltmarsh sparrows exhibit a broad pattern of greatest abundance

near the geographic center of the species range. However, demographic rates and adult condition did not peak near the geographic center of the range, and none of the metrics correlated well with the observed pattern of abundance (ranging from 0.01-0.33). Thus, abundance is a poor indicator of demographic rates in this system. Our results do not support the hypothesis that demographic rates peak at the geographic center of species' ranges. Instead, our results demonstrate a mosaic of demographic rates and indices that vary on a local scale.

Understanding how hormone-regulatory networks shape behavioral phenotype and social network structure in a lek breeding bird

Ryder, T - Smithsonian Migratory Bird Center; Brent Horton - Department of Biology, Millersville University; Ben Vernasco - Virginia Tech University; Brian Evans – Smithsonian Migratory Bird Center; Ignacio Moore - Virginia Tech University

Hormone regulatory networks underlie the expression of complex phenotypes, and these whole-organism outcomes may scale up to affect behavioral interactions and subsequent higher order social network structure. To date, no study has examined the proximate links between individual variation in hormone-signaling pathways, behavioral phenotype, and social network structure. To address this gap in knowledge, we studied the relationships between circulating testosterone, behavioral variation, and social network structure in a cooperative lek-breeding bird, the wire-tailed manakin (*Pipra filicauda*). We measured male behavioral phenotype and social network dynamics using an automated proximity data logging system, which provides high spatial and temporal resolution data on the frequency and directionality of male-male interactions within social networks. We obtained samples of circulating testosterone throughout the breeding season to understand how hormones modulate male behavior and influence status specific roles and positions within the social network. Finally, we aim to understand how the hormonal mechanisms that shape male phenotype scale-up to influence the emergent properties of weighted networks. Our results indicate strong status-specific variation in circulating hormones with territorial males having higher testosterone than floaters, however, substantial variation exists within status classes. Moreover, circulating testosterone appears to underlie variation in male social behavior within each status class and influence connectivity within the social network. Given that circulating testosterone is merely one component of the complex hormone-regulatory pathway, this work is a stepping stone for understanding how gonadal steroids act in the brain to influence complex social behaviors like cooperation.

Managing Bird-Building Collisions at the National Renewable Energy Laboratory

Ryon, Thomas - National Renewable Energy Laboratory

Collisions with buildings are a major source of anthropogenic mortality of birds. Recently, researchers estimate between 365 to 988 million birds die each year by collisions with buildings, mainly glass. Residential, industrial and commercial buildings can be involved including single-story, low-rise, and high-rise buildings. Bird-friendly building designs and retrofits can effectively reduce avian collisions. The National Renewable Energy Laboratory in Golden, Colorado has had success in avoiding collisions at new structures and reducing collisions at existing structures. Three case studies that include glass access structures, a building atrium, and bus shelters with different solutions are discussed. Additionally, a 3-story atrium in a laboratory building was retrofitted after bird strikes were observed; pre- and post-monitoring results are presented. Several methods were used to make glass structures bird-friendly and many products are available for the practitioner. Finally, parallels between

energy efficiency building design and bird-friendly design are considered.

Avian Occupany Relationships to Prescribed Fire in Dry Forests of Western North America

Saab, Victoria - Rocky Mountain Research Station, U.S. Forest Service; Quresh Latif - Rocky Mountain Research Station, U.S. Forest Service; Jonathan Dudley - Rocky Mountain Research Station, U.S. Forest Service; John Lehmkuhl - USDA Forest Service Pacific Northwest Research Station; Jeff Hollenbeck - USGS; William Block - Rocky Mountain Research Station, U.S. Forest Service

Historical fire regimes influenced vegetation structure and animal distributions in dry coniferous forests of Western North America. An understanding of how avian species and community responses vary with historical fire regimes is needed to effectively manage dry forests for maintaining biodiversity. We compared avian relationships with prescribed fire among seven dry forest locations in five western states. Three (Washington, Idaho, and Colorado) and four (Arizona and New Mexico) locations represented mixed- and low-severity fire regimes, respectively. We predicted occupancy changes in relation to fire would vary among locations based on historical fire regimes. We conducted point count surveys for occupancy of songbirds at 598 stations for 2-4 years before and 1-3 years after prescribed fire. Multispecies hierarchical models were used to analyze relationships of bird occupancy with burn severity. We observed proportionately more positive species relationships with burn severity at mixed-severity locations compared to low-severity fire regimes, a pattern congruent with our predictions. Of 95 species observed across locations, 14 species exhibited statistically significant occupancy changes in relation to prescribed fire. Generally, patterns were consistent with our predictions based on species life histories, although we expected more positive changes at low-severity locations. Our results imply locational differences in relationships with fire, suggesting that management strategies for maintaining avian diversity could differ by historical fire regime. Specifically, intensive fuels management may be ecologically less appropriate for mixed-severity fire regimes (Washington, Idaho, Colorado), where dense forest patches were historically more common than in forests with low-severity fire regimes (Arizona and New Mexico).

Divergent phenotypes and their influence on genome-wide divergence in barn swallows.

Safran, Rebecca - University of Colorado, Boulder; Elizabeth Scordato - University of Colorado, Boulder; Semenov Georgy - University of Arizona; Alex Rubtsov - Darwin Museum, Moscow; Matthew Wilkins - University of Nebraska; Joanna Hubbard - University of Nebraska; Brittany Jenkins - Montana State University; Tomas Albrecht - Charles University in Prague; Samuel Flaxman - University of Colorado, Boulder; Hakan Karaadic - Keykubat University, Turkey; Yoni Vortman - Tel-Hai Academic College; Arnon Lotem - Tel-Aviv University; Patrik Nosil - Sheffield University; Peter Pap - Babeş-Bolyai University, Romania; Sheng-Feng Shen - Biodiversity Research Center, Academia Sinica, Taiwan; Thomas Parchman - University of Nevada, Reno; Nolan Kane - University of Colorado, Boulder

Analyses of closely related populations that do and do not experience ongoing gene flow provide the basis of comparisons for how phenotype and geographic distance influence genomic divergence. The barn swallow *Hirundo rustica* complex comprises six closely related subspecies distributed across the Holarctic. Populations differ with respect to both phenotype and migratory behavior. We leverage previous experimental evidence for divergent sexual selection on phenotype to determine the relative contributions of selection and geographic distance to genome-wide differentiation. We compared

genotypic and phenotypic variation from 350 barn swallows sampled across eight populations (28 pairwise comparisons). Accounting for spatial autocorrelation, we are able to infer that phenotype differentiation with respect to plumage color and wing shape plays a large role in shaping population-level differentiation in this group of closely related populations from four different subspecies. We further explored the role of these aspects of phenotype in two different Russian hybrid zones where one sub-species from north Asia is introgressing into two different genomics backgrounds (sub-species from Europe and southern Asia). Here, we find that both migratory behavior and plumage color shape patterns of genomic divergence. Yet, there are important and fascinating differences between the two hybrid zones.

Foraging habitat selection of Breeding Bank Swallows in New Brunswick, Canada
Saldanha, Sarah - Dalhousie University; Marty Leonard - Dalhousie University; Philip D Taylor - Acadia University

Bank Swallows (*Riparia riparia*) have suffered from steep population declines across Canada and are currently being considered for formal protection under the Species at Risk Act (SARA). If listed under SARA, this species' critical habitat will need to be identified and protected. However, this first requires detailed knowledge on Bank Swallow habitat selection. Using a combination of manual and automated radio telemetry, we monitored 68 breeding adults in 2014 and 2015 from three colonies in Sackville, NB. For each individual, we then identified habitat selection by comparing the use of different habitat types to the available habitat within 2km from the colony sites. In addition, we investigated the effects of weather conditions and breeding stages on habitat selection throughout the breeding season. Results will be presented and possible implications for the species habitat protection will be discussed.

Communal roosting in breeding and pre-migratory Bank Swallows in New Brunswick
Saldanha, Sarah - Dalhousie University; Marty Leonard - Dalhousie University; Philip D Taylor - Acadia University

Although avian communal roosting during the migratory and wintering period has been well documented, little is known about this behaviour during the breeding season. Bank Swallows (*Riparia riparia*) have been recently found to roost communally during this period. Furthermore, this species is suffering from steep population declines and a better understanding of its roosting behaviour can aid conservation efforts. Using Bank Swallows as study species, we investigated the effect of biological and environmental variables on the likelihood of roosting communally on a given night. In addition, we measured how the same biological and environmental variables affected the timing and the duration of the commute to the roost sites, as well as roost site selection for all individuals that roosted at known locations. Results will be presented and possible implications for the species conservation will be discussed.

INCIDENCE OF HEMATOZOOA IN A LOGGERHEAD SHRIKE (*Lanius ludovicianus*) POPULATION FROM CENTRAL MEXICO.
Salgado-Ortiz, Javier - Universidad Michoacana, Facultad de Biología; Israel Alvarez-Mena - Universidad Michoacana, Facultad de Biología; José Fernando Villaseñor-Gómez - Universidad Michoacana de San Nicolás de Hidalgo, CIPAMEX

The Loggerhead Shrike (*Lanius ludovicianus*) is an endangered species in Northamerica. In Mexico where both resident and migratory populations are found, information about life history traits is scarce, and thus, it's conservation status is uncertain. In this study we determined the host incidence of avian hemoparasites in a year-round population

from central Mexico. Based on blood samples from 49 individuals, we found an incidence of 86% of *Plasmodium sp*., 83% of *Leukocytozoon sp.,* and 55% of *Haemoproteus sp*. We found significant higher abundance of Plasmodium sp., (41.2 ± 48.9 parasites) in nestlings in contrast to adults (10.6 ± 12.2), with similar pattern, but not significant in the abundance of *Leukocytozoon sp.* (nestlings = 24.7 ± 25.2, vs adults = 16.1 ± 23.1, P = 0.08). No differences between sexes. There was a significant negative relationship between the abundance of *Plasmodium* and *Leukocytozoon* with body condition (wing length/weight index), in nestlings, but not in adults. Our results evidenciated a high incidence of hemoparasites with higher abundance on nestlings, especially *Plasmodium sp*., (malaria vector) responsible of significant declines of avian populations such as those in the Hawaiian Islands. The fact that the abundance of hemoparasites was higher in nestlings and related to lower body condition suggests that this interaction could be an important source of mortality during the breeding period and post-fledgling in our study population, this however deserves further investigation.

Bird diversity and abundance on two different avocado plantation landscapes in Michoacan, Mexico

Salgado-Ortiz, Javier - Universidad Michoacana, Facultad de Biología; Laura E. Villaseñor-Gómez - Universidad Michoacana de San Nicolás de Hidalgo; José Fernando Villaseñor-Gómez - Universidad Michoacana de San Nicolás de Hidalgo, CIPAMEX

The state of Michoacan in Mexico produces around 50% of the avocados (*Persea americana*) consumed worldwide. Being a powerful economic incentive valuated around one billion dollars, there are currently 110,000ha dedicated to avocado production just in the state. Michoacan is considered fifth in terms of biodiversity; however, the increasing demand of avocados, both in Mexico and internationally is resulting in a dramatic loss of pine-oak forest and its biodiversity. As a result of differences in stake holders economy and land tenure, forest conversion to plantations has resulted in a landscape mosaic varying from large avocado extensions (LP) to smaller plantations immersed within forest patches (SP-FO). We predicted higher species number, endemics and forest dependent species in SP-FO. Based on combined sampling techniques, we recorded a total of 174 species representing 58% of the regional avifauna. A total of 152 species (87%) were recorded in SP-FO versus only 89 (51%) in LP. Of 128 resident species 110 (86%) were found in SP-FO in contrast to 61 (47.5%) in LP. Of 47 migrant species, 42 (89%) were recorded in SP-FO in contrast to 28 (60%) in LP. Of 41 species with endemism, 39 (95%) were recorded in SP-FO in contrast to 14 (34%). Our result show a dramatic loss in bird diversity in LP. As it has been with shade coffee, it's urgent to promote changes in avocado plantations that maintain forest remnants, to maintain higher regional bird diversity, and benefit producers facilitating certification for organic production.

The evolution of bilateral ear asymmetry among Typical Owls (Strigidae)

Salter, Jessie - Louisiana State University; Carl Oliveros - Louisiana State University; Brant Faircloth - Louisiana State University

External asymmetry in animals, particularly chordates, is extremely rare, but the evolution of asymmetric traits often confers substantial adaptive benefits to the organisms possessing them. One of the most complex examples of asymmetric trait evolution is the bilateral ear asymmetry observed within the owl family, Strigidae. The larger of the two families in the order Strigiformes, Strigidae contains 27 currently recognized genera comprising 220 globally-distributed species, of which nearly 50 species in 5 genera show varying degrees of bilateral asymmetry in the fleshy and bony structures of the ear. This

adaptation allows owls within the family to pinpoint the origin of sound both vertically and horizontally, conferring significant adaptive benefits to their largely nocturnal, raptorial predatory lifestyles. Although bilateral ear asymmetry is a key trait underlying the evolutionary success of some species within this family, our understanding of when and how it arose in owls is limited. We inferred the first complete genus-level phylogeny of Strigidae using next-generation sequencing of ultraconserved element (UCE) loci, and our taxonomic sample included representatives from all 27 extant genera and the extinct monotypic species *Sceloglaux albifaces*, which has not been included in previous phylogenetic studies. In addition to working with fresh tissue samples, we used sequence capture protocols optimized for historical DNA, allowing us to capture genomic data from 100+ year-old museum specimens. Using well-known Strigiformes fossils, we produced the first time-calibrated phylogeny of Strigidae, from which we reconstructed the evolution of bilateral ear asymmetry and the ancestral biogeography of this globally-distributed family.

Connecting the Dots–A Case Study for Inclusion and Relevance as Critical Tools for the Future of Bird Conservation
Samis, Carrie - Delmarva Discovery Center

The conservation “movement” suffers from a lack of ethnic inclusion and diversity which threatens to sidetrack initiatives to broaden environmental action, including avian conservation. Future efforts to “save” birds , habitats and engage a rapidly changing population more broadly in natural resources issues will demand novel ways to relate to more diverse stakeholders and make conservation relevant such that protection and management move beyond traditional audiences. Effective engagement requires empathy and inclusion. Using a seven year case study from the Eastern Shore of Maryland and a successful program built to engage under-served teenagers and young adults in local conservation activities, we show how meaningful relationships to nature, including bird conservation, evolve from an environmental education context that focuses on several factors. These include long-term, intensive (often individual) outreach; consistent attention to cultural values (cultural competence); regular and compensated engagement in ecologically meaningful and significant activities (such as bird banding, rookery counting, habitat restoration), extensive networking through social media (e.g. Project SNOWstorm) and youth empowerment through direct contact with stakeholders and leaders at every level from community through national. Connected together these factors proved to be key replicable components in building conservation ethic among a heretofore ignored populous, who going forward, can have significant impacts on wild bird well-being.

Habitat-specific demography for resident birds in tropical agroforestry systems: is there evidence for ecological traps?
Sanchez-Clavijo, Lina M. - University of Central Florida; Pedro F. Quintana-Ascencio - University of Central Florida; Nicholas Bayly - SELVA: Investigacion para la conservación en el Neotrópico

High species richness and abundance has been documented in agroforestry systems but long-term demographic data are required to assess their true value for biodiversity conservation. We analyzed mark-recapture data to estimate and evaluate consistency between abundance and apparent survival for twelve resident birds in shade coffee and premontane forest in northern Colombia. We adapted a Bayesian Jolly-Seber population model by making encounter probabilities conditional on effort during 12 sampling occasions. We found variation in both parameters among species, habitats and occasions by considering differences when 50% credibility intervals did not overlap. Seven species were generally more abundant

in forest, and five in coffee. We found evidence of differences in apparent survival for most species (up to 5 occasions). For abundance, 46% of comparisons were higher in forest, 20% were higher in coffee, and 34% were unresolved. For apparent survival, 16% of comparisons were higher in forest, 6% were higher in coffee, and 78% were unresolved. To assess whether ecological traps exist, we assumed abundance as indicative of habitat preference and apparent survival as quality. When comparing the two, we found strong evidence for undervalued resources (50% of comparisons), but limited evidence for severe ecological traps (1%), equal-preference traps (6%), and adaptive selection (15%). More conclusive inference from these patterns will require additional information on preference (e.g. age ratios, occupancy) and fitness (e.g. mass, nesting success), and will allow us to assess more accurately how demographic modelling can be incorporated to improve our understanding of population processes at the landscape level.

Engaging Birders and Local Communities in the Conservation and Stewardship of the U.S. Important Bird Areas Network
Sanchez, Constance - National Audubon Society; Lynsy Smithson-Stanley - National Audubon Society; John Rowden - National Audubon Society

For over a century, the National Audubon Society has been a catalyst, activating individuals and communities in taking action for birds. Audubon volunteers have been engaged in monitoring birds, in science and restoration, and in advocating for protection of birds and their critical habitats. We have focused engagement and action on key conservation issues, species, and critical places on which these birds depend, including Important Bird Areas. However, what do we know about the audience we are engaging and what have we learned from our outreach efforts? Recently, Audubon has invested more in understanding their audience, digging into motivators and the variety of ways different segments of this group can and would like to be engaged. Local opportunities and the concept of conserving vital places for birds resonated with many across various segments studied. Looking across reports of conservation actions at or for Important Bird Areas by close to 150 stewardship groups (Audubon chapters), bird monitoring was reported by the highest percentage of groups, with 48% of the groups indicating involvement. This was followed by threats monitoring by 37% of the groups and outreach events reported by 32%. Approximately 22% of groups surveyed lobbied for protection of their Important Bird Area, and 21% reported habitat restoration work. In this presentation, we'll highlight more on what we uncovered about individual action and motivation of volunteers within these stewardship groups, focusing on the birder mind-set as it relates to on-the-ground action at priority sites.

Seasonal Components of Survival in Migratory Upland Sandpipers
Sandercock, Brett - Kansas State University; Matilde Alfaro - Universidad de la República, Uruguay; Ashley Casey - Kansas State University; Tony Mong - Wyoming Game and Fish Department; Khara Strum - Audubon California

Conservation of migratory birds requires a better understanding of the seasonal components of demography in the annual cycle. Understanding seasonal patterns of demographic losses is important for identifying the ecological factors that limit population numbers, and the regulatory mechanisms that determine population dynamics. I report sex-specific estimates of survival for migratory Upland Sandpipers (*Bartramia longicauda*) from a 9-year breeding study in Kansas and a 4-year nonbreeding study in Uruguay. Annual rates of apparent survival were estimated with mark-recapture models for live encounter data that controlled for imperfect detection

and losses of transient individuals. Monitoring of radio-marked birds showed that seasonal survival was high during the breeding period in Kansas, and no losses were detected during the nonbreeding period in Uruguay. Combining annual estimates of survival with seasonal estimates for the stationary period indicates that most mortality occurs during migratory movements. Results from the demographic model successfully predict mass mortality events of Upland Sandpipers that regularly occur in the northern Andes of South America during fall migration. Migration is a risky period, and most demographic losses may occur during migration for shorebirds, songbirds, and other groups of birds. Models of seasonal demography can help to identify research needs, and to improve conservation planning in the future.

Is a mesopredator release underlying increased songbird nest predation near natural gas development?
Sanders, Lindsey - Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, University of Wyoming; Anna Chalfoun - USGS Wyoming Cooperative Fish & Wildlife Research Unit, University of Wyoming

Understanding the mechanisms underlying avian responses to human-induced habitat change is a rare but critical endeavor for conservation and management. Energy development has become a major source of anthropogenic habitat alteration globally. In the western US, the majority of development is occurring within sagebrush dominated landscapes. Previous research in western Wyoming demonstrated decreased nest survival of the three sagebrush-obligate songbird species (Brewer's sparrow, sagebrush sparrow and sage thrasher) with increased surrounding habitat loss due to natural gas development. This decreased nest success was primarily due to predation, with three quarters of observed depredation events attributed to rodents. Here, we tested the hypothesis that rodents may experience a release from predation risk near energy development due to reduced numbers of their avian (e.g., raptors) and terrestrial predators (e.g., canids and badgers), thereby increasing local rodent abundance. We simultaneously measured songbird nest survival, rodent abundance, apex predator activity and perceived predation risk across a gradient of energy development, and did not find support for the mesopredator release hypothesis. Instead we observed increased activity of apex predators and perceived predation risk around energy development, suggesting that apex predators may actually be drawn to development sites to take advantage of rodent food resources. The rejection of this hypothesis is a key step towards understanding the drivers of nest survival in this system and how human-induced habitat change can influence species of concern.

Condor Kids: At the Intersection of Research, Conservation, & Education
Sandhaus, Estelle - Santa Barbara Zoo; Aaron Marshall - Santa Barbara Zoo; Michael Brady - Hopper Mountain NWRC/California Condor Recovery Program; Joseph Brandt - USFWS California Condor Recovery Program, Hopper Mountain National Wildlife Refuge

The federally endangered California condor remains a highly publicized symbol of wildlife conservation even as we continue to address challenges that threaten its long term survival. Because anthropogenic threats are the primary factors limiting condor recovery, education and outreach have been identified by the California Condor Recovery Program as key priorities. In partnership with the U.S. Fish and Wildlife Service (USFWS), the Santa Barbara Zoo worked with Fillmore Unified School District (FUSD) to develop a California Condor focused science curriculum – 27 enrichment lessons aligned to Common Core and Next Generation Science Standards at the third grade level, and organized by the EQuIP rubric. The CondorKids curriculum

links students to current conservation research, web-based live streaming nest cameras, classroom visits, field experiences, and interactive lesson plans designed to emphasize project based and experiential learning. The 27 lessons cover biology, history, geography, and conservation, giving students a clear sense of the California Condor Recovery Program and the principles of wildlife management.

Urban development effect on Costa Rican bird species: evidence from multiple points of view
Sandoval, Luis - Universidad de Costa Rica

Urban development occurred at rapid rates in tropical countries, and in last decades occurred at a rate without precedents. Changes in land use reduce natural habitats and create new options (e.g., gardens or parks) for species that survive in an urban environment. How bird species surviving in urban habitats and respond to those changes has been studying intensively in temperate habitats, but poorly studied in the tropics. I present results of two studies conducted to evaluate changes on bird communities and use of nesting substrates. First, we compared changes in bird abundance and richness in an urban developing habitat, in three time periods (1990, 2004, and 2014), and evaluated if findings were explained by changes inside or outside the study area. We found an extinction of 66 species and colonization of 18 species between 1990 and 2004; and an extinction of 23 species and colonization of 37 species between 2004 and 2014. Second, we compared the abundance and use of snags and wood phone posts by woodpeckers along an urban gradient between 2005 and 2015. Compared to 2005, in 2015, we found fewer snags and posts in semi-urban areas, but the same abundance in natural and urban areas. We also found woodpeckers used both substrates lesser in 2015 compared to 2005. These results showed that urban development produces different patterns of response on bird species and communities; therefore, it is necessary to study in more detail and for longer time periods the responses of species and communities to those changes.

Ground validation of avian roost rings located using weather surveillance radars
Sandra, Pletschet - University of Oklahoma; Jeffrey Kelly - University of Oklahoma

Weather surveillance radars (WSR) detect morning departures of birds from roosts. WSR detection of roosts has been used in numerous studies to infer phenology, movement, distribution and abundance of birds. However, there has been limited investigation of the species identity or on-the-ground location accuracy of the roosts observed by WSR. We used a WSR mosaic to locate avian roosts between June and September of 2010 through 2015 in the eastern US. Internet citizen science observations were the primary source of our on-the-ground data. Over this period we identified 258 unique roost locations with a total of 788 annual observations. Of these we were able to confirm147 on-the-ground locations of 66 unique roosts. Most of these roosts (n=61, 92%) were predominated by Purple Martins (Progne Subis). In the northeastern US there were 5 roosts dominated by Tree Swallows (*Tachycineta bicolor*) or Bank Swallows (*Riparia riparia*). The distance between locations estimated from radar and those recorded on-the-ground was 2.94 + 1.57km. There was a tendency for the estimated locations to be east-southeast of the on-the ground locations. These results suggest that radar data enables detection of roost locations to within 5km of their on-the-ground locations and demonstrates that, during the summer months, WSR observations provide accurate and precise locations for avian roosts, particular those of Purple Martins.

The effects of onshore wind farms on breeding shorebirds

Sansom, Alex - RSPB; **David Douglas** - RSPB

Studies have shown negative associations between wind energy development and breeding shorebirds, however the magnitude and causes of such associations remain uncertain, pending detailed studies. In a comprehensive BACI study of a new onshore wind energy development on the European Golden Plover, breeding abundance was reduced within the wind farm (-79%) following the erection of turbines, exceeding changes on control sites. Plovers were significantly displaced up to 400m from turbines during operation. Hatching and fledging success were not affected by turbine proximity, during construction or operation. The marked decline in abundance within the wind farm, during operation but not construction, suggests displacement of breeding adults through behavioural avoidance of turbines. In a second study, Common snipe, Northern lapwing and Eurasian curlew showed no significant changes in abundance following development of a turbine extension at an operational wind farm. European oystercatcher increased within the original wind farm, contrasting with changes within the extension. Snipe and lapwing showed increasing displacement from areas closer to turbines over time. Oystercatchers shifted distribution towards turbines in the original wind farm, and were progressively less likely to occur closer to extension turbines. Changes in oystercatcher abundance and distribution could relate to increasingly suitable habitat closer to turbines during the study. Habitat changes provide less evidence to support the changes in snipe and lapwing distribution, and these may be related to turbine avoidance. Breeding shorebirds show varying responses to wind farms and planning decisions should consider species-specific evidence of responses wherever possible.

Integrated Population Models for Broad-scale Bird-monitoring Data in North America

Saracco, James - The Institute for Bird Populations; Farshid Ahrestani - The Institute for Bird Populations; John Sauer - USGS Patuxent Wildlife Research Center; J. Andrew Royle - USGS Patuxent Wildlife Research Center; Keith Pardieck - USGS Patuxent Wildlife Research Center

Integrated population models (IPMs) provide a unified framework for analyzing independent data sets to provide inferences about vital rates and population dynamics. We developed IPMs for application to count data from the North American Breeding Bird Survey (BBS) and capture-recapture data from the Monitoring Avian Productivity and Survivorship (MAPS) program. Joint analysis of these two data sets presents unique challenges associated with accounting for sources of bias and noise induced by sampling and observation processes at scales of data collection, while providing inferences about population parameters at aggregated scales of interest. We present alternative IPM formulations and apply them to simulated data and to data from the two monitoring programs at regional (bird conservation region) and survey-wide scales for species with good representation in both data sets. Estimates of population state and annual adult survival probability in models are directly informed from the two monitoring data sets, while recruitment and, in some model variants, immigration, are estimated as latent parameters. The immigration parameter is an essential component of models whenever a population within a particular region goes to zero (local extinction) because it prevents inconsistencies between models and data and allows for a means of population recovery. We show how these models can inform conservation by providing a framework for assessing demographic and environmental drivers of population change.

Parental characterization of hybrids from the Helmeted Manakin and the Swallow-tailed Manakin using DNA sequencing
Sari, Eloisa - Universidade Federal de Minas Gerais, Departamento de Biologia Geral, ICB; Fabricio Santos - Universidade Federal de Minas Gerais, Departamento de Biologia Geral, ICB

Species hybridization is a natural phenomenon in species evolution, and several cases are reported for manakins. In Brazil we find hybrids whose parental species are thought to be the Swallow-tailed Manakin (STM) and the Helmeted Manakin (HM). These are very rare hybrids found in transitional zones between the Atlantic Forest and the Cerrado, the respective habitats of their parental species. The identification of these parental species was previously assessed using only morphological characteristics, and confirmation of this identification using DNA markers is necessary. We used mitochondrial and nuclear DNA sequences to confirm the identification of putative parental species from these hybrids, and to quantify the genetic contribution of each species to the hybrid genome. All hybrid cytochrome b sequences were identical to HM sequences, showing that the female parental species from these hybrids is the HM. The nuclear intron DNA sequences totaled to 2994 base pairs, with 46 polymorphic sites between the two parental species. All polymorphisms found between the two species were also present in their hybrids, confirming the parental species identification and showing that the male parental species is the STM. Our results indicate that the hybrids are likely the F1 generation between STM and HM, and they did not point to a case of gene introgression in either parental species. Our work has confirmed the hybridization between STM and HM. We believe this hybridization might be a consequence of anthropogenic activities, but more studies are necessary to understand the evolution of this hybrid zone.

Population Change in North American Birds: a 50-year Perspective from the North American Breeding Bird Survey
Sauer, John - USGS Patuxent Wildlife Research Center

Started in 1966, the North American Breeding Bird Survey (BBS) is the primary data source of population change information for >400 species of North American birds. Conceived and implemented with shoestring budgets and equivocal support from administrators, its unique melding of citizen science with a design that permitted almost continent-scale collection of reliable information about breeding bird populations has made the BBS an essential component of conservation and scientific activities related to birds over the past 50 years. This presentation examines the history and design of the BBS, providing some examples of the design compromises that allowed the survey to be feasible from a logistical standpoint but sometimes complicate analyses and interpretation of results. The BBS is often the only data source for addressing fundamental questions about status and trends of bird populations in North America, but it only speaks for sampled populations; a constraint that managers and scientists alike often ignore. Analysis of 50 years of BBS data reemphasizes the themes that have become evident in recent summaries of the data: (1) Overall, slightly more bird species tend to be declining than increasing in population size; (2) declines are generally not random among species, but are concentrated in species that share common habitat and life history attributes; (3) large-scale environmental influences such as severe winter weather, consistent changes in breeding season weather, and habitat change cause observable signals for many species in BBS data.

Planning host exploitation: temporal distribution of prospecting visits by parasitic cowbirds

Scardamaglia, Romina - Faculty of Exact & Natural Sciences, University of Buenos Aires; Vanina Fiorini - Faculty of Exact & Natural Sciences, University of Buenos Aires; Alex Kacelnik - Department of Zoology, Oxford University; **Juan Reboreda** - Faculty of Exact & Natural Sciences, University of Buenos Aires

We studied the temporal sequence of visits to host nests by two avian brood parasites: a host generalist, the Shiny Cowbird, *Molothrus bonariensis*, and a host specialist, the Screaming Cowbird, *M. rufoaxillaris*. We recorded presence of radio tagged females within a fixed area around nests of Chalked-browed Mockingbirds, *Mimus saturninus* (a common host of the generalist parasite) and Baywings, *Agelaioides badius*, (the main host of the specialist parasite) using proximity data-loggers placed at the nests during prelaying, laying and early incubation. Females of both species visited nests prior to laying. Visits were less frequent and shorter in Shiny than in Screaming Cowbirds and parasitic events occurred earlier in the morning in Screaming than in Shiny Cowbirds. Shiny Cowbirds did not return after a single laying visit, thus avoiding interfering with their own previously laid eggs, while Screaming Cowbirds visited host nests repeatedly after laying and in some cases, parasitized them again. The high frequency of prospecting and post-parasitism visits of Screaming Cowbirds to Baywing nests are probably adaptations to the uncommon length of the prelaying period and to the low availability of nests of this host.

Mitigating the negative effects of road noise on songbird abundance with song playback

Schepers, Matthew - Calvin College; Darren Proppe - Calvin College

Noise from human activity is known to reduce abundance and diversity in many animal communities. Songbirds are particularly vulnerable because of their reliance on vocal communication, and many songbird species are less common in areas with high levels of anthropogenic noise. Chronic noise likely disrupts acoustic communication under certain conditions, such as near a high-use highway, but songbird abundance is also reduced in locations exposed to low-level or intermittent noise. In these cases, reduced abundance may be due to fear of novel stimuli rather than a true impediment to communication. If fear is a factor preventing songbird establishment, we hypothesize that playback of con- and heterospecific song may facilitate reestablishment in noisy areas. Previous studies show that playback of conspecific bird song increases localized habitat selection for many songbird species. We investigated whether the playback of song from six migratory species near low to moderate-use roads increased songbird territory establishment in playback areas. To evaluate the effect on the broader community, we also censused twenty-five non-focal species. The total number of territories was significantly higher at playback sites. This pattern remained similar for analysis including only focal or non-focal species. Six of thirty-one species had significantly altered distributions, each positively skewed toward playback sites. Although not significant, an additional seven species increased by >30% in playback sites. Our results suggest conspecific song playback may be a useful tool to mitigate the effects of anthropogenic noise for some songbird species, although future studies should assess songbird fitness in these areas.

Are local site conditions or landscape structure more important in predicting waterbird distribution? Testing competing hypotheses across the non-breeding season

Schepker, Travis - University of Missouri Columbia; Ted LaGrange - Nebraska Game and Parks Commission; Jessica Tapp - Missouri Department of Conservation; Elisabeth Webb - USGS Missouri Cooperative Fish & Wildlife Unit

Previous research has identified landscape structure, including wetland density and area, as being important determinants of waterbird distribution and species richness during the non-breeding season. However, these studies rarely accounted for local (within wetland) site conditions, especially food availability and it is unclear how waterbird habitat selection is influenced by resource availability at multiple spatial scales. Thus we developed and evaluated competing models containing a variety of local and landscape-level metrics explaining waterbird distribution during winter and spring migration. Concurrently we conducted waterfowl surveys, and assessed local wetland habitat conditions for wintering waterfowl in Missouri's Bootheel and at spring staging areas in Nebraska's Rainwater Basin. At the landscape scale we used recurring LandSat imagery to quantify changes in total wetland area within a 4.6km radius of study sites. We used generalized linear mixed models and AICc to evaluate and select models that best explained variation in waterfowl distribution during both time periods. Food availability (+) and vegetative cover (-) were significant predictors of dabbling duck density during winter, whereas food availability (+) and inundated wetland area in the surrounding landscape (+) were significant predictors of dabbling duck density during spring migration. Waterbird habitat selection during migration and wintering periods is likely a complex series of decisions that include landscape context, local habitat conditions, and energetic requirements. Conservation of wetland complexes may be paramount to ensuring adequate stopover and wintering resources are consistently present and available within landscapes that are constantly being altered by anthropogenic land management.

Seeing the female perspective: Directional appearance of visual ornaments in the courtship phenotype of Wilson's Bird-of-Paradise, *Cicinnurus respublica*.

Scholes, Edwin - Cornell Laboratory of Ornithology

The structure and function of appearance is an important part of understanding the elaborate, visually oriented, components of phenotype presented by male birds-of-paradise during courtship display. The courtship phenotype of male *Cicinnurus respublica* includes a patch of highly iridescent breast feathers called the breast shield. Because the breast shield has evolved via sexual selection by female choice, it is important to understand how it appears to females during courtship. In order to better understand the courtship appearance of the *C. respublica* breast shield ornament, we deployed an array of remotely controlled ultra-high definition videocameras to simultaneously capture courtship displays from multiple directions, including the perspective in which the breast shield ornaments is seen by observing/evaluating females. Preliminary results show that multiple visual components of the *C. respublica* courtship phenotype, including the breast shield ornament, are highly directional with striking appearances when viewed within the specific contexts from which they are intended, and have presumably evolved, to be seen. Future work will follow methods being pioneered for similarly directional, and context dependent, visual ornaments in other birds-of-paradise and will combine these data with digital imagery of feather microstructure and the courtship environment to construct 3D computer graphics models that will allow

investigation of appearance biomechanics at multiple structural scales.

Effect of noise from periodical cicada emergence on avian communication strategies
Schreffler, Lisa - George Mason University; David Luther - George Mason University

Birds often need to communicate through an environment that has varying noise levels from a dynamic diversity of taxa. Since many species in a community may vocalize at one time, it may be difficult to discriminate between signals. To accommodate for noise, birds have been shown to sing within a narrowed frequency bandwidth, or with an increased minimum frequency, and sometimes birds will simply stop singing. Insects are a major contributor to noise in terrestrial habitats. Cicadas have been shown to affect avian communication in tropical areas, and this study represents the first to investigate how the periodical cicada (brood II emergence) affected avian communication in a temperate forest. The 2013 periodic cicada emergence represents background noise as an example of a high amplitude, consistent patterned noise in the eastern US temperate forest during the migratory bird breeding season. Results show cicada abundance reached approximately 2.6x106 cicadas/ha, and cicada choruses maintained a sound pressure level range of 50-86 decibels. Significant differences in both birdsong timing and repetitiveness were noted (during dawn chorus) when comparing before and during cicada emergence timeframes. Additional analysis will include an investigation of alterations of frequency within birdsong. Results indicate that birds did alter their communication strategy in order to be distinguished within this noisy environment.

Mapping Antarctic avian biogeography and species overlap with multi-state occupancy models
Schrimpf, Michael - Stony Brook University; Christian Che-Castaldo - Stony Brook University; Heather Lynch - Stony Brook University

Logistical challenges in sampling and imperfect detection of presence often limit available information about avian distribution in remote regions, which is crucial for conservation action. Recent advances in multi-state occupancy modeling allow us to account for non-detection, while making inferences about multiple states (such as species presence and breeding status). We used such a model in conjunction with a ternary visualization framework to simultaneously map probabilities of multiple occupancy states, producing a novel form of probabilistic range map. These efforts allowed us to comprehensively map the terrestrial distributions of the entire Antarctic Peninsula seabird community, using a multi-year data set of opportunistic site visits. Using single-species Bayesian models we found evidence that both environmental forcing and site-fidelity affect occupancy for many species. Species detection probability followed a bimodal pattern that generally reflects known life-history differences among species. Our probabilistic state results from all species can also be overlaid spatially to examine patterns of species overlap, which is traditionally done with less nuanced binary (i.e. presence/absence) data. By aggregating our species-specific estimates of probable state, we produced probabilistic site-specific estimates of diversity, identifying several areas of high diversity that could be designated species ‘hotspots’ and may warrant special protection. We also highlight how the results could be strongly influenced by apparently uninformative priors. Despite the need to carefully consider the underlying biological process when developing Bayesian multi-state occupancy models, we demonstrate how such models can improve

our understanding of species distributions when faced with limited sampling or imperfect detection.

Timing of isolation of the Jackson Hole, Wyoming Greater Sage-grouse population
Schulwitz, Sarah - The Peregrine Fund; Bryan Bedrosian - Teton Raptor Center; Sara Oyler-McCance - United States Geological Survey; Jeff Johnson - University of North Texas

The Greater Sage-grouse (*Centrocercus urophasianus*) is a widespread species of conservation concern where molecular inference has identified isolated populations across the range. Populations became isolated at varied times, possibly ranging from hundreds to tens of thousands of years ago. Therefore, appropriate conservation management of these populations should be different. The Jackson Hole Greater Sage-grouse population was shown to be genetically isolated from other populations in Wyoming and to have comparably low genetic diversity based on analysis of sixteen microsatellite loci. It is unclear however, when the population became isolated. For example, high-elevation, forested mountains surround this population and may have acted as long-term barriers to dispersal. Alternatively, it is possible that the population maintained gene flow until relatively recently. To infer the demographic history and timing of isolation of the Jackson Hole Greater Sage-grouse population, I used multiple marker types (i.e., microsatellites, mitochondrial control region, autosomal, Z-linked loci) and methods (i.e., Network analysis, DIYabc, MSVAR) to show that the current population size is the result of a relatively recent decline from a much larger population size. The magnitude of this decline, therefore, suggests that the Jackson Hole Greater Sage-grouse population was most likely connected to a much larger population, such as the core Wyoming Basin population currently located ~90 km to the south. Increasing the population size and re-establishing gene flow of the Jackson Hole population with the larger metapopulation will help prevent extirpation due to stochastic factors such as disease or climate change by maintaining evolutionary potential.

Weather Severity Indices For Projecting Changes in Autumn-Winter Distributions of Dabbling Ducks in the Mississippi and Atlantic Flyways During the Twenty-First Century
Schummer Michael - SUNY Oswego; Michael Notaro - Nelson Institute Center for Climatic Research; Lena Van Den Elsen - Ducks Unlimited Canada; John Coluccy - Ducks Unlimited Inc.; Michael Mitchell - Ducks Unlimited Inc.; Robb Macleod - Ducks Unlimited Inc.

Each year, millions of waterfowl migrate from their breeding grounds in Arctic, northern and mid-latitudes to more southern locales to exploit abundant food and wetland resources as freezing wetlands and snowfall progress north to south in North America. These migrating birds consume and distribute an abundance of seeds and invertebrates, are a cultural resource for waterfowl watchers and hunters (hereon waterfowl enthusiasts), and provide economic benefit through the activities of waterfowl enthusiasts. Recognition of the tangible and intangible importance of this diverse group of birds by waterfowl enthusiasts also gave rise to substantial international efforts to conserve wetlands and associated habitats throughout North America. Thus, inter-annual variation in their distribution during autumn-winter can influence ecological, environmental, cultural, and economic relationships. We developed weather severity indices (WSIs) to estimate autumn-winter distributions of gadwall (*Anas strepera*), American wigeon (*A. americana*), American black duck (*A. rubripes*), mallard (*A. platyrhynchos*), blue-winged teal (*A. discors*), northern shoveler (*A. clypeata*), northern pintail (*A. acuta*), and green-winged teal (*A. crecca carolinensis*) based on contemporary weather conditions (1980–2000), describe historic changes to weather known to influence migration by these ducks

(September – March 1979 – 2013), and forecast their future spatial distributions based on dynamically downscaled climate change scenarios (mid-21st [2046–2065], late-21st [2091–2100]). For all species, the WSI models with the greatest explained variance in the timing of migration included combinations of temperature and snow depth thresholds that predicted decreased abundances of these ducks at northern and mid-latitudes with increasing WSI. Our models predict that the arrival of these ducks from Canada into the U.S. and on to more southern latitudes may become delayed by at least a month by the late 21st century; such a shift would have substantial ecological, cultural, and economic consequences, and may necessitate changes to North American-wide conservation efforts.

Understanding Conservation Activities among Birdwatchers Using the Recreational Specialization Framework
Scott, David - Texas A&M University

A useful tool for understanding diversity among birdwatchers is the recreation specialization framework, which arranges participants along a continuum from highly casual to highly serious. Along the continuum there are typical stages of involvement through which birdwatchers progress the longer they participate in an activity. As birdwatchers progress from one stage to another, their motivations and resource preferences change as well. As I show will in this presentation, birdwatchers' attitudes about conservation evolve as they become increasingly committed to the activity. Colleagues identified four clusters of birdwatchers along the specialization continuum: causal birdwatchers (37%), interested birdwatchers (53%), active birdwatchers (6%), and listers (4%). We found that specialization is indeed related to conservation behavior but only to a point. In this case, active birdwatchers were the most likely to participate in conservation activities, followed by interested birdwatchers, listers and finally casual birdwatchers. Here are some general conclusions about conservation activities among birdwatchers. First, as birdwatchers become increasingly specialized, they tend to develop a conservation ethic as reflected by their attitudes and behavior. Second, simply getting people interested in watching birds may be sufficient in instilling a conservation ethic. The point here is people do not need to become serious birdwatchers to acquire a heightened awareness and interest in bird conservation. Finally, hard core listing may be antithetical to bird conservation. Stated differently, birdwatchers who are interested in simply adding birds to a life list may not be focused on short-term or long-term habitat needs of birds.

How many birds is enough? Developing population targets for common birds to guide ecosystem management and restoration
Seavy, Nathaniel - Point Blue; Kristen Dybala - Point Blue Conservation Science; Thomas Gardali - Point Blue Conservation Science

Quantitative population objectives are necessary to successfully achieving conservation goals of secure or healthy wildlife populations. However, existing methods for setting quantitative population objectives commonly require extensive species-specific population viability data, which are often unavailable, or rely on estimates of historical population sizes, which may no longer be possible to achieve. As an alternative, we relate how principles of conservation biology helped to inform a framework structured as a hierarchy of four population sizes, from very small populations at increased risk of inbreeding depression and extirpation (large populations with minimized risk of extirpation and the capacity for ecological function (>50,000 adults). This framework has been used to guide the development of riparian landbird population objectives by the Central Valley Joint Venture. These objectives provide a simple

way to measure the benefit of individual riparian restoration projects to riparian birds. Although examples of population objectives for species that are not threatened or harvested are rare, we propose that by generating the science that supports these targets, ornithologists can contribute to on-the-ground decision making. In order to do so, the first step is to become comfortable with a conversation about “how many birds is enough?”

Using Capture-Mark-Recapture Data to Estimate the Population Growth Rate for Wood Ducks in Western Nevada

Sedinger, Benjamin - University of Nevada Reno; Christopher Nicolai - University of Nevada Reno; Kelley Stewart - University of Nevada Reno

Population growth is driven by the relative difference between births and immigration and deaths and emigration. Capture-mark-recapture (CMR) studies often focus on departures from capture histories, which indicate either mortality or permanent emigration. Pradel (1996) suggested reversing capture histories to estimate entries into the population (recruitment) in addition to standard estimates of apparent survival (departures). We used this approach in combination with a long term and intensive CMR study of wood ducks on the Carson River in Churchill County, Nevada, to estimate: survival, encounter, recruitment, and realized population growth rate (pgr) from 2008-2015. Annual estimates of survival varied across months and years, and between males and females. Across the study, mean annual survival was 0.48±0.02 for males and 0.46±0.02 for females. Annual encounter probabilities varied across months, years, and sexes. Within the annual cycle, encounter rates were highest in the spring (March-May) and lowest in the fall (September-December). Mean annual encounter probability was 0.87±0.01 for males and 0.90±0.01 for females. Per-capita recruitment varied among years and the mean annual recruitment was 0.54±0.02. Estimates of pgr varied across years; 2011 experienced the greatest rate of population growth and 2012 the lowest. We observed little variation in pgr for wood ducks in Western Nevada although we observed annual variation in survival and recruitment. Most years there appears to be a negative relationship between survival and recruitment such that when survival is increased, recruitment is reduced and vice versa except in 2011 when both survival and recruitment were above normal levels.

Cross-seasonal demographic effects and fitness in Black Brant

Sedinger, James- University of Nevada Reno; Alan Leach - University of Nevada Reno; Amanda VanDellen - University of Nevada Reno; Thomas Riecke - University of Nevada Reno; David Ward - Alaska Science Center, USGS; Sean Boyd - Environment Canada

Cross-seasonal linkages maintain variation in fitness and drive population dynamics in Black Brant (*Brant bernicla nigricans*). Black Brant are terrestrial during the breeding season but feed on marine plants outside the breeding season. Thus, spatial-temporal variation in oceanographic conditions during winter and spring influence demography. We use a large database of observations of marked individuals (100,000 on breeding area, 80,000 on wintering/migration areas) combined with manipulation of reproduction and mark-recapture approaches to assess the impact on individual fitness and population dynamics of events occurring throughout the annual cycle. Fewer Black Brant breed following El Nino events because warmer ocean temperatures have a negative influence on winter foods. Specific wintering bays influence breeding the next summer, associated with variation in food abundance among bays. Successful breeders are more likely to return to a higher quality winter site the next winter, creating positive covariation between breeding in successive years. We attribute this result to the fact that family

groups are socially dominant to pairs without young and single Black Brant so family groups can displace nonbreeders and failed breeders from higher quality wintering locations. We reduced family size in a recent experiment, which reduced breeding effort the next breeding season; we attribute this result to the lower social status of treated individuals during the next winter. We have also observed a long term decline in both first-year and adult survival in Black Brant from two widely separated breeding areas, which we also attribute to oceanographic conditions away from the breeding areas.

Complex patterns of population divergence underly dramatic phenotypic cline in an Andean songbird

Seeholzer, Glenn - Museum of Natural Science / Louisiana State University; Robb Brumfield - Louisiana State University

Clinal phenotypic variation provides a window into the processes shaping population divergence. Phenotypic clines are commonly observed along environmental gradients where phenotypic and environmental variation are correlated. Such correlations provide some of the most-widespread evidence for natural selection's role in population divergence, particularly when an underlying adaptive scenario links the correlated variables. Yet, correlated phenotypic and environmental variation alone is insufficient to claim selection because phenotypic clines can also be generated by neutral processes (e.g. isolation-by-distance). Genomic data can help distinguish between these alternatives by providing information on population connectivity and history. To investigate these issues we collected ~5,000 SNP's from across the genome of the Line-cheeked Spinetail (*Cranioleuca antisiensis*), a striking example of rapid divergence and morphological adaptation to elevation. C. antisiensis is distributed in the central Andes along an elevational gradient (950 – 4300 m) spanning dramatically different environments, along which its mass increases clinally more than twofold (12.5 to 30 g). We found a strong signal of isolation-by-distance along three distinct genetic clines that were correlated with mass even after controlling for geographic distance. This suggested that loci in our dataset were under selection, violating assumptions of neutrality. To identify these putatively adaptive loci we employed a Bayesian outlier detection algorithm and whole genome association analysis. When these adaptive loci were excluded, we found that the phenotypic variation was greater than expected given neutral genetic variation, indicating an adaptive origin of the phenotypic cline.

What a permanent banding monitoring scheme tell us about migration, territoriality and effects of hurricanes on birds of tropical dry forests of southeastern Cuba.

Segovia Vega, Yasit - Centro Oriental de Ecosistemas y Biodiversidad (BIOECO); Malbelis Padilla Sánchez - Centro Oriental de Ecosistemas y Biodiversidad (BIOECO); Carmen Plasencia León - Centro Oriental de Ecosistemas y Biodiversidad (BIOECO); Nicasio Viña Dávila - Centro Oriental de Ecosistemas y Biodiversidad (BIOECO); Misleidys Almeida de la Cruz - Centro Oriental de Ecosistemas y Biodiversidad (BIOECO); Arelis Mustelier Lescay - Centro Oriental de Ecosistemas y Biodiversidad (BIOECO); Eduardo E. Iñigo Elias - Cornell Lab of Ornithology; Freddy Rodríguez Santana - Centro Oriental de Ecosistemas y Biodiversidad (BIOECO)

We set up in 2010 a permanent bird banding office in the tropical dry forest at Siboney-Jutici Ecological Reserve using "ad hoc" aluminum bands and protocols from North America and Europe. Our data suggest that *Setophaga daerulescens*, *S. discolor* and *S. tigrina* were the most abundant winter residents in this coastal tropical dry forest of southeastern Cuba, although the area is also an important stopover site for these and other species of neartic-neotropical migrants. We

also describe territoriality of two endemic species the *Vireo gundlachii* and *Teretistris fornsi* and one breeding resident *Myiarchus sagrae* using color bands and repetitive sighting of breeding pairs during the breeding season. Hurricane Sandy affected body condition and territoriality of migrant and resident birds with significant weight loss and increase in territory and wandering on several species of birds one month after the hurricane.

ddRADseq identifies gene associated with avian malarial infection in Red-billed Teal
Seibert, Sara - Wright State University; Brittany Bowers - Wright State University; Graeme S. Cumming - James Cook University/ARC Centre of Excellence for Coral Reef Studies; Jeffrey Peters - Wright State University

Migratory waterfowl can serve as vectors of infectious diseases, spreading pathogens across landscapes and potentially between different landmasses. Although wild birds are infected by different lineages of Plasmodium than humans, they serve as good model systems for ecological and genetic associations between hosts and parasites. Previous research has found South African waterfowl have a low prevalence of malarial infection (7%) in comparison to other South African birds, especially songbirds (25%). We tested for regions of the genome associated with malarial infections in six different populations of Red-billed Teal (*Anas erythrorhyncha*), which are dabbling ducks found in freshwater habitats of southern and eastern Africa. Using double-digest restriction site associated DNA sequencing (ddRAD-seq), we screened over 3,000 loci. Our genetic analyses did not detect significant levels of population structure between the six Red-billed Teal populations (mean Fst < 0.01). However, we did identify a single nucleotide polymorphism (SNP) that appears to be associated with malarial infections; 57% of the variation at this locus was partitioned between Teal with and without malarial infections. This single nucleotide polymorphism is located in an intron of a gene coding for a heparin binding protein (HBP). HBPs are known to influence protein-protein interactions during the invasion of Plasmodium merozites into their vertebrate host's red blood cells (RBCs). Our study suggests Red-billed Teal, and perhaps other species of aquatic birds, have a genetic mechanism for mitigating Plasmodium infections.

Impacts of bird declines on avian ecological function and ecosystem services
Şekercioğlu, Çağan - University of Utah

Although most bird species avoid agricultural areas, nearly a third of all birds regularly to occasionally use such habitats, often providing important ecosystem services like pest control, pollination, and seed dispersal. Combining literature review with large-scale analyses of the ecological characteristics of the world's birds, I compared tropical bird species that prefer forests, agricultural areas or both, with respect to body mass, diet, range and population size, frequency, conservation status, habitat and resource specialization. Compared to primary forests, species richness of large frugivorous and insectivorous birds (especially terrestrial and understorey species) often declines in agroforests. In contrast, nectarivores, small-tomedium insectivores (especially migrants and canopy species), omnivores, and sometimes granivores and small frugivores do better, frequently by tracking seasonal resources. However, changes in guild species numbers do not necessarily translate to changes in relative abundance, biomass or function, and more studies are needed to quantify these important measures. These findings indicate that the replacement of forests and agroforests with simplified agricultural systems can result in shifts towards less specialized bird communities with altered proportions

of functional groups. These shifts can reduce avian ecosystem function and affect the ecosystem services provided by birds in agroforests and other agricultural landscapes.

Why Birds Matter: Avian Ecological Function and Ecosystem Services
Şekercioğlu, Çağan - University of Utah; Matthew Johnson - Humboldt State University; Diane Tomback - University of Colorado Denver; Daniel Wenny - San Francisco Bay Bird Observatory; Christopher Whelan - Illinois Natural History Survey

Birds are one of the most diverse groups of ecosystem service providers, whose ecological functions range from creating soil to shaping primate behavior. Nevertheless, the impression that birds have little influence on ecological processes has been hard to change. Given the ongoing declines in avian functional groups, there is a pressing need to compare avian ecological functions to those of other taxa, to understand how these functions translate to ecosystem services and to estimate the ecological implications of bird declines. We review the ecological functions of birds, link them to ecosystem services and outline research priorities for understanding avian contributions to ecosystem functioning. Birds are conspicuous in many habitats, occur worldwide, are ecologically diverse, and are better known than other vertebrate groups. Birds devour pests, pollinate flowers, disperse seeds, scavenge carrion, cycle nutrients, and modify the environment in ways that benefit other species. Yet the ecological importance of birds is not widely appreciated and the economic relevance to human society of birds' ecological roles is even less understood. Quantifying the services provided by birds is crucial to understand their importance for ecosystems and for the people that benefit from them. Birds' ecological roles and ecosystem services are critical to the health of many ecosystems and to human well-being. By studying birds' ecological functions and ecosystem services, we can better assess the environmental consequences of bird declines and extinctions and communicate these findings to the public and policy makers, thereby increasing public support for the conservation of birds and their habitats.

The effects of climate change on tropical birds
Şekercioğlu, Çağan - University of Utah; Richard Primack - Boston Uiversity; Janice Wormworth - CSIRO

We assess the potential impacts of climate change on tropical birds and discuss the factors that affect species' ability to adapt and survive the impending alterations in habitat availability. Tropical mountain birds, species without access to higher elevations, coastal forest birds, and restricted-range species are especially vulnerable. Some birds may be especially susceptible to increased rainfall seasonality and to extreme weather events, such as heat waves, cold spells, and tropical cyclones. Birds that experience limited temperature variation and have low basal metabolic rates will be the most prone to the physiological effects of warming temperatures and heat waves. Mostly unknown species' interactions, indirect effects, and synergies of climate change with other threats, such as habitat loss, emerging diseases, invasive species, and hunting will exacerbate the effects of climate change on tropical birds. 3.5 °C surface warming by the year 2100 may result in 600–900 extinctions of land bird species, 89% of which occur in the tropics. Depending on habitat loss, each degree of warming could lead to approximately 100–500 additional bird extinctions. Networks of protected areas need to be designed with climate change in mind and need to incorporate extensive topographical diversity, cover wide elevational ranges, have high connectivity, and integrate human-dominated landscapes into conservation schemes. Most tropical bird species vulnerable to climate change are not currently considered

threatened with extinction, often due to lack of knowledge. Locally based, long-term tropical bird monitoring and conservation programs are essential to help protect birds against climate change.

Out of Africa: An African origin of the Old World Suboscines (Passeriformes: Eurylaimides) and the successful diversification of the ground-foraging pittas (Pittidae)

Selvatti, Alexandre - Occidental College/Universidade Federal do Rio de Janeiro; Ana Galvão - Universidade Federal do Rio de Janeiro; Anieli Pereira - Universidade Federal do Rio de Janeiro; Luiz Gonzaga - Universidade Federal do Rio de Janeiro; John McCormack - Moore Laboratory of Zoology, Occidental College; Claudia Russo - Universidade Federal do Rio de Janeiro

The Eurylaimides are one of the few passerines with a pantropical distribution. In this study, we generated a multi-calibrated tree with 83% of eurylaimid species diversity and 30 molecular loci with special attention to the monotypic Sapayoidae and reconstructed the biogeography of this radiation. We conducted several topological tests including non-overlapping subsampling of the concatenated alignment and coalescent species tree reconstruction which firmly placed Sapayoidae as the sister group of all other Eurylaimides, with increasing branch support as highly variable sites were removed. We found the Eurylaimides originating in South America and Sapayoidae as the first branch to split from all the remaining Old World lineages (core Eurylaimides) at ~28 Ma. This agrees with the breakup of the insular connection between Africa and South America (Atlantogea) during the middle Eocene. We recovered Africa as the cradle of the core Eurylaimides and this is supported by all African lineages corresponding to the oldest splits within each family in this group. Our timescale suggests that desertification and the uplift of the Tibetan plateau caused a parallel divergence between African and Asian lineages in all major clades in the core Eurylaimides at 22-9 Ma. Lastly, we propose that the ground-foraging behavior in the Pittidae ancestor was decisive for this lineage to thrive and coexist with the older arboreal lineages of the core Eurylaimides. Contrastingly, the diversification of pittas in Australia was probably hindered by the direct competition with the endemic ground-foraging Oscines that were well established in that continent since the Eocene.

Genomic and morphological analysis of a hybrid zone reveals variable contribution of divergent traits in maintenance of partial reproductive isolation.

Semenov, Gregory - University of Arizona; Rebecca Safran - University of Colorado, Boulder; Elizabeth Scordato - University of Colorado, Boulder; Nolan Kane - University of Colorado, Boulder; Chris Smith - University of Colorado, Boulder

Abrupt transitions in phenotypic traits between hybridizing populations implies some degree of reproductive isolation or very recent contact; pattern that can usually be revealed through molecular analyses. In some hybrid zones phenotypic divergence coexists with lack of genetic divergence, suggesting that only a restricted set of genomic regions remain differentiated in the face of ongoing gene flow. Such hybrid zones provide the unique opportunity to address questions about the mechanisms behind the formation and maintenance of reproductive isolation. Our previous findings revealed that the hybrid zone between white (*Motacilla alba* alba) and masked (*M. a. personata*) wagtails displays a steep transition in one plumage trait, but lacks genetic differentiation in mitochondrial and microsatellite markers. Here, we investigate patterns of introgression across the hybrid zone using a set of 46500 SNPs, and a complete set of morphological traits that distinguish two subspecies to analyze the phenotypic and genomics factors

contributing to partial reproductive isolation. We present evidence for i) direct disruptive selection on one plumage trait but not the others; ii) different patterns of introgression between traits and genomics markers; iii) significant geographic displacement of one plumage cline, suggesting asymmetric introgression. Our results indicate that the partial reproductive isolation in this hybrid zone is driven by assortative mate choice on the plumage, but selection strength varies substantially for different traits. We discuss potential drivers of asymmetric introgression and the role of genetic architecture of phenotypic traits in the maintenance of partial reproductive isolation.

Relaxed Selection and the Cost of Migration in the Anthropocene
Senner, Nathan - University of Montana; Mo Verhoeven - University of Groningen; Theunis Piersma - University of Groningen

Some studies have found that for migratory populations the majority of mortality occurs during the migratory period, while other studies instead observe that individuals can truncate their migratory preparations and still fly thousands of kilometers without stopping or incurring negative fitness consequences. We use migratory tracking and reproductive success from hundreds of individual Continental Black-tailed Godwits *Limosa limosa limosa* to explore how ecological and evolutionary forces combine to shape the annual cycles of long-distance migratory birds and determine in which situations migration is likely to be costly. Individual godwits exhibit high levels of flexibility in their migratory behavior, including the ability to alter their migratory timing, migratory route, and choice of stopover sites and habitats from year to year. This flexibility is driven by the combination of (1) a lack of selection on the timing of arrival at the breeding grounds; (2) a concurrent decline in overall reproductive success leading to a severe reduction in the number of juveniles recruiting into the population; and (3) a recent increase in the amount of foraging habitat available outside of the breeding season. Nonetheless, migration is not without costs: despite no evidence for sequential density dependence, survival rates during migratory flights crossing the Sahara Desert were lower than those during the rest of the annual cycle, including other multi-day flights. These findings suggest that contemporary ecological processes may largely explain differences in migratory behavior among populations and while long-distance migration may not be inherently inflexible or dangerous, it is inherently complex.

Traffic noise reduces foraging efficiency in wild owls
Senzaki, Masayuki - Hokkaido University, Japan; Clinton D. Francis - Cal Poly San Luis Obispo

Anthropogenic noise has been increasing globally. Laboratory experiments suggest that noise disrupts foraging behavior in captive bats, but to reveal the full impacts of noise, we must examine the impacts of noise on foraging behavior among species in the wild. Owls are widespread nocturnal top predators and use prey rustling sounds for localizing prey when hunting. We conducted field experiments to examine the effect of traffic noise on owls' ability to detect prey. Results suggest that foraging efficiency declines with increasing traffic noise levels due to acoustic masking and/or distraction and aversion to traffic noise. Moreover, we estimate that effects of traffic noise on owls' ability to detect prey reach >120m from a road, which is larger than previously known. Our study provides the first evidence that noise reduces foraging efficiency in wild animals, and highlights the possible pervasive impacts of noise.

The effects of roads on bird community composition in Pennsylvania's core forest
Serno, Kimberly - Penn State University; Margaret Brittingham - Penn State University; David Miller - Penn State University; Abigail Barenblitt - Penn State University; Glenn Stauffer - Penn State University

Roadways are a prominent feature on the landscape and a major factor in determining the impact of human development on wildlife populations. This is especially true in areas of low development, such as Northcentral Pennsylvania where roads act as the major source of land modification and fragmentation. Our goal was to determine how bird communities differ between roadside and off road surveys and identify which road-characteristics have the greatest effect on forest bird communities. In 2015 we conducted point counts at 1255 locations, on and off roads, in Northcentral Pennsylvania. We analyzed data using multi-species occupancy models, allowing us to measure factors most strongly related to road-effects and to determine how average road effects differed among different species-groups. We found road type and canopy width are better indicators of road effects than the presence of a road itself. Road-effects are negative for forest interior species with a mean estimated effect size (logistic regression coefficients for the effect of road type on occupancy) of -0.304 (95% credible interval (CI): -0.597 to -0.006) for paved roads, and positive for human-associated species with a mean effect of 0.371 (95% CI: 0.075 to 0.693) for gravel roads. Early successional/edge associated species had a positive mean effect of 0.065 (95% CI: 0.021 to 0.110) per one meter increase in canopy width. We will discuss the implications this has on the interpretation of results from large scale surveys utilizing roadside counts, as well as minimizing road impacts on forest bird communities in Pennsylvania's core forested landscape.

Can we reduce greenhouse gas emissions from rice and still maintain waterbird habitat?
Sesser, Kristin - Point Blue Conservation Science; Matthew Reiter - Point Blue Conservation Science; Daniel Skalos - California Department of Fish and Wildlife; Khara Strum - Audubon California; Catherine Hickey - Point Blue Conservation Science

In California's Sacramento Valley, flooding rice fields during winter provides habitat for over 50 species of waterbirds. Rice fields are also flooded during planting, providing habitat for spring migrants and locally breeding waterbirds. Because California has lost over 90% of its historic wetlands, flooded rice is critical wildlife habitat, providing up to 80% of the total flooded habitat. Flooding rice fields, however, contributes to greenhouse gas (GHG) emissions. Several rice field management practices may reduce methane emissions including reduced flooding in winter, removal of rice straw after harvest (baling), and drill seeding during planting. During the winters of 2011–2012 and 2012–2013, we compared waterbird use in four combinations of post-harvest practices: baled/flooded, baled/non-flooded, non-baled/flooded, and non-baled/non-flooded. We found significantly higher dabbling duck and shorebird densities in the non-baled/flooded practice compared to the other three practices. During the spring of 2012 and 2013, we compared waterbird use of drill-seeded fields (reduced GHG) with flooded fly-on seeded fields (status quo GHG). We found no significant differences in mean density between the two seeding practices for waterbirds. Our study found evidence that some post-harvest practices (reduced winter flooding, baling) that reduce GHG emissions from rice also reduce use by waterbirds. While reducing GHG is globally necessary to minimizing the impacts of climate change, doing so in an area of hemispheric importance for waterbirds should be done with caution.

Diversity, Ecology, and Conservation of Bird Communities of Polylepis Woodlands in the Northern Andes of Peru

Sevillano, C. - Cornell University; Amanda Rodewald - Cornell Lab of Ornithology and Cornell University Department of Natural Resources

As one of the highest and most unique systems in the world, Polylepis forests are recognized both as center of endemism and diversity along the Andes and as a system under serious threat from human activities, fragmentation, and climate change. This research investigated patterns of species richness and bird-habitat relationships across along an elevational gradient (~3,300 – 4,700 m) in the highest Tropical mountain range of the world, Cordillera Blanca - Peru. In 2014-2015, birds and habitat characteristics were surveyed at 130 point count locations and systematically observed between points during wet and dry seasons. Estimates of species richness exceed previous studies in Polylepis forest and peaked at mid-elevations (~4,000 m) for the overall bird community; while the greatest number of endemics and threatened birds were found at ~4,300 m. Species-habitat associations of 50 species of birds, including 13 of conservation priority, showed that birds were associated with four habitat types. Results suggest that, although declines in species richness during dry seasons may negatively affect certain species under the projected warmer and drier conditions for this region, Polylepis forest fragments might provide important refuge or buffering against future changes in climate. Moreover, in addition to conserving and using large (>10 ha) Polylepis forests at lower elevations as the cornerstone for maintaining the Andean bird diversity, any high elevation (> 4,200 m) relicts of Polylepis, irrespective of size, should be prioritized for conservation in order to protect key habitat of threatened avian species.

Effects of Wind-Energy Facilities on Breeding Grassland Bird Distributions

Shaffer, Jill - US Geological Survey; Deborah A. Buhl - US Geological Survey

The Before-After Control-Impact (BACI) design is considered the optimal impact study design. The difficulty in getting “before” data, however, means that the design is rarely implemented in wildlife studies. The U.S. Geological Survey, Northern Prairie Wildlife Research Center conducted a behavioral study that is nearly unparalleled in North America because of its geographical scope, duration, and implementation of the BACI design. We conducted a long-term (>10 yr) study that evaluated the displacement effects of 3 wind facilities in North Dakota and South Dakota on grassland birds in native grasslands. We assessed the immediate and delayed (2-5-year average) effects of wind facilities for several bird species. The BACI design allowed us to examine this question in two ways: 1) to test the prediction that overall densities of individual species on wind facilities will change from pre-construction to post-construction, relative to reference sites, as a result of disturbance or attraction, and 2) to assess the effects within 100-, 200-, 300, and >300-m zones of turbines. Avoidance of wind facilities was detected in 7 of 9 species. One species exhibited attraction, and one species showed neither avoidance nor attraction. Displacement/attraction varied by study area, time period, and distance from turbine. Our results are the most comprehensive analysis of displacement effects on grassland passerines to-date and the avoidance metrics we estimated can facilitate future development of models evaluating impacts of wind facilities under differing land-use scenarios.

Is The Waterfowl Breeding Population And Habitat Survey Conducted Too Early For Late-nesting Duck Species?

Shaffer, Terry - USGS Northern Prairie Wildlife Research Center; Brian Wangler - U.S. Fish and Wildlife Service, Habitat and Population Evaluation Team; Terry Liddick - U.S. Fish and Wildlife Service, Division of Migratory Bird Management

Since 1955, the internationally coordinated Waterfowl Breeding Population and Habitat Survey (WBPHS) has provided annual estimates of North American breeding duck numbers by species. The survey consists of a single aerial count accompanied by a ground count that provides a correction factor for birds not seen from the air. In the Eastern Dakotas, timing of the survey (early to mid-May) coincides with onset of nesting for early nesting species, such as Mallard (*Anas platyrhynchos*) and Northern pintail (*A. acuta*), but precedes that of late-nesting species like Lesser scaup (*Aythya affinis*) and Gadwall (*Anas strepera*). The Four-Square-Mile Survey (FSMS) is a ground-based survey of breeding ducks in the Eastern Dakotas that has been done annually since 1987. Unlike the WBPHS which is transect-based, the FSMS is pond-based and utilizes both early (early to mid-May) and late (late May to early June) counts to estimate breeding duck numbers. To understand if timing of the WBPHS introduces bias in population size estimates of late-nesting species, we compared estimates for the Eastern Dakotas from the FSMS between early and late counts for 10 species. We then correlated abundance estimates from the WBPHS with abundance estimates from either the early or late count from the FSMS, depending on whether the species was an early or late nester. A weak correlation for a late-nesting species may indicate that the WBPHS is being conducted too early to adequately determine settling patterns and breeding population size for the species.

Hypothermic hummingbirds - an energy management story

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Climate change will likely influence many aspects of an organism's energy budget. Torpor (short-term hypothermia) is used by some animals to save energy overnight when they cannot forage. Most studies on the use of torpor explore how it is affected by decreased environmental temperatures, and have associated its use with decreased ambient temperature. But, increasing nighttime temperatures may limit the degree to which metabolic rate could be lowered, creating problems for species that use torpor. With climate change, organisms face increased, rather than decreased, ambient temperatures both in the daytime and at night. Because torpid organisms reduce their body temperature and metabolic rates as ambient temperatures get colder, warming temperatures could reduce the efficiency, and potentially the use of hypothermia. Here, we first defined new ways of comparing torpor use across species. We then compared measurements of torpor in hummingbirds across different natural temperature regimes (in Arizona and Ecuador) to evaluate the possible effects of rising temperatures on energy management. We found that when hummingbirds use torpor they save an average of 82% of their energy per hour. We also found that temperate birds at a colder site used torpor more often than those at a warmer site, supporting our hypothesis that warming could reduce torpor use. In contrast, tropical hummingbirds at a slightly warmer site used torpor more often than hummingbirds at a slightly colder site, suggesting that climate change could affect tropical and temperate birds differently.

Does breeding phenology and strength of selection on first egg date vary with environmental conditions in a long-distance migratory songbird, the purple martin (*Progne subis*)?
Shave, Amanda - University of Manitoba; Kevin Fraser - University of Manitoba

With the progression of global climate change, weather patterns and their associated environmental effects are also changing. Mismatched timing between migratory birds and their environment may have important negative consequences on their fitness, as the timing of breeding must match the availability of resources for birds to be successful. If breeding phenology is phenotypically plastic to new conditions, birds may be able to adjust breeding time to fit the changing conditions, whereas an evolved response may be too slow to prevent the decline of songbird populations. The purple martin (*Progne subis*) is a Neotropical long-distance migrant and an aerial insectivore, a group experiencing steep population declines. We investigated the impact of climate change on breeding phenology of purple martins using a 19 year (>66 000 nest) data set collected by citizen scientists, spanning the entire eastern breeding range, from Texas to Alberta. We investigated whether first egg date: 1) varies with local environmental conditions; 2) is advancing at a greater rate in populations breeding at higher latitudes where climate warming is greatest; and 3), if the strength of selection on first-egg date varies by breeding latitude owing to differences in seasonality across a latitudinal gradient. By using an historical, continent-wide breeding data set for purple martins, we can provide important new insights regarding how breeding phenology is responding to altered environmental conditions associated with climate change.

Orchard nest boxes increase American Kestrel presence in a fruit-growing region of Michigan
Shave, Megan - Michigan State University; Catherine Lindell - Michigan State University

Although the American Kestrel (*Falco sparverius*) is the most common falcon in North America, monitoring programs have detected significant population declines. Human development removes sources of natural nesting cavities, which can lead to nest site limitation of local breeding populations. However, kestrels will readily use nest boxes in open areas with valuable hunting habitat. In addition, nest boxes in agroecosystems potentially promote regulatory ecosystem services, specifically biological control, provided by kestrels. This study investigated the response of kestrels to the ongoing installation of cherry orchard nest boxes in northwestern Michigan, a major U.S. fruit-growing region. We predicted that kestrel presence would be more likely at sites with nest boxes compared to sites without boxes, and that an increase in boxes would correspond to an increase in kestrel presence. Beginning in 2013, we conducted temporally-replicated surveys along four roadside transects divided into 1.6 km sites. We developed a multi-season occupancy model under a Bayesian framework to determine the effects of site and sampling covariates on site-level occupancy, colonization, survival, and detection probabilities. Installation of nest boxes had positive effects on first-year occupancy, as well as colonization and survival probabilities. The estimated number of occupied sites increased between 2013 and 2014, which seems to reflect the increase in number of sites with boxes. Our results indicate that orchard nest boxes can benefit conservation and agricultural efforts in fruit-growing regions: providing nest boxes can increase or maintain the presence of breeding kestrels, which in turn promotes kestrel predation in and around orchards.

40 years hacking through the jungles of Borneo: finally, some biogeographic light
Sheldon, Frederick - Louisiana State University; Haw Chuan Lim - Smithsonian Institution; Robert Moyle - University of Kansas

After much work on the phylogeny and phylogeography of Southeast Asian birds, we are finally in a position to propose explanations for patterns in bird distribution on Borneo and other landmasses of Sundaland. The biogeographic forces responsible for these patterns span from the Eocene to present and encompass mountain building, appearance and disappearance of land bridges, extreme changes in climate, movements of habitats laterally and elevationally, coalescence of terranes, maintenance of rainforest refuges, and much more. Here are some examples. Two patterns that have mystified ornithologists are the occurrence in Southeast Asia of many similar Harpactes trogons and one, distinct, Apalharpactes trogon, and the occurrence of many similar Megalaima (=Psilopogon) barbets and one, very different, Brown Barbet (Caloramphus). Our explanation: the singular taxa are ancient hang-overs that survived hard climatic times in mountain-associated rainforest refuges in NE Borneo; the common taxa radiated more recently, in the warm Miocene. Other examples: the Bornean Bristlehead (Pityriasis) is an artifact of early invasion of Southeast Asia by Australian corvoids; the dryland species of Java, whose nearest relatives live in Indochina, reached the island when rainforest in central Sundaland was temporarily replaced by dry habitat; parapatric lowland and montane populations on Borneo evolved in allopatry in Pleistocene rainforest refuges and have only recently come into secondary contact; and more. The bottom line: Borneo was the savior of ancient lineages and the source of more recently evolved taxa.

The Role of Modern Zoos in Avian Conservation
Sheppard, Christine - American Bird Conservancy

Birds die in extraordinary numbers from collisions with glass on structures from sheds to skyscrapers. Like humans, birds can't see glass. Unlike humans, birds do not learn the architectural cues that humans use to predict where glass will be. They take reflections literally and don't see transparent glass as a barrier. Half of the billion birds that die in the US each year hit home windows. However, new solutions are being proposed, based on avian visual ecology, and are being tested, both in controlled studies, like those at Carnegie's Powdermill Avian Research Center, and by post remediation monitoring when potential solutions have been applied to glass where collisions have been documented. Solutions with a range of effectiveness, cost, appearance, longevity, ease of application and visibility have been identified. Zoos and aquariums are ideal for explaining the problem of glass collisions and modeling a diversity of solutions for guests, who are then empowered to return home and take direct action to conserve birds.

Gut contents reveal dietary opportunism and diffuse competition among migratory Parulid warblers wintering in Jamaican shade coffee farms
Sherry, Thomas - Tulane University; Matthew Johnson - Humboldt State University; Kelly Williams - Ohio University

Traditional methods to study bird diets using gut contents may be old-fashioned, and certainly too rarely applied, but represent untapped potential to address new questions. This potential applies at all levels of study, from sampling design, to laboratory and data analysis. In this paper I first illustrate the potential strengths of gut content analysis with a case study involving five primarily insectivorous parulid warblers (Redstart, Black-and-White, Black-throated Blue,

Northern Parula, Prairie) wintering in moderate elevation Jamaican coffee farms. Regurgitated stomach contents document both foraging opportunism and prey resource partitioning. Based on 6,120 prey items identified from 80 stomach samples (76.5 items per sample!) from one-week in late dry season, all five warblers overlapped strongly on the same prey types, down to the prey species level, and on the most available, often patchily distributed, small-bodied arthropods, including coffee berry borers (*Hypothenemus hampei*; Coleoptera). Nonetheless, permutational multivariate analysis of variance also revealed significant species dietary differences, primarily with respect to prey mobility (winged vs. sessile), inferred from prey differences largely consistent with bird foraging differences. These substantial diet overlaps, abundant evidence for winter food limitation and intraspecific competition in some of these warblers, and an apparent rarity of interspecific aggression, taken together make a strong case for hitherto unappreciated interspecific competition, probably via a diffuse exploitative mechanism. Secondly, I briefly review strengths and weaknesses of traditional gut content studies, especially relative to next-generation methods, and suggest some hybrid approaches and novel applications.

Evolutionary specialization in a changing world: are resident tropical insectivores at greater risk than previously thought?
Sherry, Thomas - Tulane University; Natalie Sánchez - University of Alberta; Çağan Şekercioğlu - University of Utah

In theory, species in the most environmentally stable, species-rich environments on the planet ought to be the most evolutionarily specialized, and mainland tropical insectivorous birds are highly diverse and in many cases specialized both ecologically and evolutionarily. If evolutionary specialization comes at a cost of ecological flexibility, then tropical insectivores ought to be highly vulnerable to global change, and in fact tropical insectivores are declining across the tropics in response to logging, habitat degradation and fragmentation, and climate change. In this paper we explore and review multiple novel ways, both analytically and conceptually, to assess evolutionary specialization, including diets, ecomorphology, and behavioral stereotypy; and we present results using different kinds of data suggesting that in fact resident tropical insectivorous birds may be relatively specialized in diet compared to migratory and higher-latitude species, putting the resident tropical species at greater risk than previously appreciated. These methods and results suggest that not all species are equal from a conservation perspective, and provide another potential tool for setting conservation priorities and highlighting categories of species particularly at risk of future declines and extinctions.

Escaping the winter: behavioral plasticity in snow burrow use of a gallinaceous bird
Shipley, Amy - Department of Forest and Wildlife Ecology, University of Madison-Wisconsin; Benjamin Zuckerberg - Department of Forest and Wildlife Ecology

While many species migrate to escape harsh winter conditions, resident birds employ a variety of strategies to avoid cold temperatures. Snow burrowing, a behavior largely unique to gallinaceous birds, provides superior thermal insulation. Populations of ruffed grouse (Bonasa umbellus), winter-adapted birds that use snow burrows in northern forests, have declined by 50% since the 1950s. Reduced snow cover duration may limit the ability of grouse to use burrows. In fact, spring counts of drumming males have been positively correlated with the number of nights with deep, fluffy snow during the previous winter. However, it is unknown if snow burrow use by individuals is influenced by variation in snow depth across the landscape or has demographic consequences. We monitored survival of 24

radio-tagged grouse and documented snow burrow use and snow conditions at 250 roosts at Sandhill Wildlife Area in central Wisconsin. On 56 days when snow roosting was possible in portions of the study site, an effect of a mild El Niño winter, we documented 116 roosts, 41 of which were snow roosts. The use of snow roosts varied considerably among individuals. Only about one third of grouse primarily roosted in snow. Contrary to predictions, preliminary analyses suggest grouse that tended to use snow burrows were slightly more susceptible to predation. Further analysis of snow conditions across individual home ranges will allow us to refine our estimation of the role that warming winters and snow availability plays in the demographics of species that use this unique behavior.

Across-year dynamics of population turnover and network structure in a winter society of migrant sparrows

Shizuka, Daizaburo - University of Nebraska-Lincoln; Alexis Chaine - CNRS-Moulis; Bruce Lyon - University of California, Santa Cruz

Seasonal social networks of migrant birds offer a rare opportunity to observe the process of network assembly and disassembly each year and provide new insights into the interplay between social dynamics and demography. We previously showed that the complex social network of migratory golden-crowned sparrow (*Zonotrichia atricapilla*) at their wintering grounds is shaped in part by across-year fidelity of flock mates. The sparrow social network structure was very stable across 3 years, in part because a large proportion of birds (approx. 50%) return to their winter home ranges and flock together in tightly-knit social communities within a small spatial scale. Here, we analyze a 6-year dataset of this wintering population and show that aspects of social structure such as modularity and assortativity based on previous affiliations fluctuate across years. The overall community structure of the network remained stable across this longer timescale, but a closer look reveals dynamic changes in community membership, as well as the birth and death of new communities. The fluctuations in social network structure are related to population turnover: network structure partially breaks down when return rate is low and/or when recruitment of new immigrants is high. Thus, annual survival rates directly affect social network structure, providing a novel link between population ecology and social networks. In turn, these fluctuations in social network structure could affect aspects of social evolution, such as the function of context-dependent social signals that mediate interactions between familiar or unfamiliar individuals.

Evolution of the Innate Immune System Across the Bird Tree of Life

Shultz, Allison J - Harvard University; Julia Yu - Harvard University; Tim Sackton - Harvard University

The ongoing evolutionary arms race between pathogens and their hosts can result in accelerated rates of evolution and signatures of positive selection when played out over a long period of time. Evidence of strong positive selection on the recognition and effector genes of the innate immune system is evident in invertebrates, including fruit flies and mosquitos. In addition to the ancestral innate immune system, the first line of defense against pathogens, vertebrates posses an adaptive branch of the immune system. The adaptive immune system acts as an immunological memory, and confers immunity to pathogens acquired over the lifetime of an organism. Because most studies of vertebrates focus on the adaptive immune system, the evolution of the innate system remains understudied, particularly in birds. The adaptive immune system may act as a shelter for the innate immune system, and therefore may reduce or eliminate the signatures of positive selection on receptor and effector genes that are observed in invertebrates. Here, we use an alignment of

39 bird genomes and employ likelihood-based models of molecular evolution to identify and quantify positive selection in protein-coding genes across birds. We compare genome-wide levels of selection to those observed in 284 curated receptor, signaling, and effector innate immune genes. With these results, we test whether in birds the presence of the adaptive immune system changes the dynamics of evolution of the innate immune system.

Habitat Selection and Nest Site Fidelity: Are we asking the right question?
Shustack, Daniel - Massachusetts College of Liberal Arts

Reuse of nest sites across breeding seasons is commonly observed in some bird species but only rarely observed in other species. The precise location where eggs are deposited can be considered the “nest site,” even if no structure is built. Using the “Birds of North America” species accounts I reviewed 700+ breeding birds for evidence of nest site reuse. Nearly half (46%) of BNA species have been confirmed reusing a conspecific nest site in different breeding seasons. Nest site reuse has occurred in most bird Orders, but fewer Passerines (~34% of 323 species) have been confirmed reusing nest site compared to all other North American bird species (~56% of 386 species). The average nest reuse rate of Passerines is ~4%, ~12% for all other North American species, and ~9% for all North American species combined. All nest types, including nest sites with no apparent structure, have been reused. All types of nest sites, except those adhering to herbaceous vegetation, have been reused. Nest site reuse does not appear to be related to migration behavior. Reuse rates increases ~4% per 1 kg increase in female mass. The widespread nest site reuse across Orders, nest types, and nest sites implies this behavior is more common than generally considered. I suggest that nest site reuse is best understood in the context of habitat fidelity behavior and that ornithologists should consider why nest site reuse is not more common than currently documented.

Survival of passerines during spring and fall migration: the importance of seasonal interactions
Sillett, Scott - Smithsonian Migratory Bird Center; Clark Rushing - Smithsonian Institute Migratory Bird Center

Few studies have been designed to measure survival rates of migratory passerines in both the stationary and migratory phases of their annual cycle. Previous work on the black-throated blue warbler (*Setophaga caerulescens*) demonstrated that the majority of adult mortality occurred during the migratory period. However, we have lacked the analytical methods needed to estimate survival probabilities separately for spring and fall migration in small species that cannot carry satellite telemetry tags. This limits our ability to understand how events in the summer and winter stationary periods carry-over and contribute to the relatively high mortality of passerines during migration. Here, we present a Bayesian approach for estimating survival probabilities for 4 seasons (breeding, fall migration, winter, and spring migration) based on mark-recapture data collected from different but demographically linked populations in the stationary periods. Using data from *S. caerulescens* breeding in New Hampshire and wintering in Jamaica, we found that monthly migration mortality rates were highest during spring migration for both sexes. Females, however, had lower and more variable survival probabilities during both spring and fall migration compared to males. For males, spring migration mortality was lower following wet winters in Jamaica whereas for females spring migration mortality increased following wet winters. Fall migration mortality in both sexes was not strongly related to weather or food availability in New Hampshire. Additional data from multiple species will improve our understanding of how the breeding, migration, and winter periods interact to

determine the abundance of migratory bird populations.

Historic and Emerging Sources of Mortality in Bald Eagles in Michigan, 1987-2011

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Necropsies on dead birds or diagnostic evaluations on the occasional grounded individual were performed on 1,001 bald eagles (*Haliaeetus leucocephalus*) recovered within the state of Michigan, USA from 1987 to 2011 to determine the primary cause of mortality or grounding (COD). Recovered dead or grounded eagles increased proportionally with the increasing number of occupied breeding areas throughout the study period. Trauma and poisoning were the greatest primary CODs. Within trauma and poisoning, vehicular trauma (n = 268) and lead poisoning (n = 99) caused the greatest number of recovered dead or grounded bald eagles, respectively. The trend in number of eagles recovered due to lead poisoning also positively increased in magnitude within the most recent five years in comparison to the constant growing trend of occupied breeding areas, suggesting density dependent effects related to increasing wintering or breeding populations. Clostridium botulinum type E and barbiturate poisoning are also increasing and emerging causes of mortality. We recommend moving road-killed carcasses, especially white-tailed deer (*Odocoileus virginianus*), from the main thoroughfare to the back of the right-of-way, and the transition from lead ammunition to non-toxic alternatives to decrease these main anthropogenic sources of mortality for bald eagles and a multitude of scavenger species.

Ecological factors primarily determine timing of departures in nocturnally migrating songbirds

Sjöberg, Sissel - Lund University

Most songbird migrants travel between their breeding areas and wintering grounds by a series of solitary nocturnal flights. Several recent studies on timing of nocturnal flights in migratory songbirds have observed departures throughout the night, contrary to the earlier accepted belief that nocturnal departures occur in a narrow time-window during twilight after sunset. It has been suggested that the departures are a response to a specific sun elevation related to the availability of celestial orientation cues. However, little is known about the actual causes of variation in departure timing. We investigated the departure timing of nocturnal songbird migrants using an automated radiotelemetry system in Falsterbo, Sweden. We found that variability in departure timing in relation to sunset and sun elevation is caused by season- and species-specific differences and effects of intrinsic and environmental factors. The birds departed earlier when the nights were shorter, indicating that the duration of the night is an important ecological factor that may drive a large part of the timing differences within and between species. In addition, lean birds delayed their departures compared to fat individuals, and the birds departed earlier when they had favorable wind conditions (following or weak winds) during sunset. These results stress adaptive responses to ecological factors as the primary determinants for timing of nocturnal flights.

Long-term efforts toward understanding the natural history of influenza A viruses in Delmarva waterfowl

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It has been determined that waterfowl are a natural reservoir of influenza A viruses, however many questions regarding persistence, transmission, and agent-host interactions still remain unanswered. With over 500 bird species using the Atlantic flyway, the Delmarva peninsula is a prime location for capturing influenza A virus diversity in a variety of species. Gaining understanding of the natural history of influenza A viruses in waterfowl in Delmarva has required the development of a long- term, coordinated, systematic surveillance approach. Mutually-beneficial collaborations among researchers, wild life biologists, veterinarians, and private land owners have been key in the coordination of this on-going surveillance effort over the last fifteen years. As a result of this collaboration over 15,000 clocal swabs/environmental samples have been collected from wild and captive waterfowl leading to the isolation of over 700 influenza A virus isolates. Isolates representing twelve hemagglutinin subtypes and all nine neuraminidase subtypes have been identified and genomic sequencing has been completed for select isolates. Sequence analysis shows viral transmission events occurring between different populations of birds using Delmarva habitats, giving insight into the maintenance cycle of influenza A viruses in a natural reservoir.

Prothonotary Warbler nest selection, survival and demographic rates in east-central Arkansas

Slevin, Morgan - Arkansas State University; Alix Matthews - Arkansas State University; Than Boves - Arkansas State University

Prothonotary Warblers (*Protonotaria citrea*; PROW) are Nearctic-Neotropical migrants that breed mainly in the bottomland forests of the southeastern United States. PROW have declined by 1%/yr over the past 60 years, and our ability to reverse this decline is limited by a lack of basic biological data. Although much research has been devoted to PROW, most studies have focused on local populations that use nest boxes; we still have little information about their habitat selection behavior or the reproductive rates of individuals that use natural cavities (the predominant nest type). To address these critical knowledge gaps, we studied PROW using both nest boxes and natural cavities in the Dale Bumpers White River NWR in east-central Arkansas during the breeding seasons of 2014 and 2015. We aimed to determine: (1) patterns of nest site selection, (2) relationships between various habitat variables and nest survival, and (3) demographic rates in natural cavities versus nest boxes (including clutch size, no. fledged, and daily nest survival). Comparing used to random (i.e., available) cavities, PROW preferred nesting in higher cavities, and canopy cover was negatively related to daily nest survival rates. Demographic rates and nest survival did not differ between natural cavities and nest boxes. These results should provide information for improving management practices in bottomland hardwood forests and demographic rates that will be necessary inputs in future full-annual-cycle modeling efforts for the species, which is a goal for the Prothonotary Warbler Working Group.

Independent evolution among the modular subcomponents of avian plumage

Sly, Nicholas - University of Montana; Zachary Cheviron - University of Montana

Pleiotropy in developmental and functional subcomponents of complex traits can create severe evolutionary constraints, which can theoretically be overcome through evolution of modular phenotypes – grouping components into tightly-correlated functional modules with reduced pleiotropic connections to other such modules. Reducing pleiotropy increases trait evolvability, potentially facilitating increases in morphological

evolutionary rates and diversification. Plumage can be modeled as modular, by deconstructing it into patches of feather follicles, within which independent developmental pathways (pigment types) combine to produce feather phenotypes. This has been hypothesized to facilitate plumage diversification, but few studies provide direct tests. Here we test whether plumage traits show independent evolution predicted by modular structure, and whether modularity has increased plumage's evolutionary rate and diversification. For each species in five diverse passerine families, we divided adult plumage into forty-five patches and scored each patch for presence of four color-producing developmental modules – melanins, carotenoids, structural colors, and patterning mechanisms. We estimated evolutionary correlation matrices for each families' plumage traits and simulated models of modular correlation structure to test their fit to observed matrices. Our results are consistent with hypothesized modular structure of plumage: each coloration source is uncorrelated in evolutionary change from others within and across patches. However, change within any single color source is highly correlated across patches, suggesting that color sources do achieve evolutionary independence while plumage patches may not be wholly independent. We estimated evolutionary rates and morphological disparity for each clade, but did not find a strong correlation with the inferred extent of trait modularity.

Reproductive success and lifespan in a long-lived passerine: sex specific consequences of stress-response phenotypes

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The rapid elevation of glucocorticoids during a stressor is well documented in a variety of animals. In many species, including Florida Scrub-Jays (*Aphelocoma coerulescens*), the magnitude and time course of increased corticosterone (CORT) during a stressor varies greatly among individuals. These differences among individuals are repeatable throughout the adult lifespan (up to nine years), which indicates they are a persistent aspect of an individual's phenotype. These differences are also correlated with behavioral differences, such as the degree of neophobia, suggesting they are a part of a broader physio-behavioral phenotype. Further, by monitoring jays throughout their entire lives (up to 14 years), sex-specific differences in life span are also associated with differences in stress responsiveness. More stress responsive females (faster release and higher levels of CORT) live significantly longer than females that are less stress-responsive. Interestingly, the opposite relationship is true for males. In males, the lifelong reproductive success (offspring surviving to adulthood) of individuals in the longer-lived phenotype is not greater than that of their shorter-lived counterparts, whereas females of the longer-lived phenotype do have greater success. This suggests that males and females with similar stress responsive phenotypes experience different costs and benefits associated with these phenotypes and employ different reproductive strategies.

Seabird Colony Decline, Nesting Performance, Human Harvest, and Invasive Predators in the Southern Grenadine Islands

Smart, Wayne - Arkansas State University; Natalia Collier - Environmental Protection in the Caribbean; Virginie Rolland - Arkansas State University

Seabird colonies have been declining in the Grenadine islands. Although St Vincent and the Grenadines comprise 15 Important Bird Areas, seabird colonies in the Grenadine islands have also been declining, and the causes remain uncertain. The objective was to assess the role of suspected causes on Grenadine seabird nesting performances,

namely human harvest and rat predation, through nest and predator monitoring, and interviews. The study was conducted on five seabird species at five islands from mid-May to early August 2014-2015. Not only more nesting attempts were recorded, but hatching success estimated with nest survival models was also higher in 2015 (range = 0.18-0.71; N = 81 nests) than in 2014 (0.06-0.81; N = 44) for most species. Colony size could only be compared for Laughing Gulls and did not change between 2014 and 2015. Despite anecdotal observations reported by locals, rats have not been visually detected on the monitored islands. However, we recorded potential evidence of rat presence with one baited trap. Finally, interviews (N = 21 locals) suggest that Boobies are the most sought-after birds of all study species. Fishermen confirmed that they collect and sell seabirds (adults, chicks, and eggs), an illegal activity that is not considered a tradition by 86% of the respondents, but that is not as prevalent as in the past because of increased gas prices. These suggest that other causes, such as habitat degradation (caused by goats) or climate change (through a change in seabird prey availability), may be have greater impacts.

Do I always want the best model? The conservation implications of alternative models for status and trend estimates from the Breeding Bird Survey
Smith, Adam - Environment and Climate Change Canada

Statistical models used to produce the BBS status and trend estimates by the US and Canadian governments are constantly evolving. Recently, Link and Sauer (doi: 10.1890/15-1286.1) provided a metric for selecting among the hierarchical Bayesian (HB) models that are commonly applied to the BBS: the Bayesian Predictive Information Criterion (BPIC). Their cross validation approach to selecting the best model is a major advance in the statistical evolution of the BBS status and trend estimates, liberating these analyses from the current one-model-fits-all-species approaches. However, predictive accuracy (e.g., BPIC) is not the only consideration. The best model for a given species may not be best for all situations. For example, population managers and modellers may have different goals, such as estimating long-term trends, short-term trends, annual abundance, changes in trends, or even forecasting future changes in abundance. And, depending on the conservation goals, some models may be inherently better or worse, because of their differing hierarchical structures and some of the sampling imperfections of the BBS. I will overview the key conservation implications of a selection of published and proposed models for estimating status and trends from the BBS. Using this suite of models and a combination of simulated and real BBS data, I will demonstrate that the BPIC provides an extremely useful tool to help select models for BBS status and trend assessment, but in some cases, users of BBS estimates and data may prefer an alternative to the BPIC best model.

Does enrollment in the Safe Harbor Program affect breeding performance of endangered Red-cockaded Woodpeckers?
Smith, Jennfer - Virginia Tech; Kerry Brust - Sandhills Ecological Institute; James Skelton - University of Florida; Jeffrey Walters - Virginia Tech

Land-use restrictions imposed by the Endangered Species Act may hinder conservation efforts on private lands. In 1995, the Safe Harbor Program was initiated to alleviate concerns of private landowners in the North Carolina Sandhills about conservation of endangered Red-cockaded Woodpeckers (*Picoides borealis*;RCW). Landowners enrolled in Safe Harbor are obligated to manage habitat for existing (baseline) populations of RCWs. Yet, the benefits of Safe Harbor for RCWs remain largely unknown. Here, we evaluate the

effects of Safe Harbor on RCW breeding performance using a before-after control-impact approach. Between 1980 and 2014, we monitored 55 RCW clusters (30 Safe Harbor, 25 control). Following the initiation of Safe Harbor, cluster occupancy on control properties declined by approximately 11% over a 19-year period (β= -0.06, 95% CI = -0.17–0.08) while it increased by approximately 0.2% on Safe Harbor properties (β= 0.04, 95% CI = -0.03–0.10). We suggest that the provisioning of artificial cavities as a habitat management technique on Safe Harbor properties underlies this difference. Safe Harbor affected lay date; following the initiation of Safe Harbor, lay date on Safe Harbor properties advanced by 11.6 days over a 19-year period (β= -0.06, 95% CI = -0.09– -0.03), compared to 6.8 days on control properties (β= -0.03, 95% CI = -0.09–0.02). Conversely, Safe Harbor had no effect on clutch size, or nest, brood, or fledgling success. Our results can be used to inform incentive programs used to promote the conservation of RCWs on private lands.

Phenological matching drives annual cycle timing in a long distance migratory shorebird

Smith, Joseph - Niles and Associates; Kevin Regan - Biodiversity Research Institute; Ashley Green - Massachusetts DCR; Luanne Johnson - Biodiversity Works; Elizabeth Baldwin - Biodiversity Works; David Evers - Biodiversity Research Institute; Peter Marra - Smithsonian Migratory Bird Center

We examined the influence of breeding habitat phenology on life history timing the eastern willet across a latitudinal gradient on the east coast of North America. To determine wintering locations and the timing of life history events we deployed geolocators on willets at study sites in NJ, MA, and ME. We incorporated additional data on life history timing and migratory connectivity from published studies and band recoveries. We hypothesized that breeding habitat phenology is the primary driver of progressively later timing at higher latitudes and that all sites would be at the same phenological stage when nesting began. To test this, we derived indices of salt marsh phenology from (1) published biomass measurements and (2) temperature data. Cumulative Growing Degree Days and salt marsh biomass were closely correlated with each other and with nesting dates across the latitudinal range of the study. These results suggest that eastern Willets time their departure from wintering sites in northern South America to correspond with a phenological wave of spring salt marsh green-up. The timing of all lifecycle phases was earlier for more southern-breeding willets but the duration of stages was consistent, indicating that breeding habitat phenology is the primary driver of the timing all events in the annual cycle.

Population Trends of Shorebirds in the Western Hemisphere: Using Patterns to Identify Problems

Smith, Paul - Environment and Climate Change Canada; Adam Smith - Environment and Climate Change Canada; Stephen Brown - Manomet; Christian Friis - Environment and Climate Change Canada; Julie Paquet - Environment and Climate Change Canada; Bradford Winn - Manomet

Shorebirds have been monitored annually at migratory stopover locations since 1974 as part of the International Shorebird Survey, the Atlantic Canada Shorebird Survey and the Ontario Shorebird Survey. With over 100 million shorebirds counted during over 100,000 surveys, these largely volunteer-based programs offer the most comprehensive source of trend information for shorebirds breeding in North America. Here, we report the results of a recent analysis of data from 1974-2014 using hierarchical Bayesian models. These results suggest continued declines of shorebirds, placing them alongside aerial insectivores and grassland birds as a taxon of conservation concern in North America. The

number and severity of declines is greater for Arctic breeding shorebirds than for temperate breeders. The recent analysis also sheds light on finer-scale geographic patterns in trend. Population trends were more negative in Atlantic Canada and Ontario than along the Atlantic and Gulf Coasts of the United States, but these regional patterns are complicated by differences among species. Moreover, regional patterns could reflect long-term shifts in migration behaviour, especially temporal changes in routes and rates of migration. While time-series of data to assess behavioural changes such as these do not yet exist, recent advances in tracking technology now offer the promise of such assessments in the future. We briefly review some of the ongoing efforts to track migrant shorebirds and discuss how these will improve future assessments of status from migration monitoring data.

Tracking 2.0: Using Tracking Data to Improve Population Monitoring of Long-Distance Migrant Shorebirds
Smith, Paul - Environment and Climate Change Canada; Yves Aubry - Environment and Climate change Canada; Amanda Dey - New Jersey Fish and Wildlife; Christian Friis - Environment and Climate Change Canada; Diana Hamilton - Mount Allison University; Stephanie Koch - United States Fish and Wildlife Service; Ann McKellar - Environment and Climate Change Canada; David Mizrahi - New Jersey Audubon; Christy Morrissey - University of Saskatchewan; Larry Niles - LJ Niles Associates LLC; David Newstead - Coastal Bend Bays & Estuaries Program; Erica Nol - Trent University; Julie Paquet - Environment and Climate Change Canada; Jennie Rausch - Environment and Climate Change Canada; Yves Turcotte - Cégep de La Pocatière; Sjoerd Duijns - Carleton University

The technology allowing us to track birds throughout the year continues to improve and has radically transformed our understanding of connectivity, cross-seasonal interactions and movement ecology. The conservation applications of tracking studies have the potential to be equally transformative, but are in an earlier stage of development. Surveys to document trends in the abundance of birds are often carried out during the migration period; this is especially true for shorebirds that congregate in large numbers at a restricted set of stopover sites during migration. Surveying birds during these mobile phases of the annual cycle creates complications in that variable rates and routes of passage can greatly influence interpretation of the population trends. We are currently using the Motus Wildlife Telemetry System to study the migration ecology of shorebirds, and linking this tracking information to the surveys carried out at stopover sites throughout North America. With over 1500 shorebirds of various species and age classes tagged to date, this effort is poised to make a substantial contribution to our understanding of migration timing, rate, route and behaviour. Here we present the general framework whereby tracking data such as these can be integrated with counts from surveys of migrant birds (shorebirds or otherwise) to address the biases that have proven problematic to date.

Validating multi-species distribution modeling under climate change
Sofaer, Helen - USGS; Catherine Jarnevich - USGS; Curtis Flather - Forest Service

Climate change poses ongoing and increasing threats to biodiversity. Understanding the relative vulnerability of different organisms would allow managers to target monitoring and management towards the most susceptible species. Species distribution modeling is the most prominent tool used in multi-species climate change vulnerability and risk assessments. However, it is not clear how the many assumptions inherent in distribution modeling and the frequent lack of species-specific model development affects the reliability of multi-species vulnerability rankings. We provide a

rare validation of multi-species distribution modeling under climate change, based on North American breeding birds. We estimated ensembles of distribution models for 190 passerine species using Breeding Bird Survey data for the conterminous U.S. from the late 1970s. We then predicted occurrence under climatic conditions from recent years, and validated model ensembles by comparing predictions to recent observed BBS data. Our results provide a striking demonstration of how models based only on climate covariates and generic covariate selection can fail to reliably predict vulnerability. Indeed, vulnerability rankings based on projected range loss may bear little resemblance to observed vulnerability rankings. We discuss the sensitivity of our results to methodological choices, as well as implications for climate change vulnerability assessments and the allocation of scarce conservation resources.

Eastern Golden Eagles wintering in Tennessee – Tree hugging forest dwellers
Somershoe, Scott - U.S. Fish and Wildlife Service; David Hanni - Tennessee Wildlife Resources Agency

Golden Eagles are rarely documented in the non-breeding season in Tennessee. In winters 2011-2012 through 2014-2015, we conducted camera trapping surveys across the state, using road kill deer carcasses as bait to attract eagles. Golden Eagles were detected at 56% of bait sites in middle and east Tennessee. Some bait sites recorded at least seven different individuals during the camera trapping period in February-March. We also trapped and attached GSM/GPS solar transmitters to 10 Golden Eagles from middle and east Tennessee. The results of the camera trap surveys suggest that Golden Eagles are significantly more abundant in the non-breeding season in Tennessee than previously thought. In addition, tracking seven eagles for one to three full annual cycles has shown that Golden Eagles primarily utilize larger forest blocks, especially wooded ridge and valleys and the higher elevations of the southern Appalachians, and infrequently utilize or fly over fragmented forests, agricultural lands, and/or developed areas except during migration or larger regional movements. The results of our research, in collaboration with additional camera and GSM/GPS tracking data from other southeastern states, is providing significant information about movements, habitat use, and landscape features used by eastern Golden Eagles in the non-breeding season in the southeastern United States. Finally, specific migration routes and small and large scale landscape features used in migration between breeding sites, primarily in northern Quebec, are providing significant information to inform conservation issues related to potential wind development across eastern North America.

Do feathers of arctic nesting species track changes in a rapidly changing environment?
Soos, Catherine - Environment and Climate Change Canada; Asha Perera - University of Saskatchewan; Sebastian Llanos - Universidad de Concepcion; H. Grant Gilchrist - Environment and Climate Change Canada/ Carleton University; Tracy Marchant - University of Saskatchewan; Karen Machin - University of Saskatchewan

In a rapidly changing environment, arctic nesting species are faced with an increasing number and magnitude of stressors associated with a changing climate, increasing contaminant exposure, and increasing industrial activity. Variations in climate are occurring more rapidly in polar regions, and may have significant impacts on arctic wildlife health. Our recent work examining five years of data indicated that corticosterone measured in feathers was positively associated with temperature during the period of moult in arctic nesting common eiders (*Somateria mollissima*). Given that feather corticosterone is an integrated measure of the amplitude and duration of

corticosterone secretion during feather growth, this suggests that eiders experience an energetic cost related to increasing temperatures in the arctic. Furthermore, higher energetic expenditure during moult may have significant fitness consequences to common eiders, resulting in carry-over effects many months later on pre-breeding body condition and arrival dates, ultimately affecting both reproductive success and survival. In this study, our goal is to evaluate temporal trends in feather corticosterone over the last 100 years in relation to climatic variation. Using common eider feathers obtained from archived museum specimens throughout the Canadian arctic, preliminary results from samples spanning over 25 years reveal that feather corticosterone is a consistent and powerful tool for tracking impacts of temperature changes over time in arctic-nesting common eiders.

Linking foraging patterns with energetic physiology in an Arctic seabird: Effects of varying ice conditions

Sorenson, Graham H. - University of Windsor; Thomas Lazarus - McGill University; Travis White - Carleton University; H. Grant Gilchrist - Environment and Climate Change Canada/ Carleton University; Oliver Love - University of Windsor

Arctic ecosystems currently face some of the most rapidly emerging environmental stressors worldwide. Because polar systems tend to exhibit extreme, but highly stable environments, polar species may not have the flexibility to respond to rapid environmental change. Unfortunately we know very little about the underlying mechanisms (e.g. physiology, behavior) that allow individuals to respond optimally to this degree of change. Seabirds provide a great model to study the effects of large-scale anthropogenically-derived change as top predators with wide distributions, extensive foraging ranges, and strong dependence on oceanic patterns for food resources. We took an individual-level approach and combined measurements of energetic physiology with behavioural tracking using GPS units in Thick-billed Murres (*Uria lomvia*) during the reproductive period at Digges Island, Nunavut to compare two significantly different environmental years. In 2015, ice concentrations surrounding Digges Island were higher than 2014 throughout incubation. Individuals travelled further in 2015 (maximum foraging distance, $p < 0.0001$; mean trip distance, $p=0.0001$). However, there was no yearly difference in average daily foraging distance ($p=0.6$). While this indicates overall foraging flight effort was maintained across these years, estimated daily energetic expenditure was slightly higher in 2015 ($p=0.015$). Despite longer foraging flights and slightly higher energetic expenditure in 2015, physiology indicates a complex story for individual state. Birds in 2015 were lighter ($p=0.0002$), yet experienced less energetic demand (higher baseline corticosterone, $p < 0.0001$), and had greater circulating energetic levels (higher plasma triglycerides, $p=0.03$). Greater ice concentration in 2015 seemed to be better for the physiological condition of individual murres.

Advancing Caribbean Bird Conservation through the Media

Sorenson, Lisa - BirdsCaribbean; Leo Douglas - BirdsCaribbean; Scott Johnson - Bahamas National Trust/ BIrdsCaribbean

Use of various forms of media is critical for getting conservation messages out to the public. Educators are not always knowledgeable about how to work with the media and are therefore missing opportunities to raise awareness about conservation issues and share the good work they are doing. Over the years, BirdsCaribbean's Media Working Group has provided media training at our international conferences, including topics such as how to: give an interview on television and radio, write an effective press release, blog, and take good photographs of your events and

birds that will help get your work published. As a regional capacity building organization, we also provide direct support to our partners and educators, assisting them with their media work. For example, for our bird festivals, we provide template press releases and photos for pre- and post-festival articles and give step-by-step instructions for how to modify the template for each person's use. We also develop and share powerpoints and webinars on festival themes that can be used by all of the educators in our network. We share examples of our training and media work in the Caribbean and the impacts that it has had.

Contrasting Patterns of Genetic Divergence in Obligate Brood Parasites: Implications for the Genetics of Host-Specific Adaptation

Sorenson, Michael - Boston University; Wenfei Tong - Cambridge University; Claire Spottiswoode - Cambridge University

Avian brood parasites and their hosts have served as important models of coevolution and have produced a spectacular diversity of behavioral, morphological and physiological adaptations and counter-adaptations, our knowledge of which has expanded as additional species in Asia and the southern hemisphere have received intensive study. Until recently, essentially nothing was known about the genetic basis of host-specific adaptation in parasitic birds, but intriguing results from three recent studies are consistent with a long-standing hypothesis of maternal inheritance via the avian W chromosome. The cuckoo finch *Anomalospiza imberbis* is arguably the most compelling of these examples. Cuckoo finches parasitize Cisticola and Prinia warblers, which have evolved highly variable egg "signatures" as an anti-parasite adaptation. In turn, cuckoo finches have evolved eggs that not only mimic different species but also approximate the range of variation within each host. Remarkably, mtDNA indicates not only deep divergence between cuckoo finch females parasitizing the two host genera, but also more recent diversification associated with egg phenotypes: blue versus red background color in females parasitizing *Prinia subflava*, and bright versus dull phenotypes in females parasitizing *Cisticola erythrops*. These divergent matrilines, however, belong to a single population based on a complete lack of differentiation at autosomal RAD-seq loci. The avian W-chromosome and mtDNA, both maternally inherited, share a common phylogenetic history (confirmed by 33 W-linked RAD-seq loci). Thus, the mtDNA results strongly suggest that differences in egg phenotype are coded on the W chromosome.

Seasonal variation in male and female White-bellied Wren acoustic responses to conspecific and heterospecific songs

Sosa-López, J. Roberto - CONACYT - CIIDIR Unidad Oaxaca, IPN; Daniel Mennill - University of Windsor; Katherine Renton - Universidad Nacional Autonoma de Mexico

Intraspecific interactions in birds is known to be strong in the tropics, influencing range distributions and patters of diversity and abundance in tropical avifaunas. The vast majority of studies, however, focuses on competition between closed related species, often belonging to the same genus. However, competition may also occur between distant related species. Therefore, the hypothesis that competition within a community it is more likely to occur between sister species may not always be true. Documenting such interactions is strongly needed to understand its effects on structuring bird communities in the tropics. We investigate several aspects of the territorial behaviour in male and female White-bellied Wrens (*Uropsila leucogastra*). Using a series of experimental playbacks, we simulated conspecific and heterospecific intruders across the breeding and non-breeding seasons. We explorer whether songs emitted by a heterospecific bird that share a similar behaviour and habitat elicited

responses on focal birds, and whether such responses vary with sex. We also examine whether male and female responses to conspecifics and heterospecifics vary with season. Our experiments show that the number of males that responded to heterospecifics is significantly higher that the responses elicited by the control stimulus, suggesting that they recognize heterospecifics signals as coming from potential competitors. The number of males that responded to heterospecifics and the number of females that responded to conspecifics varied with breeding season, showing the lowest number of individual responses during the breeding season and suggesting a change in the response behaviour with season.

Tree senescence as a direct measure of habitat quality: linking red-edge vegetation indices to space use by Magellanic woodpeckers

Soto, Gerardo - Cornell Lab of Ornithology and Cornell University Department of Natural Resources; Christian Perez-Hernandez - Laboratorio de Ecologia y Conservacion, Universidad de Santiago de Chile; Ingo Hahn - University of Munich, Department of Geo-Information; Amanda Rodewald - Cornell Lab of Ornithology and Cornell University Department of Natural Resources; Pablo Vergara - Laboratorio de Ecologia y Conservacion, Universidad de Santiago de Chile

Accurate estimates of the quality and quantity of remnant habitats is critical for conservation of threatened species. Although habitat quality usually is understood from a multidimensional niche space approach, the availability of foraging substrates can be a more proximate habitat quality index for specialized species, like woodpeckers that feed almost exclusively on wood-boring beetle's larvae in infested trees. Here, we tested the ability of 103 Vegetation Indices (VI) to estimate habitat quality for Magellanic woodpeckers for its usage as a reliable habitat suitability estimator. We hypothesized that space use of Magellanic woodpeckers is positively associated with the spatial distribution of decayed trees in the landscape. We developed a methodological framework based on high-resolution, multispectral imagery with three basic steps. First, we mapped individual Nothofagus trees based on estimates of species composition from a supervised classification procedure, VI and image segmentation. Second, we selected the best VI predicting the tree quality for Magellanic woodpeckers. Third, we tested these habitat quality predictors by using two Synoptic Models of Space Use (SMSU) of Magellanic woodpeckers based on VHF radio telemetry and GPS telemetry data. The VI that best predicted habitat quality at the tree-scale was the Plant Senescence Reflectance Index (PSRI), included in almost all the most parsimonious GLMM models. The most parsimonious SMSU included only PSRI, with a strong positive relation. Consequently, Red-edge based PSRI can be considered a reliable estimator of tree habitat quality at the landscape scale for future habitat suitability mapping for Magellanic woodpeckers living on heterogeneous Nothofagus forests.

Population Trends for North American Winter Birds

Soykan, Candan - Verisk Analytics; John Sauer - US Geological Survey; Justin Schuetz - Gulf of Maine Research Institute; Geoff LeBaron - National Audubon Society; Kathy Dale - National Audubon Society; Gary Langham - National Audubon Society; **Chad Wilsey** - Audubon

For over 100 years the Audubon Christmas Bird Count (CBC) has enlisted volunteers in bird monitoring efforts that span the Americas, especially the United States and southern Canada. We employed a Bayesian hierarchical model to control for variation in survey effort among CBC circles and, using CBC data from 1966–2013, generated early-winter population trend estimates for 551 species of birds. Selecting a subset of

species that do not frequent bird feeders and have ≥25% range overlap with the distribution of CBC circles (228 species) we further estimated aggregate (i.e., across-species) trends. Moreover, we examined the relationship between ten biological traits—range size, population size, migratory strategy, habitat affiliation, body size, diet, number of eggs per clutch, age at sexual maturity, lifespan, and tolerance of urban/suburban settings —and CBC trend estimates. Our results indicate that 68% of the 551 species had increasing populations within the study area over the interval 1966–2013. When trends were examined across the subset of 228 species, the median population trend for the group was 0.9% / year at the continental level. At the regional level aggregate trends were positive in all but a few areas. Negative population trends were evident in lower latitudes, whereas the largest increases were at higher latitudes, a pattern consistent with range shifts due to climate change. Nine of ten biological traits were significantly associated with median population trend, but none explained >34% of the deviance, reflecting the indirect relationships between traits and population trends.

Avian Response to a Spruce Beetle Epidemic in a Southern Rocky Mountain Spruce-fir Forest

Sparks, Rob - Bird Conservancy of the Rockies; David Pavlacky - Bird Conservancy of the Rockies

Bird population responses to spruce beetle (*Dendroctonus rufipennis*) outbreaks are not as well understood as those of the mountain pine beetle (*D. ponderosae*). The study of bird habitat relationships in post-epidemic forests may be useful for informing the management of the spruce beetle outbreak. The objectives of this study were to 1) evaluate the effects of forest structure and composition following the outbreak on bird occupancy at the territory scale, and 2) determine the effects of the outbreak on bird occupancy at the landscape scale over space and time. We applied a multi-scale occupancy model to data from the Integrated Monitoring in Bird Conservation Regions program to evaluate hypotheses for woodpecker and bark-gleaner responses to the spruce beetle outbreak in the Rio Grande National Forest between 2008 and 2014. The American Three-toed Woodpecker (*Picoides dorsalis*) was positively related to the extent of the spruce beetle outbreak, whereas the occupancy of the Hairy Woodpecker (*P. villosus*) increased with severity as measured by snag density. The Red-breasted Nuthatch (*Sitta canadensis*) was negatively related to the extent of the outbreak, whereas the Brown Creeper (*Certhia americana*) was positively related to the extent of the outbreak, but negatively related to the severity of the outbreak. The regional occupancy of American Three-toed Woodpecker and Brown Creeper showed increasing trends through time, while the Hairy Woodpecker was concentrated in landscapes with recent outbreaks.

Geographic variation in the worn-out, shabbily dressed trumpeter (better known as the Rock Wren)

Spellman, Garth - Denver Museum of Nature & Science; Nadje Najar - University of Northern Colorado; Nickolas Godlove - University of Northern Colorado; Andrew Doll - Denver Museum of Nature and Science; Lauryn Benedict - University of Northern Colorado

The Rock Wren (*Salpinctes obsoletus*) is a ubiquitous constituent of arid, rocky habitats in western North America and Central America. Taxonomists during the mid-1900's recognized 14 subspecies of Rock Wren, although further examination of specimens suggested that much of the variation appeared clinal and the number of subspecies was subsequently reduced to seven. We combine analyses of morphology and genetics of all seven currently recognized subspecies to explore geographic variation in

the Rock Wren. Discriminant analysis of the morphological data suggests that one Mesoamerican subspecies (guttatus) and the Isla Guadelupe subspecies (guadelupensis) are easily distinguished (>95% classification). Nonmigratory and island populations of Rock Wrens possess significantly shorter and less convex wings than their migratory brethren indicating possible selection for flight performance in migrants. Preliminary analysis of mitochondrial DNA variation (mostly from historical specimens, >50 years old) supports the uniqueness of the Mesoamerican subspecies guttatus, but reveals little phylogeographic structure throughout the remainder of the Rock Wren's range.

Identification of four genes involved in the development of feathers but not scales in birds

Stabile, Frank - Yale University; Jacob Musser - European Molecular Biology Laboratory; Richard Prum - Yale University; Günter Wagner - Yale University

Despite advances in our understanding of feather development and avian evolutionary history, little is known about the relationship between feathers and bird scales. To better grasp the relationship between these structures, we examined the genetics of developing feathers and scales in Leghorn chicken embryos. Using transcriptomics, we identified four genes that seemed specific to feathers later in development—Gata3, Ghrh, Akap12, and Tcf7l2. Whole-mount in situ hybridizations confirmed the activity of these genes in the feather buds of developing chicken embryos, but not the scales. The experiments also revealed that these four genes are involved in the development of the feather sheath, follicle polarization, barb formation, and follicle growth, respectively. To further demonstrate the feather specificity of these genes, we also performed whole-mount in situ hybridizations on the legs of Silkie chickens. Silkies are a unique chicken breed with many unusual features, including feathers in areas on the tarsometatarsus and phalanges where scutate scales are normally present. The expression patterns of these four genes on Silkie legs matched patterns observed on the Leghorn chickens. These experiments take advantage of natural morphological variation in chickens to show that the four genes identified by transcriptomics are truly specific to the feather, a morphological structure, rather than a particular location on the body. Thus, these four genes are specific to the development of feathers, but not avian scales.

Juncos as Models for Pattern and Process in Metabolic Flexibility

Stager, Maria - University of Montana; Zachary Cheviron - University of Montana

The energetic costs of seasonal climatic fluctuations can be severe for small endotherms, such as passerines, that live in seasonally variable environments. Under these conditions, metabolic flexibility – the ability to reversibly adjust metabolic capacity in response to current selective pressures – can have profound implications for organismal fitness and adaptation. As such, passerines increase their metabolic flexibility with exposure to decreasing minimum temperature at broad geographic scales. Dark-eyed Juncos (*Junco hyemalis*) are an ideal system with which to investigate the mechanisms underlying this flexibility, because they are widely distributed and have been a natural model system for physiological investigations throughout the past century. We found that variation in junco summit metabolic rate was correlated with recent temperature acclimatization across their distribution. This enhanced summit metabolic rate was associated with increased cardiopulmonary organ size within a subset of these individuals, but not blood-oxygen parameters. Studies in the lab exploring changes in metabolic capacity in response to temperature have corroborated some of these findings and, in addition, implicated the upregulation of several genes involved in the oxygen transport cascade and lipid oxidation

pathway with heightened summit metabolic rates. Finally, through recent lab acclimations, we have explored the timescale at which modifications are made across levels of physiological organization to build whole-organism changes in metabolic performance. Taken together, this work can help illuminate the ability of natural populations to respond and adapt to environmental fluctuations.

Sex-specific natal dispersal in the San Clemente Loggerhead Shrike

Stahl, Justyn - Institute for Wildlife Studies; Andrew Bridges - Institute for Wildlife Studies; Nicole Desnoyers - Institute for Wildlife Studies; Melissa Booker - U.S. Navy; David Garcelon - Institute for Wildlife Studies

Islands provide unique opportunities for studying dispersal patterns due to limited area, unlike mainland studies, where movement beyond the study area cannot be separated from death. San Clemente Island, home to the endemic San Clemente Loggerhead Shrike (SCLS, *Lanius ludovicianus mearnsi*), is isolated from the mainland by over 100 km of ocean. As breeding habitat has recovered following feral grazer removal, the intensively monitored population of SCLS increased from 14 birds in 1998 to a maximum of 179 in 2009. Within this framework of increasing habitat and population size we investigated patterns of natal dispersal in the SCLS. We followed 250 color-banded shrikes (128 females, 122 males) hatched 1998–2013 and breeding 1999–2014, and measured the distance between natal sites and first breeding territories. Mean dispersal distance was 3.15 km. Females dispersed further than males (3.99 km vs. 2.28 km, $P < 0.0001$). A marked decline in dispersal occurred for males (from 2.78 km to 1.99 km, P P = 0.95). This pattern appeared unrelated to adult population size, and we suspect habitat factors are driving this change. As shrubs recover, the amount of nesting habitat between historically isolated canyon woodlands is also increasing, and our findings suggest that the SCLS population may expand into currently suitable but unoccupied areas. These data may also be useful for future occupancy modeling efforts, habitat enhancement planning, non-native predator control efforts and release site selection.

Potential barriers to the establishment of exotic highly pathogenic influenza A viruses in North American wild bird populations.

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Influenza A viruses (IAV) are maintained in wild bird populations worldwide but despite remarkable similarities in the epidemiology of these viruses in wild birds in Eurasia and North America and the exchange across continents, successful viral introductions are uncommon. The reasons for this are not understood but may be important in defining long-term risks associated with IAV introductions of concern, such as the 2014 introduction of clade 2.3.4.4. highly

pathogenic H5N8 avian influenza (HPAI) virus into North America. Two potential barriers to successful HPAI virus introductions, relate to differences in pathogenesis, especially associated with host susceptibility and viral shedding, and to factors such as population immunity. Both are connected and poorly understood in relation to these complex wild bird systems. In general, low pathogenic IAVs normally associated with wild bird populations, especially waterfowl, involve multiple subtypes that are not equally represented, do not occur randomly, and may be seasonally distributed with a very high proportion of the population infected annually. Although population immunity has long been suspected as a driver of these patterns, experimental and field studies have demonstrated a complex relationship involving both homo-specific and hetero-specific immunity that also may limit the probability for establishment of “new” viruses. Although an exotic virus may exhibit replication characteristic that would be compatible with efficient transmission between wild birds, potential success also involves competing in a diverse immunologic landscape that already includes interactions between numerous and diverse avian hosts and IAVs.

The effect of Protocalliphora larvae on the condition of Carolina Chickadee nestlings
Stanback, Mark - Davidson College; Esther Niemasik - Cornell University

Hematophagous arthropods are extremely common parasites in the nests of birds. Despite the fact that nests may contain a hundred or more larvae of the fly genus Protocalliphora, results of investigations into their negative effects have been mixed. We counted the number of larval/pupal Protocalliphora in over 400 Carolina Chickadee nests collected in Davidson, NC within 5 days of the fledging of the chicks (we weighed and measured chicks prior to fledging). Nest date and nest size/mass both had significant effects on larvae number. Brood size, nest date, rank within brood, and number of Protocalliphora larvae all had significant effects on nestling condition (mass/wing residuals). Of these, however, parasite load had the smallest effect. Our results suggest that Carolina Chickadee nestlings can generally tolerate the blood loss caused by these parasites.

Drivers of overwintering space use strategies of wood thrush (*Hylocichla mustelina*)
Stanley, Calandra - Smithsonian Migratory Bird Center

Determining the key ecological factors influencing behavioral strategies of migratory songbirds during the non-breeding season representsa crucial step to understanding the factors that limit population growth across the annual cycle. Through intensive monitoring of radio-tagged wood thrush (*Hylocichla mustelina*) in southern Belize, I explored the hypothesis that moisture indirectly drives food abundance (insects and fruit) and determines the space use dynamics and departure schedules of wood thrush. Territory size was driven by the positive relationship between dry season insect availability and soil moisture levels, but not fruit availability. Contrary to expectations individuals foraging in areas of high insect availability inhabited larger home ranges. These results suggest that as home ranges become drier through the late wintering period, individuals may increase their territory to include moist microhabitats with high insect availability. The majority of individuals (79.1%) departed the study location prior to the spring migration period of this population. Individuals inhabiting home ranges with higher wet season insect abundance departed the study site significantly later, fruit availability and soil moisture had no influence. GPS tags deployed across 5 breeding locations in North America found 33% of tracked individuals exhibited intra-winter movements ranging from 2- to 83-km. Thus, as food resources become depleted during the non-breeding

season, individuals may engage in large-scale dispersal movements. The potential importance of moisture levels for Neotropical migratory songbirds has serious implications for the management of these species as the wintering range of most species are predicted to become increasingly arid in climate model forecasts.

Predicting the future: 'half-life' projections and urgency metrics for North American birds
Stanton, Jessica - U.S. Geological Survey; Wayne Thogmartin - United States Geological Survey

Regional conservation programs need reliable metrics or indicators for planning activities and evaluating progress. Ideally, a good metric should be customizable to the goals of a program, objective, easy to comprehend and communicate, and directly related to the phenomenon or process of interest. We'll present a quantitative and objective framework we developed for generating metrics for the purpose of prioritizing species at regional scales in terms of conservation urgency. We used data from the North American Breeding Bird Survey (BBS) time series of indices of abundance summarized by Bird Conservation Regions (BCRs) to fit multivariate state-space models for approximately 300 species of North American landbirds. This approach allows for estimation of the trend and year-to-year population variability while removing some of the residual variance belonging to the observation process. With the characterization of the population variability and the most recent trend observed over the last decade, we then forecast how many years in the future until a population size that is half of the current abundance is expected to be observed. This metric is presented in the Partner's in Flight 2016 Landbird Conservation Plan update as the 'half-life' urgency window for action.

Preparing for an Uncertain Future: Assessing Responses of Migrating Shorebirds to Climatic Fluctuations in the Prairie Pothole Region
Steen, Valerie - Colorado State University; Susan Skagen - U.S. Geological Survey; Barry Noon - Colorado State University

The Prairie Pothole Region, situated in the Northern Great Plains, provides important stopover habitat for migratory shorebirds. During spring migration in the U.S. Prairie Potholes, 7.3 million shorebirds refuel in the region's myriad small, freshwater wetlands. Shorebirds use mudflats, shorelines, and ephemeral wetlands that are far more abundant in wet years than dry years. Generally, climate change is expected to bring warmer temperatures, seasonality shifts, more extreme events, and changes to precipitation. In the Prairie Potholes, earlier spring onset and warmer temperatures may advance drying of wetlands or, alternately, increased spring precipitation may produce abundant shallow water habitats. To look at the availability of habitats for migratory shorebirds under different climate regimes, we compared habitat use between a historic wet year and a dry year using hierarchical models to describe local and landscape patterns. We found that in the dry year shorebirds were distributed more northerly and among more permanent wetlands, whereas in the wet year shorebirds were distributed more southerly and among more temporary wetlands. These results point to the importance of conserving a range of wetlands types throughout the region to help mitigate the impacts of uncertainty in future climate change.

Effect of river restoration on riparian bird density and nest success on the Trinity River, California, USA
Stephens, Jaime - Klamath Bird Obsevatory; Sarah Rockwell - Klamath Bird Observatory

Water crises and endangered salmon are pressing environmental concerns in the

western United States. Restoration of instream habitat and ecological processes are common, but effects on bird populations are often overlooked. We studied the effect of bank rehabilitation via vegetated berm removal and subsequent channel and floodplain construction along a 64 km stretch of the Trinity River, California. From 2012-2015 we measured density and nest success for four riparian bird species at six restored sites and four reference sites. We used linear mixed models and information theoretic model selection to compare metrics between three habitat types: newly constructed floodplain and remnant riparian habitat at restored sites, and reference sites. Yellow-breasted Chat territory density was lower on restored sites than reference sites, and lower on newly constructed floodplain than remnant riparian. In contrast, Song Sparrows had similar density in all habitat types, an indication that restoration provided adequate early seral riparian. For all species combined, canopy cover was important on both reference and restored sites, but alder and blackberry were positively associated with density on reference sites only. Nest success did not differ between the three habitat types for any focal species. For individual species, nest success was positively associated with various nest site and vegetation metrics, but not with landscape metrics. Birds provide good indicators of ecological function, thus, these results can be used to quantify whether restoration is on a successful trajectory and to inform future restoration designs.

Using habitat features to predict and manage nest success of American oystercatchers and Wilson's plovers along the Georgia coast

Sterling, Abby - University of Georgia; Joanna Hatt - University of Georgia; Tim Keyes - Georgia Department of Natural Resources; Robert Cooper - University of Georgia

Many species of beach-nesting shorebirds have experienced population declines despite conservation efforts. Significant threats include loss of nesting habitat, increased predation pressures, and human disturbance. A multispecies approach to shorebird conservation is increasingly necessary for efficient and effective management. American oystercatchers (*Haematopus palliatus*) could serve as an umbrella species for other shorebirds, given recent successful management of East coast populations. To assess our ability to use the American oystercatcher as an umbrella species for other beach-nesting birds, we determined whether American oystercatcher and Wilson's plover (*Charadrius wilsonia*) breeding success was explained by similar habitat characteristics of nest sites at three spatial scales. Our research was conducted on three Georgia barrier islands, which comprise the majority of breeding habitat for both species in the state. During 2012 and 2013, we located and monitored 432 Wilson's plover nests and 50 American oystercatcher nests. We used logistic exposure models and model selection to determine the habitat variables at each scale that best explained nest success for each species. Nest success varied by year, thus we examined years independently. Via modeling we identified common features of productive nesting habitat for the two species. We also found the importance of different habitat features varied across spatial scales. This research will help to elucidate how habitat variables affect shorebird nest success and can be used to prioritize and guide management activities to increase fecundity. By understanding habitat requirements and landscape use, we will develop more effective conservation strategies for declining shorebird populations.

Full Life Cycle Conservation through Education

Stewart, Sarah - National Audubon Society; Matthew Jeffery - Audubon; **John Beavers** - National Audubon Society

Limited opportunities for income generation often drive local communities to engage in activities that degrade the natural resource

base. Ecotourism, specifically the niche bird watching tourism is one economic alternative that can raise incomes in communities living close to biodiversity-rich areas, while helping to conserve natural capital. There is an estimated 48 million bird watchers in the United States, of which more than 17 million are willing to travel for birding activities. The National Audubon Society has partnered with development agencies and local NGO's to advance this niche market within the Americas. This pilot project is being implemented in Belize, Guatemala, Paraguay, The Bahamas and Colombia and focuses efforts on communities living in or around key protected areas and Important Bird and Biodiversity Areas. To date the project has developed a regional bird guide curriculum (basic level and advanced), and tailored bird curriculums for each country. Begun training of local community members and park staff, begun implementation of community education programs, developed market statistics and begun to advance the marketing of the sites to the bird watching community. Most importantly we are measuring success through third party, community pre and post project analysis.

Diel Variation in Vocalization and Detection Rates of King and Clapper Rails in Virginia Intracoastal Waterways

Stiffler, Lydia - West Virginia University; James Anderson - West Virginia University; Todd Katzner - U.S. Geological Survey

Surveys for secretive marsh birds are usually conducted by human observers who record numbers of vocalizations and estimate numbers of birds. However, even these surveys could be improved with refinements to address regional, diel, and species-specific variation in detection probabilities. The goal of our study was to understand diel variation in vocalization and detection rates of king (*Rallus elegans*) and clapper rails (*R. longirostris*) in intracoastal Virginia, to inform potential optimization of future marsh bird monitoring. We recorded vocalizations of rails using autonomous recording units over continuous 48hr periods in a series of five marshes along a known riverine salinity gradient that we expected resulted in a rail density gradient. We collected 3,600 hours of audio at 75 survey locations. Although rails vocalized a great deal throughout the day, preliminary analyses indicate significant differences in average ($P < 0.001$) and maximum ($P < 0.001$) number of rails detected across marshes, with higher detection rates exhibited within areas of high density. There were significant differences in number of hourly detections ($P < 0.001$), such that hour 0500 > 2100, hour 0500 > 2200, and hour 0600 > 2100. Likewise, there were significant differences in number of hourly vocalizations ($P=0.011$), with 0600 >1500 and 0600 >2100. These data demonstrate that because hour-to-hour variation in vocalization rates are minimal, surveys for rails in Virginia intracoastal waterways can be conducted throughout the day. However, it may be useful to calibrate survey results to rail density and to the hour in which surveys were conducted.

Egg Camouflage in Plovers and Terns: Insights from Computer Vision and Edge Detection

Stoddard, Mary - Princeton University; Kristina Kupán - University of Graz; Harold Eyster - Harvard University; Wendoly Rojas-Abreu - Universidad Autónoma de Tlaxcala; Medardo Cruz-López - Universidad Nacional Autónoma de México; Martin Serrano-Meneses - Universidad Autónoma de Tlaxcala; Clemens Küpper - University of Graz

- Animals achieve camouflage through many mechanisms, of which background matching and disruptive coloration are likely the most common. Although many studies have investigated camouflage mechanisms using artificial stimuli and in lab experiments, less work has addressed camouflage in the wild. Here we examine egg camouflage in clutches laid by ground-nesting Snowy Plovers

Charadrius nivosus and Least Terns *Sternula antillarum* breeding in mixed aggregations at Bahía de Ceuta, Sinaloa, Mexico. We obtained digital images of clutches laid by both species. We then calibrated the images and used custom computer software and edge detection algorithms to quantify measures related to three potential camouflage mechanisms: pattern complexity matching, disruptive effects and background color matching. Based on our image analyses, Snowy Plover clutches, in general, appeared to be more camouflaged than Least Tern clutches. Snowy Plover clutches also survived better than Least Tern clutches. Unexpectedly, variation in clutch survival was not explained by any measure of egg camouflage in either species. We will discuss these surprising results in detail and present our new computer software tool, which can be applied to diverse studies of animal camouflage.

Species 2.0: Successive replacements keep species young and make them older at the same time?
Stoeckle, Mark - Rockefeller University; David Thaler - University of Basel

The success of DNA barcoding in animals rests on the nearly universal finding that mitochondrial DNA differences within species are low. However, the underlying evolutionary mechanism puzzles, as standard theoretical models predict variation proportional to population size. Yet more than a decade of DNA barcoding surveys, examining more than 100,000 animal species, with population sizes ranging from a few thousand to more than a billion individuals, document similarly low intraspecific variation. In population biology terms, effective population size (Ne) is low regardless of census population size (Nc). Here we ask whether this nearly universal finding reflects common mechanism acting on all animal species. We note that limited variation means that most animal species appear as if they originated from a uniform population relatively recently. We present a hypothesis that most animal species are of recent origin, that extant organisms represent population outgrowths following recent adaptive bottlenecks. For contemporary forms, the average apparent time since bottleneck is on the order of 100,000 years. This hypothesis can be seen as a macroevolutionary, whole-genome perspective on selective sweeps, and fits with increasing evidence for positive selection in nuclear genomes. We identify potentially decisive lines of investigation, including taxonomically broad-range analyses of nuclear genome variation and species duration.

Beyond forest fragmentation: Abundance declines in Amazonian bird species within undisturbed rainforest in Amazonian Brazil over a 30 year interval
Stouffer, Philip - Louisiana State University; Vitek Jirinec - Louisiana State University; Erik Johnson - Audubon Louisiana; Jared Wolfe - USDA forest Service Pacific Southwest research station Arcata; Luke Powell - Smithsonian Migratory Bird Center; Richard Bierregaard - PDBFF; Thomas Lovejoy - PDBFF

Most studies of bird abundance in tropical systems are motivated by direct landscape or habitat change. Few tropical sites offer the opportunity to examine long-term trends in the absence of landscape effects, although these data could be important for identifying larger patterns. We used mist net captures from 34 continuous forest sites sampled in 1979-1984 and 16 comparable sites sampled in 2008-2013 to examine long-term abundance changes within a vast area of undisturbed forest at the Biological Dynamics of Forest Fragments Project near Manaus, Brazil. Three species of terrestrial or near-terrestrial insectivores showed dramatic changes: *Myrmotherula guttata*, *Sclerurus caudacutus*, and *Myrmornis torquata* declined by >85%, corresponding to naïve occupancy reduction of >50%. As a guild, terrestrial insectivores declined by ~50%. The majority

of the understory avifauna showed no meaningful change, although common understory frugivores increased by ~60%. Common canopy species poorly sampled by nets accounted for few captures, but were three times more common in the new sample. Ordination showed consistent differences in community structure between the two time periods. We interpret these results as population changes within continuous forest for species efficiently sampled with mist nets. The change for canopy species suggests birds are using lower strata of the forest. Possible mechanisms for both responses could be directional forest structural change or microclimatic alteration driven by climate change.

Identifying climate-change refugia and conservation priorities for boreal passerines

Stralberg, Diana - University of Alberta; Fiona Schmiegelow - University of Alberta; Erin Bayne - University of Alberta / Department of Biological Sciences; Peter Solymos - Alberta Biodiversity Monitoring Institute, Alberta Innovates Technology Futures and University of Alberta / Department of Biological Science; Scott Nielsen - University of Alberta; Carlos Carroll - Klamath Center for Conservation Research

Bioclimatic niche models provide useful insights about the potential for species' range shifts and patterns of community reshuffling in response to anthropogenic climate change. However, uncertainty about the rate and magnitude of change, as well lags in ecological responses, pose challenges for applying these models to conservation planning efforts. At broad spatial scales, a key component of efficient resource allocation is the identification of multi-species climate refugia, or areas of relatively high climate stability over time. Climate refugia can be identified at different scales, and for individual species as well as ecosystems and climate types. Climate velocity metrics can be useful for identifying specific areas—and environmental characteristics of those areas—that are more likely to retain existing species and communities or receive those that are nearby. Although conservation planning should encompass a broad range of climate outcomes, including areas of rapid change, biologically-defined climate refugia provide a unique opportunity to efficiently conserve existing ecological communities given climate change. Whether in perpetuity or as stepping stones for population migration, refugia may be considered high priority areas for land conservation under climate change. We used density models for boreal bird species to map species-specific biotic velocity, develop an index of multi-species refugium potential, and identify refugia-driven bird conservation priorities using the Zonation software. We found that, although specific priorities for land conservation depend upon conservation goals and constraints, certain mountain and coastal regions characterized by higher moisture availability are consistently identified as key refugia for multiple boreal species.

Oversimplification of habitat associations leads to unnecessary conflict and counterproductive conservation and management actions

Streby, Henry - University of Toledo

We generally organize breeding birds into guilds based on associations with similar habitat types resulting in descriptors like shrubland birds, forest birds, grassland birds, etc. Management and conservation plans based on these habitat associations often result in competing viewpoints about which habitat types should be prioritized for which species in a given region. Habitat associations are most commonly derived from locations where males are observed singing during morning hours, early in the breeding season. However, often when we attach tracking devices to birds and observe their behaviors outside this unique period of vocal territoriality, we find them using areas and habitat types that differ from their song

territories. Later in the season, and even later in the day, some shrubland birds are foraging and raising young in the canopy of older forest and forest birds are doing the same in riparian areas or dense early-successional forests. Oversimplification of habitat associations can result in counterproductive management plans that neglect critical components of breeding-grounds habitat for species that would be more appropriately described as diverse cover-type obligates. As songbird research rushes to catch up with the waterfowl folks in full-annual-cycle conservation and management, let us not overlook the critical, unpicked, low-hanging fruit of the post-fledging period. Full-season habitat associations from spring arrival through fall departure can more fully inform conservation and management plans on the breeding grounds. Examples involving Ovenbird (*Seiurus aurocapilla*), Golden-winged Warbler (*Vermivora chrysoptera*), and American Woodcock (*Scolopax minor*) in managed forest landscapes will be featured.

Late summer habitat as a limiting factor for fitness in Greater Sage-grouse

Street, Phillip - University of Nevada, Reno; Tessa Behnke - University of Nevada-Reno; James Sedinger - University of Nevada, Reno

Identifying quality habitat is critical in the conservation and management of populations. Species often select habitat that maximizes their fitness in terms of reproduction and survival. For Greater Sage-grouse, the presence of protein rich forbs is required for chick growth. These forbs are abundant in spring, but die during dry summers, with the exception of forbs found in moisture rich refuges. These refuges can be in the form of wet meadows or elevations high enough to receive more precipitation than the surrounding landscape. Using known locations of sage-grouse during July and August, we build year specific resource selection models identifing these refuges as quality late summer habitat. We assess how locations of sage-grouse on the landscape relative to predicted late summer habitat quality affects survival of pre-fledged chicks and adults. We found chicks in lower quality habitat did not survive as well as chicks in higher quality habitat. Alternatively, adults located in higher quality habitat did not survive as well as adults located in habitat of lower quality. These results suggest that moisture rich refuges are essential for successful reproduction, but attending these refuges likely comes at a cost in terms of adult survival. We attribute these cost to biotic processes such as density dependence and predation. Identifying these areas will help managers balance grazing pressure, mining, and energy development in the Great Basin with the long term persistence of sage-grouse.

The Bobolink Project: Payment for Ecosystem Services for Grassland Bird Conservation

Strong, Allan - University of Vermont; Stephen Swallow - University of Connecticut; Lisa Chase - University of Vermont Extension; Anwesha Chakrabarti - University of Connecticut

Rapid population declines of grassland birds has necessitated new conservation approaches to address habitat loss and incompatible agricultural management activities. In the Northeast, the overwhelming majority of suitable grassland habitat is on private land such that conservation initiatives solely on public land will be ineffective. In 2013, we began The Bobolink Project to test a crowd-sourced, payment for ecosystem services model to incentivize landowners to adopt “bird-friendly” management practices in hayfields. In conjunction with the crowd-sourced fund-raising, we asked landowners to submit bids for the per hectare price that they would need to alter their hay harvest schedule to avoid cutting during the nesting period. We used a uniform-price reverse auction method to determine the highest per hectare bid across all interested landowners that could be met with existing donations. In

2013, we received $32,000 in donations from the public and were able to enroll 81 ha ($395/ha). In 2014, we received a similar level of donations, but greater landowner interest and lower bids allowed us to enroll 138 ha ($235/ha). In 2015, better marketing of the project led to a significant increase in donations ($50,000), and although the $/ha price point remained similar to 2015, we were able to enroll 219 ha. Nesting densities of Bobolinks (*Dolichonyx oryzivorus*) in 2015 were 0.9 pairs/ha. The success of the project suggests that this approach may be appropriate where there is a charismatic species of conservation need and relatively simple options for conservation actions on private land.

POPULATION AND HABITAT OBJECTIVES FOR BREEDING SHOREBIRDS IN CALIFORNIA'S CENTRAL VALLEY

Strum, Khara - Audubon California; Kristen Dybala - Point Blue Conservation Science; W. David Shuford - Point Blue Conservation Science; Monica Iglecia - Manomet

The Central Valley of California supports breeding populations of many waterbirds, despite the loss of over 90% of naturally occurring wetlands. Most shorebirds breeding in this region rely on shallow flooded habitat adjacent to sparsely vegetated uplands, a habitat in short supply. We applied a population status framework to set population and habitat objectives for breeding shorebirds in California's Central Valley. We selected two focal breeding habitats, rice (*Oryza sativa*) fields and permanent wetlands and three focal species, black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostira americana*), and killdeer (*Charadrius vociferous*). We chose population objectives that would provide large and resilient populations for each focal species and then estimated the long-term (100-year) and short-term (10-year) habitat and density objectives to meet those goals. We assessed the amount of wetland habitat needed to support population increases concurrent with increases focal species densities. The total wetland habitat objective is 54,802 ha (134,418 ac) of permanent wetlands to support an overall Central Valley population objective of 50,000 individuals of each focal species in 100-years. The short term goal is restoration of permanent wetlands and/or enhanced management of existing seasonal wetlands to provide appropriate nesting habitat for focal species on 4,770 ha (11,046 ac) every ten years. These objectives provide guidelines and measureable outcomes for the conservation of breeding shorebirds and their habitats in the Central Valley and can be used when considering changes in land use and land management to unite stakeholders around common goals.

A Bayesian model for assessing multiscale species-habitat relationships

Stuber, Erica - University of Nebraska-Lincoln; Lutz Gruber - Quantco; Joseph Fontaine - U.S. Geological Survey Nebraska Cooperative Fish & Wildlife Research Unit, University of Nebraska–Lincoln

Despite a keen awareness that species-habitat relationships work across spatial scales few studies investigate the relative importance of multiple scales at resolutions higher than local versus landscape-level. In part our limited understanding of habitat relationships is due to a paucity of methods capable of simultaneously handling multiscale data. We developed an N-mixture model for species abundance that incorporates different spatial scales by allowing the selection of the scale that best explains species abundance based on evaluations of posterior quantities. Our fully Bayesian selection method facilitates model averaging for improved estimation and allows propagation of model uncertainty to subsequent analyses. We present results from a simulation study validating our selection method based on simulated relationships between the proportion of woodland, grassland, small grains, row crops, CRP, and wetland at multiple spatial scales and count data for a

simulated species. Next, we apply our method to avian point count data and associated landcover from Nebraska. Our analysis revealed that spatial scales of the top performing models were generally clustered around neighboring scales; furthermore, the spatial scale of predictors with strong effects were better identified than those of weak predictors, which typically had relatively uniform posterior distributions across scales. Our results demonstrate the importance of spatial scale of data collection for explaining species-habitat relationships and we outline avenues for future research in conservation and management, particularly under the umbrella species concept.

Reliance on the Yellow Sea predicts population collapse in a migratory flyway
Studds, Colin - University of Maryland, Baltimore County; Bruce Kendall - Bren School of Environmental Science & Management, University of California, Santa Barbara; Howard Wilson - University of Queensland; Danny Rogers - 5Arthur Rylah Institute for Environmental Research; Robert Clemens - University of Queensland; Nicholas Murray - University of New South Wales; Ken Gosbell - Victorian Wader Study Group; Chris Hassell - Global Flyway Network; Rosalind Jessup - Ornithological Society of New Zealand; David Melville - University of New South Wales; David Milton - Victorian Wader Study Group; Clive Minton - Victorian Wader Study Group; Hugh Possingham - University of Queensland; Adrian Riegen - Ornithological Society of New Zealand; Phil Straw - Avifauna Research and Services Pty Ltd; Eric Woheler - University of Tasmania; Richard Fuller - University of Queensland

The great spectacle of animal migration has fascinated people for centuries. However little is known about how stopover habitat, essential for refueling along the migration route, affects the population dynamics of migratory species. Migratory shorebirds in the East Asian-Australasian Flyway provide a natural experiment, as each of 10 species with sufficient data differ in how they use tidal mudflats in the Chinese and Korean Yellow Sea, an ecosystem that has declined in extent by > 65% in recent decades. We discovered that taxa relying more on the Yellow Sea while on migration have declined faster over the past 20 years. This is the first demonstration that migratory stopover sites can limit populations of multiple species on a flyway. It provides evidence that conservation efforts must focus more intensively on protecting stopover sites for migratory species.

Migratory Networks and Full-life Cycle Modelling in Migratory Songbirds
Stutchbury, Bridget - York University

Many migratory songbirds are in decline but understanding their population dynamics is challenging because individuals occupy widely divergent and geographically distant habitats during a single year. There is currently a large effort underway to gather sufficient demographic data on reproduction and survival, to measure seasonal carry-over effects, and to track migration movements to create ‘full-life cycle’ models to better predict population dynamics of migratory songbirds. Network modeling has been used to show, theoretically, that shifts in migratory connectivity patterns can occur in response to habitat or climate changes and that habitat loss in one region can affect sub-populations even in regions that are not directly connected. For instance, Taylor and Stutchbury (2016) developed a network model, parameterized by integrating long-term monitoring data with direct tracking to explain population trends in the rapidly declining Wood Thrush. This network model suggests that species-level declines in Wood Thrush are driven primarily by tropical deforestation in Central America and that future shifts in migratory connectivity could lead to unexpected population declines in key

breeding regions. In Purple Martins, however, about half of individuals undergo intratropical migration (ITM) movements that vary both spatially and temporally, and so the migratory network becomes far more complex. A growing number of migratory songbirds exhibit ITM on their wintering grounds, which greatly complicates the task of quantifying migratory connectivity and evaluating how this impacts conservation decisions.

What Science Tells US About Bird-Friendly® Farms
Stutchbury, Bridget - York University

Extensive tropical deforestation is a major driver of population declines of Neotropical-Nearctic migratory birds. For example, migration tracking of Wood Thrushes using geolocators has revealed that the forests of eastern Central America support over 50% of the entire North American population yet this same region is a global tropical deforestation hotspot. Forested coffee farms promote migratory bird conservation because they support a higher abundance and biodiversity of birds compared with sun coffee farms and other agricultural crops. Bird Friendly® coffee farms are not just for the birds and also support high biodiversity of other tropical species.

Bird community interaction between native forest fragments and Acacia mangium plantation in Borneo
Styring, Alison - The Evergreen State College; Joanes Unggang - Sarawak Planted Forests; Frederick Sheldon - Louisiana State University

Fragmentation of tropical rainforest is an important conservation concern. In Southeast Asia some plantation developers have retained patches of native forest within plantations to promote wildlife diversity, but few studies have examined effectiveness of such efforts. To provide more information on the interaction between native forest and plantation, we conducted surveys of birds in patches of logged native forest and surrounding groves of exotic plantation in Borneo. We asked the following questions: Does plantation age influence the bird community in adjacent native forest fragments? Are bird communities in the plantations influenced by the presence of native fragments? Are bird communities in more intensively managed plantations different compared to less intensively managed plantation? Do bird distributions across habitat types vary by functional trait? Our study was conducted in a 500,000 ha multi-use landscape in Sarawak, Malaysia. We identified 15 native forest fragments within exotic plantation, and these were partitioned into old groves (>7y) and young (< 5y). We conducted surveys in the native fragments and in the two age-groups of adjacent plantation at distances near (< 500m) and far (>500) from fragments. Species richness was highest in native forest fragments. In plantation groves near fragments, species richness remained comparable to native forest but dropped significantly ($p < 0.05$) in young plantation far from fragments. Functional traits such as feeding guild ($p < 0.05$) and species range ($p < 0.05$) significantly indicated habitat type with Bornean endemics and understory insectivores preferring native forest and widespread species preferring intensively managed plantation.

Identifying foods of a declining prairie grouse using DNA metabarcoding
Sullins, Daniel - Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University; David Haukos - U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, Department of Biology, Kansas State University

Diets during critical brooding and winter periods can influence lesser prairie-chicken (LEPC, *Tympanuchus pallidicinctus*)

population growth rates. During the brooding period, rapidly growing LEPC chicks have high calorie demands and are restricted to foodstuffs within their immediate surroundings. During cold winters, meeting thermoregulatory demands on available food items of limited nutrient content may be challenging. Therefore, our objective was to determine the primary animal and plant components of LEPC diets among native prairie, cropland, and Conservation Reserve Program (CRP) fields in Kansas and Colorado during brooding and winter using a DNA meta-barcoding approach. LEPC fecal samples (n = 314) were collected during the summer of 2014 and winter of 2014–2015, labeled, frozen, and DNA was extracted, amplified, and sequenced. Cytochrome oxidase I (COI) was sequenced to determine arthropod component of diet and a portion of the trnL intron region was used for the plant component. Among 80 readable fecal samples for arthropod, 35% of the sequences were from Lepidoptera, 26% from Orthoptera, 14% from Araneae, and 13% from Hemiptera. Plant sequences from 137 fecal samples were comprised of Ambrosia spp. (28%) followed by species in genera similar to Symphyotrichum (10%), Medicago (6%), and Triticum (5%). The predominant use of Lepidopteran prey contrasts with a hypothesized importance of Orthopteran foods. Lepidopteran genera that are known agricultural pests contributed greatly to the diets of LEPC in landscapes with a cropland component.

Street-wise: productivity, individual health, diet and prey abundance of Black Sparrowhawks (*Accipiter melanoleucus*) in a newly colonized urban population

Sumasgutner, Petra - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Jessleena Suri - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Eléonore Hellard - Biological Sciences Department, University of Cape Town; Sanjo Rose - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Gareth Tate - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Ann Koeslag - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Arjun Amar - Percy FitzPatrick Institute of African Ornithology, University of Cape Town

Despite the rapid and global transformation of natural landscapes into urban environments, we still lack a clear understanding on how these developments impact ecological interactions and evolutionary processes. This is particularly true for predator-prey and host-parasite interactions and the influence of urbanization on individual animal health. Urban birds may be exposed to prolonged stress; this may alter their body condition and parasite resistance. We explored if highly abundant avian prey might increase the reproductive output of an urban raptor and can buffer individuals from potential negative health impacts of novel urban stressors. We focus on the Black Sparrowhawk (*Accipiter melanoleucus*) and relate the timing of breeding, adult productivity and individual nestlings health (blood parasites, body condition and heterophils/lymphocyte ratios) to an urbanization gradient in Cape Town, South Africa. We found an interesting interaction term between the degree of urbanization and the timing of breeding, whereby early breeders produced more young in highly urbanized areas, but late breeders performed poorly in urban habitats. Surprisingly, no negative health impacts of urban nestlings were obvious. In fact for one

blood parasite, Leucocytozoon, we found a positive association between the degree of urbanisation and infection, potentially because there are fewer habitats for this parasite's vectors available. We also found no change in diet composition, consistent with the finding that prey species of Black Sparrowhawks were equally abundant across different habitat types. Our findings help to understand the success of the species in this newly colonised urban environment.

Habitat-linked fine-scale genetic structure, foraging behaviour and demographic responses to land-use changes in the Eurasian kestrel

Sumasgutner, Petra - Percy FitzPatrick Institute of African Ornithology, University of Cape Town; Julien Terraube - University of Helsinki; Alexandre Villers - Université de la Rochelle; Nayden Chakarov - Lund University; Aurélie Coulon - Université de Montpellier; Luise Kruckenhauser - Museum of Natural History Vienna; Erkki Korpimäki - University of Turku

Food availability is a major factor driving the reproductive output and survival of wild predator populations. However, few studies have investigated the interplay between land-use change, limitation in food resources triggering subsequent dietary shifts and spatial variation in fitness parameters. Here we predict that recent land-use change in northern landscapes might trigger a mismatch between individual and habitat quality during low food abundance years with negative consequences in terms of reproductive performance. We used a 3-year dataset of Eurasian kestrels (*Falco tinnunculus*, n=453 individuals) breeding in western Finland, combining main prey abundance (over a full populations cycle of voles) and diet composition analysed by stable isotopes, to examine how trophic ecology relates to individual quality indices including genetic heterozygosity, blood parasite infection, morphometric measurements, and breeding parameters. Specifically we investigated mismatches between individual quality, landscape composition (from intensive agricultural areas to more heterogeneous forested habitats) and reproductive success under fluctuating food conditions. Stable isotope analyse showed that passerine birds and lizards are both important alternative prey during low vole phases. Breeding males of high individual quality (i.e. high genetic heterozygosity) performed well in terms of nestling survival no matter in which habitat type they settled, while low quality individuals performed best in more heterogeneous habitats. These results suggest that heterogeneous landscapes might allow predators to buffer against food limiting conditions by offering more alternative prey, resulting in average levels of reproductive success for a higher proportion of individuals. This conclusion has important implications for biodiversity conservation in nordic agricultural landscapes.

Climate-driven carry-over effects on cached food quality and reproductive success of a boreal passerine

Sutton, Alex - University of Guelph; Dan Strickland - Algonquin Provincial Park; D. Ryan Norris - University of Guelph

Although long-term changes in climate have been shown to influence a number of species, we still have a limited understanding of the climatic mechanisms driving long-term changes in population abundance. The Gray Jay (*Perisoreus canadensis*) is a year-round resident of the boreal forest that relies on cached food for both over-winter survival and reproduction in the late winter. At the southern edge of their range in Algonquin Provincial Park, Ontario, Gray Jays have declined by over 50% in the last three decades. One hypothesis for this decline is that warmer temperatures are spoiling cached food, which then carries over to negatively influence reproductive performance (the hoard-rot hypothesis). We used multiple climate variables associated with processes that are known to either

maintain or degrade food quality based on previous studies from the field of food science to predict annual variation in brood size (on day 11) and breeding success (whether a nest successfully fledged young). Both brood size and breeding success were negatively influenced by the frequency of freeze-thaw events during the previous fall. During the pre-breeding period, brood size was also negatively influenced by environmental moisture, whereas breeding success was negatively influenced by mean temperature. Our results provide evidence that climate during different periods of the annual cycle can carry-over to influence reproductive performance in a resident, winter-breeding bird. Furthermore, incorporating knowledge from the field of food science could represent a novel avenue of future research aimed at understanding how caching species are susceptible to changing environmental conditions.

Back where they belong: Developing genomic resources to aid reintroductions of an 'extinct in the wild' species
Sutton, Jolene - University of Hawaii at Hilo, Department of Biology

Historically widespread within forest habitats on the Island of Hawai'i, the 'alalā, Hawai'i's only remaining crow species, declined rapidly during the twentieth century. Today there are fewer than 120 individuals, all existing in captivity, and all descended from just nine genetic founders. Although a detailed pedigree has been established and utilized for captive management (for example in choosing breeding pairs), the current population exhibits signs of inbreeding depression, such as poor hatching success. We recently generated a PacBio SMRT genome for the 'alalā to aid the long-term conservation of this species. This project is particularly timely given that there is a reintroduction experiment planned for September 2016. We have three main aims in utilizing our genome for downstream research. First, we will develop genome-wide SNP (single nucleotide polymorphisms) markers to elucidate the genomic basis of traits associated with inbreeding depression. SNP genotypes will also help to accurately estimate molecular relatedness, which will provide a tool for choosing breeding pairs. Second, we will examine diversity at candidate genes, especially those associated with immunity, and behavior. Understanding diversity at these genes can help managers predict how well individual birds will respond to new environments, including the transition from captivity to the wild. Third, we will use transcriptomics to assess gene expression patterns among individuals in the population. Together, these projects provide an opportunity to fully explore the value of genomics in biodiversity conservation, by combining the latest sequencing technologies and molecular analyses with data from a well-documented conservation- breeding program.

Metabolic Flexibility and Biogeography in Birds
Swanson, David L. - University of South Dakota Biology

Organismal metabolic rates are flexible traits which can respond reversibly to changes in climate or energy demands, prompting hypotheses for how metabolic flexibility is related to environmental variation. A central hypothesis is the climatic variability hypothesis (CVH), which posits that species inhabiting more variable climates will have more flexible metabolic phenotypes. Studies addressing the CVH in birds have begun to appear recently, mostly examining variation in basal metabolic rates, but a few also examining variation in cold- or exercise-induced maximal metabolic rates. Two generalizations can be made from these studies: 1) temperate-zone birds generally show higher metabolic rates in winter than in summer, but subtropical and tropical birds show more variable seasonal patterns of metabolic variation; and 2) species with populations inhabiting climates differing in

seasonality, often, but not always, show positive associations between metabolic and climatic variability. A growing area of research in this field seeks to understand the mechanistic underpinnings of metabolic flexibility at multiple levels of organization. This research has revealed that metabolic variation may be correlated with variation in several factors, and their regulatory pathways, including muscle size, cellular aerobic capacity, lipid transport and catabolism, and oxygen transport. A clearer understanding of how such factors are regulated in response to variation in temperature promises to be a helpful path forward to understanding how and over what time scales organismal metabolic flexibility can respond to variation in temperature and how such flexibility relates to broad-scale biogeographic patterns in birds.

Intercontinental Spread of H5N8 from Asia to North America

Swayne, David - SEPRL/USNPRC/ARS/USDA; Dong-Hun Lee - SEPRL/USNPRC/ARS/USDA; Justin Bahl - University of Texas Health Sciences Center at Houston; Mia Kim-Torchetti - NVSL/VS/APHIS/USDA; Mary Lea Killian - NVSL/VS/APHIS/USDA; Hon S Ip - DVL/NWHC/USGS/Department of the Interior; Thomas J DeLiberto - NWRC/WS/APHIS/USDA

H5N1 high pathogenicity avian influenza (HPAI) virus emerged in 1996 in Guangdong China (Gs/GD lineage) and has since spread to infect and cause deaths in wild birds, poultry and humans in over 68 countries in Asia, Europe and Africa. This H5N1 HPAI virus, through genetic drift in the hemagglutinin gene, has given rise to an interrelated family of different clades of H5 HPAI viruses. Phylogenetic network analysis and understanding of waterfowl migration patterns suggest the most recent Gs/GD lineage H5N8 clade 2.3.4.4 HPAI virus emerged in late 2013 in China, spread in early 2014 to South Korea and Japan, and reached Siberia and Beringia by summer 2014 via migratory birds. Three genetically distinct subgroups emerged from this intercontinental A group (icA) and subsequently spread along different flyways during fall 2014 into Europe (icA1), North America (icA2), and East Asia (icA3), respectively. All three subgroups reappeared in Japan, a wintering site for waterfowl from Eurasia and parts of North America. Novel H5N1, H5N2, and H5N8 viruses emerged in December, November and December 2014, respectively, by reassortment with North American low pathogenicity avian influenza viruses.

Hornbills: A role for zoos in supporting field conservation

Sweeney, Roger - Virginia Zoo

Modern zoos have long focused on advancing their ability to maintain healthy captive populations as a resources with the potential to be used to support in situ conservation work. Zoos have also work hard to match their ex situ management of captive populations with increased fund-raising for field conservation and conservation education and awareness campaigns. For a few highly threatened species of birds, zoos have also actively participated in more integrated field conservation and reintroduction programs, which sets a high standard for more zoo programs to aspire towards. Hornbills have some unique challenges for both in situ and ex situ conservation management, although recent advance in research and adaptive management are emerging for both zoological management and reintroduction biology. The Southern ground hornbill serves as an interesting case study showing how a better understand of developmental learning process within the cooperative breeding system has been critical for both zoological management, as well as for birds being reintroduced back into the wild. Recent advances with studying the developmental

learning process of juvenile southern ground hornbills within a cooperative breeding system has opened new opportunities for field biologists and zoos to combine behavioural research projects. Lessons learned from ground hornbill conservation have significant implications for the conservation management of other threatened hornbill species.

Wild American crows use age to assess relative risk communicated by dead conspecifics

Swift, Kaeli - University of Washington; John Marzluff - University of Washington

In corvids, discovery of dead conspecifics often provokes scolding and mobbing, suggesting that they may indicate risk. It remains unclear if the season (breeding or non-breeding) or the age of the dead conspecific (adult or juvenile) has any bearing on such response. To address this, we tested the response of wild American crows (*Corvus brachyrhynchos*) to dead (mounted) con- and heterospecific stimuli including an adult crow, a juvenile crow, a rock pigeon (*Columba livia*) and an eastern grey squirrel (*Sciurus carolinensis*). Our sites were within crow territories across the greater Seattle, WA area during summer 2015 (breeding, N=70 tests/stimulus) and winter 2016 (non-breeding, N=15 tests/stimulus). We presented the stimulus in the absence of the territorial pair and then recorded the number of adult crows and scold calls for 30 minutes following the discovery by an adult. Across stimuli, we observed no difference in the frequency of scolding between seasons. Scolds, however, were more likely to result in mobbing during the non-breeding season, a pattern largely driven by an increased rate of mobbing at pigeon and juvenile stimuli. Whereas dead adults elicited intense scolding and subsequent mobbing year round, dead juveniles and pigeons garnered less interest during the breeding season. As crow survival generally increases with age, a dead adult could act as a more conspicuous indication of danger than a dead juvenile. Wild crows appear sensitive to this and use this information to gauge appropriateness of mobbing during the breeding season, when it may be more costly.

Do habitat and risk of predation explain spatial patterning of nests?

Swift, Rose - Cornell University; Amanda Rodewald - Cornell Lab of Ornithology and Cornell University Department of Natural Resources; Nathan Senner - University of Montana

While nest placement may be guided by a wide variety of proximate abiotic and biotic cues, it often reflects preferences for particular habitats and interactions (or lack thereof) with other species, including predators. Examining spatial patterns of nest placement provides an opportunity to evaluate how various components of habitat and predation risk may define habitat suitability. We assessed the spatial distribution of 112 nests of a migratory shorebird, the Hudsonian Godwit (*Limosa haemastica*), found in Beluga River, Alaska, between 2009 and 2012, and explicitly tested the relative influence of habitat and predation risk on nest locations. We examined relationships between nest location, predation risk, and proximity to roads on nest fate using 64 nests that were monitored through nest completion between 2009 and 2011. Hudsonian Godwit nests were significantly clustered across the landscape (Figure 1), despite a lack of significant spatial autocorrelation (i.e. patchiness) in landscape scale vegetation parameters. At the micro-scale, vegetation patchiness within the bog also did not correlate with the density of godwit nests. Nest fate was not predicted by either the distance to the nearest conspecific neighbor nor proximity to roads. Thus, neither habitat attributes nor predation risk explained the clustering of godwit nests. These results suggest that Hudsonian Godwit nest locations may be based more on social cues than

underlying heterogeneity in vegetation or predation risk.

Atlantic Puffins and Razorbills Use Several Strategies to Partition Resources in Atlantic Canada

Symons, Stephanie - Atlantic Laboratory for Avian Research, University of New Brunswick; Tony Diamond - Atlantic Laboratory for Avian Research, University of New Brunswick

Seabirds are wide-ranging marine predators that are often used as indicators of marine food availability. They aggregate in large colonies during the breeding season making them easy to observe. Most knowledge of seabirds is collected from land-based observations at the birds' breeding sites, yet little is known about time spent at sea. Machias Seal Island, New Brunswick, Canada, is a migratory bird sanctuary, home to several breeding seabird species including the largest number of Atlantic Puffins (*Fratercula arctica*) and Razorbills (*Alca torda*) in the Gulf of Maine/Bay of Fundy. Puffins and Razorbills, are long-lived, pursuit-diving, central-place foragers that feed on forage fish. Little is known about how these two species partition resources in this area. Generally, seabirds partition resources by foraging habitats, foraging depths, and/or differences in prey. Using a mix of GPS technology and long term data collected over the past 20 years, my thesis project focused on determining differences in foraging distributions and/or selected prey items that allow these two species to breed sympatrically. Logger data collected from Puffins and Razorbills (n=8 for each) revealed that Razorbills fed in significantly shallower water than puffins and took shorter foraging trips. Colony observations of prey brought in to chick also showed a higher proportion of high-energy fish in the Razorbills diet. In addition to describing sympatric seabird interactions, locating and describing foraging hotspots will serve as a valuable base for delineating marine protected areas in the Gulf of Maine and the Bay of Fundy.

Rapid Physiological and Behavioral Flexibility in a Wild Bird: Optimizing Phenotypes in a Dynamic World?

Taff, Conor - Cornell Lab of Ornithology; Maren Vitousek - Department of Ecology & Evolutionary Biology, Cornell University

Responding appropriately to changing conditions is critical in dynamic environments. Individual variation in the flexibility of physiological mediators of phenotype may influence the capacity to mount an integrated response to unpredictable changes in social or ecological context. We describe a recently developed conceptual framework of rapid physiological flexibility that integrates ecological endocrinology with theoretical and empirical studies of phenotypic plasticity and behavioral syndromes (Taff & Vitousek, 2016 TREE). Recent advances in the study of behavioral flexibility and behavioral syndromes have clearly demonstrated the importance of incorporating dynamic measures of phenotypic traits, but key questions remain unresolved. For example, does between individual variation in behavioral flexibility reflect underlying variation in physiological flexibility? Do individuals exhibit integrated 'flexible phenotypes' or does flexibility vary independently for different phenotypic traits? We explore these questions using data from a wild population of tree swallows with repeated sampling of both oxidative stress and corticosterone responses to handling stress within individuals across temperature and life history stages. We couple these measures of physiological flexibility with extensive data on provisioning and incubation behavior from >250,000 RFID records to ask whether physiological flexibility is associated with greater behavioral flexibility in response to sudden weather changes, experimental predator presentations, and captures. Finally, we highlight the need for more research addressing variation in the scope and speed of physiological flexibility, discussing

implications for the evolution of behavior and for predicting the response of individuals and populations to rapidly changing environments.

Host associations and biogeography of parasitic avian chewing lice from Sub-Saharan Africa

Takano, Oona - Texas A&M University; Preston Mitchell - Texas A&M University; Gary Voelker - Texas A&M University; Jessica E. Light - Texas A&M University

Parasitic chewing lice (Insecta: Phthiraptera) of birds are found everywhere their avian hosts are distributed and are fairly well known from many regions. Lice have obligate parasitic relationships with the host (entire life cycle occurs on the host) and undergo vertical transmission across host generations, which can lead to high host specificity. Compared with Europe and the Americas, the ectoparasite fauna of African birds is poorly understood. Recent field expeditions exploring the avian diversity in South Africa, Benin, and the Democratic Republic of the Congo (DRC) allow an opportunity to obtain louse specimens from across this area. We investigated host associations and diversity of lice throughout South Africa. Lice were obtained from ornithological museum specimens representing a diversity of bird families. Lice were identified by morphology to genus and species when possible. Phylogenetic analyses were based on the mitochondrial COI and nuclear EF1-α genes, including closely related louse lineages from GenBank. A total of 167 species of bird hosts were examined, revealing 65 new host associations. Many of the newly collected lice appeared to be new lineages, and may represent species new to science. We also investigated biogeographic patterns of lice across Sub-Saharan Africa by constructing a molecular phylogeny of chewing lice from Benin, DRC, and South Africa. These widespread localities provide a broad geographic sampling and encompass several distinct habitat types with variation in humidity and other ecological factors. Patterns of species diversity and host specificity across the region will be discussed.

Surviving the heat: Nocturnal Sonoran Desert birds

Talbot, William - Department of Biology, University of New Mexico; Blair Wolf - Biology Department, University of New Mexico

In the Sonoran Desert, where diurnal surface temperatures can reach 70°C and air temperatures can reach 50°C, it is imperative for birds to defend body temperatures below lethal levels. Nocturnal activity buffers nightjars and owls against extreme environmental temperatures, and when environmental temperatures exceed body temperature, excess heat must be lost by evaporative cooling. During the breeding season, Lesser Nighthawks (*Chordeiles acutipennis*) and Common Poorwills (*Phalaenoptilus nuttallii*) nest on the soil surface and must cope with very high diurnal temperatures, while Western Screech-owls (*Megascops kennicottii*) and Elf Owls (*Micrathene whitneyi*), in contrast, use cavities in trees and cacti for nesting. As a consequence, owls and nightjars are subjected to very different diurnal heat loads, which affects their costs of thermoregulation and ability to balance their water budgets. More frequent and severe heat waves will raise nocturnal temperature minima and may affect activity periods or costs. An understanding of the thermoregulatory capacity across species may offer some prediction of their ability to adapt to changes in climate. We measured resting metabolic rates, body temperature, rates of evaporative water loss and thermal tolerance using flow-through respirometry. Nightjars showed markedly different capacities for thermoregulation in the heat tolerating air temperatures as high as 64°C and owls, in contrast, showed thermal tolerances similar to passerine birds (ca. 50°C).

Bills as radiators of body heat
Tattersall, Glenn - Brock University/Department of Biological Sciences

Bird bills rest at the cross-roads between form and function. Known for their diversity of forms as adaptive feeding structures, bills are also mechanosensory, chemosensory, and respiratory structures, served by a network of nerves and blood vessels. As endotherms, birds also must also contend with heat conservation in the cold and heat dissipation under warm conditions, and as uninsulated structures, bills are potentially significant sites of heat exchange. We initially demonstrated the potential for heat exchange to the bill of the toco toucan. The toucan bill is well vascularised, and blood flow appears to be altered according to ambient temperatures or changes in internal heat loads. The capacity for heat loss is up to 4-5 times the rate of resting heat production. We have also demonstrated that bill size is thermally plastic trait in terms of developmental growth. Quail reared in the cold show slower bill growth than birds reared at warm temperatures, and as adults are more effective at conserving heat loss from the bill, suggesting permanent alterations in the underlying vasculature. This pattern of bill size-temperature dependency is a widespread evolutionary response. In over 200 species of non-migratory birds, we found strong evidence for smaller bill sizes in species living in cold environments, with the strongest relationships in avian families with the highest latitudinal ranges. Combined, the story emerging is that avian bills are subject to selection by environmental temperatures in addition to their functional role in feeding.

Effects of migration distance on life history strategies of Western and Semipalmated Sandpipers in Perú
Tavera, Eveling - Simon Fraser University; David Lank - Simon Fraser University; Patricia Gonzalez - Fundación Inalafquen

Among and within species, shorebirds vary widely in life history strategies. Differences in migration distances correlate with slow vs. fast strategies, as assessed by juveniles' propensity to migrate and attempt to breed during their first spring of life, and variation in adult wing molt patterns. To assess age-specific migratory preparation and adult wing molt strategies of Western and Semipalmated Sandpipers, we compared both species' body mass, the extent of breeding plumage, and primary molt patterns at the Paracas National Reserve in Perú, 2012–2015. Primary molt for both species starts prior arrival at Paracas, with more than half of primaries molted by early October, including some with suspended molt. Within Semipalmateds, longer culmen lengths indicates eastern vs. western breeding populations, and those with longer bills molted later. Adults of both species prepared for migration in February-March, but no Western juvenile did so, indicating an oversummering strategy. In contrast, juvenile Semipalmateds showed bimodality. Most showed no migratory preparation, but ca. 31% fattened, molted and replaced outer primaries. Juveniles with more breeding plumage, lighter mass and longer culmens were also more likely to molt primaries. Those with longer culmens were heavier and tended to have more breeding plumage during the pre-migratory period. These culmen-related differences indicate a higher propensity for fast life history strategies in the eastern population of Semipalmated Sandpipers. In Western Sandpipers, fast life histories occur in northern non-breeding sites, and slow ones in southern ones. This study shows that in Semipalmated Sandpipers, both strategies co-exist in one non-breeding site.

Using networks to understand declines in migratory birds.
Taylor, Caz - Tulane University

The complex life-cycles of migratory birds make it challenging to identify limiting factors and drivers of declines. Potential drivers include habitat loss in breeding or non-

breeding ranges, climate change, or redistribution of populations caused by changes in migratory connectivity. Support for different hypotheses in real species is often provided in the form of correlations between patterns of local declines and habitat loss or weather patterns, assessment of occupancy patterns, or changes in vital rates. I developed a landscape network population model with three types of "nodes" (representing breeding regions, stationary non-breeding regions, and migration pathways). I simulate the removal of habitat in different seasons in networks that are limited by different factors and explore whether patterns of occupancy, correlations between habitat loss and abundance or declines, and changes in vital rates can be used as indicators of drivers of population trends.
Local habitat loss caused spatially-autocorrelated declines across the network but the autocorrelation pattern was hard to discern when habitat loss occurred in multiple places. The importance of individual nodes in stationary seasons was strongly related to local population size but the importance of pathway nodes was influenced more by the spatial arrangement of nodes. Only a small proportion of available of pathways were occupied, lending support for the "flyway" concept often used in conservation or management of migratory birds. Neither occupancy nor correlations between abundance/local declines and habitat loss were good indicators of limiting factors. Shifts in survival was the best way to pinpoint drivers of declines.

Allochrony and speciation in the band-rumped storm-petrel (*Hydrobates spp.*) species complex

Taylor, Rebecca - Queen's University; Mark Bolton - RSPB, UK; Annalea Beard - St Helena Government; Andre Raine - Kaua'i Endangered Seabird Recovery Project; Vicki Friesen - Queen's University

Allochrony, or differences in breeding time between populations of a species, can lead to divergence and eventually full speciation. Allochronic divergence is occurring throughout the range of the band-rumped storm-petrel species complex, where both spring and autumn breeding populations occur on different archipelagos. In the Azores, the spring and autumn populations were found to be strongly genetically differentiated. Differences in morphology and vocalisations were also found, leading to the hot season breeders being named as a distinct species, Monteiro's storm petrel (*Hydrobates monteiroi*). The other archipelagos with allochronic populations are at earlier stages along the speciation continuum between spring and autumn breeders, allowing us to investigate this type of divergence at different levels of differentiation. In addition to the allochronic divergence within archipelagos, the population of storm-petrels found on Cape Verde, which breed year-round, are also highly genetically differentiated from all other populations and are likely a separate species, *Hydrobates jabejabe*, and both the spring and autumn Galapagos populations also appear to be quite distinct. New research is further suggesting that the South Atlantic populations on St Helena and Ascension Island are highly genetically differentiated from all other populations as well, as are the Hawaii population. Our phylogenomic research should help to resolve the taxonomy of this cryptic species complex, as well as gain insight into the process of allochronic speciation.

Natural selection and the maintenance of reproductive isolation between hybridizing chickadees

Taylor, Scott - University of Colorado; Matt Carling - University of Wyoming; Zachary Cheviron - University of Montana; Irby Lovette - Cornell University

When locally adapted species meet and interbreed their hybrid offspring often exhibit reduced fitness. Although this is a common pattern, we still lack an understanding of the mechanisms that underlie reduced hybrid fitness. Black-capped (*Poecile atricapillus*), Carolina (*P. carolinensis*), and mountain (*P. gambeli*) chickadees hybridize where their ranges overlap. These species differ in physiological traits that contribute to aerobic capacity and basal metabolism, and preliminary data indicate that selection against hybrids may be related to genetic incompatibilities in core metabolic pathways. We sequenced RNA from five individuals of each species, assembled species-specific transcriptomes, and assessed sequence variation. Results of enrichment analyses indicate that multiple pathways involved in aerobic capacity (e.g., OXPHOS, lipid metabolism, glycolysis) are significantly enriched for fixed differences between the species. We hypothesize that a breakdown in aerobic capacity in hybrid chickadees due to these sequence differences may be facilitating maintenance of reproductive isolation.

The influence of coloration and life-history in the evolution of prealternate molt in Parulidae

Terrill, Ryan - Louisiana state University; Jared Wolfe - USDA forest Service Pacific Southwest research station Arcata; Glenn Seeholzer - Museum of Natural Science / Louisiana State University

Birds use their feathers for many different functions, and molt serves both to renew damaged feathers and alter phenotype. The patterns and drivers of the evolution of molt remain poorly understood. North American warblers are well known for their seasonal differences in plumages, which are caused by a partial molt of some feathers before the breeding season, called a prealternate molt. We hypothesize that the extent and function of prealternate molt varies with respect to a species' life history; and test to what extent prealternate molt serves to replace worn feathers or change phenotype. We hypothesize that warblers facing variable selective pressure on crypsis and species recognition through the year use prealternate molt for an ephemeral signal that does not preclude crypsis for the entire annual cycle. We investigated the influence of dichromatism and geographic/color-space overlap on replaced feathers using spectrophotometric measurements on museum specimens. The extent of prealternate molt may be influenced by feather wear incurred by solar exposure, migration, and parasite loads from nest type and foraging stratum We find that longer distance migrants undergo a more extensive prealternate molt, and that species with geographic overlap show phenotypic dissimilarity during the breeding season, and phenotypical similarity during the nonbreeding season; as well as a higher degree of color diversity in feathers replaced in the prealternate molt than those replaced in the prebasic molt. This suggests that migratory birds are able to use molt to optimize fitness over the variable selective regimes that they encounter during their annual cycle.

A generalizable energetics-based full-annual-cycle model of avian migration to facilitate continental-scale waterbird conservation.

Thogmartin, Wayne - United States Geological Survey; Eric Lonsdorf - Franklin and Marshall College; Kevin Aagaard - United States Geological Survey; Sarah Jacobi - Chicago Botanic Garden; Malcolm Jones - United States Fish and Wildlife Service

Effective migratory bird conservation requires consideration of the spatially disparate locations used throughout the annual cycle. To meet this need we developed a spatially explicit energetic-based mechanistic bird migration model, operational at a variety of spatial and temporal scales. Our framework incorporates information about weather patterns, land use change, and seasonally variable availability of forage material to inform expectations of the influence of climate change on bird migration patterns. We applied this model to the non-breeding period and parameterized it using empirically derived information on movement patterns, stopover dynamics, and physiological constraints of a dabbling-duck like bird. Results of our model indicate agreement with telemetry-derived migration patterns (mean autumn migration length: 27.5 d of flight; mean autumn survivorship (95% CI): 90.5% (89.2%, 91.9%); mean spring migration length: 23.5 d of flight; mean spring survivorship (95% CI): 93.6% (92.5%, 94.7%). Sensitivity analyses suggested survival was sensitive to flight speed, flight cost, fuel load (i.e., fat deposits), and the configuration of forage material on the landscape (but was generally insensitive to total energy availability). Continental patterns in bird-use days occurred in relation to wetland cover and agricultural habitat in the fall. Bird-use days were highest in both spring and fall in the Mississippi Alluvial Valley and along the southeast Atlantic Coast. This sort of spatially explicit information may allow decision-makers to prioritize conservation actions toward locations most influential to migratory success. Thus, this mechanistic model of avian migration provides a decision-analytic medium integrating the potential consequences of local actions to flyway-scale phenomena.

A day in the life of a Whooping Crane: habitat use and movements on the wintering grounds

Thompson, Hillary - International Crane Foundation; Patrick Jodice - U.S. Geological Survey, South Carolina Cooperative Fish and Wildlife Research Unit; Anne Lacy - International Crane Foundation

In the late 1940s, Whooping Crane (*Grus americana*) populations declined to ca. 15 individuals that migrated from Canada to Texas. In an effort to save this species from extinction, an Eastern Migratory Population (EMP) was established in 2001 which currently consists of ca. 100 individuals that breed in Wisconsin and winter throughout the southeastern United States. A general understanding of winter distribution is known for the EMP, but a thorough assessment of local scale habitat characteristics of the wintering grounds has not been conducted. The objectives of this study are to quantify daily movement and identify local scale habitat characteristics of areas used by wintering Whooping Cranes in the EMP. During 2015 and 2016, we used radio telemetry to track 20 and 23 groups of Whooping Cranes respectively, each for one full day. We recorded location, behavior, and habitat characteristics of used areas every 30 minutes from before sunrise until after sunset. Daily home range sizes averaged 3.6 km2 in 2015 and 4.1 km2 in 2016, calculated with 95% kernel density estimates. During both winters, cranes moved an average of 8.4 km in one day. We describe used areas by combining remotely-sensed land cover data and observed habitat characteristics. Wintering Whooping Cranes occupied areas including riverine wetlands, flooded agricultural fields, and coastal marshes and appeared to avoid forested and developed areas. This research will help inform management and protection of the wintering grounds of Whooping Cranes in the EMP and ultimately contribute to the recovery of this endangered species.

Can heat dissipation behaviour be used as an indicator of underlying physiological stress?

Thompson, Michelle - University of Pretoria; Andrew McKechnie - University of Pretoria; Susan Cunningham - University of Cape Town

Conservation researchers are currently faced with the challenge of finding methods to easily and efficiently assess species' relative vulnerabilities to climate change. Avian heat dissipation behaviour (e.g. panting or gular fluttering) is easily observable in the field and might provide such a tool. We developed an index, the 'HD50', calculated as the air temperature (Ta) at which half the observed individuals of the species are displaying panting or gular fluttering. We aimed to test whether HD50 can indicate the degree to which an organism is undergoing thermal physiological trade-offs, as indicated by changes in core body temperature (Tb). We focused on seven species of Kalahari Desert birds with varying HD50 values (10°C range), body masses and foraging guilds. To establish whether the differences in HD50 within species were related to the availability of water, we compared daily modal Tb (Tbmod) and variation in Tb during the hottest period of the day (12:00 – 18:00) on water restricted and non-restricted days. We hypothesised that all species would show more variation in Tb and reduced activity on water restricted days, with species with low HD50s showing a greater response compared to species with high HD50. On restricted days species greatly increased HD50, although frugivorous species showed no change. Contrary to expectations, high HD50 species increased Tbmod and showed higher variation in Tb on water restricted days, whereas lower HD50 species did not adjust Tb responses with water restriction. Results will be discussed in conjunction with diet, adjustments in activity and microclimate selection.

Autonomous Recording Devices Reveal Complex Patterns in Avian Availability and Site Occupancy

Thompson, Sarah - USGS Alaska Science Center; Colleen Handel - USGS Alaska Science Center; Skyler Vold - Montana State University; Lance McNew - Montana State University

We assessed how date, time, and weather affected avian availability for detection (i.e. the probability that an individual signals its presence by vocalizing) with the use of autonomous recording devices in northwestern Alaska during 2013 and 2014. We processed 1,420 10-minute recordings at 11 sites, spanning a range of dates and times. Despite the lack of distinctive dawn and dusk at this latitude, most species demonstrated strong diel patterns in singing activity, increasing sharply around 0500 and maintaining a high rate of availability for much of the day, often as late as midnight. We also documented seasonal patterns in availability with many species having their highest availability immediately upon arrival at breeding grounds. Our goal was to isolate availability from other subcomponents of detection probability (e.g., perceptibility, presence). We minimized the influence of perceptibility by using a single, skilled observer who was allowed to replay recordings until confident that all possible species were detected. To focus on availability of species at occupied sites, we needed to omit sites where the bird was not an occupant. This step turned out to be more complicated than we had anticipated. Different species were detected in 0.28-89% of recordings for each site, demonstrating that occupancy exists along a gradient. Sites had 16–27 total species, but even with reasonably generous definitions of occupancy, we found that 33–55% of species were observed very rarely, and, depending on study goals, may not represent true site occupants. We use this information to recommend optimal survey strategies.

Seasonal movements during the non-breeding season

Thorup, Kasper - Center for Macroecology, Evolution and Climate, Natural History Museum of Denmark, University of Copenhagen

Traditionally, migration is thought of as the to-and-fro movements linking the stationary periods of breeding and non-breeding. However, regular seasonal movements also occur during the non-breeding season (so-called itinerancy) and considerable movement occur in species breeding within those areas serving as winter grounds for higher-latitude breeders, such as the Tropics. Little is known about why some species are itinerant and others not and how such movements ties in with the movements of local breeding birds. Large seasonal vegetation changes occur also in the Tropics, generally controlled by rainfall instead of temperature, and the non-breeding movements are naturally linked to these changes. Recent technological developments enables detailed spatiotemporal mapping of movement schedules for many smaller species. Such movements have been described within Africa and recent tracking has shown this to also occur in the South America. Here, we compare data on movements during the non-breeding season for several African-Palearctic species (common cuckoo, red-backed shrike, thrush nightingale, redstart, European nightjar and common swift) and evaluate potential relationships of movement to vegetation state. Co-occurring with these species are local species that also move. We compare movements of the locally breeding African and the high-latitude breeding common cuckoos to evaluate potential adaptation and constraints for moving in response to seasonal vegetation changes.

The genomic basis of bridling and thermal adaptation in a dimorphic seabird

Tigano, Anna - Queen's University; Ian Burns - University of Alberta; Vicki Friesen - Queen's University

Increases in temperature due to climate change are predicted to occur worldwide, but more intensely in arctic regions. Although one of the predicted effects of climate change in the Arctic is an increase in pathogen abundance and diversity, little is known about the potential of arctic species to adapt to emerging diseases. Standing genetic variation is the most readily available source of adaptive variation, and given the predicted speed and magnitude of climate change, arctic species must be able to adapt rapidly. To assess the potential to adapt to emerging diseases in a widespread arctic seabird, the thick-billed murre (*Uria lomvia*), we screened genetic variation at six toll-like receptor genes involved in innate immune response at each of six colonies along a wide latitudinal cline. We found no differentiation among colonies but significant differences in haplotype and peptide diversity indices, suggesting differences in local selective regimes, with evidence for balancing and/or positive selection. We reported low genetic diversity overall, exacerbated by a deficit of functional variation due to loss of function, lack of variation and gene loss in each of three of the six genes examined respectively. Our results suggest that thick-billed murres are maladapted to high pathogen abundance and diversity, and have little adaptive potential to emerging diseases due to climate change in the Arctic.

The genome of Bambusicola thoracicus and insights on molecular evolution in Phasianidae
Tiley, George - University of Florida; Peter Hosner - University of Florida; J. Gordon Burleigh - University of Florida; Rebecca Kimball - Department of Biology, University of Florida; **Edward Braun** - University of Florida

Recent large-scale whole genome sequencing efforts in birds have elucidated broad patterns of avian evolution and genome biology. However, despite the great interest in agriculturally important phasianids like *Gallus gallus* and *Meleagris gallopavo* we have limited knowledge about closely related species. We sequenced the *Bambusicola thoracicus* genome using a single insert library. The Bambusicola genome should be useful for evolutionary comparisons to Gallus, its sister genus. Our assembly was sufficient to generate high-quality data for evolutionary analyses. We examined the impact of selection on coding regions by examining shifts in the average nonsynonymous to synonymous rate ratio (dN/dS) and the proportion of sites subject to episodic positive selection. More protein-coding genes appear to have been subject to selection in Bambusicola than in Gallus (~3-fold more); there were ~6-fold more in Bambusicola than in the Gallus-Bambusicola ancestor. Many GO categories were enriched in the set of proteins that appeared to be subject to selection. This apparent genome-wide increase in positive selection in Bambusicola relative to Gallus probably reflects demographic differences between the species. One explanation might be the maintenance of larger long-term effective populations sizes in the Bambusicola lineage, possibly due (at least in part) to differences in the mating systems of the taxa. Genome assemblies generated using a single library have the potential to be a valuable tool for testing evolutionary hypotheses. That approach provided new insights into phasianid molecular evolution and generated a new resource (the *B. thoracicus* genome) for comparative studies.

Filling the Grinnellian niche: Capitalizing on Big Data to understand long-term range dynamics
Tingley, Morgan - University of Connecticut

Whether from citizen science efforts or museum drawers, biodiversity databases provide unprecedented access to information on the temporal and spatial aspects of bird occurrence. As such, these datasets are increasingly used to study how distributions are changing over short and long time-spans. Large amounts of spatio-temporal occurrence can also be used to comprehensively delineate the broad-scale environmental limitations of a species' distribution – the so-called Grinnellian niche. This talk will outline several key avenues of research that utilize fine-scale spatio-temporal occurrences to understand how the Grinnellian niche influences range dynamics over time, including relating quantifications of the niche to physiological tolerances in birds, and using a multi-dimensional climatic niche to understand apparently idiosyncratic shifts in range limits over time. Advances in Big Data provide novel opportunities not just to observe how distributions change, but also to understand the environmental underpinnings of those movements.

Effects of hummingbird morphology on specialization in pollination networks vary with resource availability
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Specialization of species in interaction networks influences network stability and ecosystem functioning. Spatial and temporal variation in resource availability may provide insight into how ecological factors, such as resource abundance, and evolutionary factors, such as phylogenetically conserved morphological traits, influence specialization

within mutualistic networks. We used independent measures of hummingbird abundance and resources (nectar), information on hummingbird traits and plant-hummingbird interactions to examine how resource availability and species' morphology influence the specialization of hummingbirds in three habitat types (forest, shrubs, cattle ranch) sampled over 10 sessions across two years in the southern Andes of Ecuador. Specialization of hummingbird species in the networks was measured by three indices: d' (related to niche partitioning), generality (related to niche width) and PSI (related to pollination services). Specialization indices d', generality and PSI of hummingbird species were influenced by resource availability. All indices indicated that specialization of hummingbirds increased when the availability of resources decreased. Variation in d' was also explained by an interaction between resource availability and bill length; hummingbirds with a long bill switched from being more specialized than other species when resource availability was low to being similarly specialized when availability was high. Overall, our results highlight the importance of ecological and evolutionary factors determining the specialization of species in interaction networks. We demonstrate in particular that ecological gradients in resource availability cause substantial changes in consumers' foraging behavior contingent on their morphology. Changes in pollinator specialization along resource gradients can have impacts on ecosystem functions, such as pollination by animals.

Seed selection and winter diet of Baird's Sparrow (*Ammodramus bairdii*) and Grasshoppper Sparrow (*A. savannarum*) in the Chihuahuan Desert of northern Mexico

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We analyzed the diet of Baird's (*Ammodramus bairdii*, n=146) and Grasshopper sparrows (*A. savannarum*, n=182) in three different sites and sampling periods across the Chihuahuan Desert in northern Mexico. Seeds in regurgitated stomach contents were identified to genus or family level with a DNA barcoding approach using the P6 loop of the trnL intron as genetic marker. Seeds from Panicoideae contributed most to the diets (53 ± 19 %), followed by Bouteloua (10 ± 12 %). We compared diet composition to the soil seed bank using a Dirichlet regression. Preferred seeds were Panicoideae ($P < 0.001$), Pleuraphis ($P < 0.001$), Eragrostideae ($P < 0.001$) and Verbena ($P = 0.038$). Avoided seeds were Chloris ($P = 0.003$) and Aristida ($P < 0.001$). Amaranthus, Asteracea and Bouteloua were consumed in proportion to their availability ($P > 0.05$). Bird species did not differ in selectivity ($P = 0.306$). In a related study we compared seed preferences of captive Baird's, Grasshopper, and Savannah sparrows (*Passerculus sandwichensis*) between native and exotic grass seeds. Of the exotic grasses, natal grass (*Melinis repens*) was preferred, but buffelgrass (*Pennisetum ciliare*) and Lehmann lovegrass (*Eragrostis lehmanniana*) were avoided, indicating that the invasion of these grasses may be a threat to overwintering passerines. Blue grama (*Bouteloua gracilis*) was frequently consumed by all birds, and Grasshopper Sparrow preferred sideoats

grama (*Bouteloua curtipendula*). The importance of Panicoideae in the field, and Bouteloua in both field and captivity, indicates that these seeds are important for winter survival of Baird's and Grasshopper sparrows.

Plumage genes and little else distinguish the genomes of hybridizing golden-winged and blue-winged warblers

Toews, David - Fuller Evolutionary Biology Program, Cornell Lab of Ornithology; Scott Taylor - University of Colorado; Rachel Vallender - Canadian Wildlife Service, Environment and Climate Change Canada; Alan Brelsford - University of California, Riverside; Bronwyn Butcher - Fuller Evolutionary Biology Program, Cornell Lab of Ornithology; Philipp Messer - Department of Biological Statistics and Computational Biology, Cornell University; Irby Lovette - Cornell University

When related taxa hybridize extensively their genomes may become increasingly homogenized over time. This mixing via hybridization creates conservation challenges when it reduces genetic or phenotypic diversity and when it endangers previously distinct species via genetic swamping. However, hybridization also facilitates admixture mapping of the traits that distinguish each species and the associated genes that maintain distinctiveness despite ongoing gene flow. We address these dual aspects of hybridization in the golden-winged / blue-winged warbler complex, two phenotypically divergent warblers that are indistinguishable using traditional molecular markers and which draw substantial conservation attention. Whole-genome comparisons show that differentiation is extremely low: only six small genomic regions exhibit strong differences. Four of these divergence peaks occur in close proximity to genes known to be involved in feather development / pigmentation. Throat coloration—the most striking plumage difference between these warblers—is perfectly associated with the promoter region of one of these genes, and genotypes at this locus obey simple Mendelian recessive inheritance of the black-throated phenotype characteristic of golden-winged warblers. The more general pattern of genomic homogeneity between these warblers likely results from a protracted period of hybridization, contradictory to the broadly accepted hypothesis that admixture between these species results from anthropogenic habitat change in the past two centuries. Considered in concert, these results are relevant to both the genetic architecture of avian feather pigmentation as well as the evolutionary history and conservation challenges associated with these declining songbirds.

Male and female genetic and non-genetic effects on breeding phenotypes in the Nazca booby (*Sula granti*)

Tompkins, Emily - Wake Forest University; Katharina Foerster - University of Tubingen; David Anderson - Wake Forest University

Recent evidence indicates that a male's identity can influence breeding traits that were once considered sex-limited characters expressed only in females. When relevant differences between males are genetic in origin, the indirect effect of his genes on her trait expression may profoundly alter trait micro-evolutionary potential. We quantified direct (female) and indirect (male) effects on laying date, egg volume, clutch size, and laying asynchrony in a socially and genetically monogamous tropical seabird, the Nazca booby (*Sula granti*), using GLMMs. Fixed effects included both parents' ages; male and female identity were fit as random factors. Males are numerically over-represented and individual differences may manifest most strongly on breeding probability. We contrasted age and identity effects on annual breeding probability with equivalent effects on breeding traits. We then decomposed the variance associated with identity effects into additive genetic and

permanent environment components using Bayesian animal models. Male age effects and male repeatabilities are greater for annual breeding probability than for traits expressed only in successful breeders. Annual breeding probability is reduced, and laying date delayed for young and old males. Male identity explains variability in breeding date, egg volume, and laying asynchrony expressed in his female partner, although effects are minor (repeatabilities < 0.10). However, indirect (male) genetic effects are not present for breeding traits, implying that any evolutionary change in trait values depends on genetic variation in females alone (heritabilities are low, but significant, for breeding traits in females).

Adventitious molt in an overwintering migratory bird: color change, carotenoid content, and implications for seasonal interactions.

Tonra, Christopher - The Ohio State University; Matthew Reudink - Thompson Rivers University; Kristen Marini - Thompson Rivers University; Kile McKenna - Thompson Rivers University; Kingsley Donkor - Thompson Rivers University; Rebecca Holberton - University of Maine; Ryan Germain - University of Aberdeen; Peter Marra - Smithsonian Migratory Bird Center

Plumage coloration in birds plays a critical role in communication and can be under selection throughout the annual cycle as a sexual and social signal. However, for migratory birds, little is known about the acquisition and maintenance of colorful plumage during the non-breeding period. Winter habitat could influence the quality of colorful plumage, ultimately carrying over to influence sexual selection and social interactions during the breeding period. In addition to the annual growth of colorful feathers, feather loss from agonistic interactions or predator avoidance could require birds to replace colorful feathers in winter or experience plumage degradation. We examined how conditions on the wintering grounds of migratory birds influence the quality of colorful plumage in both yearling and adult males. We predicted that the quality of American redstart (*Setophaga ruticilla*) tail feathers regrown after experimental removal in Jamaica, West Indies would be positively associated with habitat quality, body condition, and testosterone. Further we measured the carotenoid content of the colorful portions of original feathers and regrown feathers to determine if carotenoid availability in the breeding vs. winter range explains changes in feather coloration. Our results demonstrate how feather loss on the non-breeding grounds can negatively affect social signals, which can negatively carry over to the breeding period.

Prevalence, pathogenic potential, and fitness consequences of *Campylobacter* in migratory crows

Townsend, Andrea - Hamilton College; Conor Taff - Cornell Lab of Ornithology; Allison Weis - University of California, Davis

Campylobacter jejuni is the leading cause of foodborne illness worldwide, most commonly transmitted to humans through contaminated poultry. Although some wild bird species are documented carriers of Campylobacter, their role in human disease epidemiology is unclear. We examined the prevalence and pathogenic potential of *Campylobacter jejuni* in a human commensal bird, the American crow, in relation to its local and migratory movements. We found that more than 60% and 80% of feces sampled in California and New York, respectively, tested positive for *Campylobacter jejuni*. Full-genome sequencing revealed that many of these isolates carried genes associated with virulence in humans. Moreover, although Campylobacter is generally believed to be commensal in birds, Campylobacter appeared to have negative fitness consequences for crows: adult birds that tested positive for Campylobacter were in relatively poor condition and had a lower

apparent survival than birds that tested negative. Movement data, collected using GPS and satellite telemetry, illustrated the potential for crows to act as transport vectors of Campylobacter between urban and agricultural environments, and also their potential to vector the bacteria long distances along their migratory routes through the northern latitudes of the United States and into Canada.

Marsh bird occupancy dynamics, trends, and conservation in the southern Great Lakes basin

Tozer, Douglas - Bird Studies Canada

Using data from ~20,000 point counts conducted throughout the southern half of the Great Lakes basin by volunteers in Bird Studies Canada's Great Lakes Marsh Monitoring Program, I assessed: 1) whether occupancy of breeding marsh bird species increased or decreased between 1996 and 2013; 2) how occupancy and subsequent colonization or extinction was influenced by various site, wetland, and landscape scale covariates; and 3) to what extent wetland conservation projects that manage water levels for waterfowl benefit certain species. I found that occupancy of 9 of 15 (60%) breeding marsh bird species significantly decreased; that the largest number of decreasing species will benefit from conserving, restoring, or creating large wetlands surrounded by limited urban land use, and from addressing issues within International Joint Commission Areas of Concern; that individual or smaller groups of decreasing species will also benefit from conserving, restoring, or creating robust-emergent-dominated but interspersed, purple loosestrife (*Lythrum salicaria*)-free, Phragmites-free wetlands surrounded by higher proportions of wetland cover in the surrounding landscape, and from addressing issues within Great Lakes coastal wetlands; and that occupancy was significantly greater for 7 of 15 (47%) species at wetlands that manage water levels for waterfowl compared to unmanaged wetlands. The results show the power of citizen science and suggest a number of actions that will help promote colonization or reduce extinction and help slow or maybe even reverse declining trends in occupancy among decreasing species across the southern portion of the Great Lakes basin.

Simulating spatio-temporal dynamics of boreal bird habitats under natural and anthropogenic disturbances in a climate-change context

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Climate change is thought to strongly alter boreal forest processes, vegetation composition and age structure. As such, bird habitats should greatly change, triggering potential range shift in bird species. Most of studies projecting future bird habitats rely on species distribution models which are mainly based on projections of where climate conditions within the current species range might be expected in the future, but this approach does not take into account the projected realized migration of the habitat (e.g., forest cover). On the other hand, forest landscape models (FLM) simulate spatially and temporally stand- (e.g., succession, growth) and landscape-scale vegetation processes (e.g., seed dispersal, natural and anthropogenic disturbances). In this study, we present two study cases where a forest landscape model is used to simulate boreal bird habitats under natural and anthropogenic disturbances in a context of climate change. Specifically, we evaluate 1) habitat quality of a focal bird species in boreal forests, the black-backed woodpecker, and 2) critical habitat of a threatened boreal bird species, the Bicknell's thrush. Our results show that impacts of climate change are regionally

specific, and are amplified by anthropogenic disturbances. Generally, biomass decline for boreal tree species induced by climate change impact on growth as well as on natural disturbances (mainly increase in fire activity) prompt changes in boreal bird habitats especially in regions where harvesting rates are already important.

Diet of migratory bird nestlings in a riparian habitat revealed by DNA metabarcoding and next-generation sequencing of feces

Trevelline, Brian - Duquesne University; Steven Latta - National Aviary; Leesia Marshall - Louisiana State University - Alexandria; Tim Nuttle - Civil and Environmental Consultants, Inc.; Brady Porter - Duquesne University

Elucidating the diet of Neotropical migratory birds is essential to our understanding of their ecology and to their long-term conservation. Reductions in prey availability negatively impact Neotropical migrants by affecting their survival as both nestlings and adults. Beyond broad taxonomic or morphological categories, however, the diet of Neotropical migrants is poorly documented. Using the molecular techniques of DNA barcoding and next-generation sequencing, we elucidated the diet of Louisiana Waterthrush (*Parkesia motacilla*) nestlings in Arkansas and Pennsylvania, USA. Waterthrush have been shown to respond negatively to the reduced availability of aquatic insects in the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT taxa). We hypothesized that Louisiana Waterthrush nestling diet would be primarily composed of these pollution-sensitive aquatic taxa, and that changes in the riparian insect community would be reflected in their diet. Unexpectedly, the orders Lepidoptera (92%) and Diptera (70%) occurred frequently in the diet of Louisiana Waterthrush nestlings. Among EPT taxa, only the order Ephemeroptera (61%) was frequently detected whereas Plecoptera (7%) and Trichoptera (1%) were poorly represented. The frequency at which aquatic Ephemeroptera and terrestrial Lepidoptera were detected in waterthrush nestling diet differed significantly over the nesting period in Pennsylvania but not in Arkansas, suggesting that phenological shifts in the availability of non-EPT prey taxa may be an important yet undescribed factor influencing the foraging ecology of waterthrush on the breeding grounds. Furthermore, these findings suggest that terrestrial insects may be more important to waterthrush nestlings than previously thought, which enhances our understanding of this biological indicator and Neotropical migrant.

A Tale of Two Colonies: Using Stable Isotopes to Study Herring Gull Diet Over 30 Years of Rapid Change in the Great Lakes

Trimbath, Ryan - University of Akron; Anne Wiley - University of Akron; Craig Hebert - Environment and Climate Change Canada

The Laurentian Great Lakes ecosystems have seen dramatic changes in the 20th and 21st centuries, including the introduction of sea lamprey and dreissenid mussels, loss of wetlands, and pollution. Bulk C and N stable isotope data (d13Cbulk and d15Nbulk values) suggest that across the Great Lakes as a whole, Herring Gull (*Larus argentatus*) populations have shifted their diet to include more terrestrial and lower trophic level aquatic prey, apparently in response to decreased fish abundance. Here we use bulk and amino acid-specific stable isotope analysis on Herring Gull eggs collected from two Great Lakes colonies (Middle Island, Lake Erie and Double Island, Lake Huron) to further investigate the nature of dietary shifts over a 30 year period (1980-2012). Our results show that these two colonies exhibit contrasting patterns in response to ecosystem changes. Double Island shows a convergence on lower trophic level prey over time (decreasing d15NGlu-Phe; reduced

variability in d15Nbulk through time), suggesting that individuals' diets are becoming more similar (smaller isotopic niche). The lack of change in d15NPhe in Double Island Herring Gulls indicates that aquatic prey still dominates their diets during the period of egg formation. On Middle Island, individuals do not show a significant trophic decline and we see an expansion of the isotopic niche space (increased variance in both d15Nbulk and d13Cbulk through time).These data demonstrate the complexity of dietary shifts and encourage further investigation at smaller spatial scales to better understand how animal populations are responding to broad-scale changes in ecosystem processes and composition.

The benefits of juvenile dominance in Florida Scrub-Jays (*Aphelocoma coerulescens*)

Tringali, Angela - Archbold Biological Station; Reed Bowman - Archbold Biological Station

Within-brood dominance relationships may have important fitness implications. For example, socially-dominant juveniles, which enjoy priority access to resources, are expected to have higher overwinter survival than their subordinates. If dominance relationships established early in life are maintained into adulthood, juvenile dominance also may be an important predictor of reproductive success. We tested these hypotheses in the cooperatively breeding Florida scrub-jay (*Aphelocoma coerulescens*). We predicted that dominant juveniles would have higher overwinter survival, be more likely to breed, and do so earlier in life. Lighter birds bred earlier in life, as did dominant females. However, dominant males bred later than subordinate males. These differences are consistent with differing selection pressures on age at first breeding in male and female scrub-jays. Female scrub-jays that first breed at age two have higher lifetime reproductive success than those that breed at age three, but for males there is no difference. Although juvenile dominance did not influence overwinter survival or whether or not an individual ultimately bred, it did predict age at first breeding, indicating that juvenile dominance has fitness consequences later in life.

Next-generation sequencing of museum skins uncovers Mexican endemic bird lineages

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New DNA sequencing technologies are allowing researchers to explore large portions of the genomes of millions of natural history museum specimens. This is increasingly important given recent and current threats to biodiversity. In many cases, existing museum specimens provide the best source of DNA for genetic studies because modern sampling would be very difficult, unethical, or even impossible based on conservation status. Wood-Partridges of the genus Dendrortyx provide an excellent case study for next-generation sequencing of museum specimens. They are secretive and seemingly rare (or actually endangered) making collection of new samples difficult and most existing specimens were collected before it became commonplace to collect tissue samples. We performed target enrichment of 5,000 ultraconserved elements (UCEs) on DNA from Dendrortyx specimens already housed in the Moore Laboratory of Zoology. The phylogeny generated from concatenated UCE loci matched current species limits within the genus. Within one of the species, *D. macroura*, our concatenated tree supports three monophyletic lineages that correspond to geographically isolated populations in

Mexico that might be better described as full species rather than subspecies. Results from this study, and other recent studies, demonstrate the importance of natural history collections and their utility as genomic resources.

Assessing the influence migratory connectivity and stopover site disturbance on population dynamics using a full annual cycle simulation model
Tucker, Anna - Auburn University; Conor McGowan - USGS, Alabama Cooperative Fish and Wildlife Research Unit

Understanding the interactions between conditions at breeding, wintering, and migratory stopover sites is the focus of a growing body of research in full annual cycle ecology. Recent migratory network models have linked breeding and wintering sites to provide a better understanding of population dynamics in migratory species, but most models oversimplify the conditions encountered during migration itself. We build upon this framework by 1) including stopover sites as distinct nodes in the network and 2) incorporating migratory connectivity as a user input that influences network arrangement. This model allows us to better understand the importance of stopover habitat quality to long-term population dynamics of migratory species under varying degrees of connectivity. We simulated migratory networks with varying degrees of migratory connectivity. Using stochastic population projections for 25 years under different scenarios of migratory connectivity and stopover site perturbation, we show that decreasing stopover site carrying capacity results in a lower global population size, and these populations converged on a lower stable carrying capacity. As migratory connectivity (mc) increased (i.e. fewer connections between individual nodes), populations were more likely to go extinct, but extinction probability was lower at mc = 1 (0.20) than mc = 75 (0.50). Networks with low mc (more connections among nodes) had the highest projected population sizes under all scenarios of stopover site disturbance. This simulation model allows for population projections under a range of conditions, and can both enhance our understanding of the pressures faced by migratory species and inform management decisions at key stopover sites.

Patterns of divergence in wing morphology and stable isotope signatures across three barn swallow hybrid zones
Turbek, Sheela - University of Colorado, Boulder; Elizabeth Scordato - University of Colorado, Boulder; Rebecca Safran - University of Colorado, Boulder

Wing morphology is shaped by the conflicting demands of numerous selective pressures, including predation risk, foraging behavior, and migratory habit. In many taxa, migratory distance is positively correlated with wing length and wing pointedness, as longer, more pointed wings are thought to minimize energy expenditure during sustained forward flight. The barn swallow (*Hirundo rustica*) species complex contains three migratory subspecies that hybridize in Asia. *H. r. rustica* forms a hybrid zone with *H. r. gutturalis* in China and *H. r. tytleri* to the west of Lake Baikal in Russia, while *H. r. tytleri* hybridizes with *H. r. gutturalis* to the east of Lake Baikal. We examined divergence in wing morphology and stable isotope signatures across these zones. Whereas *H. r. tytleri* and *H. r. gutturalis* did not differ in wing pointedness or isotope signatures, *H. r. rustica* had longer, pointier wings and more enriched carbon isotope signatures than *H. r. tytleri* in Russia and *H. r. gutturalis* in China. The *H. r. rustica* x *H. r. tytleri and H. r. rustica* x *H. r. gutturalis* contact zones lie along the same line of longitude directly north of the Tibetan Plateau, a likely barrier to migration. These patterns of divergence thus suggest the presence of a migratory divide that intersects the two hybrid zones, with *H. r. rustica* migrating further than the other two subspecies. Future research will examine the

role of migratory behavior in promoting and/or maintaining phenotypic and genetic divergence among these parapatric subspecies.

When less is more: Omega-3 long-chain polyunsaturated fatty acids support aerial insectivore performance more than food quantity

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Once-abundant aerial insectivores, such as Tree Swallows (*Tachycineta bicolor*), have declined steadily in the past several decades, making it imperative to understand all aspects of their ecology. Aerial insectivores forage on a mixture of aquatic and terrestrial insects that differ in fatty acid composition, specifically long-chain omega-3 polyunsaturated fatty acid (LCPUFA) content: aquatic insects contain much higher levels of LCPUFA than terrestrial insects. We manipulated food quantity and quality for Tree Swallow chicks in a fully factorial design. High quality diets contained high amounts of LCPUFA, while low quality diets were low in LCPUFA, but contained an abundance of the LCPUFA precursor ALA, allowing us to separate the effects of LCPUFA in diet from the ability of Tree Swallows to convert ALA into LCPUFA. Fatty acid composition was more important for chick performance than food quantity. On high quality diets, chicks grew faster, were better conditioned, had greater immunocompetence and lower basal metabolic rates compared to chicks on both low quality diets. Increasing the quantity of high quality diets resulted in improvements to all metrics of performance while increasing the quantity of low quality diets only resulted in greater immunocompetence and lower metabolic rates. Chicks preferentially retained LCPUFA in brain and muscle when food quantity and quality were limited. In addition, compound-specific stable isotope analyses suggested that chicks did not convert ALA in diet into LCPUFA. Our work highlights the importance of fatty acid composition for aerial insectivores and reinforces the importance of high quality aquatic habitat for aerial insectivores.

The eyes of flycatchers: A new and unique cell type confers exceptional motion detection ability

Tyrrell, Luke - Purdue University; Esteban Fernández-Juricic - Purdue University

Tyrant flycatchers are a group of agile songbirds that must solve the difficult visual tasks of detecting, tracking, and capturing mobile insect prey. We have discovered a completely new cell type in the photoreceptor layer of two tyrant flycatcher species that could aid them in their difficult foraging task. All other birds have five types of cone photoreceptors. Each individual photoreceptor cell contains a visual pigment that absorbs light energy and a spherical oil droplet that filters light before the light reaches the visual pigment. The newly discovered structure in flycatchers is located in the same plane as the traditional spherical oil droplets, but the new structure is large, conical, and bright orange under light microscopy. Transmission electron microscopy has revealed that the structure is a large, dense group of megamitochondria surrounded by dozens of tiny oil droplets. With so many dense mitochondria present, the energy production potential within the cell is extremely high. Furthermore, the orange oil droplets surrounding the mitochondria only allow light wavelengths over 600 nm to pass. Light at these wavelengths increase energy production further, thus increasing temporal visual resolution and motion detection ability. Independent of the mitochondria, the orange droplets could further increase motion detection ability by preventing light in the blue and green wavelengths from reaching the visual pigment. By reducing the perceived light intensity of the blue sky background or

green vegetation background, the signal to noise (prey to background) ratio is increased to further amplify flycatchers exquisite motion detection ability.

Naturalized Parrots in the United States: Biophysical and Anthropogenic Influences on Their Distribution
Uehling, Jennifer - Cornell University; Jason Tallant - University of Michigan Biological Station; Stephen Pruett-Jones - University of Chicago

Established populations of exotic parrots now occur throughout the United States. The monk parakeet (*Myiopsitta monachus*) is the best known of these species due to its wide distribution in multiple states; however, numerous other parrot species are also now established. Using the citizen science databases eBird and Christmas Bird Count (CBC), we identified all species of parrots sighted outside of captivity in the contiguous United States during the five-year period 2009-2013. A total of 29 species were observed in the wild, and of these 23 are confirmed as breeding. We then used MaxEnt, a species distribution model, to examine the relative importance of different biophysical and anthropogenic variables in explaining the presence of these parrot species across the United States. Minimum January temperature was the most important for explaining parrot distribution across the entire U.S. When the northern and southern U.S. were considered separately, the distribution of parrots in the South was explained primarily by climatic factors. In the North, however, the relative importance of land covers, in particular forest, herbaceous, shrub, and planted or cultivated land covers, increased dramatically while the importance of climatic factors decreased. We suggest that in the South, suitable parrot habitat may be more widespread and therefore species distribution depends more on variation in climatic factors. In the North, there are fewer year-round food resources and human-altered urban areas may lack adequate nesting sites, which could explain why land cover variables are more important in determining habitat suitability.

Movement, isolation and gene flow of habitats specialist species among patches of white sand forests
Ungvari-Martin, Judit - Smithsonian Migratory Bird Center; Scott Robinson - University of Florida

One of the most critical questions in the origin and maintenance of species diversity is the extent to which isolation of habitat patches affects species composition, dispersal, gene flow and, thereby, incipient speciation, local evolution and differentiation. White sands forests form on essentially permanent soil formations and often consist of small, isolated patches or archipelagos. The questions we were interested in were the following: First, does patch size and distance between patches affect species richness in white sand forests? Second, do white sand forest specialists ever occur in the matrix outside of sandy patches? And third, can we find evidence of dispersal or gene flow among these patches? We hypothesized that species richness of habitat specialists in a habitat patch could be predicted by its area, and therefore we predicted that larger white sand forest patches would harbor more species of white sand specialists. We examined genetic variation within and among populations and we examined these variables for a white-sand specialist focal species (*Neopelma chrysocephalum*) living in a landscape in which patches of white sands forests are embedded in a matrix of clay sand forest. we found evidence that habitat specialization does not necessarily prevent birds from moving across the matrix of a different habitat. Genetic distances between inferred populations and the observed populations were consistent, suggesting high levels of gene flow throughout the populations.

Confronting models of central-place foraging in seabirds with data from a high-resolution radar

Urmy, Samuel - Stony Brook University; Joseph Warren - Stony Brook University

Seabirds forage in a dynamic, variable environment where food is patchily distributed in space and time. A variety of strategies, including random searches, commuting to remembered “hot spots,” and social behaviors such as local enhancement, network foraging, and colonial information transfer have been proposed as adaptations for foraging at sea. However, the data needed to test these hypotheses, especially those relating to social foraging, are rarely available: even with high-quality telemetry, the number of individuals tracked is typically too small to resolve social interactions. In contrast to the usual individual-based perspective, we take a population-level view of seabird foraging movements. Using theoretical analysis and simulation modeling, we predicted diagnostic patterns in the distribution of birds which emerge from different foraging behaviors and are practical to observe in the field. These predictions were tested at a colony of common terns (*Sterna hirundo*) at Great Gull Island, NY, USA, using data from a scanning marine radar mounted on the island during the summers of 2014 and 2015. This radar could detect feeding flocks and individual birds up to several km from the island. Bird movements and distributions consistent with several foraging behaviors were observed, with memory-based “commuter” foraging more predominant in the fish-poor year of 2014 and network foraging more common in 2015, when prey fish were more abundant. Population-level models and observations of seabird movements offer information on foraging behaviors not available through other approaches, and can provide a starting point for linking individual behaviors to population outcomes.

Evaluating the relationship between breeding bird distributions and functional connectivity in fragmented forest landscapes

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Maintaining functional connectivity is important for ensuring species persistence in fragmented systems. Consequently, understanding how animal movements are influenced by landscape pattern and composition is a critical challenge facing ecologists. Not all avian species exhibit sensitivity to fragmentation, possibly because only some are limited in their ability to disperse. Further, many researchers have begun using breeding season species distribution models (SDMs) to quantify functional connectivity, but empirical tests of their utility in this capacity are lacking. We used avian distribution data collected over a three-year period in southern Indiana forests to identify fragmentation-sensitive breeding birds, and to generate high quality species distribution models. We then conducted experimental translocations with Wood Thrush and Ovenbird to test the hypotheses that 1) movement abilities are more limited for fragmentation-sensitive species, and 2) homing routes are predictable based on SDMs. We found no evidence that landscape context influenced homing success, homing time, or path tortuosity for either species. Similarly, we found no evidence that the steps taken were influenced by the SDM values in proximity to those steps. Rather, birds maintained an unexpectedly high degree of fidelity to riparian corridors during homing. While neither of our hypotheses were supported, our results suggest that riparian corridors are important for avian movement, and possibly dispersal. However, lack of a link between fragmentation sensitivity and movement behavior indicates either that 1) factors motivating translocated

breeders (e.g., navigation or conspecific avoidance) do not mimic dispersal behavior, or 2) factors other than movement govern fragmentation sensitivity in these species.

Primordial germ cells as a route to access the avian genome

Van de Lavoir, Marie-Cecile - Crystal Bioscience

Embryonic stem cells and IPS cells are well known as conduits to genetic modification of the genome in mice. In chickens, ES cells do not enter the germline and this is thought to be due to a very early or predetermined segregation of the germline. In birds PGCs migrate from the germinal crescent, where PGCs are first morphologically identified, to the gonad via the vasculature. Hence PGCs are relatively easy to collect from one embryo and introduced into another embryo. To access the germline in chickens, primordial germ cell (PGC) cultures have been established that can be genetically modified and after reintroduction into a recipient embryo, will colonize the germline and develop into functional eggs and sperm. Random and targeted integrations, knock-outs and knock-ins have all been introduced into chickens using the PGC technology. Recently TALEN and CRISPR technologies have been added to the toolbox.
Birds are also unique in that PGCs can colonize the germline of other species, for example, cultured chicken PGCs can colonize the germline of guinea fowl embryos and the resulting guinea fowl roosters produce chicken sperm. This ability allows propagation of one species using the germline of another species, allowing for domestic birds to be surrogate parents for endangered birds.
The PGC technology is well established in chicken and is slowly spreading to other bird species. Primordial germ cell lines have been established from the houbara bustard, a bird in the order of the Gruiformes, indicating that these cell lines are not restricted to chicken.

Too close for comfort?: A long term investigation of Black Brant nest survival, density-dependent effects and changing threats

Van Dellen, Amanda - University of Nevada, Reno; James Sedinger - University of Nevada, Reno

The disadvantages of living in high densities of conspecifics are numerous, including greater rates of disease and parasite transmission, increased competition for food and increased aggressive interactions. Yet most species of seabirds and several species of waterfowl are predominately colonial breeders. Therefore, colonial breeding must be beneficial to maintain this otherwise detrimental grouping behavior. As the climate continues to change, coastal obligates will be subject to rising sea levels as well as an increase in extreme weather events. Species must now manage tradeoffs between historic (e.g. predation) and novel (e.g. extreme storm events) threats. We studied the effect of nest density on black brant nest success over a 22 year period on the Tutakoke River Colony in western Alaska and explored how density dependent effects changed during years of heavy arctic fox predation and extreme storm events. Here we show a positive effect of conspecific nest density on brant nest success especially in years with intense fox predation (high density nest success ± SE = 0.62 ± 0.01; low density nest success ± SE = 0.35 ± 0.01) and less so in years with storm event flooding (high density nest success ± SE 0.71 = 0.01; low density nest success ± SE = 0.67 ± 0.01). Our results demonstrate that colonial nesting brant clearly benefit from nesting in dense aggregations and imply that coloniality may be an evolved behavioral strategy for arctic nesting geese to compensate for nesting in open tundra habitats where conspicuous individuals may benefit from predator swamping.

The role of waterfowl movements in the spread of avian influenza virus

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Waterfowl are predominantly infected with avian influenza virus (AIV). Since AIV infection is weakly associated with body condition and immune status, waterfowl are proposed to transport this virus asymptomatically over large distances. Besides migratory movements, regional movements of waterfowl could also play an important role in the transmission of AIV to other wild birds, and potentially introduce the virus into poultry. However, whether these movements are hampered when birds are infected is unclear, but fundamental for understanding the emergence and spread of AIV. Therefore, we investigated the impact of AIV on daily movements of a key host species, free-living mallards *Anas platyrhynchos*. Adult males were fitted with GPS loggers, and local (< 100 m) and regional (>100 m) movements were recorded during the autumn infection peak. We compared movement behavior (i) within individuals (the same individual; infected vs non-infected state), and (ii) between individuals (infected and non-infected individuals). AIV infection was assessed at logger deployment and removal. To account for potential weather effects on mallard movements we included wind speed, temperature and precipitation in the analyses. Our findings suggest that AIV infected waterfowl are capable of transporting viral particles to other areas, although the distance of spread might be lower than one might expect from the behavior of non-infected individuals.

Conserved genomic landscapes of genetic diversity and divergence across an avian family

Van Doren, Benjamin - Cornell University; Leonardo Campagna - Cornell University; Barbara Helm - University of Glasgow; Juan Carlos Illera - Oviedo University; Irby Lovette - Cornell University; Miriam Liedvogel - Max Planck Institute for Evolutionary Biology

Comparative studies of genomic differentiation among multiple independent lineages provide insights into the speciation process, the relative importance of selection and drift in shaping genomic landscapes, the role of “divergence islands,” and the degree to which molecular evolution occurs in parallel. We investigated patterns of genetic diversity and differentiation in stonechats (genus Saxicola), a widely distributed avian species complex with phenotypic variation in plumage, migratory behavior, and morphology. We assembled a draft reference genome of a Siberian Stonechat (*Saxicola maurus*) and used pooled sequencing to explore patterns of divergence across the genomes of 262 individuals from 5 stonechat taxa. We found high conservation of genetic diversity and differentiation landscapes, suggestive of recurrent natural selection both before and after speciation. Furthermore, we compared differentiation outlier regions in stonechats to those in the closely related Ficedula flycatchers and found additional conservation of genomic outlier regions between genera. This correspondence of patterns of genetic diversity and differentiation suggests that similar processes are driving divergence in independent lineages, which may be the result of intrinsic properties of these genomic regions (e.g., low recombination rates). We also present evidence that, in some settings, genetic drift caused by strong founder effects may overwhelm these conserved patterns and result in a high degree of divergence across the entire genome. Studies employing genome scans should consider conserved regions of parallel differentiation when

searching for areas important in reproductive isolation, as evolutionarily conserved regions of high divergence may not necessarily represent speciation islands or be involved in local adaptation.

Reproductive Biology of the Sapayoa (*Sapayoa aenigma*), the 'Old World suboscine' of the New World
Van Doren, Benjamin - Cornell University; Sarah Dzielski - Cornell University; **Jack Hruska** - University of Kansas; Justin Hite - Kauai Forest Bird Recovery Project

The Sapayoa (*Sapayoa aenigma*), a low-density resident of Chocó rainforests from Panama to Ecuador, has long perplexed ornithologists. Originally described as a manakin (Pipridae), molecular work has revealed its closest living relatives to be Old World suboscines (Eurylaimides) and supported its placement it in the monotypic family of Sapayoidae. Despite such phylogenetic intrigue, little is known about the Sapayoa's general life history or reproductive biology; only one nest has been described. Here we present information on 2 actively attended and 13 inactive Sapayoa nests in Darién National Park, Panamá. We provide the first detailed description of individual effort at an active nest, family group dynamics during the nesting period, the plumage of immature birds, and the range of vocalizations produced. We also present the first documentation of cooperative breeding and compile several recent nesting observations, extending the published breeding period of Sapayoa by several months. Furthermore, we describe unusual behaviors among provisioning birds, including mounting between individuals of the same sex and mounting of a female by immature male helpers during chick provisioning. The receiving individual gave a conspicuous solicitation display before each mounting. Finally, we highlight elements of the Sapayoa's natural history that echo its Old World relatives and contrast with members of the New World Tyranni. For example, Sapayoa resembles the eurylaimid broadbills—and differs starkly from the manakins—in diet, nest structure, breeding system, and mode of parental care.

Evaluating Efficacy of Fence Markers in Reducing Greater Sage-Grouse Collisions
Van Lanen, Nick - Bird Conservancy of the Rockies; David Pavlacky - Bird Conservancy of the Rockies; Taylor Gorman - Bird Conservancy of the Rockies; **Adam Green** - Bird Conservancy of the Rockies; Laura Quattrini - Bird Conservancy of the Rockies

Greater sage-grouse populations have declined substantially over the last several decades, with much of these declines being attributed to habitat loss and fragmentation. Additionally, the density of fences and other anthropogenic structures has increased dramatically in sagebrush habitats over the last 50 years, with potential negative impacts on sage-grouse. Markers have been applied to fences to reduce collisions, yet there is little empirical evidence on their efficacy and how other characteristics of a fence and the surrounding landscape influence the probability or abundance of collisions. We developed a multi-scale occupancy model to estimate the probabilities of >1 sage-grouse fence collision and evaluate factors influencing those probabilities at 2 spatial scales among 26 leks in Wyoming, 2014-2015. We found strong evidence for lower collision probabilities at fences with wood posts and those farther from a lek. We also found substantial evidence for the ability of markers to reduce collision probabilities, although there was little difference between marker types, and a negative relationship between collision probabilities and the amount of fence exposure. Though fence markers were effective, wood posts were more effective at reducing collisions; therefore, t-posts should be replaced with wood-posts, when possible. Generally, markers should be placed on fences close to leks and in areas with shorter vegetation. Our study provides further evidence for the

efficacy of fence markers at reducing collisions, the influence of landscape- and local-level factors on collision rates, and provides land owners and managers with recommendations for efficiently implementing these methods to reduce collisions.

Population Structure and Movement Ecology of the Hawaiian gallinule (*Gallinula galeata sandvicensis*)

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The Hawaiian gallinule (*Gallinula galeata sandvicensis*) persists on the island of Oahu despite habitat loss in excess of 75% and the high prevalence of invasive predators. Remnant populations are primarily found in protected areas and artificial habitats like golf courses, botanical gardens, and wet agricultural areas, but these areas are separated by a diverse and likely inhospitable urban matrix. These fragmented populations are mostly small in size (5-30 individuals), and if isolated from one another have elevated extinction risk. Understanding the connectivity of remaining Alaeula populations is of critical importance to the species' persistence. We describe the current findings of an extensive, ongoing mark-resight study of alaeula on Oahu, and preliminary results of a population genetics analysis in which 83 individuals from 9 different wetlands were genotyped at 13 microsatellite loci and along 495 bp of the ND2 region of mitochondrial DNA. Remarkably few inter-wetland movements have been documented in Oahu's Alaeula population, and these observations are corroborated by evidence of moderate genetic structuring among Oahu's HAGA, even at very small scales (< 5km). The scale at which this structuring is occurring is small for avian taxa, even for sedentary tropical species, and may be the result of the rapid urbanization of Oahu's landscape. Habitat connectivity in this endangered subspecies is of major concern for its long-term conservation prognosis and future management.

GEOSCAPE: A new tool for tracking potential zoonotic disease and heavy metal contaminant sources in small wild birds

van Riper, Charles - USGS/University of Arizona

Although a great deal of information exists on migrant, breeding and wintering birds, and tools like geolocators are now available, determining the location of where small birds have acquired diseases or heavy metal contamination can be extremely difficult. A new tool called GEOSCAPE is being developed that, when added to existing technology, provides the ability to refine origin of location in smaller birds. Using mass spectrometry on known age feathers, Geoscape utilizes the newly produced U.S. Geological Survey mineral deposit maps and couples that information with breeding range and stable hydrogen isotope maps. This combination of tools will allow scientists to obtain a more precise location of avian disease origin. Disease examples will be given on tracking the origin of a migrant Wilson's Warbler found in Arizona with zoonotic disease antibodies, and a Dusky Woodswallow in Australia found with Hendra virus antibodies. A study on resident Song Sparrows in southern Arizona will be presented that demonstrates how Geoscape can be utilized as an indicator or recent heavy metal

Leveraging temporally sparse data to identify possible causes for population change in boreal forest bird communities

Van Wilgenburg, Steven - Canadian Wildlife Service / Environment and Climate Change Canada / Government of Canada; Diana Stralberg - University of Alberta / Department of Biological Sciences; **Samuel Haché** - Canadian Wildlife Service / Environment and Climate Change Canada / Government of Canada; Péter Sólymos - University of Alberta / Department of Biological Sciences; Steven Cumming - Université Laval / Department of Wood and Forest Sciences; Erin Bayne - University of Alberta / Department of Biological Sciences; Fiona Schmiegelow - University of Alberta / Department of Renewable Resources

The conservation of migratory bird populations is complicated by the need to identify and address limiting factors for declining species across their breeding and wintering ranges. Unfortunately, we lack detailed information on how specific populations are connected for many species. Because many populations are presently in decline, there is a need to identify when and where populations are most limited and what factors contribute to these declines. Recent technological advances in tracking migration combined with North American Breeding Bird Survey (BBS) data have yielded insights into climate- and land-use related factors driving population dynamics for several species. However, BBS sampling in the boreal forest is not sufficiently comprehensive to link population change to specific breeding or wintering ground factors. Furthermore, the time and resources required to amass detailed information on migratory connectivity for dozens of species would delay necessary conservation efforts. To address the paucity of data available for the boreal forest, we integrated BBS data with a large collection of point count data amassed by the Boreal Avian Modelling Project. Using these combined data sources, we used a machine learning approach to rapidly identify hypotheses for factors driving population change for 37 long-distance migrant species. Overall, our preliminary results suggest that breeding ground factors explained more variation in abundance, but a strong wintering ground signal was also observed. We discuss how our approach provides hypotheses for causes of population change that can inform conservation, as well as putative connectivity that can be further tested.

Comparative conservation genomics of the Endangered California Gnatcatcher and three co-distributed birds in Baja California

Vazquez Miranda, Hernan - Florida International University; Robert Zink - University of Nebraska

Population genetics and phylogenetics have aided species conservation by helping draw limits between differentiated populations. In Baja California most animals have endemic subspecies south of the Vizcaíno Desert. Mitochondrial DNA has confirmed many southern populations are separate species. In birds, subtle phenotypic differences despite genetic differentiation have led to species level and conservation status controversies. Moreover, the endangered California Gnatcatcher (*Polioptila californica*) controversies have generated scrutiny over known genetic and phenotypic variation assessment for listing/delisting species. Thus, novel high-resolution genomic markers promise to increase our differentiation diagnostic power for conservation.
To test the Vizcaíno diversification hypothesis, we genotyped single nucleotide polymorphisms (SNPs) in the endangered California Gnatcatcher, and unprotected Cactus Wren (*Campylorhynchus brunneicapillus*), Le Conte's Thrasher (*Toxostoma lecontei*), and Gila Woodpecker (*Melanerpes uropygialis*). We used Next-Generation Genotyping-by-Sequencing (GBS) and Restriction site-Associated DNA (RADseq) sequencing and SNP-based phylogenetic species-trees methods. We

found two phylogeographic patterns with over 60,000 SNPs: (A) a North/South break on the Vizcaíno Desert in unprotected species; and (B) an unstructured genealogy for the endangered species. Split species trees in unprotected species are consistent with mitochondrial DNA. Lack of population structure in California Gnatcatchers matches previous studies rejecting the Vizcaíno diversification hypothesis. We found substantial genomic differentiation in three out of four southern taxa and recommend full species status. Conversely, our data does not support distinct gnatcatcher populations indicating a single species. Our broader and more objective comparative population genomics framework will help governmental agencies evaluate and diagnose species levels in the genomic era.

How well do route survey areas represent landscapes at larger spatial extents? An analysis of land cover composition along Breeding Bird Survey routes

Veech, Joseph - Texas State University; Keith Pardieck - USGS Patuxent Wildlife Research Center; David Ziolkowski - USGS Patuxent Wildlife Research Center

The occurrence of birds in a survey unit is partly determined by the habitat present. Moreover, some bird species preferentially avoid some land cover types. As such, land cover composition within the 400-meter survey areas along a Breeding Bird Survey (BBS) route clearly influences the species available to be detected. Ideally, to extend survey results to the larger landscape, land cover composition within the survey area should be similar to that at larger spatial extents defining the landscape. Such representativeness helps minimize possible roadside effects (bias) here defined as differences in bird species composition and abundance along a roadside as compared to a larger surrounding landscape. Land cover data from the 2011 National Land Cover Database (NLCD) were used to examine representativeness of land cover composition along routes. Using ArcGIS, the percentage of each of 15 land cover types within 400 m buffers along 2,220 BBS routes were calculated and compared to percentages in 2, 5, and 10-km buffers surrounding each route. This assessment revealed that aquatic cover types and highly-urbanized land tend to be slightly under-represented in the survey areas. Two anthropogenic cover types (pasture/hayfields and cropland) may be slightly over-represented in the survey areas. Over all cover types, only 194 routes exhibited “poor” representativeness in that the difference in proportional cover between the 400-m and 10-km buffers was greater than 5 percentage points per cover type. This assessment further supports previous research indicating that any land-cover-based roadside bias in the bird data of the BBS is likely minimal.

Integrating dynamic vegetation models with abundance models to identify priorities for avian conservation and habitat management

Veloz, Sam - Point Blue Conservation Science; Leo Salas - Point Blue Conservation Science; John Kim - US Forest Service; Michael Case - University of Washington, US Forest Service; Dennis Jongsomjit - Point Blue Conservation Science; Joshua Lawler - University of Washington

Managers and decision makers recognize that successful climate-smart conservation strategies must focus on a broad range of future scenarios that include differences in climate, habitat types and species assemblages. Past attempts to model the changes in vegetation and animal species distributions tend to either rely upon coupled dynamic climate and vegetation models (DGVM), but produce output vegetation types that are too coarse to be useful for managers, or statistical models, which lack mechanisms that would actually lead to changes on the landscape. We developed a methodology for combining the projections from DGVM and statistical distribution models to project future

changes in vegetation and bird distributions across Oregon and Washington. Our approach makes more realistic projections of how Pacific Northwest ecosystems will respond to different climate change scenarios. We demonstrate how land managers can use our results to make climate-smart conservation decisions.

Impact of European settlement on genetic variation and population size of an endemic bird species of the California Channel Islands: *Aphelocoma insularis*

Venkatraman, Madhvi - Smithsonian Institution; Scott Sillett - Smithsonian Migratory Bird Center; Naoko Kurata - CUNY; Nandadevi Cortés-Rodríguez - Smithsonian Institution; Frank Hailer - Cardiff University; Nancy McInerney - Smithsonian Institution; Scott Morrison - The Nature Conservancy; Terry Chesser - USGS/NMNH; Robert Fleischer - Smithsonian Institution

Understanding how humans impact biodiversity and the environment is a central goal of conservation biology. The California Channel Islands provide a model system to assess the effects of anthropogenic processes on wildlife over hundreds of years. Following the settlement of Europeans in the 1800s, the islands were used primarily for livestock ranching. Overgrazing was widespread and caused habitat destruction, wildlife population declines, and the loss of many endemic taxa. We examined the effect of habitat change on genetic structure in the island scrub-jay (*Aphelocoma insularis*), a passerine endemic to Santa Cruz Island. The jay's chaparral and woodland habitat was heavily degraded during the ranching era, but began to recover after sheep were removed in the late 20th Century. We used a RAD capture approach to compare genetic diversity and effective population size of 28 individuals sampled in 2007 - 2008 with 28 historical museum specimens from 1898-1909. We found that the scrub-jay population showed evidence of a historical bottleneck that coincided with the change in land use followed by population expansion. Our new understanding of the island scrub-jay's population history will guide future decisions regarding the conservation of this species and the Channel Islands as a whole.

Effects of habitat heterogeneity on movements and survival of fledgling Dickcissels

Verheijen, Bram - Kansas State University; Brett Sandercock - Kansas State University

Many species of songbirds in North America have been declining in population numbers. Ongoing declines have been linked to habitat loss and fragmentation, and increased landscape homogeneity caused by agricultural intensification. To counter ongoing declines of grassland songbirds, we tested the potential benefits of patch-burn grazing management, which creates high levels of heterogeneity in vegetative structure. Recent studies found that patch-burn grazing management increases bird diversity and nest survival in Dickcissels (*Spiza americana*), but the impacts on fledglings, and total reproductive output of grassland songbirds, have been largely ignored. Due to their limited initial movements, the survival of altricial young after fledging is likely influenced by local variation in habitat structure, food abundance, and predator pressure. To assess the effects of heterogeneity in vegetative structure on the survival and movements of fledgling Dickcissels, a species of conservation concern, we applied transmitters to 48 fledglings at five experimental units at Konza Prairie LTER, Kansas.We found a potential conflict between the nest and fledgling stage of Dickcissels. Although nest survival tended to be highest in treatments with low heterogeneity, fledglings showed high mortality and actively moved away from those treatments. Rangeland management could potentially affect predators of nests and

fledglings in species-specific ways, potentially leading to life-stage specific responses to management in Dickcissels. Conflicts in habitat requirements among life-stages could have important implications for how we structure and evaluate conservation efforts.Moreover, a heterogeneous landscape could provide songbirds with a mosaic of habitats that could maximize both nest and fledgling survival.

Metabolic variation in snow buntings during phenotypic adjustments for wintering and migration

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Snow buntings are known for their association with cold environments. They spend winter in open and snow covered farmlands and males arriving on the Arctic breeding grounds face harsh winter-like conditions for weeks before breeding. However, whether this cold specialist undergoes substantial physiological adjustments to live in these environments remains to be determined. Working with captive birds exposed to semi-natural outdoor conditions in eastern Canada, our objectives were (1) to determine if metabolic adjustments were apparent during winter months and (2) to investigate whether metabolic changes occurring during spring migratory fattening could predispose birds to face cold on their arrival in the Arctic. Individual birds were measured repeatedly throughout a complete yearly cycle to measure variation in body components and metabolic performance. In winter, snow buntings showed phenotypic adjustments typical of those known for resident species wintering at this latitude. Birds increased their fat reserves (+50%) and exhibited significant changes in mass-independent summit (Msum +12%) and basal (BMR +6%) metabolic rates with the latter declining before the end of winter. During migratory fattening, birds enlarged their fat reserves by 400% and elevated their mass-independent BMR by 28%. In contrast, Msum did not vary during this period but remained at levels comparable to peak wintering conditions. These preliminary results therefore show that snow buntings do change their phenotypes for wintering. They also suggest that birds preparing for spring migration retain their winter thermogenic capacity and cold endurance, a feature that may be an asset for their arrival on the breeding grounds.

Domestic pigeon's checkered past: a link between wing color patterning, introgression, and hereditary blindness

Vickrey, Anna - University of Utah; Zev Kronenberg - University of Utah; Rebecca Bruders - University of Utah; E.j. Osborne - University of Utah; Mark Yandell - University of Utah; Michael Shapiro - University of Utah

Birds have evolved a vast array of color patterns in response to natural, sexual, and artificial selection. Domestic rock pigeons (*Columba livia*) are a stunning example of this diversity because individuals within the same species vary tremendously in color pattern. Classical genetics suggest that four alleles(T-check, Checker, Bar, Barless in decreasing order of dominance and melanism) at a single locus determine wing color pattern. Although the Bar pattern is thought to be the ancestral phenotype, Checker and T-check birds are more numerous in urban environments, possibly due to enhanced fitness. In this study we investigate the genetic basis of wing color pattern variation. We compared whole-genomes of Bar and Checker birds to identify a candidate region that was highly differentiated between the two phenotypes. Surprisingly, sequence comparisons suggest that a haplotype in this region that is shared by all Checker birds was introgressed into the rock pigeon from speckled pigeon (Columba guinea), providing a striking example of cross-species transmission of a potentially adaptive phenotype. One gene in the candidate region shows expression

differences among Bar, Checker, and T-check alleles in regenerating feathers indicating a cis-regulatory change at this locus. Lastly, Barless birds, which have an increased incidence of vision defects, are homozygous for a mutation in a gene that is associated with blindness in humans. Remarkably, the same mutation is also observed in two human families with hereditary blindness. This study highlights unexpected molecular links between color pattern, adaptive introgression, and vision defects in a classical model organism.

Distance in the dark: use of silent and playback methods to estimate abundance of the endangered Puerto Rican Nightjar in the coastal dry forests of Puerto Rico
Vilella, Francisco - USGS Cooperative Research Units; Rafael Gonzalez - US Fish and Wildlife Service

Estimating abundance of nocturnal birds with precision can be challenging given the inherent limitations in detectability. This can be further complicated for species inhabiting structurally complex environments such as tropical forests. Nevertheless, improved estimation techniques that account for detection probability and multiple observer bias are available. The Puerto Rican Nightjar (*Antrostomus noctitherus*) is an endangered caprimulgid restricted to coastal dry and lower montane forests of southern Puerto Rico. We estimated abundance of the Puerto Rican Nightjar (hereafter, nightjar) in three separate sites of southwestern Puerto Rico; Guánica Biosphere Reserve, Susúa Forest, and a small private reserve in the region of Guayanilla. We conducted silent and playback (point transect sampling with lures) surveys and used distance sampling to estimate abundance and density (nightjars/ha). Moon phase, cloud cover, and time of night were recorded during every survey. Our results suggested distance sampling was a viable method to estimate nightjar density and abundance. Both methods accounted for detectability and environmental variables (moon phase and cloud cover). However, point transect sampling with lures derived estimates with greater precision than silent surveys. Playback surveys increased detections among all habitat types. Nightjar detection was greater during the last quarter moon phase. Stratification based on habitat suitability levels may improve nightjar population estimates and allow comparison among habitat suitability levels and available habitat types. This approach may improve the information available to government agencies and non-governmental organizations involved in protection of the nightjar and its dry forest habitats.

What do birds indicate about landscape change resulting from intensive forest management?
Villard, Marc-André - Universite de Moncton

In northern Maine and the Maritime Provinces of Canada, natural disturbance regimes typically create landscapes dominated by old, uneven-aged stands with scattered, small canopy gaps. In contrast, the past and current forest management regimes of the region are creating extensive even-aged stands under short rotation systems, as well as structurally-complex deciduous stands under partial harvest systems. My students and I have used birds as indicators of the effects of forest management at both stand and landscape scales. Our study region (northern New Brunswick) comprises some of the most intensively-managed forest land in Canada, including extensive spruce plantations. Our research has yielded some interesting and, sometimes, unexpected results. For example, experimental translocations revealed that spruce plantations were consistently less permeable to the movements of a Neotropical migrant species (Ovenbird) than matrix types more similar to its breeding habitat, whereas no such effect was observed in the Black-throated Green Warbler. Brown Creeper nest survival decreased with the proportion of

spruce plantations within a 2-km radius, and within 100 m of the nearest edge. Intensive forest management through conifer plantation causes habitat loss for some species while promoting populations of some nest predators and reducing functional connectivity for species associated with deciduous-dominated stands. Forest birds appear to be sensitive indicators of such changes. Our current research aims to integrate data on habitat quality and distribution with estimates of functional connectivity to predict habitat supply and population viability under current and alternative management scenarios.

Science and bird conservation in Mexico: the role of The Sociedad para el Estudio y Conservación de las Aves en México CIPAMEX (1947-2015)

Villaseñor-Gómez, José Fernando - Universidad Michoacana de San Nicolás de Hidalgo, CIPAMEX; Raúl Ortiz-Pulido - Universidad Autónoma del Estado de Hidalgo, CIPAMEX; Katherine Renton - Universidad Nacional Autonoma de Mexico

The Sociedad para el Estudio y Conservación de las Aves en México (CIPAMEX) is the major Mexican ornithological society; it began in 1947 as the Mexican Section of Birdlife International, and its name and structure have been modified twice (1988 and 2008). During its first years (as part of a government structure), activities were limited to local research and species inventories; after its reorganization, focus and interests expanded importantly. Since then, research has covered new areas, and actions have targeted the development of new visions for conservation, innovative approaches, and international cooperation. Examples of those are the establishment and update of official instruments (such as the endangered bird species list for Mexico), the definition of Mexican Important Bird Areas, and the participation of the society as a member of the North American Bird Conservation Initiative committee. Among its publications are “Áreas de Importancia para la Conservación de Aves en México” (2000), “Conservación de Aves: experiencias en México (2003), “HUITZIL” as the Mexican Journal of Ornithology (since 2001), and “Avifaunas Estatales”, an ongoing effort to compile and maintain an updated list of birds for Mexican States. Since 1983, CIPAMEX has organized the Congreso para el Estudio y Conservación de las Aves en México” (CECAM), now in its XIV meeting. CIPAMEX has challenges and opportunities ahead; promoting cooperation and involvement at national and international levels are priorities. In order to fulfill those priorities, this symposium includes a sample of different approaches implemented in basic research, and actions demanded by present conservation challenges.

Eastern migratory bird species records in western Mexico

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Although isolated records of more than 30 species of warblers and other passerine species normally considered eastern migrants have been documented since the 18th century in western North America, a comprehensive synthesis and analysis of information is needed. We present information of museum specimens, publications, and field observations for ten species recorded for the State of Michoacan (western Mexico): two tyrants, a mimid, and seven parulids; they breed in eastern North America and are mainly transients or winter visitors in eastern and southern Mexico, as well as the Caribbean. Although these species have a few records as vagrants in different states for northwest and western Mexico, their potential distribution maps in Mexico of Navarro and Peterson (2007) do not include the new records presented for

Michoacan. We analyze the most recent records for the state, recognizing two patterns in relation to their known distributional ranges: (1) eight species normally migrate through eastern Mexico and do not have a defined route in western Mexico (Eastern Wood-Pewee, Yellow-bellied Flycatcher, Gray Catbird, Mourning Warbler, Canada Warbler, Prothonotary Warbler, Hooded Warbler, and Northern Parula), and (2) two species that winter in the south-east, east and southern Mexico could be considered as winter visitors in the Atlantic as well as in the Pacific slopes of Mexico (Worm-eating Warbler and Tennessee Warbler). With a more extensive fieldwork and monitoring is very likely to add at least other ten parulid species with similar patterns of migratory movements in the State of Michoacan.

Vocal divergence in the Yungas Manakin along an Andean elevational gradient
Villegas-Bilbao, Mariana - University of Florida, Wildlife Ecology and Conservation; John Blake - University of Florida, Wildlife Ecology and Conservation

Elevation provides an example of an ecological gradient along which sexual and natural selection interact and drive divergence in communication signals. Here we test the sensory drive hypothesis, which states that communication signals diverge as a direct adaptation to the signaling environment and can evolve to minimize degradation and maximize transmission. We examined variation in vocalizations along an elevational gradient (1300-2500 m) in cloud and humid montane forests in the Andes of Bolivia. We conducted sound transmission experiments to determine if transmission properties (i.e., reverberation, attenuation and distortion) changed along the gradient. Both reverberation and attenuation increased at higher elevations; distortion did not change. We recorded vocalizations from ~50 individuals throughout the elevational gradient and examined variation in duration and bandwidth of short calls (used as contact calls between males), 2 display calls (advertisement for females) and 2 types of male-male duets (including interval times between males). Duration of short calls increased slightly with elevation whereas bandwidth increased at mid-elevation categories and decreased at high elevations. Duration of display 1 and duet 1 both increased significantly with elevation; and bandwidth of both vocalizations decreased with elevation. Interval time between males in duet 1 also increased significantly with elevation. This study suggests that vocalizations in *C. boliviana* may be adapted to the habitat transmission properties along the elevational gradient; and perhaps increasing song length and concentrating energy within a narrow-frequency band may lead to an increase in amplitude and improvement in transmission. Overall, our results support the sensory drive hypothesis.

Corticosterone responses predict components of fitness in tree swallows
Vitousek, Maren - Department of Ecology & Evolutionary Biology, Cornell University; Conor Taff - Cornell Lab of Ornithology; Kelly Hallinger - Cornell Univerity; David Winkler - Cornell University

Glucocorticoid hormones, which rise in response to challenges, mediate changes in a diversity of phenotypic traits. Individual variation in glucocorticoid levels, or their context-dependent flexibility, could therefore impact the ability to cope with challenges. Here, we test whether corticosterone (the primary avian glucocorticoid) predicts components of fitness in a population of tree swallows (*Tachycineta bicolor*) breeding in central New York, USA, over a three-year period, under moderately variable conditions. Females with low baseline corticosterone levels during the incubation period, and those that mounted a stronger corticosterone response to a standardized stressor, had lower annual reproductive success. Model selection indicated that these measures of corticosterone, which did not covary within

individuals, better predicted annual reproductive success across years than any of the other factors we assessed, including body mass, age, nest box location, and weather conditions. Females with high baseline corticosterone during the provisioning period, and those that mounted a stronger corticosterone response, were also less likely to return the following year. These results fit with a growing body of literature that suggests that circulating glucocorticoid levels can, under some conditions, be intimately linked with fitness. Understanding how glucocorticoid-fitness relationships vary across contexts, and whether patterns stem from glucocorticoid-mediated changes in phenotype, or reflect non-causal associations, will be crucial for determining how these highly flexible traits may be shaped by selection.

Salmon subsidize songbird success
Wagner, Marlene - Simon Fraser University

Pacific Salmon (*Oncorhynchus spp*) provide a complex cross-ecosystem link between the ocean, freshwater, and terrestrial systems. When marine-derived nutrients from spawning salmon are transferred to riparian forests through various food web pathways, they increase invertebrate abundance and enhance plant growth and structure; thereby subsidizing resources that are important to birds. We quantified the influence of the annual salmon spawning event on the spatial aggregation, reproductive success, and diet of songbird communities across a wide range of salmon-spawning biomass on 14 discrete streams along the remote northern coast of British Columbia. Birds attained higher numbers, had higher body condition, and nested more densely as salmon biomass increased. Furthermore, marine-derived nutrients were found in feather samples on streams with salmon. This work further elucidates the holistic ecological importance of salmon to terrestrial ecosystems and provides new information to inform ecosystem and landscape-based management.

Habitat Use by Adult and Juvenile Black-capped Vireos: Natural Selection and the Importance of Considering a Broader Definition of Breeding Habitat
Walker, Lauren - University of Washington; John Marzluff - University of Washington

Across a diversity of wildlife taxa, natural selection shapes the choice of breeding sites to optimize reproductive success while balancing numerous tradeoffs such as adult survival and survival of dependent young. Breeding habitat may also, however, impact survival of independent juveniles, particularly in species such as migratory songbirds whose young face a risky period with high mortality rates shortly after independence. Juvenile songbirds may mediate risk by selecting pre-migratory habitat that provides cover and abundant food resources. To uncover potential tradeoffs in songbird breeding habitat use, we monitored territorial and independent juvenile Black-capped Vireos (*Vireo atricapilla*) and documented patterns in nest success, juvenile survival, and habitat use by both age classes. Breeding and juvenile vireos used habitats with relatively high deciduous and evergreen forest cover. However, while juvenile survival generally improved with increasing forest cover, perhaps because of increased insect availability, territory success was relatively low on breeding sites with abundant evergreen forest. Thus, adult vireos may accept tradeoffs in selecting breeding territories with more canopy cover to benefit survival of juveniles. Shrubland habitat was used also frequently by both adults and juveniles but was, surprisingly, inversely related to nest and territory success as well as juvenile survival, suggesting that alternative tradeoffs exist in selection of shrub cover. Land managers should thus consider the entire reproductive cycle in conserving vireo breeding habitat. While current

management guidelines focus on maintaining moderate shrub cover, breeding sites that provide nearby or adjacent forested areas may improve survival of recently independent juveniles.

MATE COMPATABILITY AND FITNESS IN A HYBRID ZONE BETWEEN SALTMARSH AND NELSON'S SPARROWS

Walsh, Jennifer - Cornell University; Brian Olsen - The University of Maine; Katharine Ruskin - University of Connecticut; Logan Maxwell - University of New Hampshire; W. Gregory Shriver - The University of Delaware; Kathleen O'Brien - United States Fish and Wildlife Service; Adrienne Kovach - University of New Hampshire

The effects of hybridization on evolutionary processes are primarily determined by the differential between hybrid and parental fitness. Identifying mechanisms responsible for driving fitness patterns in admixed populations can offer insight into the forces shaping zone dynamics. We evaluated the fitness consequences of hybridization between two tidal marsh birds, the saltmarsh (*Ammodramus caudacutus*) and Nelson's (*A. nelsoni*) sparrow. We assessed fitness of pure and hybrid females through nesting success and survival to adulthood, and fitness of males through paternity. We collected DNA samples from adults (n = 394) and nestlings (n = 431) and determined the extent of introgression using microsatellite loci. We predicted that differences in nesting and mating behaviors would influence fitness in pure and admixed individuals. Lastly, we assessed the role of mate compatibility, defined as a dissimilarity index, in influencing reproductive success. For females, we found that fledging and hatching success varied by genotypic class, with pure Nelson's sparrows exhibiting 33% lower success than any other genotype. Although we found no sign of reduced nesting success in F1 females, we found evidence for reduced survival in hybrid females. For males, we found extreme levels of multiple paternity for both Saltmarsh and Nelson's sparrows. In addition, we found that hybrid males sire few offspring, suggesting reduced fitness in F1 individuals. We found evidence for assortative mating, with few intraspecific crosses observed. Our findings suggest that extrinsic (differential behavior and nesting adaptations) and intrinsic (reduced survival) factors result in reduced fitness hybrid individuals, contributing to hybrid zone maintenance.

Temporal variability and cooperative breeding: testing the bet-hedging hypothesis in the acorn woodpecker

Walters, Eric - Old Dominion University; Walter Koenig - Cornell University

Cooperative breeding is generally considered an adaptation to ecological constraints on dispersal and independent breeding. This phenomenon may be a bet-hedging strategy that reduces variance in reproductive success (fecundity variance) in populations living in highly variable environments. We tested this hypothesis using long-term data on the polygynandrous acorn woodpecker (*Melanerpes formicivorus*). In general, fecundity variance decreased with increasing sociality when controlling for annual variation in ecological conditions. Decreased fecundity variance was insufficient to compensate for reduced per capita reproductive success of larger, more social groups, which typically suffered lower estimated mean fitness. We did find evidence that sociality in the form of larger group size resulted in increased fitness in years following a small acorn crop due to reduced fecundity variance. Bet-hedging, although not the factor driving sociality in general, may play a role when acorns are scarce and ecological conditions are poor.

To hear a mockingbird: The effects of urban noise pollution on Northern Mockingbird acoustic and visual signaling

Walters, Mitchell - University of Florida

With the steady rise in urbanization, species

are now forced to adapt to acoustic environments with increased levels of urban noise pollution and signal masking. The Northern Mockingbird (NOMO) is a species whose highly complex song is essential to reproductive success, yet it thrives in urban environments we know hinder signal propagation. I hypothesized that the NOMO makes both acoustic and non-acoustic adjustments to compensate for living in a noisy environment. I studied an urban/suburban NOMO population to see if urban noise affected song frequency and visual "flight display" behavior. I predicted that NOMOs in noisy areas would increase their song frequency and use more visual displays as urban noise increased. Because of the NOMO's complex repertoire, I further predicted that the increase in song frequency in noisy areas was due to birds shifting the same "masked" song types upward (syllable pitch plasticity) and choosing higher-pitched sounds to use in their song (differential syllable use). Although flight display use did not change significantly across the noise gradient, NOMO songs were higher-pitched in noisier areas. More specifically, the shift in song frequency was due to syllable pitch plasticity and not differential syllable use. Results from this study confirmed that urban birds change their vocal behavior to compensate for urban noise, but also suggest that many elements of their songs and displays may not be flexible.

Phylogenomics and mitogenomics place enigmatic phasianids (Aves: Galliformes)
Wang, Ning - University of Florida; Peter Hosner - University of Florida; Bin Liang - Hainan Normal University; Edward Braun - University of Florida; Rebecca Kimball - Department of Biology, University of Florida

The phylogeny of the Phasianidae (pheasants, partridges, and allies) has been studied extensively. However, positions for a number of taxa, e.g., Blood Pheasant (*Ithaginis cruentus*), Snow Partridge (*Lerwa lerwa*), and Long-billed Partridge (*Rhizothera longirostris*), remain enigmatic. Previous studies using different data types place Lerwa and Ithaginis in similar positions, but the absence of overlapping data means the relationship between them cannot be inferred. Although Rhizothera was originally placed in Perdix (true partridges), a partial CYTB sequence suggests it is sister to Pucrasia (Koklass Pheasant). To test these hypotheses, we used 3692 ultra-conserved element (UCE) loci and complete mitogenomes from 19 species selected to represent previous hypotheses and the major phasianid clades. Toepads were used for poorly studied taxa. All UCE analyses strongly supported placing Lerwa sister to Ithaginis plus a large clade including turkey, typical pheasants, tragopans, Pucrasia, and Perdix. Rhizothera was in this clade, sister to a large group including Perdix, typical pheasants, Pucrasia, turkey and grouse. The results of mitogenomic analyses differed, supporting a sister relationship between Ithaginis and Lerwa, rather than a grade. The position of Rhizothera using mitogenomes depended upon analyses, with unpartitioned and codon-based analyses placing Rhizothera sister to a tragopan clade, whereas partitioned DNA model was congruent with the UCE data. In all mitogenome analyses, Pucrasia was sister to a clade comprising Perdix and the typical pheasants with high support, in contrast to UCEs and published nuclear intron data. Overall, we have been able to place these enigmatic, poorly-studied, phasianid taxa with strong support.

The footprints of a moving Setophaga warbler hybrid zone: an analysis of plumage and behavior over space and time
Wang, Silu - University of British Columbia/Zoology; Darren Irwin - University of British Columbia/Zoology

The evolution of reproductive isolation is a key process in the generation of new species. It can be observed in hybrid zones, where

previously diverged lineages interbreed. Hybrid zones move over time due to density gradients or fitness differences between parental lineages. A moving hybrid zone admixes the parental gene pools differently than stationary hybrid zones, which needs to be considered when investigating speciation mechanism. The Townsend's and Hermit Warbler hybrid zone in the Washington Cascades is a great opportunity for understanding hybrid zone movement. Earlier work in the 1980s and 2000s concluded that this hybrid zone has been moving south over time. We confirmed the ongoing southward movement with sampling from 2015-16. We also investigated signatures of hybrid zone movement that can be observed within a single sampling period: both the cline shape and the linkage disequilibrium pattern across the zone suggested southward movement of this hybrid zone. We further tested the "competitive displacement hypothesis," which holds that the movement of this hybrid zone was driven by aggressive dominance of Townsend's over Hermit warblers. We found that all phenotypes responded with roughly similar aggression level to phenotypes like their own, suggesting no innate differences in aggression level to similar-looking individuals, but leaving open the possibility that each form responds differently to other phenotypes. By comparing spatial patterns of variation in a single season with variations spanning decades, this study builds our understanding of how to recognize moving hybrid zones and test potential causes of such movement.

Using automated telemetry to investigate small scale behaviors

Ward, Michael - University of Illinois at Urbana-Champaign; Antonio Celis Murillo - Illinois Natural History Survey; Matthew McKim Louder - East Carolina University; Todd Jones - University of Illinois; Jill Deppe - Eastern Illinois University; Lynn Schofield - National Park Service

Automated telemetry systems are becoming more popular and much of the interest in these systems is related to the data they can collect on migration. While these systems are providing interesting data on the long-distant migration, the systems can also be used to understand other behaviors. We used an automated system to understand the nocturnal behavior of Yellow-breasted Chats and Field Sparrows. While we know these diurnal species are active during the day the telemetry system provided data to show that both species were occasionally active at night and their activity patterns were likely associated with extra-pair copulations. In some environments automate telemetry is very challenging given the attenuation and multi-path (signal bouncing). Given these challenges we were still able to investigate the behavior of Brown-headed Cowbirds in a cypress forest. We determined when female cowbirds entered forests and when fledgling cowbirds left forests. Automated telemetry can also be used to quantify the mobility of fledglings. We investigated how active/mobile fledgling Dickcissels were and found that an individual's ability to move was closely associated with its survival. The final example is the behavior of migratory birds when they are not migrating. We studied the activity patterns of Red-eyed Vireos, Wood Thrushes, and Swainson's Thrush that were stopping over and found that at least Swainson's Thrushes change their activity patterns before migrating. These are just a few of the behaviors that can be investigated with automated telemetry. We discuss both the strengths and weaknesses of using automate telemetry to quantify behavior.

Facultative nest modification by Rock Wrens (*Salpinctes obsoletus*)

Warning, Nathanial - University of Northern Colorado; Lauryn Benedict - University of Northern Colorado

Dynamic nest-construction behaviors suggest that birds can facultatively adjust nest structures in response to environmental conditions. This is particularly true when nest-builders configure environmental structures

that are supplemental to the nest itself, because these structures can be adapted to local nest site conditions. Rock Wrens (*Salpinctes obsoletus*) mechanically alter their nest environments by amending cavities with stones, which are placed below and around a soft nest cup, anchoring the assembly. Nest stones often occlude cavity entrances and extend out of nest cavities. We measured stones and cavity dimensions in 68 Rock Wren nests to quantify stone form and functional variability in stone use. Nests in our study contained stones with a consistent, flat shape, suggesting that Rock Wrens were selective when choosing stones for use around nests. We found significant positive correlations between the size of the nest cavity entrance, the amount of stones placed in nests, and the occlusion rates of the nest cavity entrances. Our data suggest that Rock Wrens place stones around their nests using selective, goal-directed behavior with the objective of approaching an optimal cavity entrance size. Stone use at nests reflects high behavioral flexibility, and can be considered tool-use during nest construction.

A waterbird crisis of global proportions: filling in the Yellow Sea and implications for North American birds
Warnock, Nils - Audubon Alaska

The vast mudflats bordering the Yellow Sea provide critical support for a number of bird species that use the East Asian-Australasian Flyway (EAAF), including many Arctic breeding species. Of the 178 waterbird species that regularly use this flyway, 34 are classified as being either globally Near Threatened or Threatened on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List, making it the most threatened flyway of the world. The primary threat to birds using the Yellow Sea comes from the conversion of coastal wetlands and associated habitats to other land uses including industrial, residential, and agricultural. Since the 1950s, over 65% of the intertidal flats within the Sea have been reclaimed and the loss is projected to continue. As a consequence, rapid declines of various bird populations, particularly Arctic migrants, have been documented. An estimated 1.5–2.3 million birds from the families Anatidae, Charadriidae, and Scolopacidae come to Alaska from the EAAF each year. Over 80 species of waterbirds move between Alaska and Asia. The Yellow Sea is of particular importance to North American breeding populations of Dunlin, Bar-tailed Godwit, and Red-throated and Yellow-billed loons. The most recent study looking at survival of various Arctic shorebird migrants using the Yellow Sea, including Alaska's Bar-tailed Godwit, show steep population declines.

Integrating 'omics' approaches to understand physiological coping mechanisms in urban environments
Watson, Hannah - Lund University

Unprecedented rates of global urban expansion are already severely impacting ecological interactions and evolutionary processes. Marked differences in life-history traits, physiology, behaviour and morphology have been widely documented in urban birds. For example, urban birds often breed earlier, lay smaller clutches, have elevated antioxidant levels and exhibit bolder exploratory behaviour, compared with their non-urban conspecifics. Such phenotypic changes may enable them to cope with, and/or adapt to, the urban environment. Yet, we know little about the mechanisms underlying observed phenotypic variation, and to what extent differences are driven by genetic adaptation, epigenetic variation and/or phenotypic plasticity. The development of high-throughput 'omics' approaches has powerful potential to enhance our understanding of physiological coping mechanisms in urban birds. We used transcriptome sequencing, SNP (single nucleotide polymorphism) genotyping and DNA methylation sequencing, alongside the quantification of phenotypic markers of

physiological stress, to develop a comprehensive understanding of the genetic and non-genetic mechanisms underlying physiological responses to urban environments in the great tit Parus major. The great tit is widely distributed throughout Europe and common in both urban and rural habitats, and thus it has become a model system in avian urban ecology. Through this multidisciplinary approach, we aim to understand if urban-induced changes in physiology reflect (i) evolutionary (i.e. genetic) adaptation, (ii) direct up- or down-regulation of physiological regulatory pathways, and/or (iii) non-genetic adaptation via epigenetic modifications or maternal effects.

Relationships among attributes of glass prototypes and avian detection in an experimental flight tunnel.

Webb, Matthew - Caernegie Museum of Natural history; Luke DeGroote - Powdermill Nature Reserve - Carnegie Museum of Natural History; Christine Sheppard - American Bird Conservancy

We tested glass in a rotating flight tunnel stationed at Powdermill Avian Research Center in western Pennsylvania by artificially representing glass installed on a building, using mirrors and a background. Birds released from one end of the tunnel flew towards either a patterned test or clear (control) pane mounted on the opposite end of the tunnel before colliding with a mist net. Flights were video recorded and coded as “colliding” with the test or control pane. Although birds were able to detect the mist net moments before collision, we found no evidence of an interaction between glass pattern detection and mist net detection when a background was appropriately applied. We determined that birds flying quickly and straight down the tunnel were more likely to avoid the test pane, revealing that patterns can be detected more than 10 feet away. Probability of pattern detection was consistent among 21 species tested with more than 40 usable flights. Measurable attributes such as distance between lines or dots, pattern type (ultraviolet, translucent, opaque), glass thickness, and pattern surface were not related to avoidance. Efficacy of glass prototypes was entirely related to manufacturer, thus indicating that coatings, insulating gas, laminate, and ultraviolet reflectance were the primary drivers of collision deterrence. Our results of collision avoidance are consistent with recent results from other experiments and demonstrate that flight tunnels can be used to rapidly test numerous bird-friendly glass prototypes to reduce bird-window collisions for an array of North American species.

Parasites as markers of avian host ecology and evolution: Examples from the micro and macroevolutionary histories of parasitic chewing lice (Insecta: Phthiraptera)

Weckstein, Jason - Academy of Natural Sciences of Drexel University, Ornithology Department and Department of Biodiversity, Earth, and Environmental Science; Kevin Johnson - Illinois Natural History Survey

Prior to the advent of DNA sequencing technology, there was a long history of biologists using parasites to make inferences about host biology and evolution. However, the analysis of variation in associated parasite DNA sequences can serve as powerful tools for making inferences about host population structure, ecology, and phylogenetic history. In some cases, avian host DNA has not had time to accrue variation required to make inferences about genealogical history and thus the relatively rapid rate of evolution of their associated parasites provides an excellent proxy for reconstructing recent host evolutionary history. Patterns of parasites switching hosts or sharing of conspecific parasites among divergent hosts can provide inferences about historical opportunities for parasites to disperse between avian host species, and thus can elucidate historical distributions and

ecological interactions among bird species. Lastly, parasite evolutionary history can provide independent evidence to corroborate higher-level macroevolutionary relationships among lineages of birds. We will present examples from our own research and from the literature, where analysis of parasite DNA sequences at macro and micro-evolutionary scales allows us to make inferences about avian evolutionary history and ecology. We will focus on ectoparasitic chewing lice (Insecta: Phthiraptera), which are excellent markers for host evolutionary history and ecology, because they are permanent parasites on birds, evolve more rapidly than their hosts, and are a model system for the study of bird-parasite coevolutionary history.

Integrated population models reveal local weather conditions and not climatic effects explain variation in adult survival and fledging success in an aerial insectivore

Weegman, Mitch D. - University of Minnesota; Todd W. Arnold - University of Minnesota; Russell D. Dawson - University of Northern British Columbia; David Winkler - Cornell University; Robert Clark - Wildlife Research Division, Environment and Climate Change Canada

Expected changes to current weather patterns under a warming climate are complex: while warmer temperatures are expected virtually worldwide, a decrease in mean precipitation is expected at mid-latitudes and subtropical dry regions. Migratory birds are susceptible to spatially variable climatic and local weather conditions because most birds cannot predict conditions at the next stage of migration. Thus, population models which combine information from breeding, staging, and wintering areas are needed to understand environmental drivers of migratory bird population dynamics, and better inform conservation and management efforts. We utilized Bayesian integrated population models (IPMs), which combine capture-mark-recapture and fledging success data, to assess whether climatic (continental-scale) or local weather effects explained population dynamics in an aerial insectivorous bird of conservation concern, the tree swallow (*Tachycineta bicolor*), at sites in British Columbia (Prince George), Saskatchewan (St. Denis) and New York (Ithaca). Juvenile survival at all three sites was stable over time and greatest at Ithaca. Adult survival was more variable among years, and greatest at Prince George and St. Denis. Fledging success was greatest over the study period at St. Denis. Local weather conditions explained significant variation in adult survival at St. Denis and fledging success at Ithaca, whereby both demographic rates were greatest when birds experienced ‘good’ local weather conditions. Climatic effects did not explain significant variation in demographic rates. Hence, local weather conditions were most important to tree swallow population dynamics. Our findings illustrate the utility of IPMs to holistically estimate demographic rates and test hypothesized drivers of dynamics.

Predicting population trends of Arctic-breeding shorebirds in the context of global change

Weiser, Emily - Kansas State University; Brett Sandercock - Kansas State University; Stephen Brown - Manomet; Richard Lanctot - U.S. Fish and Wildlife Service; The Arctic Shorebird Demographics Network - Various

The Arctic supports large breeding populations of many species of birds and is threatened by climate change and altered predator communities. Available data suggest that many species of Arctic-breeding shorebirds are experiencing population declines, but information is sparse and population trends are often unclear or uncertain. The Arctic Shorebird Demographics Network used standardized protocols to monitor Arctic-breeding shorebirds at circumpolar field sites in Alaska, Canada, and Russia in 2010-2014. We used Bayesian hierarchical models to estimate

annual adult survival rates and breeding success for individually marked birds, and obtained estimates of chick survival and juvenile survival from related studies and the literature. We found that climate variables affected clutch size, nest survival, and chick survival, while abundance of anthropogenically subsidized predators affected survival of adults, nests, and chicks. We used our estimates of demographic rates and effects of covariates to develop full life-cycle models in a stochastic framework for six species of shorebirds (one plover, three sandpipers, and two phalaropes) to obtain estimates of current population trajectories. We then used the models to predict population trends in the context of expected scenarios for continuing anthropogenic change. Our results illustrate potential effects of global change and will help focus further research into key stages of the life cycle for these threatened species.

Examining dietary overlap in resident and wintering migratory warblers using next-generation metabarcoding of feces
Welch, Andreanna - Durham University; Luke Powell - Smithsonian Migratory Bird Center; Peter Marra - Smithsonian Migratory Bird Center; Robert Fleischer - Smithsonian Institution

Every winter billions of migratory birds travel to the Neotropics, thus dramatically increasing the numbers of insectivorous birds in terrestrial habitats. In the Caribbean, this annual peak coincides with a period of low arthropod availability. When food is limited, species with overlapping ecological niches can coexist, but interspecific competition may reduce individual fitness of one or both species. Therefore, the strategy by which species partition food resources is critically important. To examine overlap in diet niche, we collected fecal samples from birds at Font Hill Nature Preserve on the south coast of Jamaica. We employed a metabarcoding approach using next-generation sequencing to identify arthropod prey items of wintering American Redstarts (*Setophaga ruticilla*) and resident Yellow Warblers (*Setophaga petechia eoa*). We amplified a short fragment of the COI gene and sequenced resulting products on an Illumina MiSeq. We obtained sequences for up to 55 prey items per individual. We found a higher diversity of Dipterans (flies) in the diet of redstarts (59% of all prey items), whereas the diets of yellow warblers had a higher diversity of Lepidoptera (probably caterpillars; 24%). This was reflected to a greater degree in the relative abundance of prey sequences: 60% of sequences from redstarts were from Diptera (vs. 20% in yellow warblers), and 11% were Lepidoptera in redstarts vs. 48% in yellow warblers. Redstarts may take advantage of aerial maneuvering abilities to exploit an alternative prey source or yellow warblers may exclude redstarts from high quality habitat patches rich in caterpillars.

Conflicting regulations: balancing aviation safety and threatened/ endangered species using airport habitats
Weller, John - Federal Aviation Administration (FAA)

The Endangered Species Act (ESA) directs all U.S. Federal agencies to use their authorities to help conserve threatened and endangered species (TES). Section 7 of the ESA, called “Interagency Cooperation,” is the mechanism by which agencies ensure the actions taken, including those they fund or authorize, do not jeopardize the existence of any ESA-listed TES. TES may inhabit or intermittently use portions of the 2 million acres that comprise the 3,300 airports eligible for federal funding under the National Plan of Integrated Airport System. The presence of TES, combined with the special designation of critical habitat, can challenge the balance between the Federal Aviation Administration’s (FAA) duel mandates to provide safe aviation and species preservation. Because regulatory conflicts can impact development and management projects at airports, the FAA has developed a Memorandum of Agreement

with the U.S. Fish and Wildlife Service, Army Corps of Engineers and other agencies to ensure that aviation safety is duly considered related to the ESA. TES on airports may pose a direct safety risk by colliding with aircraft or an indirect risk by providing habitat for larger species. In addition, providing habitat for TES on airports presents a mortality concern for the protected species. Solutions to reduce impacts following the designation of a TES or the designation of critical habitat include the creation of habitat off-airport or, less ideally, on-airport but away from aircraft movement areas in undeveloped areas. Candidate Conservation Agreements and Candidate Conservation Agreements with Assurances may also prove beneficial to the airport.

Examining barn owl nest box occupancy at three spatial scales in Napa Valley vineyards

Wendt, Carrie - Humboldt State University; Matthew Johnson - Humboldt State University

Barn owls (*Tyto alba*) have the potential to provide pest removal services in a variety of agricultural systems worldwide including rice paddies, oil palm plantations, row crops and orchards. Rodent pests such as pocket gophers (*Thomomys bottae*) and voles (Microtus spp.) cause significant damage in vineyards. For decades, winegrape growers in California have erected artificial nest boxes in vineyards to attract breeding barn owls. The aim of this study was to examine the factors affecting nest box occupancy. We monitored 297 nest boxes in Napa Valley, CA during the spring breeding season of 2015. Nest boxes of variable design and placement were distributed across 65 vineyards that varied in local and landscape habitat composition. Barn owls occupied 92 of the nest boxes for breeding. We used variance decomposition to address cross scale correlations between three nested spatial scales and to analyze the variation in nest box occupancy explained by predictors at each spatial scale. The full model explained 41% of the variation in nest box occupancy. The nest box and home range scales were the most important spatial scales for predicting box occupancy. The home range scale explained the majority of the variance in nest box occupancy, indicating that barn owls select artificial nest boxes based on broad scale characteristics more than fine scale local habitat variability. Placing well-designed nest boxes in optimal habitat can boost rates of nest box occupancy, which could help farmers control rodent pests and increase regional barn owl populations.

Migration strategies and environmental factors influence annual survivorship in western USA hummingbirds

Wethington, Susan - Hummingbird Monitoring Network; Kira Newcomb - Hummingbird Monitoring Network; Scott Goetz - Woods Hole Research Center; Catherine Graham - Stony Brook University

With a decade of monitoring on species whose longevity records range from 10 to 12 years and with females nesting at 9 years, we can now begin detecting trends in hummingbird populations using data collected by the Hummingbird Monitoring Network. We combined mark/recapture data with remote-sensing and climate data and used Cormack-Jolly-Seber (CJS) open population Capture-Mark-Recapture (CMR) models with predictions that migration strategy and environmental conditions influence hummingbird survivorship. Due to greater environmental variability experienced, we predict that latitudinal migrants have lower survivorship than range-expansion migrants and males who migrate first have lower survivorship than females. Because expansion habitats likely are not optimal, we predict that habitat quality impacts survivorship of range-expansion migrants and females, because they perform all nesting activities, have lower survivorship than males. Analyses between migration strategies and sex included CMR data from 6 species, 3 in each strategy. Predictions were generally supported. To explore the effect of

environmental conditions and habitat quality, we estimated survivorship for Black-chinned (*Archilochus alexandrii*), a latitudinal migrant, and Broad-billed (*Cynanthus latirostris*), a range-expansion migrant, and included mean minimum and maximum temperatures, NDVI, total precipitation, and an aridity index; all calculated for each breeding season (March/April-July) and each prior wintering season (November – February/March). For Black-chinned Hummingbirds, increasing mean maximum temperatures during the breeding season negatively influenced survivorship; whereas for Broad-billed increasing winter NDVI had the strongest negative influence on survivorship. This paper begins a series of papers exploring how environmental conditions influence demographies of hummingbird species, using different migration strategies.

Louse on Snowy Owl Highlights Importance of Documentation During Specimen Preparation

Whatton, James - Smithsonian Institution; Ralph Eckerlin - Northern VIrginia Community College

The Snowy Owl (*Bubo scandiacus*) is a resident of the Arctic tundra with a circumpolar distribution. In the winter of 2013-2014 there was an unusually large incursion of Snowy Owls into the temperate zone of North America. During this timeframe, two Snowy Owls were struck by airplanes at Ronald Reagan National Airport, Arlington County, Virginia (38^0 51' 08" N 077^0 02' 16" W). One of these owls was donated to the Smithsonian Institution Division of Birds by the U.S.D.A airport biologist. While preparing the owl as a museum study skin, ectoparasites were found and preserved. These parasites were identified as biting lice, *Strigiphilus ceblebrachys* (Denny, 1842). The ectoparasite sample consisted of 5□, 3□ adults and 2 nymphs. This louse species, a member of the Order Phthiraptera, Suborder Ischnocera, and Family Philopteridae is a new record for Virginia. *Strigiphilus ceblebrachys* is apparently a very host specific parasite of the Snowy Owl and is not known to parasitize any other host species regularly. There are records of this species of biting louse in the United States, but Virginia may be the southern-most known locality of its occurrence in the United States. This case highlights the importance of complete examination of museum specimens to record all parasite observations and underscores potential methods of louse distributional movements.

Modeling transition rates of sandhill cranes using a multi-state model and estimating population trends with N-mixture models

Wheeler, Michael - University of Wisconsin, Madison; Tim Van Deelen - University of Wisconsin, Madison; Jeb Barzen - International Crane Foundation

Long-term trends in Midwestern sandhill crane populations indicate positive growth despite much yearly variability, and continued monitoring will be required for effective management. This study is being conducted to explore relationships between life-history stage and recruitment in sandhill crane populations, as well as to estimate the size of the study population. Since 1990, the International Crane Foundation (Baraboo, Wisconsin) has collected long-term re-sightings data on territorial and non-territorial sandhill cranes in southcentral Wisconsin. We used these data in a multi-state model to estimate survival and state-transition probabilities of different demographic groups. Primary sessions were on an annual basis, with observations being recorded during the breeding and chick rearing seasons. State variables were Territorial and Non-territorial, and classifying birds in either category was based on behaviors observed during re-sightings. Results suggest high annual survival rates (~90%) and low annual rates of territory acquisition or loss (~5%). Distance sampling and N-mixture models were used to estimate population size with visual

observation data independent of the mark-resight models. With estimates of population trends through time, we calibrated our matrix model to produce more realistic estimates of recruitment. Preliminary results suggest that survival of territorial adults and their continued tenure on territory have appreciable effects on growth rate – hence availability of suitable territories may regulate growth rates. Consequently, management of crane populations in the Midwest may depend on creating habitats that support territory establishment.

Differential sensitivity to weather in nestlings of two co-occurring songbird species

Wheelwright, Nathaniel - Bowdoin College; Robert Mauck - Kenyon College

Sensitivity of nestlings to weather is likely to differ among bird species and to depend upon when they occur relative to fledging. We examined the effect of wind, temperature, precipitation and fog on hatching and fledging success and on nestling condition over a 17-year period in Savannah Sparrows (*Passerculus sandwichensis*) and Tree Swallows (*Tachycineta bicolor*) breeding on Kent Is., New Brunswick. The two species are similar in size and occur in the same habitat, but swallows nest in elevated boxes and feed almost exclusively on the wing on flies and other small insects whereas sparrows build terrestrial cup nests and forage mainly on the ground for seeds, fruits and a wide variety of insect prey. We averaged weather variables over 3-d intervals over the entire incubation and nestling periods and used a multi-step GLMM approach to identify weather conditions and sensitive periods for each species. Weather had little effect on hatching or fledging success in Savannah sparrows, but Tree Swallow fledging success was highly sensitive to low temperatures, poor visibility, strong winds and heavy rain. Weather also had a much bigger effect on nestling condition in Tree Swallows, even conditions occurring a week or more before fledging. Our results suggest that differences in foraging behavior and reproductive biology affect sensitivity to weather, which in turn can have demographic consequences.

Species Limits in Red Warblers

White, Emma - Occidental College; James Maley - Moore Laboratory of Zoology, Occidental College; Whitney Tsai - Moore Laboratory of Zoology, Occidental College; Amanda Zellmer McCormack - Occidental College; John McCormack - Moore Laboratory of Zoology, Occidental College

Red Warblers (*Cardellina rubra*) are endemic to the highly biodiverse and threatened regions of pine-oak and humid montane forests of the highlands of Mexico, and are currently classified into three subspecies based on plumage characteristics and geographic ranges. We studied the morphology, coloration, niche specialization, and phylogenetic relationships of *C. rubra* and the closely related Pink-headed Warbler (*Cardellina versicolor*) using museum specimens. We found significant differences in morphology, coloration, and niche between *C. r. melanauris* from the Sierra Madre Occidental and the two other subspecies to the south. *C. r. melanauris* was 100% diagnosable using discriminant function analysis of plumage and morphology. We also found that *C. r. melanauris* males had significantly longer wings and tails than other red warblers, consistent with the idea they may exhibit more migratory behavior. Given phenotypic and niche differences, and prior work on genetic differences among the subspecies, there appears to be a strong case that *C. r. melanauris* should be elevated to species level.

Is target mist-netting an effective control method for reducing Brown-headed Cowbird parasitism?

Whitfield, Mary - Southern Sierra Research Station; Anna Buckardt - Southern Sierra Research Station

Brown-headed Cowbird nest parasitism is recognized as a problem for many endangered and sensitive bird species. As a result, managers use cowbird control programs to reduce parasitism. Cowbird traps are the primary method for reducing cowbird populations; investigators may also remove cowbird eggs in host nests and occasionally supplement traps with shooting. Unfortunately, cowbird trapping can be expensive, is limited to areas with vehicle access, and can result in the death or nest failure of many non-target birds. Removing cowbird eggs and shooting also have their drawbacks. Thus, we investigated whether target-netting for cowbird females is effective for controlling cowbirds near areas where the target host is nesting. In 2015, we target-netted female cowbirds in California and compared those results with trapping. The target-netting involved using mist nets, a female cowbird decoy, and cowbird calls. We captured 38 female cowbirds with target-netting, and nine female cowbirds with traps. The capture rate for netting was 0.46 females/hour and 0.04 females/hour for trapping. The number of non-target captures per female cowbird captured was much lower with netting (2.07) compared to trapping (9.22). Our results indicate that netting for female cowbirds is highly effective to remove cowbirds from areas with less impact to non-target species. We will continuing target-netting cowbirds in 2016 and will add the results to our presentation.

Over 8,000 songbirds die at a gas flare on the Bay of Fundy coast

Whittam, Becky - Environment and Climate Change Canada; Donald F. McAlpine - New Brunswick Museum; Pierre-Yves Daoust - Canadian Wildlife Health Cooperative; Barry Rothfuss - Atlantic Wildlife Institute; Peter Thomas - Canadian Wildlife Service

In September 2013, 7,352 songbirds, 907 still living, were collected at the LNG Canaport Facility near Saint John, NB, Canada, on the Bay of Fundy. All birds eventually died or were euthanized. Birds were apparently attracted to the light of the gas flare during nocturnal migration when weather was unsettled and cloud cover was low. Total mortality was estimated at 8,428 birds, based on recovery rates of 90% for dead birds, and 70% for live birds. Birds were given injury codes from 1-6 with 1 being no injury and 6 being all or most feathers incinerated. Of 7,346 birds coded for injury, 4.2% showed minor injury (codes 1-2), 48.6% moderate injury (codes 2-3), and 47.2% severe injury (codes 5-6). These results, combined with necropsy results, indicate that all birds died from either direct collision with industrial structures or heat from the flare stack (87.6%), or subsequent stress and predation or emaciation (12.4%). Of all songbirds retrieved, 92.1% (n=6777) were identified to species. Twenty-six species were found, with the bulk of mortalities being Red-eyed Vireo (*Vireo olivaceus*; 27.3%), Magnolia Warbler (*Dendroica magnolia*; 20.1%) and Northern Parula (*Parula americana*; 14.0%). Included among the mortalities were four Canada Warblers (*Wilsonia canadensis*), a Threatened species under Canada's Species At Risk Act. Canaport was charged with, and subsequently pleaded guilty to, violations of both the Migratory Birds Convention Act and the Species At Risk Act. They were fined $750,000.

Northern flickers only work when they need to: how individual traits and landscape disturbances affect excavation rates
Wiebe, Karen - University of Saskatchewan

Northern Flickers *Colaptes auratus* have the option of excavating a new cavity for breeding or reusing an existing hole but factors which influence this propensity to excavate have rarely been examined in woodpeckers. Using 18 years of data on a population of flickers in British Columbia, I tested six hypotheses to explain the propensity to excavate in a landscape which experienced two types of disturbance: pine beetles and wildfires. Woodpecker age, breeding experience and mate retention had little influence on excavation rates which varied between 13-39% annually and averaged 23% for 1843 first nests over the 18 years. Body size and body condition of males and females were not associated with excavation but rates of excavation declined seasonally, suggesting time rather than energy costs. Reduced cavity availability on the landscape mediated through high conspecific density coupled with wildfires triggered relatively high excavation rates, up to 39% but excavation decreased to baseline levels three years after the landscape disturbances. Nearly 2/3 of males did not excavate in their lifetime but apparently the rate of excavation by flickers in this forest is great enough to balance the average rate of cavity tree loss which is 11% annually. Excavation propensity in flickers is flexible, but the birds reduce their work levels if there is a surplus of holes available.

Comparing phenotype networks across barn swallow populations: sexual selection and phenotypic integration
Wilkins, Matthew - University of Nebraska-Lincoln; Daizaburo Shizuka - University of Nebraska-Lincoln; Rebecca Safran - University of Colorado, Boulder

Describing and understanding evolutionary drivers of complex signals has long been a major target of research. Much of this work focuses on whether signals are redundant or nonredundant–conveying the same information or multiple messages to receivers. We recently proposed an alternative conceptual approach, wherein trait correlations are used to generate a phenotype network. In a phenotype network, highly correlated traits are connected by edges (lines), and edge width reflects correlation strength. A network approach makes it immediately clear that communication systems as a whole can contain both “redundant” and “multiple” messages simultaneously, and we can begin to characterize the functional architecture of complex signals. Here, we extend this framework to compare phenotype networks across populations with divergent sexual signals. We constructed networks of 14 traits describing color and morphology among 8 closely related barn swallow populations from across the Northern Hemisphere. We show that populations with darker belly color also have higher transitivity (i.e. traits correlated with darker belly also become more correlated to each other), suggesting that divergence in one trait may result in changes to the architecture of the trait network itself. As previous work demonstrates stronger sexual selection for color in the darkest populations, this suggests that directional selection for darker belly color drives increased phenotypic integration (i.e. clustering) across all color patches. Because phenotype networks can be adapted to any signaling system, we hope future studies adopting this approach will allow researchers to assess how different selective pressures structure the architecture of communication systems across taxa.

Full Life Cycles: Migratory Connections in Birds and Coffee
Will, Tom - U.S. Fish and Wildlife Service

Long-distance migratory birds spend only a few months of their annual cycle on the breeding grounds. During the remainder of

the year, they fly often thousands of miles to and from the tropical habitats where they spend most of their lives. Innovative advances in tracking technology and wintering ecology make it very clear that events occurring during breeding, migration, and non-breeding residency are inextricably linked in determining bird health and lifetime avian reproductive success. In keeping with the insight delivered by birds, there are also other kinds of cycles that need to be closed in order for our conservation actions to be significant—cycles in research, monitoring, sustainable landscape design, sustainable economies, and human capacity-building that cross and bind together habitats, nations, market systems, and human generations. For example, the imaginative outreach and education expertise of our Latin American partners leverages the power of birds and bird art to transfer environmentally empowering knowledge across generations. Engaged scientists and enlightened journalists complete the cycle of story maker and story teller to empower informed citizens. As a commodity produced in the tropics and imported to North America, coffee also has a migratory path. The choice made by consumers to drink bird-friendly certified coffee completes the full life cycle, since coffee grown organically under scientifically documented structural shading regimes results in greater biodiversity, healthier birds, and greater community health and economic benefit for both producers and farm workers during the Nearctic migrant non-breeding and coffee's breeding (production) season.

The Conservation Atlas for Midwest Grasslands: A New Mapping Tool to Support Strategic Decisions and Cross-sector Collaboration

Will, Tom - U.S. Fish and Wildlife Service; Dan Lambert - High Branch Conservation Services; Ryan Drum - U.S. Fish and Wildlife Service; Wayne Thogmartin - United States Geological Survey; Chad Wilsey - Audubon; Katie Koch - U.S. Fish and Wildlife Service; Rosalind Renfrew - Vermont Center for Ecostudies

Despite decades of conservation attention, grassland bird populations are declining faster than any other group of breeding birds in North America, with especially pronounced decreases occurring in the Midwest. Agricultural intensification and land-use change have contributed to the declines via widespread habitat loss and degradation. In response, conservation agencies and organizations have identified large remaining grasslands and grassland complexes as priorities for protection. These groups are now partnering to create a network of grassland landscapes in order to support coordinated implementation of local, state and regional conservation plans. The Midwest Grasslands Network has recently synthesized spatial information in a conservation-planning atlas that is designed to display and uphold the ecological and societal values of native, restored, and surrogate grasslands. The Conservation Atlas for Midwest Grasslands is an online mapping tool and information clearinghouse serving the eastern Prairie Potholes, Upper Mississippi River/ Great Lakes, and Central Hardwoods ecoregions. It combines information about grassland values and vulnerabilities to support decisions at multiple scales. Atlas users can view strategic focal areas in relation to current conservation boundaries, bird locations, and areas that are important for water-quality protection, carbon sequestration, and butterfly conservation. Potential applications include: landscape conservation design and gap analysis; project ranking for grants, easements, purchases, and incentive programs; coordination of research and monitoring; land-use education; and building partnerships among diverse grassland stakeholders.

Short-term Changes in Breeding Bird Community Following Variable Timber Harvest in Bottomland Forests of Arkansas

Wilcox, Jennifer - Arkansas State University; Than Boves - Arkansas State University; Amy Wynia - Department of Biological Sciences, Sub-Antarctic Biocultural Conservation Program, University of North Texas, Denton, TX, USA and Institute of Ecology and Biodiversity, Chile

Variable retention harvest (VRH) to achieve Desired Forest Conditions (DFC) is being implemented as an alternative to traditional management practices to benefit migrant and breeding birds in the southeastern U.S. However, effects of this widely recommended practice on the avian community are unclear. Using a BACI design, we evaluated breeding bird numerical responses to VRH in bottomland hardwood forests in east-central Arkansas. Three 72-ha blocks were divided into three 24-ha experimental stands. Within each block, stands were treated with one of three randomly assigned VRH regimes: modified shelterwood (MS), DFC, and no-harvest control (NHC). Point counts were conducted on all stands pre-harvest and one- and two years post-harvest. We estimated individual species densities using DISTANCE and statistically assessed changes in guild-specific- and brood parasite densities on all stands pre-harvest to one- and two years post-harvest, and among stands within post-harvest years. Post-harvest densities of all guilds increased on all stands but guild-specific responses varied among treatments. Notably, overstory species significantly increased in MS stands (ANOVA, $F(2,24)$, $P=0.02$), and secondary cavity nesters significantly increased in NHC and MS stands (ANOVA, $F(2,24)$,$P=0.04$). These results suggest that alternative harvest regimes in bottomland forests may, in the short-term, increase densities of many avian species both at the stand level and in surrounding unharvested forest. Additionally, the extent of increase depends on nesting guild. Despite these seemingly positive effects of VRH, we recommend reassessment of the avian community 5-6 years post-harvest and assessing effects on reproduction before recommending them more broadly.

A Temporally Explicit Species Distribution Model for a Sub-Saharan Avian Migrant, the Common Cuckoo

Williams, Heather - State University of New York at Buffalo; Mikkel Willemoes - University of Copenhagen; Kasper Thorup - Center for Macroecology, Evolution and Climate, Natural History Museum of Denmark, University of Copenhagen

Modelling the seasonal distribution of migratory species has rarely been extended beyond breeding and wintering ranges despite the fact that many species show much more complex movement patterns. We modelled the seasonally changing distribution of the common cuckoo (*Cuculus canorus*) throughout its annual cycle in a temporally explicit modelling framework informed by satellite telemetry data. The resulting distribution model is highly predictive (AUC = 0.94) and appears to have generality at the species-level despite being informed by data from a single breeding population. The distribution is predicted by maximum monthly temperature, mean precipitation of the previous month, mean monthly NDVI and the difference between the month's NDVI and that of the previous month. Comparison of our methodology with a seasonal distribution model showed that our method provided more general and extensive predictions and performed better when tested with an independent dataset. By keeping temporal data associated with spatial data, our modelling framework more successfully captures the finer-scale distribution changes expected in seasonal environments compared to single season models. It should therefore be preferred when aiming for realistic temporal distribution models for species with complex migration patterns.

Laying the Groundwork for Responsible Development of Offshore Wind Energy in the United States: Baseline Studies of Avian Distributions and Movements
Williams, Kathryn - Biodiversity Research Institute; Iain Stenhouse - Biodiversity Research Institute; Andrew Gilbert - Biodiversity Research Institute; Emily Connelly - Biodiversity Research Institute; Holly Goyert - University of Idaho, Dept. of Fish and Wildlife Sciences

Offshore wind energy development is a nascent industry in the western hemisphere and a major impetus of marine spatial planning efforts in the USA. American regulators, developers, and other stakeholders have generally looked to the European experience with offshore wind for guidance. Careful project siting may help to avoid or minimize wildlife impacts, so challenges in the USA include (1) identifying areas of persistently high densities of seabirds, and (2) predicting environmental variables and biological conditions that support these aggregations. A large, collaborative baseline study recently completed in the mid-Atlantic USA included examinations of avian individual movements, migration patterns, and resident distribution and abundance patterns in relation to areas designated for offshore wind energy development. Species richness and densities of birds observed during diurnal surveys were generally higher in nearshore locations, particularly offshore of large bays. However, species responses to environmental variables varied widely, and there were strong seasonal and interannual variations in community composition and distributions. In autumn, nocturnal migration activity offshore was comparable to terrestrial activity levels, indicating a substantial offshore migration pathway in some locations. While exposure to offshore development does not necessarily indicate that animals will suffer deleterious effects, or that these will translate to population impacts, baseline studies are an important first step towards understanding the implications of offshore wind energy development for avian populations. We place the mid-Atlantic study results in a broader context to identify key management implications for siting offshore wind energy projects and developing best practices to minimize avian impacts.

Linking foraging behavior to environmental variation and parental care
Williams, Kelly - Ohio University

Parents face trade-offs between providing resources for the development of their offspring and acquiring resources for their own survival. Habitat quality, including the availability of food, has implications for how females acquire and allocate resources and may affect the spatial distribution of foraging territories as well as the patterns of behaviors used to obtain food (a foraging strategy). This study examines how foraging strategies in female hooded warblers (*Setophaga citrina*) are related to arthropod prey, parental care and reproductive success. Markov model analysis of individual behavior transition matrices yield multivariate estimates of individual behavior variation that can be used together to test hypotheses about how behavioral strategies and environmental conditions affect variation in parental care and nest success. Females foraged farther from their nests on territories with lower arthropod prey abundance and foraging distance was related to how females searched for and attacked prey. Females that forage farther from the nest use more long flights to search for prey and long flights are positively correlated with aerial prey attacks. Foraging distance and the ability to acquire prey can affect time and energy budgets which in turn may affect offspring growth and survival. For example, we found that females that foraged farther from the nest actually spent a larger proportion of their time at the nest which in turn is positively correlated with nest temperature. This study links foraging strategies to environmental conditions and parental care behaviors connecting individual

behavior variation, habitat quality, and reproductive success.

Laying-sequence Variation in Yolk Carotenoids and Egg Characteristics in the House Sparrow (*Passer domesticus*)
Williams, Madison - Columbus State University; Jennifer Newbrey - Columbus State University; Michael Newbrey - Columbus State University

Female birds allocate high concentrations of carotenoids to their egg yolks, where the pigments protect sensitive embryonic tissues against damage from metabolic free radicals. Laying-sequence variation in carotenoid allocation has been documented in several bird species, with most females allocating higher concentrations of carotenoids to earlier-laid eggs than to later-laid eggs. We collected full clutches of eggs from House Sparrow (*Passer domesticus*) nests to determine how carotenoids were distributed throughout the laying sequence. We predicted that female House Sparrows would allocate the highest concentrations of carotenoids to earlier-laid eggs, similar to other species studied. Our study site was the main campus of Columbus State University, in Columbus GA. Forty seven nest boxes were monitored from early March until early August, 2015. Eggs were marked on the day they were laid and collected 24 hours later. After an egg was collected, it was weighed and the length and width were measured. Carotenoids were extracted from yolk subsamples and quantified using high performance chromatography. We identified three carotenoids in House Sparrow eggs: β-carotene, lutein, and zeaxanthin. Lutein was the most highly concentrated carotenoid, followed by zeaxanthin and β-carotene. We found that egg number two was significantly smaller than the other eggs in a clutch. However, there were no significant laying-sequence differences in the concentrations of the three carotenoids identified. This suggests that carotenoids are not limited in the diet of egg-laying female House Sparrows breeding at our study site, which is contrary to results found in other bird species.

In mixed-species flocks in Amazonian Peru, the habitat preference of a single species is responsible for space use patterns of the whole flock
Williams, Sean - Michigan State University; Catherine Lindell - Michigan State University

Organisms prefer to spend time in areas rich in resources and devoid of predators. In Amazonian mixed-species flocks, the nuclear Dusky-throated Antshrike (hereafter antshrike) is attractive to antwrens. Antshrikes likely move to and spend time in areas with accessible prey and low predation risk. Antshrikes forage by sitting still in areas with low vegetation density and scanning distant vegetation. We investigated whether predation risk and resource availability are important drivers of the space use of Dusky-throated Antshrikes, and whether these perceptions by the antshrikes extend to the space use patterns of the flock. Data were collected at Los Amigos Biological Station, Madre de Dios, Peru in May-Aug 2014. We followed flocks and recorded geographic coordinates of the flock. We opportunistically recorded the vegetation density, attack rate, and vigilance rate of flocking antshrikes and antwrens. We estimated the home and core ranges of three flocks, and used a generalized mixed model to investigate whether the high or low use areas of the territory could be predicted by vegetation density, attack rate, and vigilance rate of each species. Only vegetation density of the Dusky-throated Antshrike predicted space use of the flock. The results support our prediction that the surrounding vegetation density of a single species, the Dusky-throated Antshrike, predicted space use patterns of mixed-species flocks. Our results support the notion that antshrikes move to and spend time in areas with low vegetation density, and their space use patterns drive the space use patterns of the whole flock.

Clark's Nutcracker Seed Use and Limber Pine Metapopulation Structure in Rocky Mountain National Park: Predicting Future Trends

Williams, Tyler - University of Colorado Denver; Diana Tomback - Department of Integrative Biology, University of Colorado Denver

Clark's Nutcracker (*Nucifraga columbiana*) is the major seed disperser for limber pine (*Pinus flexilis*). Predicted threats for this conifer, related to global warming, include mountain pine beetle (*Dendroctonus ponderosae*) outbreaks and wildfires, but also exotic white pine blister rust (pathogen *Cronartium ribicola*). Extensive limber pine mortality may force nutcrackers to rely on other conifer species. In Rocky Mountain National Park (RMNP), we are investigating: 1) the importance of alternative conifer seed sources for nutcrackers; and, 2) limber pine's metapopulation structure and how connectivity might be influenced by nutcracker spatial use. In 2014 and 2015, we examined: 1) cone production in stands of limber pine, ponderosa pine (*Pinus ponderosa*), and Douglas-fir (*Pseudotsuga menziesii*); 2) nutcracker stand visitation; and, 3) nutcracker seed harvest and caching behavior. We constructed the limber pine metapopulation for RMNP using GIS layers; and in 2015 we radio-tracked nutcrackers. Nutcrackers foraged extensively on limber pine seeds, which ripen in early September. They transitioned to foraging on ponderosa pine seeds, which ripen in early October. Annual variation in cone production influences the transition timeframe. Douglas-fir produced no cones during this study. Limber pine component populations (n = 32) range from 6 - 400 ha in size with a median inter-population distance of 3 km. We observed nutcracker movements of 1 - 12 km (n = 5 nutcrackers), indicating the potential for high limber pine metapopulation connectivity. Reliance on ponderosa pine seeds may shift nutcracker home ranges to lower elevations, which may accelerate limber pine's decline by reducing metapopulation connectivity.

The potential impacts of future climate change on bird communities across Latin American Important Bird Areas: adapting management for change

Willis, Stephen - Durham University; Alke Voskamp - Durham University; David Baker - Durham University; Chad Wilsey - Audubon; Gary Langham - National Audubon Society; Stuart Butchart - BirdLife International

Future climate change is projected to affect biodiversity substantially across much of the terrestrial world. One of the principal expected responses of biodiversity to changing climates is that species will shift their ranges to track suitable climate. However, fragmented landscapes, habitat occurrence, and the dispersal ability of individual species will limit the ability of species to track changing climates. Here we model the current climatic niche of individual bird species across Latin America, and simulate the potential future distribution of each species' climatic niche. We combine these data with data on the dispersal ability of each species to simulate potential range shifts. Finally, we apply these projections of range change to the Important Bird and Biodiversity Areas network across Latin America. We summarise potential turnover of bird species across this network; highlighting areas of community change and stability. We then utilize the ratio of colonizing and emigrating species to inform recommendations for adaptive management of each site in order to minimise avian biodiversity loss.

Model-based assessment of climate sensitivity for grassland birds

Wilsey, Chad - Audubon; Arvind Panjabi - Bird Conservancy of the Rockies; Caitlin Jensen - Audubon; Lotem Taylor - National Audubon Society; Gary Langham - National Audubon Society

Due to disappearance of grasslands ecosystems, grassland bird populations have been among the fastest and most consistently declining suite of species in North America over the past 40 years. In addition, the Central Plains of North America are predicted to have high rates of climate change in the coming century, exacerbating an already challenging situation for grassland birds. We explore the impact of projected climate change on a suite of more than 40 grassland birds using species distribution models. Models are based on point count datasets not previously synthesized at the continental scale with coverage including Mexico, the United States, and Canada. Models are built and projected at 1km resolution using both climatic and land-use variables as predictors. We compare model performance after geographic and environmental filtering of data points using spatially stratified test and training datasets, and quantify the relative importance of climate and land-use variables in modeling current distributions. We predict future distributions based on downscaled climate projections under two greenhouse gas emissions scenarios (RCP 4.5 & 8.5) for three general circulation models. Projected distribution changes for each species are used to classify overall sensitivity to climate change. We then compare sensitivity scores with those of a similar continental-scale analysis and discuss the implications for assessing species vulnerability to climate change.

Using DNA metabarcoding to link avian diets with regulation of canopy food webs in fragmented Hawaiian forests

Wilson Rankin, Erin - University of California, Riverside; Robert Fleischer - Smithsonian Institution; Jesus Maldonado - Smithsonian Institution; Daniel Gruner - University of Maryland, College Park; Jessie Knowlton - Michigan Technological University; David Flaspohler - Michigan Technological University; Tadashi Fukami - Stanford University; Christian Giardina - US Forest Service Institute of Pacific Islands Forestry

Ecologists have long sought to understand the role of predators as drivers of food web structure. Invasive rats impact forest food webs by predation, and preliminary evidence suggests that subsidies from disjunct resource pools, via scavenging, and strengthen overall ecological impacts. DNA metabarcoding provides unprecedented access and identification of these novel linkages, which have been historically overlooked because of the challenges of directly observing species interactions. By coupling molecular diet analyses with arthropod sampling and invasive species removal, we examine how Hawaiian forest birds influence arboreal food webs in the presence and absence of an omnivorous invader, the Black Rat (Rattus rattus). DNA metabarcoding analysis of fecal material from native insectivores, frugivores and nectarivores as well as invasive rats provides insights into avian resource use across the landscape and allows comparison of diet profiles in control and rat-removed forests. To date, we have identified 50 major components of the diet of Hawaiian forest birds, one-third of which overlap with invasive rats. Furthermore, we have documented shifts in the diets of some native birds, where they become more insectivorous or change the types of insects they consume when rats are removed. Since arthropods are key protein sources, such changes in diet may have important implications for the

reproductive success of native forest birds in invaded habitats.

Birds and the GMO Food Web
Wilson, Allison - Bioscience Resource Project

In 2014, over 400 million acres of commercial genetically engineered crops (GMOs; genetically modified organisms) were planted. Most were herbicide tolerant and/or Bt pesticidal crops. GMO plants produce nectar and root exudates as well as pollen, seeds and detritus. These latter disperse by land, water and air, often far from crops. A wide variety of birds (from farmland, woodland and water birds, to predators and scavengers) are thus exposed to GMO plant material, by direct consumption or indirectly through insects or other prey. The processes used to genetically engineer plants (e.g. tissue culture and plant transformation); the introduced traits and their mechanism of action and the GMO production systems used to grow the plants commercially can all alter plant nutrition and toxicity. Given GMO crop plants' record of harm toward non-target organisms, GMO-based agricultural systems pose a range of actual threats to birds. This presentation ties together what is known about GMO hazards with bird exposure routes to provide a framework for further research and action.

The feasibility of using drones to count songbirds
Wilson, Andy - Gettysburg College; Janine Barr - Gettysburg College; Megan Zagorski - Gettysburg College

Point and transect counts are the most common bird survey methods, but are subject to biases and accessibility issues. To eliminate some of these biases, we propose attaching a recorder to a consumer-grade quadcopter (Unmanned Aerial Vehicle, or UAV) to estimate songbird populations from audio recordings. We conducted a blind experiment using broadcast recordings to estimate the detection radius of a compact recorder attached to a UAV, and found that the detection radius did not vary significantly when the UAV was flown at elevations of 20, 40 and 60m. We field tested our system by comparing UAV-based bird counts with standard point count surveys at 51 locations on State Game Lands 249, PA. Species richness was similar at standard and UAV point counts, but species composition differed. For most species, the number detections on UAV recordings were similar to standard counts, but UAV surveys under-sampled Mourning Doves *Zenaida macroura*, Gray Catbirds *Dumetella carolinensis*, and Willow Flycatchers *Empidonax traillii*. Birds with quiet or low frequency songs are likely to be under-detected by UAV-based methods, due to masking by the drone noise of the quadcopter. Recordings of bird songs from ground-based recorders show that bird song output was slightly reduced when the quadcopter was overhead. The development of quieter quadcopters would overcome the masking and the possible behavioral response issues that we highlighted. We demonstrate that low-cost UAVs provide a useful new method of surveying songbirds that is accessible to organizations and researchers with restricted budgets.

Why Birds and Farms?
Wilson, Bill - Birds and Beans

What we saw on farms - 'on the farm' in the 1950's and early 1960's in the USA; on 'Bird Friendly' coffee farms in Central America today; on organic farms in the US today.

Consistency of Structural Color Across Molts: The Effects of Environmental Conditions and Stress on Feather Ultraviolet Reflectance

Windsor, Rebecca - University of South Florida; Gordon Fox - University of South Florida; Reed Bowman - Archbold Biological Station

Signaling through ornamental plumage displays has been well documented in avian species, but little is known about consistency of ornamentation throughout an individual's lifetime. In birds with structural coloration, plumage variation results from differences in energy allocation to feather growth due to environmental conditions during molt. Florida Scrub-Jays (*Aphelocoma coerulescens*) are cooperative breeders that have predominantly blue structural color and are sexually dimorphic in the UV spectrum. UV brightness in juveniles predicts social dominance and condition, but not adult reproductive fitness. We tested how environmental conditions and stress interact to affect structural coloration across molts. Feathers were collected from the same individuals in pre-basic (juvenile) and first basic (adult) plumages and corticosterone was administered to yearlings during their first basic molt. We found significant positive correlations between juvenile and adult color within individuals for brightness and chroma. However, adult feathers were often less bright relative to their juvenile feathers. On average, chroma increased from juvenile to adult feathers, and hues were shifted farther from the UV spectrum in adult feathers. Individuals dosed with corticosterone had reduced chroma and increased brightness, but these trends were not significant. Change in brightness was significantly affected by an interaction between group size and area of oak scrub. Our results demonstrate that structural color is a plastic phenotypic trait that can change yearly due to environmental conditions during molt. However, juvenile coloration is still a significant predictor of adult color supporting the notion that early-life environmental conditions may have profound effects on adult reproductive success.

Ultraconserved elements (UCEs) illuminate the population genomics of a recent, high-latitude speciation event

Winker, Kevin - University of Alaska Museum; Brant Faircloth - Louisiana State University; Travis Glenn - University of Georgia

Although ultraconserved elements (UCEs) have well-established utility for deep phylogenetics, few studies have used UCEs to study shallow evolutionary relationships. Being able to use a consistent set of thousands of orthologous loci to study all levels of relationships across all tetrapods would revolutionize among-lineage comparisons of the divergence and speciation processes. Here we apply UCEs to the population genomics of Snow Buntings and McKay's Buntings (*Plectrophenax nivalis* and *P. hyperboreus*). McKay's Bunting is considered the highest-latitude endemic passerine, and it likely arose from Snow Buntings during the last glacial maximum (LGM). With ~30× coverage and four individuals of each species, we were able to call both alleles and achieve a complete-matrix dataset of 2,635 high-quality variable loci containing 9,449 SNPs (3.6 SNPs/locus) and 792 high-quality invariant loci. There were no fixed differences between the two lineages among these loci, and few loci had large allele frequency differences. Nevertheless, individuals were 100% diagnosable to population when analyzed at 1 SNP/locus, and the two populations were significantly different with an FST = 0.034. The demographic model best fitting the data was one of split-with-migration, i.e., no appreciable signal of isolation (δaδi). This is commensurate with their recent origin.

A mechanistic predictive model for laying date in birds

Winkler, David - Cornell University; Julia Karagicheva - NIOZ; Eldar Rakhimberdiev - NIOZ; Teresa Pegan - Cornell University, Ecology and Evolutionary Biology

Laying date determines the temporal fit between the reproductive cycle, the availability of food for both parents and young, and the weather in which young of the year will be raised. In species of birds that raise only one brood per season, laying date has a fairly direct connection to the clutch size that will be laid, and evidence from multiple species shows that one of the most common responses of birds to warming springs has been to shift laying dates earlier. Laying date is influenced by both ecological and physiological factors, but we are aware of no predictive model that brings both together to try to account for variation in laying dates in a single population of birds over time. We developed such a model based on the effects of spring temperatures, insect abundance and date for 30 year's of nesting data from the Tree Swallow population near Ithaca, NY, in which mean laying dates have varied by over two weeks from year to year. Using the underlying date-dependency of laying probability as a proxy for the effects of photoperiodic cues, we added dependencies on insect availability and environmental temperatures and produced a model that did a very good job of predicting the lay dates across years. This predictive model for inter-annual variation in laying dates within a species has important implications for our understanding of avian breeding biology and many potential applications in studying and predicting the responses of birds to their changing environments and distributions.

Grasshopper Sparrow (*Ammodramus savannarum*) breeding density: effect on nest survival, brood parasitism, extra-pair paternity, and cooperative care

Winnicki, Sarah - Kansas State University; Alice Boyle - Kansas State University

In highly territorial species, spatial aggregation of competitors presents a conundrum. Territorial male Grasshopper Sparrows (*Ammodramus savannarum*) in NE Kansas exhibit diverse breeding densities, and the causes of this variation is not known. The settlement decisions which result in territory aggregation can be influenced by a variety of factors, including the rates of predation and parasitism, intraspecific competition for nest sites, food, or mates, and intraspecific cooperative defense or nestling care. We predicted that increased density of breeding males around the nest would lead to (i) increased nest success (ii) increased brood parasitism, (iii) increased extra-pair paternity, and (iv) increased cooperative care. To test these predictions, we located and mapped nests' position relative to the location of banded males. We calculated density by counting the number of males within defined radii around each nest. We observed the nests, recording the presence of cowbird nestlings, the number and fate of sparrow eggs and nestlings, and the incidence of cooperative care. We extracted DNA from blood samples, and used microsatellites to calculate the proportion of each brood likely sired by extra-pair males. Though extra-pair paternity and nest helpers are present in this population, these variables were not related to the density of males around the nests. However, nests with higher density were more likely to have reduced nest success and increased nest parasitism. Our results suggest that the aggregation of Grasshopper Sparrows is not beneficial to their immediate reproductive success and cannot explain the existence of territory aggregation.

Physiological challenges for desert bird communities in a rapidly warming world

Wolf, Blair - Biology Department, University of New Mexico; Alexander Gerson - University of Massachusetts, Amherst; Andrew McKechnie - University of Pretoria; Todd McWhorter - University of Adelaide; Ben Smit - Nelson Mandela Metropolitan University; Maxine Whitfield - Department of Zoology and Entomology, University of Pretoria; William Talbot - University of New Mexico; Eric Smith - University of New Mexicio

We studied thermoregulatory performance of summer-acclimatized wild birds to heat stress in the deserts of Australia, North America and South Africa. We measured evaporative water loss (EWL), resting metabolic rate (RMR) and body temperature (Tb) continuously using ramped temperature profiles with increasing air temperatures in 40+ species, which included 10 orders with body size ranging from 7- 450g. We estimated the heat tolerance limit (HTL) for each species by measuring body temperature, EWL and RMR and activity when exposed to air temperatures ranging from 30-64°C. We found that birds from the orders Columbiformes (pigeons and doves) and Caprimulgiformes (nighthawks and nightjars) had the highest HTLs and were able to thermoregulate at air temperatures as high as 60°C. Perching birds (Passeriformes), in contrast, showed a much more limited capacity for thermoregulation at high air temperatures and exhibited HTLs near 50°C. Body size was also a critical factor in determining the capacity of a species to tolerate high temperatures. This work greatly expands our knowledge of avian tolerance to heat and provides insights into how rapid warming and more intense heat waves may change avian distributions and community structure.

Metabolic aspects of thermoregulation in the heat and how evaporative pathways affect heat tolerance

Wolf, Blair - Biology Department, University of New Mexico; Andrew McKechnie - University of Pretoria; Alexander Gerson - University of Massachusetts, Amherst

Rapid warming of the Earth’s surface is producing significant new physiological challenges for many species; the potential capacity for individuals and species cope with these new challenges is of significant conservation interest. For animals living in hot environments rates of heat production and environmental heat loads combine to challenge the abilities of individuals to successfully balance their water budgets. As a consequence, any increase in metabolism associated with increasing evaporative heat dissipation is detrimental to water balance. The diversity in evaporative mechanisms in birds and their metabolic costs/efficiencies varies widely among different taxa. Here, we use the Scholander-Irving model to explore the differences in metabolic costs of evaporative heat dissipation among avian orders and the apparent consequences for thermo/osmo-regulation. We also examine the environmental or ecological correlates that may drive the elaboration of these processes. Ultimately, differences in the metabolic costs of thermoregulation in the heat may importantly affect the ability of some species to cope with rapid changes in the Earths’ climate and the projected increase in the severity and frequency of extreme events such as heat waves.

Does primary Lower Guinea rainforest harbor a unique Afrotropical bird community? A primary/secondary forest comparison effort from the Biodiversity Initiative

Wolfe, Jared - USDA forest Service Pacific Southwest research station Arcata; Jacob Cooper - University of Chicago; **Luke Powell** - Smithsonian Institution

Equatorial Guinea is a small, rapidly developing Central African nation with poorly known avifauna. Despite recent development driven by oil profits, large tracts of primary forest still exist in the country, both inside and outside of protected areas. In light of this matrix of forest conditions and ongoing development, the Biodiversity Initiative has identified two objectives: 1) exploration to determine the avian species composition of the country; and 2) ecological research to determine how forest type and protected area status affect avian community composition. First, we have documented over 300 species of bird in the country, including nine new country records. Second, we performed netting and audiovisual surveys at 34 separate sites within mainland Equatorial Guinea to understand the differences between different forest type and protection status for avian communities. Primary forest communities are more diverse (94 species) and have more specialized forest species. Secondary forests were less uniform and less diverse (74 species) and were dominated by more generalist and edge species. Our research improves knowledge of bird distribution and abundance in Equatorial Guinea while simultaneously training and enabling local biologists to perform more conservation work throughout the country. The Biodiversity Initiative seeks to encourage the conservation of Central African rainforests in perpetuity and improve our understanding of the effects of human disturbance on the Lower Guinea avifuana.

Diversity and function of inserted molts in landbirds: a tropical-temperate comparison

Wolfe, Jared - USDA forest Service Pacific Southwest research station Arcata; Erik Johnson - Audubon Louisiana; Ryan Terrill - Louisiana state University; Glenn Seeholzer - Museum of Natural Science / Louisiana State University

Cyclical periods of feather replacement occurring outside the annual prebasic molt are often referred to as inserted molts. The frequency, extent, intensity, and duration of inserted molts varies greatly across taxa and presumably represents varying evolutionary adaptations. Published descriptions of inserted molts suggest a diversity of selective pressures gave rise to such molts, such as crypsis, replacement of worn feathers, honest signals, species recognition, and social hierarchies. In this study, we reviewed literature pertaining to two inserted molts – the preformative and prealternate – across Neotropic and Nearctic latitudes to identify associations between life-history variation and the prevalence, extent, and speed of inserted molts within landbirds. We found that prealternate molts were uncommon in obligate-resident birds, irrespective of latitude, while migratory birds exhibit extensive variation in prealternate molt extent. Within tropical latitudes, we found striking examples of interactions between preformative molt duration, allometry, and foraging guild. For example, obligate ant-following birds in the Amazon exhibited correlations between larger home range size, smaller mass, and slower duration of the preformative molt; we believe these relationships represent tradeoffs between speed of feather replacement and flight integrity. Our results suggest that landbirds usurped and modified inserted molts to successfully occupy a diversity of habitats and niches throughout temperate and tropical regions.

Effects of variation in canopy cover, habitat perturbations and climate on California Spotted Owl (*Strix occidentalis occidentalis*) demography

Wolfe, Jared - USDA forest Service Pacific Southwest research station Arcata; John Keane - USDA Forest Service; Douglas Tempel - University of Wisconsin-Madison, Department of Forest and Wildlife Ecology; R. j. Gutiérrez - University of Minnesota; Gavin Jones - University of Wisconsin-Madison, Department of Forest and Wildlife Ecology; Andrew Wiegardt - Klamath Bird Observatory; Alexander Koltunov - USDA Forest Service; Carlos Ramirez - USDA Forest Service; William Berigan - University of Wisconsin-Madison, Department of Forest and Wildlife Ecology; Claire Gallagher - USDA Forest Service; Thomas Munton - USDA Forest Service; Paula Shaklee - USDA Forest Service; Sheila Whitmore - University of Wisconsin-Madison, Department of Forest and Wildlife Ecology; M. Zachariah Peery - University of Wisconsin-Madison, Department of Forest and Wildlife Ecology

Sierra Nevada forests have been subject to a legacy of fire suppression and clear-cutting practices which resulted in landscapes less resilient to high-severity fire. Management focused on restoring forest reliance must contend with tradeoffs between reducing fuel loads and conserving sensitive wildlife such as the Spotted Owl (*Strix occidentalis occidentalis*), a species reliant on dense and multi-layered forest. We aimed to inform such tradeoffs by evaluating effects of canopy cover, fire, logging, and climate on subsequent estimates of Spotted Owl survival, recruitment, productivity, and population growth at four long-term demographic study areas. Our results suggest that owl survival varied positively with dense canopy cover (>70%) at the two northern study areas and with moderate canopy cover (between 40-70%) at the two southern study areas. Similarly, Spotted owl productivity was associated with moderate and dense canopy cover, emphasizing the importance of foraging (moderate canopy cover) and breeding (dense canopy cover) habitats for nesting owls. Canopy cover loss due to fire appeared to have a negative influence on owl survival at the northern study areas, and a positive effect on owl productivity at the southern study areas. Additionally, climate was found to have a variable influence on owl survival and recruitment estimates implying that climate may dynamically influence demographics at local scales. We suggest an evaluation of tree diameter and forest height on owl demography at two spatial scales, breeding and foraging locations within territories, represents the next critical step towards disentangling effects of forest restoration on Spotted Owl viability.

Molecular Analysis of the Population Structure and Modern Changes in Population Size of the American Kestrel (*Falco sparverius*) Across North America

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On the North American continent the American Kestrel has a range that extends from the tree line of Alaska to the southern tip of Florida. Recent demographic studies have begun to suggest a decline in the number of individuals at both migration and nesting sites in eastern and northern areas of the species North American range. Previous genetic studies have examined changes in population size in specific areas of interest, but no study has yet examined the genetic diversity and structure of the species across the American Kestrel's full continental range. In this study we used microsatellite data from samples spanning two different subspecies (*F. s. sparverius* and *F. s. paulus*), collected from breeding localities in 19 different states across the entire geographic extent of the species in North America (n = 375). Results

were used to construct a geographic map of the population structure of the American Kestrel and identify specific areas of potential conservation concern. Results from this analysis have found that the structure and changes in population size for the American Kestrel in North America are more interconnected and subtle then was first perceived, hinting at a potential close relationship between American Kestrel population sizes and anthropogenic land use.

Understanding birders to better understand birds

Wood, Christopher - Cornell University; Daniel Fink - Cornell University; Alison Johnston - British Trust for Ornithology; Ian Davies - Cornell University; Wesley Hochachka - Cornell University; Steve Kelling - Cornell University

Data from citizen science projects can be an invaluable source of information about birds. Given the voluntary nature of participation, we believe that data collection can be viewed as coming from coupled biological and human (observer) processes. As such, understanding observers' behaviour is necessary either to model the variation in the observation process during analyses, or where possible by persuading observers to alter their own behaviour. In our presentation, we describe examples of ways in which we are learning about the behaviour of participants in the bird-monitoring project eBird, using what we have found to better collect data and model the distributions and abundances of bird species across the Americas. eBird has become successful in collecting large volumes of data by providing birders with services that they want, such as ease of record keeping and information about unusual species. This large volume of data allows us to derive an index of the efficiency with which individual observers detect species, and thus control for variation among observers in the probability of detecting species. We are currently experimenting with the use of games in order to motivate observers to collect data in ways that improve quality of both individual lists, as well as gathering information in geographic locations and habitats that are otherwise under-sampled based on where bird watchers typically watch birds. In summary, our experience to date indicates the importance of understanding bird watchers, and designing both data collection processes and analytical models in light of this knowledge.

Extreme variations in spring temperature affect ecosystem regulating services provided by birds during migration

Wood, Eric - Biological Sciences Department, California State University Los Angeles; Anna Pidgeon - University of Wisconsin-Madison

Extreme weather may alter phenological relationships of migratory birds with their seasonal food resources and thus affect ecosystem function (e.g., bird predation of herbivorous insects). In a Midwest oak savanna, in two springs with very different weather (2009 average temperatures; 2010 record highs), we documented phenology of trees, insects, and migratory wood-warblers (Parulidae), and quantified the effects of migrant bird foraging on insect herbivory using a branch exclosure experiment. The phenology of trees, insects, and birds were synchronous in 2009, but highly asynchronous in 2010 (oak flowering and insect emergence occurred four weeks prior to migratory bird arrival). In 2010, 81% of sampled leaves exhibited herbivory compared with 27% of leaves in 2009, presumably due to lack of insect regulation by birds. Our results suggest that extreme weather altered linkages between migratory birds and their prey, which affected habitat use and bird predation of herbivorous insects.

The Ecological Impacts of the Invasive Mute Swan on Submerged Aquatic Vegetation, Fish, and Abiotics in Great Lakes Coastal Wetlands

Wood, Nicole - Central Michigan University; Thomas Gehring - Central Michigan University; Donald Uzarski - Central Michigan University

Mute swans (*Cygnus olor*) are a non-native, invasive species from Europe that have been introduced multiple times to North America. Since those introductions, the mute swan population has steadily increased at a rate of 10-18% annually, resulting in a Michigan population estimated at 15,500 individuals in 2010. Mute swans are tremendous consumers of submerged aquatic vegetation (SAV), their preferred food. A reduction in SAV impacts food resources for other bird species and diminishes habitat resources for small fish and invertebrates (SFI). SAV and SFI sampling occurred in September 2012 and 2013 in the drowned river mouth lakes along the eastern shore of Lake Michigan. Transects were drawn through each SAV bed and a throw trap was placed at three different depth intervals. The SAV in the trap was removed, identified, and a dry weight of each species was obtained. Fish were seined from the trap, identified, and measured. Abiotic data was also collected from each SAV bed. Lakes with high mute swan populations showed reductions in SAV height, dry weight, DO %, and a high variability in fish counts when compared to low mute swan populations. An inverse relationship with annual mute swan population changes and SAV variables emerged. These analyses show that mute swans may be negatively impacting the Great Lakes coastal wetlands.

Beyond hacking: A method for creating survival behaviors in conservation release parrots

Woodman, Constance - Texas A&M University; Jane Packard - Texas A&M University; Donald Brightsmith - Texas A&M University

Release of captive raised birds to supplement wild populations has been critiqued due to poor survival and flocking behavior. We discuss the possibility that inter-specific cultural transmission from humans and birds during captive-rearing can enhance skills essential for survival after release. As an example process, we evaluate a method developed and replicated by private bird owners. We demonstrate that pet trade produced parrots can learn flocking skills and anti-predator behavior using this free-flight based preparation method. The training method starts before fledging, with defined criteria for advancement to each of 5 levels of environmental complexity. We assessed results of preparation in two mixed-species parrot flocks: (1) large bodied (8 macaws of 3 species and 2 hybrids) and (2) small-bodied (25 individuals of 4 species). We examine 14 behaviors relevant to survival that develop during environmental level advancement, including navigating as a cohesive unit over long and short distance flights; mobbing predators; complex diving and evasive maneuvers; and feeding on wild foods. No parrots from these flocks were lost to predation or disorientation during more than 250,000 hours of cumulative free-flight time. Both flocks showed spontaneous expression of behaviors necessary for survival and reproduction. We suggest this method of survival skill gain could function as pre-release preparation and has broader applications to parrot conservation programs..

Common Monitoring Objectives for a Gulf of Mexico-wide Avian Monitoring Network
Woodrey, Mark - Mississippi State University; Randy Wilson - U.S. Fish and Wildlife Service

Hundreds of species and millions of birds are supported by barrier islands, beaches, marshes, nearshore and offshore waters, and coastal forests found along the Gulf of Mexico. Although many avian monitoring projects have been implemented across the region, scientists and conservationists lack a comprehensive and coordinated approach to monitoring avian resources across the northern Gulf of Mexico; a critical need that was highlighted during and after the Deepwater Horizon Oil Spill. To address this need, the Gulf of Mexico Avian Monitoring Network (GoMAMN) - a diverse group of conservation partners including state and federal agencies, NGOs, and academic institutions - was formed to coalesce a community of practice and define a vision and process for framing the role of bird monitoring. Our team used a Structured Decision Making process to develop a set of fundamental objectives along with an explicit objectives hierarchy and value models to qualitatively and quantitatively define stakeholder values and goals. Collectively, this framework provides a means to establish baselines, evaluate restoration activities, and fill critical information gaps related to how ecological process drive bird populations as well as a means to establish priorities. Here, we demonstrate how this framework can be used to guide the development of a Gulf-wide, strategic plan for monitoring birds and their habitats as well as an example of how the value models can be used in a constrained optimization routine to provide a novel approach to resource allocation.

A year-round population model reveals that winter temperatures limit population growth rate of a migratory songbird
Woodworth, Bradley - University of Guelph; Nathaniel Wheelwright - Bowdoin College; Amy Newman - University of Guelph; Michael Schaub - Swiss Ornithological Institute; D. Ryan Norris - University of Guelph

Understanding the factors that limit and regulate wildlife populations requires knowledge of demographic and environmental processes acting throughout the annual cycle, yet most research has focused on the breeding season only. We combined 4 years of geolocator data with 27 years of demographic data for a migratory songbird, the Savannah sparrow *Passerculus sandwichensis*, in an integrated population-modelling framework to assess (i) the relative contributions of sex- and age-specific annual survival, fecundity, and immigration to population growth rate and (ii) effects of weather and population density throughout the year on population growth rate via the vital rates. As expected, all vital rates were positively correlated with population growth rate, with immigration explaining the most variation. Both adult male survival and fecundity were negatively density-dependent in relation to breeding population size, but no vital rates were correlated with wintering ground abundance estimates. Weather had little effect on fecundity, but survival of all age and sex groups was positively correlated with winter temperature and adult female survival was negatively correlated with early-winter precipitation. On the breeding grounds, adult and juvenile male survival were also positively correlated with temperature in early spring, prior to female arrival, and adult female survival was positively correlated with temperature during the post-breeding, pre-migration period. Combining results across seasons, winter temperatures explained the most variation in population growth rate, primarily through effects on survival. Our study highlights how identifying year-round population-specific distributions and

associated environmental variables can vastly improve our understanding of processes driving population dynamics in migratory species.

Do migratory Rusty Blackbirds have a third stationary period in their annual cycle? Automated telemetry reveals the 'stopover' ecology of a species in decline
Wright, James - The Ohio State University; Christopher Tonra - The Ohio State University; Luke Powell - Smithsonian Migratory Bird Center

The once common Rusty Blackbird (*Euphagus carolinus*) has declined precipitously since the 1960s. To investigate potential causes of this decline, I am examining the species' habitat use and behavior at migratory stopover sites on Lake Erie, during fall and spring migrations. I deployed 5 nanotag radio transmitters in Fall 2015 and 30 in Spring 2016, and tracked individual movements using hand-tracking and automated telemetry towers; habitat features at confirmed foraging points were quantified and compared to random points to determine use versus availability. The tags will last through two migration seasons, allowing for repeated measures of individuals in spring and fall. The long tag life coupled with the automated telemetry array will enable me to address other stopover questions, including duration, site fidelity, seasonal differences in habitat use, and route traveled post-departure. The nanotags may be detected by the larger Motus array, which will provide data on their migratory movements after they leave Lake Erie. The five fall birds had an average stopover duration of 24.2 days, and used numerous habitat patches over an area more than 25 km2. These preliminary data suggest that Rusty Blackbirds are not using this site as a typical refueling stop, but may in fact take up residence in the area until they are pushed further south by oncoming winter. Forthcoming spring data and a complete fall field season in 2016 will shed light on the differences between spring and fall stopover ecology.

Integration by parts: toward the estimation of spatially explicit population processes in Mountain Plovers
Wunder, Michael - Department of Integrative Biology, University of Colorado Denver; Allison Pierce - University of Colorado Denver; Colin Woolley - University of Colorado Denver; Angela Dwyer - Bird Conservancy of the Rockies

Research on the full phenology of migratory species is necessarily limited by field logistics that provide simplistic windows into comparatively complex spatiotemporal processes. Because of this, strongest inferences are often developed from efforts to collectively consider results from disparate research, inventory, and monitoring projects. Here, we evaluate a collection of information sources for understanding space-time population processes in Mountain Plover (*Charadrius montanus*), a short-distance migrant species of shorebird that breeds in North American short grass prairies and intermountain grasslands; and that winters in the desert grasslands of southwestern United States and Mexico. Mountain Plovers are rare but regular throughout this relatively small geographic range, providing an opportunity to consider species-level dynamics across the full extent of its annual range. Inventory, monitoring, and research from the summer grounds suggest population sizes have been declining for decades. Reasons for the decline are most often framed in terms of impacts to breeding attempts. Results from similar research during winter suggest that breeding populations mix and are transient, and that indexes from single sites can dramatically fluctuate over time. Limited study of migratory biology suggests that mixing likely begins in late summer as migrants move to more southern breeding locales. Our observations suggest that conclusions based on results from single site, single season research are informative but biased, even if

using tracking devices or other remote windows into alternative seasons. Future research will do well to feature strategically replicated studies across sites and years.

How to Best Detect Magellanic Woodpeckers near the Southern End of the World

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After the likely extinction of Imperial (*Campephilus imperialis*) and Ivory-billed (*C. principalis*) woodpeckers, the Magellanic Woodpecker (*C. magellanicus*, MAWO) is the largest extant species of this genus; however, its populations are declining. Despite its conservation status, no standard census technique has been identified for MAWOs. To determine the best detection method, we experimentally assessed three techniques to detect MAWOs on Navarino Island, Chile during austral summers 2014-2015 and 2015-2016. We established 42 forested points; during a 10-min period at each point, we randomly chose one detection method: (1) broadcasted a MAWO territorial call via a speaker, (2) simulated a double-knock (MAWO territorial acoustical signal) with a drumming device, or (3) passively listened (control). To reduce potential detection method effect, only one method was used per location per month over a three-month period. We found that use of the drumming device elicited a significant difference in number of responses (n = 15) from MAWOs for both summers compared with the speaker (n = 8) and control (n = 8; H21 = 3.97, p = 0.0463, n = 42). The sound of a double-knock can carry well over 100 m through the forest, while the speaker can only reach approximately 100 m (ALW, pers. obs.); thus, the drumming device likely allowed us to detect woodpeckers at farther distances. Given these results, we recommend using a drumming device to more efficiently detect MAWOs.

Determining hunting habitat preference of barn owls (*Tyto alba*) in a vineyard agroecosystem

Xeronimo, Castañeda - Humboldt State University; Matthew Johnson - Humboldt State University

Large scale conversion of natural land to agriculture threatens wildlife and can diminish ecosystem services provided by nature. Understanding the delivery of ecosystem services by wildlife to farms, such as pest control, can help incentivize wildlife conservation in agricultural landscapes. The practice of attracting barn owls (*Tyto alba*) to nest on farms for pest management has been documented in various agricultural settings worldwide, but has not been thoroughly evaluated in vineyard agroecosystems. Napa Valley, California is a world renowned winegrape growing region and viticulturists regularly deploy owl nest boxes as part of integrated pest management (IPM) programs to help minimize damage to vines and roots from pocket gophers (*Thomomys bottae*) and voles (*Microtus spp.*). The aim of this study was to identify hunting habitat for barn owls and to quantify the extent to which barn owls forage within winegrape vineyards. We deployed GPS loggers on 20 individual female nesting barn owls to determine the extent of habitat use and foraging patterns when hunting. Utilizing location and corresponding time signatures from the GPS data we constructed home range-movement

maps using Time Local Convex Hull (t-LoCoH). Preliminary results suggest barn owls forage within vineyard boundaries and on nearby natural habitats. This information can help farmers place boxes to maximize the delivery of pest control on their farms, which could encourage viticulturists to continue maintaining nest boxes on their farms, persuade others to establish nest boxes, and ensure that barn owls stay common in this heavily altered landscape.

Forest Interior Bird Habitat Relationships in the Pennsylvania Wilds

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The Pennsylvania Wilds region, located in the state's northern tier, holds some of the largest intact forest patches found statewide and contains the largest remaining strongholds of forest interior bird populations in Pennsylvania. Migratory breeders like Swainson's thrush, black-throated blue warbler, and scarlet tanager are among the species threatened by forest fragmentation from natural resource development within the region. Much of the forest land is managed by state and federal agencies with interest in bird habitat conservation. During the 2015 breeding season, we surveyed forest birds across seven agency-mapped forest plant communities within conifer, oak, and northern hardwoods forest and conducted simultaneous forest community rapid assessments, validating community classifications and measuring forest structure. We estimated detection-corrected densities for 34 bird species using R package 'detect' and identified significant associations with forest community types for management applications. We used boosted regression trees (BRT) to evaluate the response of detection-corrected densities of 22 bird species to 45 habitat attributes. Among the 21 forest attributes selected in the best species models, only forest community type was included for all 22 bird species, and it was the most important variable in all models (42-98% contribution). Aspect, elevation, tall and short shrub cover, snags and basal area (ft2/ac) were also among the most influential features. By demonstrating that forest interior bird densities are influenced by agency-used forest community classifications and structural attributes, we can provide forest managers with information to help them better manage habitats for forest interior birds.

Seasonal fecundity and post-fledging survival and habitat selection of Henslow's Sparrow

Young, Aaron C. - University of Nebraska at Omaha; W. Andrew Cox - Florida Fish and Wildlife Commision; L. LaReesa Wolfenbarger - University of Nebraska at Omaha

For species of management concern, accurate estimates of seasonal reproductive rates as well as survival estimates at every life stage are necessary in order to better understand population dynamics as well as the effects that habitat may be having on populations. The Henslow's Sparrow (*Ammodramus henslowii*) is listed as threatened or endangered in 13 states. Two important demographic parameters, rates of multiple-brooding and post-fledging survival, have not been examined for this species. We studied nesting effort, nest survival, and post-fledging survival of Henslow's Sparrows in 2015 in southwest Missouri, in order to gain a comprehensive understanding of seasonal vital rates. During the 2015 field season we monitored 37 Henslow's Sparrow nests and placed transmitters on 22 fledglings. Daily nest survival using the logistic exposure method was 0.92 ± SE 0.02. Survival during the post-fledging period was estimated at 0.28 ± SE 0.11 for the first three weeks post-fledging. We placed transmitters on 19 breeding females and recorded 29 nests for

16 birds with transmitters, for a mean of 1.8 ± SE 0.17 nests per bird for the season. Of these 16 birds with transmitters, 9 (56%) had successful nests, 6 (38%) re-nested after a successful nest, and 3 (19%) successfully fledged at least two broods. Results from 2015 highlight the importance of estimating complete life-cycle vital rates for species of management concern. This information will be important for managers and researchers attempting to understand the effects of habitat on populations.

Sylvatic plague in black-tailed prairie dogs and the effects on density and trends of grassland birds in the Mountains to Plains area of northern Colorado

Youngberg, Erin - Bird Conservancy of the Rockies; Arvind Panjabi - Bird Conservancy of the Rockies; Reesa Conrey - Colorado Parks and Wildlife

In an ongoing effort to aid conservation and management of a biological corridor containing some of the last high quality shortgrass prairie along northern Colorado's Front Range, Bird Conservancy of the Rockies has partnered with the City of Fort Collins to monitor grassland birds on 45,000 acres of city-owned properties annually since 2006. The area has experienced two outbreaks of sylvatic plague since 2008 that have significantly decreased the Black-tailed prairie dog (*Cynomys ludovicianus*) population. Many declining shortgrass prairie bird species rely on habitat created and maintained by prairie dogs. To examine the indirect impacts of plague on shortgrass bird populations we have conducted point counts within prairie dog colony habitat (PDCH) from 2006-2016. A comparison of annual densities of McCown's Longspur and Mountain Plover within PDCH suggests that the populations have declined steadily and rapidly by upwards of 50%, most noticeably following the first plague event. The populations have not recovered to pre-plague numbers even though prairie dogs have now recolonized 72% of former colonies, suggesting a delayed response to habitat loss. We observed that plover populations recovered slightly, most likely in response to controlled burns, flea dusting, and plague vaccination efforts in 2013-2016. It is clear these species have not recovered from the plague-driven loss of suitable PDCH. Management should strive to conserve and augment prairie dog populations, maintain and restore native shortgrass prairie, minimize disturbance from natural resource development and recreation, and closely monitor grassland bird populations.

Cryptic diversification within the Newtonia of Madagascar: evidence from ultra-conserved elements, nuclear introns and mitochondrial sequences

Younger, Jane - Loyola University Chicago; Lynika Strozier - Loyola University Chicago; J Maddox - Field Museum of Natural History; Steve Goodman - Field Museum of Natural History; M Raherilalao - Association Vahatra; Sushma Reddy - Loyola University Chicago

Despite its reputation as a biodiversity hotspot, the full genetic breadth of Madagascar's avifauna remains poorly understood. Newtonia are a genus of putatively four species of forest-dwelling birds originally classified as Old World Warblers, but recently placed within the monophyletic Vanginae radiation. Two of the species, *N. amphichroa* and *N. brunneicauda*, have widespread distributions. To explore relationships within Newtonia we sequenced mitochondrial genes, nuclear introns and over 3000 ultra-conserved element (UCE) loci for *N. amphichroa*, *N. brunneicauda* and *N. archboldi*. We used maximum likelihood phylogenetic inference to confirm monophyly of the three species. For the two widespread species we conducted further intraspecific analyses to assess the possibility of cryptic speciation. Our study included 45 specimens of *N. amphichroa* from five study sites spanning the latitudinal breadth of Madagascar, and 96 specimens of *N. brunneicauda*, covering both eastern and

western populations of the species. We analysed these datasets for phylogeographic patterns using both maximum likelihood phylogenetic inference and dated Bayesian (BEAST) methods.Within *N. amphicroa* we discovered three highly distinct, monophyletic clades. The three clades are isolated in geographically disjunct montane regions. Our estimation of divergence times indicated that one lineage has been isolated for ca. 1.2 million years and the remaining two separated around 0.5 million years ago. We propose that these three lineages represent cryptic diversification and possibly two new species, further expanding the remarkably diverse Vanginae radiation.

Testing for hidden histories of gene flow using genomic markers

Zarza, Eugenia - Moore Laboratory of Zoology, Occidental College; Brant Faircloth - Louisiana State University; Whitney Tsai - Moore Laboratory of Zoology, Occidental College; Robert Bryson - Burke Museum of Natural History; John Klicka - Burke Museum of Natural History; **John McCormack** - Moore Laboratory of Zoology, Occidental College

Genomic studies are increasingly revealing that divergence and speciation are marked by gene flow. Less clear is whether gene flow has played a prominent role in species-rich regions of the world where allopatry and vicariance are assumed to be the principal modes by which new species are formed. We revisit a well-studied system in the Mexican Highlands, jays in the genus Aphelocoma, to test for patterns of recent and ancient gene flow among lineages in the different Mexican sierras using a broad subsample of the genome. Prior results from mtDNA largely conformed to the standard model of allopatric divergence and speciation among four highland lineages, although there was some evidence for more obscure histories of gene flow among lineages. We tested for these “hidden histories” using genomic markers known as ultraconserved elements (UCEs) in concert with phylogenies, clustering algorithms, and newer methods specifically designed to detect ancient gene flow (e.g., ABBA-BABA tests). Phylogenies, clustering results, and introgression tests based on 4303 UCE loci and 2500 informative SNPs are consistent with prior gene flow of varying degrees that might have ceased sometime in the recent past. These results how a species complex previously thought to be a model for isolation and vicariance can reveal a more reticulate history when a broader portion of the genome is queried. As more speciation scenarios are studied with genomic data, we predict that speciation-with-bouts-of-gene-flow might turn out to be the most common mode of speciation.

Resource Use and Defense by Ruby-throated Hummingbirds (*Archilochus colubris*) during Autumn Migration

Zenzal, Theodore - University of Sothern Mississippi; Frank Moore - University of Southern Mississippi

During stopover, migrants depend on access to food that allows them to deposit fuel and continue migration. However, resource access, use, and defense are often controlled by intrinsic and extrinsic factors. We used migrant Ruby-throated Hummingbirds (RTHU; *Archilochus colubris*) and artificial feeders to determine what factors influence priority access as well as resource use and defense. We added feeders containing either a high (1:2) or standard (1:4) quality sucrose solution to a stopover site at Fort Morgan, Alabama (30°10’N, 88°00’W) during autumn migration, 2012-2014. Each captured RTHU was banded with a USGS band, aged, sexed, and mass recorded. A subset of birds received an auxiliary marker (radio-tag, passive integrated transponder tag, or back color tag) in order to identify individuals visiting feeders. Observers determined feeding rate (resource use), chase rate (resource defense), and conspecific density at feeders. Analyses showed that feeding rate

was lower in agonistic birds compared to non-agonistic birds and also had a negative relationship with fuel load. Chase rate increased with density. Males had priority access to feeders and agonistic behavior depended on sex. When agonistic, males performed chases while females were chased. The ability for birds to meet the energetic demands of migration is directly tied to their ability to exploit resources. Our results suggest that intrinsic factors have stronger influences on resource use, while extrinsic factors more strongly influenced resource defense. Further, priority access is dependent on sex, which was found to influence the behavior of individuals at feeders.

Toll-like receptor (TLR) evolution in Anatidae

Zhang, Zhechun - School of Life Sciences, Sun Yat-sen University; **Yang Liu** - School of Life Sciences, Sun Yat-sen University

Continuously evolving pathogens and parasites, usually leading emerging infectious diseases, pose strong selective forces on immune systems of their animals hosts. These consequently drive adaptive genetic variation at functionally important genes involved in the development of immune defense. Members of the Toll-like receptor (TLR) gene family play an important role in pathogen recognition and the initiation of innate and adaptive immune responses. However, their role in host-parasite interactions and adaptation has rarely been investigated in an eco-evolutionary context, and little is known about the selective pressures that have shaped TLR evolution across species and populations. Being natural reservoirs and probably potential vector species of several avian-borne diseases, long-distance migratory Anatidae birds, i.e. geese, swans and ducks, are one of important groups to study adaptive evolution of animal immune systems. Investigating molecular evolution across several Anatidae species (ducks and geese), we show that TLRs are evolutionarily dynamic and a target of parasite-mediated selection in birds. Using a phylogenetic comparative analytical approach, we further demonstrate trends that elevated positive selection was significantly correlated with breeding and migratory life history traits of Anatidae. Our findings contribute to a better understanding of evolutionary processes in multi-gene families other than the MHC, as well as important implications for host-pathogen coevolution.

Partitioning the effects of hunting and climate on waterfowl survival

Zhao, Qing - Colorado State University; Scott Boomer - U.S. Fish and Wildlife Service; William Kendall - Colorado State University

For bird populations under harvest management, it is important to be able to partition the effects of hunting and climate on survival, so that management decision-making framework can better adapt to changing climate. However, it is a challenging task to partition the mortality due to hunting from natural mortality. In this study we developed a model that (1) partitions the mortality due to hunting (kill rate) from mortality under natural conditions and (2) links natural survival to covariates. We applied the model to a 24-year (1987-2010) data set of Mallard (*Anas platyrhynchos*) band-recovery data, breeding population size, and precipitation and temperature, summarized to 17 reference areas to examine the spatiotemporal variation of Mallard survival in relation to density-dependent process and climate factors. We found evidence that survival was driven by negative density dependence for adult females, but not for adult males, juvenile males, and juvenile females. The survival of adult females and juvenile females was driven by climate factors in a way that their survival was high when precipitation was high and temperature was low. Both kill rate and reporting rate increased during the study period. Our results demonstrate that hunting

mortality is at least partially compensatory for adult females, and mostly additive for adult males, juvenile males, and juvenile females. Our results also imply that future climate change may have a major impact on the survival of adult females and juvenile females. Our approach can have important implications for adaptive harvest management to respond to climate change.

Integrating Breeding Bird Survey and Demographic Data to Inform Wood Duck Management

Zimmerman, Guthrie - US Fish and Wildlife Service; **John Sauer** - US Geological Survey; Scott Boomer - U.S. Fish and Wildlife Service; Pam Garrettson - US Fish and Wildlife Service; Pat Devers - US Fish and Wildlife Service

The US Fish and Wildlife Service (USFWS) incorporates trend information from the North American Breeding Bird Survey (BBS) to assist in monitoring and management of some migratory birds (e.g, Band-tailed Pigeons, Mourning Doves, and some waterbirds). Although BBS indices provide trend information, they are not amendable to developing numeric population objectives, which has hampered the ability of the USFWS to assess success of management at scales useful for management (e.g., flyway, Bird Conservation Region) for some species. One such species is the Wood Duck (*Aix sponsa*), which is an important harvested species throughout the Atlantic Flyway (AF). Wood ducks are difficult to survey because they prefer forested habitat, making them hard to detect from aerial surveys that are commonly conducted for waterfowl over large spatial scales. Ground plot surveys conducted by state wildlife agencies in the northeastern US provide numeric population estimates of ducks for that region, whereas the BBS provides an index to population size over the entire AF. We integrated wood duck data from these two surveys with demographic data collected throughout the AF to derive population size estimates at BCR and AF scales. Overlap between the smaller scale intensive ground plot survey and the BBS in the northeastern US provides a means for scaling BBS indices into a population estimate that could be applied to regions lacking intensive surveys. These population estimates will be useful for habitat Joint Ventures and the USFWS for informing habitat and harvest management.

The nature of the speciation process in birds

Zink, Robert - University of Nebraska

New molecular methods allow a deeper insight into the genome and processes that shape it than ever before. Currently, hopes run high genomics will answer many long-standing questions. One such topic is speciation. Is there a genetic revolution? Do just a few genes contribute to speciation? With any data, one cannot develop a research program in speciation without first declaring what is a species, and what are the minimal requirements for assessing if speciation has occurred. Under the biological species concept, genetic differences lead to reproductive isolation. Under a lineage concept, genetic differences yield diagnostic traits. Under any model of species, it is important to distinguish the genetics of species differences from the genetics of speciation, because in the former, many differences could have arisen post-speciation, and therefore are simply artifacts of time rather than speciation per se. I evaluate 30,000 single nucleotide polymorphisms in two recently evolved species of Le Conte's Thrasher (*Toxostoma lecontei*) and show that speciation involves relatively few genes. I evaluate whether mitochondrial-nuclear discordance could play a role in keeping phylogroups allopatric or species isolated by assessing if there are non-synonymous changes that affect protein structure. I compared the COI gene sequences for Empidonax and Setophaga, and found no amino acid substitutions that made a substantial change in protein function.

Therefore, I conclude that mito-nuclear discordance may not play a role in speciation or in maintaining phylogroups allopatric.

Things Everyone Using BBS Data Should Know.

Ziolkowski, David - USGS Patuxent Wildlife Research Center; Keith Pardieck - USGS Patuxent Wildlife Research Center; John Sauer - USGS Patuxent Wildlife Research Center

The North American Breeding Bird Survey (BBS) is celebrating its 50th year of providing estimates of population trends for >400 bird taxa at varying scales, ranging from the local sampling unit (the route) up to the continental scale. Data users have always found the survey's large temporal span, taxonomic breadth, and geographic scope invaluable and have taken confidence in the reliability and high quality of data knowing that newly submitted data undergo rigorous quality assurance and error checking measures. But maintaining the long-term integrity and contemporary relevance of the time series additionally requires that macro-level editing be performed on a routine basis. The frequency and extent of these edits are dictated by such occurrences as changing taxonomic rulings, shifts in bird distributions, retrospective appraisals of data, etc. It is imperative that BBS data users be aware of the ways that these factors influence the distribution of count data within and between time series in order to identify the most appropriate analytical approaches. Additionally, it is critical that users of BBS data understand the range of factors that challenge the exploitation of structure that exists below the route level – that is, at the stop level. The BBS office is in the process of developing tools that will increase the amount and visibility of metadata and has a plan to advance the survey's functional scale to the stop-level; these are significant operational paradigm shifts and will require further time and resources to implement.

Social networks and behavioral reproductive isolation across a quail hybrid zone

Zonana, David - University of Colorado, Boulder; Jennifer Gee - University of California James San Jacinto Mountain Reserve; Eli Bridge - Oklahoma Biological Survey; Max Joseph - University of Colorado, Boulder EARTH Labs; Kyle Donahue - University of Colorado, Boulder; Rebecca Safran - University of Colorado, Boulder

In regions where closely related taxa co-occur, traits used in mate selection can inhibit genetic exchange between groups. These behavioral barriers to gene flow are important mechanisms involved in the generation and maintenance of species boundaries; however, due to the fact that mate selection is the product of interactions between individuals within a complex social context, it has long been difficult to quantify behavioral reproductive isolation in the field. Through experimental trials, biologists have made great progress in identifying traits essential for mate selection, but how these traits influence assortative mating and gene flow in wild populations remain poorly understood. Recent advances in social network analyses provide novel approaches for examining the links between mating signals, networks of social interactions, and paternity across entire wild populations.

My research leverages these advances to ask questions about the role of behavior in maintaining reproductive isolation between the California (*Callipepla californica*) and Gambel's quail (*Callipepla gambelii*) in the deserts and mountains of California. Through a combination of social network data generated from RFID-equipped feeders, as well as phenotypic and genetic data, I am able to ask: 1) How do mating signals mediate social networks and patterns of paternity among individuals in allopatric Gambel's and California quail populations? and 2) How do mating signals mediate social networks and patterns of paternity (and thus gene flow) within sympatric populations?

Combined, these methods will allow me to resolve the relationships between phenotypic traits, social behavior, paternity, and gene flow within hybrid populations.

Searching for home: Boreal birds seek out familiar landscapes during irruptions
Zuckerberg, Benjamin - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison; Courtenay Strong - University of Utah; David Bonter - Cornell Lab of Ornithology; Julio Betancourt - U.S. Geological Survey; Walter Koenig - Cornell University

Ecologists have long marveled when, in some years, large numbers of birds appear far beyond their usual breeding and wintering grounds. These avian irruptions are witnessed by millions of people who frequently record the arrival of unfamiliar species to their feeders and backyards. In North America, the most well-known examples of this phenomenon are seed-eating birds that typically overwinter in the boreal forests of Canada, but in some years, irrupt south as far as Mexico. Using data generated from Project FeederWatch (PFW), an international citizen science program, we have documented how Pine Siskin (*Carduelis pinus*) irruptions are triggered by continent-wide dipoles in climate. These dipoles influenced siskin irruptions at time lags of two years, suggesting an indirect effect of climate on seed production in boreal forests. Although irruptions are a geographic phenomenon, there is virtually no information on the characteristics of landscapes that irruptive migrants occupy during an irruption event. As part of this study, we tested the hypothesis that boreal, seed-dependent birds seek out landscapes that would be most closely associated with critical food resources during irruptions. Using data from PFW across the eastern United States, we found strong support that irruptive species, such as Pine Siskins, are more likely to occupy conifer-dominated landscapes during irruption events, but the strength of these relationships vary geographically. The ability to capture the spatiotemporal characteristics of continent-wide irruptions using citizen science is a clear example of the use of Big Data in ornithology.

Novel seasonal land-cover associations through dynamic species distribution modeling
Zuckerberg, Benjamin - Dept Forest and Wildlife Ecology, University of Wisconsin-Madison; Daniel Fink - Cornell University; Frank La Sorte - Cornell University; Wesley Hochachka - Cornell University; Steve Kelling - Cornell University

Plasticity in migratory and foraging behavior allows species to exploit dynamic and novel habitats. This is especially important during seasonal transitions as species track shifting environmental resources and potentially associate with a diversity of habitats. Although land cover associations are thought to vary across seasons for many species, the prevalence of these dynamic relationships across species' distributions are unknown. We used data on bird occurrence from eBird in conjunction with dynamic species distribution modelling to quantify seasonal plasticity in species land cover associations for forest breeding bird species. We employed a multi-scaled approach relying on adaptive regression models to quantify spatiotemporally varying associations between species' occurrences and land cover diversity and composition. Species demonstrated seasonal shifts in land cover associations and, despite being forest dependent species, were more likely to occur in human-modified landscapes during seasonal transitions. From spring to autumn, Neotropical migrants were more likely to occur in landscapes of lower land cover diversity, but showed the highest seasonal plasticity in land cover associations. Residents and temperate migrants occurred in landscapes with a higher diversity of land cover, but were less variable in their seasonal land cover associations. Following summer,

migratory and insectivorous birds took advantage of a wider array of land cover ranging from open to developed landscapes. Dynamic species distribution modelling can uncover seasonally complex species–environment relationships, and identify novel aspects of habitat associations critical for supporting full life cycle research and conservation efforts.

Urbanization and birds in Mexico: current knowledge and perspectives

Zuria, Iriana - Universidad Autónoma del Estado de Hidalgo; Ruben Pineda-Lopez - Universidad Autonoma de Queretaro; **Remedios Nava-Diaz** - Universidad Autonoma de Queretaro

Urbanization is one of the major threats for wildlife and ecosystems worldwide. Currently, more people live in urban areas than in rural areas, and Latin America represents one of the most urbanized regions in the world with 80% of its population living in cities. Mexico has a megadiverse avifauna, with almost 1150 species including many that are endemic, but it is also one of the most threatened due to intensive human activity and urban development. We synthesize the current knowledge of urban bird studies in Mexico and report on resident and Nearctic-Neotropical migratory birds that can utilize the different habitats that cities offer. We also present how current research projects and researchers across the country are uniting efforts to promote studies and conservation strategies for the benefit of urban avifauna. Finally we discuss future trends and suggest lines of research to strengthen urban ornithological studies. This could aid in the development of urban conservation and management strategies that may result in more sustainable and bird friendly cities.

Early professional mini-talk symposium abstracts

Isotope analysis: a springboard for human impact studies
Abraham, Elizabeth

Many migration banding stations see thousands of birds come through every season. This provides a unique opportunity to collect large feather samples for stable isotope analysis. The stable isotope ratios of hydrogen (2H/1H; depicted as δ2H) are particularly useful for assessing temporal changes in range because the processes that create variance in these isotopes in the hydrosphere are relatively well understood. Present work has produced comparison models of isotope signatures from older feathers and current feathers that identified shifts in the area of occupancy over time. However, in order to properly adapt management plans to accommodate a shifting species, it is important to understand why these shifts might be occurring in the first place. For example, urbanization and land conversion for agriculture might be destroying a species' habitat, or climate change may be causing colonization at a species' northern boundary. Parallel research should be conducted to explore these potential causes of range change.

Creating a Monster: Combining Data from Multiple Sources for Stronger Inference
Adams, Evan - Biodiversity Research Institute

Ecology is at a time where data from multiple sources and methodologies are becoming increasingly available for answering research questions. Sometimes data sets are well-standardized and combining multiple sources of data is relatively easy but often there are many differences that prevent a clear combination of data despite surveying similar animals or areas. Our ability to inform the conservation of birds will depend upon our ability to combine increasingly disparate types of data. First, I will discuss combining highly standardized marsh bird survey data and the considerations necessary for analysis. Afterwards, I will move on to combining more mismatched types of data like boat and aerial seabird surveys, and broad-scale migration surveys with more intensive smaller-scale data. While survey standardization will always be essential, techniques that combine data in new ways will be an important means of expanding our conservation knowledgebase.

Evolutionary genomics of pedigreed wild populations
Chen, Nancy - University of California, Davis

My research is motivated by a fundamental question in evolutionary biology: how is genetic variation maintained in natural populations? I develop integrative genomic, population genetic, and quantitative genetic approaches and apply them to a long-term demographic study of the endangered Florida Scrub-Jay (*Aphelocoma coerulescens*) to investigate the evolutionary processes governing patterns of genetic variation across the genome. By taking advantage of a large, complex pedigree, my approaches have more power to distinguish between selection and drift compared to most traditional population genetic inference methods. My current work is focused on two main themes: (1) detecting short-term selection understand the role of antagonistic selection in maintaining genetic variation, and (2) elucidating the population genetic consequences of declining population size. Integrating genomics and evolutionary genetics with natural history and field biology provides unprecedented opportunities for direct measurement of evolutionary processes and comprehensive empirical evaluations of basic evolutionary theories in natural populations.

Modern ornithology and extensive interdisciplinary approach
Contina, Andrea - Oklahoma Biological Survey/University of Oklahoma

My name is Andrea Contina, and I am a postdoctoral research associate at the Oklahoma Biological Survey – University of Oklahoma. I advocate for an interdisciplinary approach in science, graduate education, and outreach. I truly believe that a modern ornithologist, besides ecology and evolution, should have extensive knowledge in the areas of geography, climate change, environmental sustainability, effective communication strategies, and big data analysis. My field of research spans from anthrozoology to conservation biology, from aeroecology to disease ecology and bird migration. During my talk, I will present a summary of my extensive interdisciplinary work which involves: genetics of avian migration, radar aeroecology, agent based modeling, and surveys related to human perception of the international bird trade and wildlife management.

Geographic Variation and population genetics in Neotropical Orioles
Cortes, Maria - Smithosnian Institutuion

I am interested in the role that geographic gaps such as Isthmuses, mountain ranges, islands, among other barriers, have played in the genetics of Neotropical birds. During my Ph.D., I studied how the Isthmus of Tehuantepec had shaping the evolutionary history of two species of Orioles (*Icterus graduacauda* and *Icterus chrysater*). I used coalescent analysis of multiple genes to calculate different demographic parameters such as: effective population size, migration and time since divergence. However, coalescent analysis showed no evidence of present gene flow. As a postdoc at the CCEG-SCBI I have been working on a variety of projects that fall into three categories: Evolutionary biology, disease testing, and conservation of endangered species from islands. My research will contribute mostly to the knowledge that past or present geographic barriers play in the evolutionary history of species, emphasizing their phylogeography, genomics and conservation of these fragmented populations.

Sexual selection before and after copulation in passerines
Cramer, Emily - Smithsonian Institute

Sexual selection is a fundamental process in biology: it drives the evolution of signals used in mate choice and competition over mates, and it potentially drives speciation. Though less appreciated in vertebrates, for species where females copulate with multiple males, sexual selection also drives the evolution of sperm. Traits that help sperm outcompete other males' sperm or that are preferred via cryptic female choice should be selectively advantageous. Given the prevalence of extra-pair paternity across bird species, post-copulatory sexual selection is likely to be an important evolutionary force for passerine birds. My work focuses on building an integrated understanding of sexual selection acting before and after copulations in passerines. I take a multi-faceted approach to understand what sperm traits are most important for determining fertilization success, how physiological processes link the traits involved in pre-copulatory and post-copulatory sexual selection, and how divergence in sexual phenotypes affects speciation.

Small animals and big data: Fusing computer science with field ecology
Dale, Katherine - United States Geological Survey/Patuxent Wildlife Research Center

Traditional methods of surveying adults, nests, and juveniles in nesting waterbird colonies typically involve physically entering the breeding area. Thermal infrared cameras (TIR) may provide a remote way to survey birds and their nests more quickly, more

accurately, and with less disturbance. However, quantifying the detection rate and precision of thermal imaging requires the use of computers, from basic image viewing to using algorithms designed to automatically detect heat signatures. We found a simple Python program detected the heat signature of an avian chick in 88% of 139 usable images. As acquiring large and/or complex datasets becomes easier and cheaper, computer programming may be essential for efficient analysis. One of the presenter's main career goals is to bridge the gap between computer science and ecology. She has a special interest in working on the early life history of fishes, especially highly migratory species.

Movement ecology going big
Dokter, Adriaan - Cornell Lab of Ornithology, Cornell University

Billions of birds traverse the globe’s continents each spring and autumn, but despite the magnitude of these movements, bird migration remains a highly elusive phenomenon. Migrants have explicit difficulties coping with anthropogenic global change and are suffering population declines. Because global changes are inherently gradual and variable across geographic regions, a comprehensive long-term and large-scale understanding of the seasonal whereabouts and fitness bottlenecks of migratory birds is needed urgently. The required long-term large-scale perspective is now coming into reach of scientists due to the push of new technologies (individual tracking, sensor networks, citizen science), which produce bigger data than ever before. I will argue why big data provides endless opportunities for movement ecology to test hypotheses at large spatio-temporal scales, both at the level of individuals and populations, and how big data approaches may give a much needed boost to the robustness of correlational and mechanistic inferences in movement ecology.

Facilitative foraging strategies in marine birds
Goyert, Holly - University of Idaho

Marine predators locate prey in an environment characterized by high spatial and temporal variability, which is increasing with climate change. My research focuses on how marine communities of endangered birds, mammals, and fish, cope with a changing environment by relying on facilitative interactions with each other. This means that the conservation and management of one mesopredator depends not only on the availability of prey and suitable habitat, but also on the ecology of other mesopredators. An application of this is the set of hierarchical models that I developed to predict the exposure of biological communities to proposed offshore wind energy facilities. By including marine birds and mammals in these models, we improve our understanding of the distribution of ‘hotspots’ than were we to focus on one taxon in isolation. Understanding how dynamic processes drive the predictability of resources and community interactions is crucial to addressing new frontiers in marine conservation.

Assessing the relationships among behavior, cognition, and physiology in the field
Jones, Blake - University of Memphis

Presumably, a threatening encounter with a predator activates the hypothalamic-pituitary-adrenal axis in free-living animals in what is commonly called a stress response, which may help mediate the lasting memory of the attack. However, these assumptions are based on experiments that do not resemble what free-living animals experience in nature, and typically involve laboratory models that can have considerably different physiological responses than their free-living counterparts. To address this gap in our understanding, I developed novel methods to examine the

physiological stress response and its effects on learning and memory in ecologically relevant contexts. My results thus far have revealed similarities and surprising differences between free-living birds and laboratory models traditionally used in endocrinology and animal cognition. Moving forward, I will continue to assess the links among physiology, behavior, and cognition in free-living animals in order to further understand the ecological significance of these relationships.

Sperm as tools of conflict, cooperation, and conservation
Liu, Irene - Duke University

I study sperm in the context of postcopulatory sexual selection and conservation genetics. My dissertation, which focused on the molecular causes and consequences of sperm competition in *Agelaius* blackbirds, used field, lab, and bioinformatics approaches to examine three topics: 1-the relationship between population genetic diversity and extra-pair paternity (EPP) in red-winged blackbirds; 2-the link between mating systems and protein evolution in three *Agelaius* species, and 3-the impact of polyandry on the conservation of the endangered yellow-shouldered blackbird. Starting this fall, I will investigate the dynamics of sperm cooperation in Peromyscus mice. I am excited to study the genetics of sperm recognition and the sperm-egg interactions required for successful fertilization in species with different mating systems. This comparative work broadens the context under which I will ultimately pursue my interests in avian reproductive strategies and fitness and biodiversity preservation.

Muddy boots, singing birds, and big trees: integrative study of bird speciation and diversification
McEntee, Jay - University of Florida

My research program is driven primarily by an interest in the origins of the various facets of vertebrate, and especially bird, diversity. How do new species arise? How do traits diverge and spread? What does within-species trait uniformity tell us about evolutionary mechanism? In the mountains of eastern Africa, I have investigated the role of song divergence in bird speciation. In my current research, I'm using global species-level bird phylogenies and large data sets to make inferences about the geography of speciation and to discover correlates of female plumage evolution. Looking toward the future, I am pursuing new studies of the origin, diversification, and range dynamics of avian nectarivores, and the evolutionary consequences of these diversifying nectarivore clades for bird-pollinated plants. I believe that diffuse mututalism's role as a contributor to diversification has been underexplored. For this work, I plan to leverage an integrative approach including empirical and theoretical components to study the evolution of bird pollinators at multiple temporal and spatial scales.

Listening to the receiver in birdsong and acoustic ecology
Moseley, Dana - Wiliam and Mary/Smithsonian MBC

My research investigates how communication signals are shaped and in turn shape the ecology of signalers and receivers. In my dissertation, I examined vocal performance, the ability to sing physically challenging songs, and how performance functions in sexual selection in swamp sparrows *Melospiza georgiana*. Previous studies found mixed results concerning whether territorial males responded to playbacks of higher performance more or less aggressively. By taking into account not only the performance of playback stimuli (signalers) but also the performance of male subjects (receivers), our model explained males' tendency to approach aggressively or to retreat in avoidance. In another experiment, captive

females (receivers) preferred higher over lower performance songs, but preference was shaped by their experiences. My postdoc examines how environmental noise can deter birds from socioeconomically important areas (airports, farms), testing the hypothesis that masking noise deters birds because signalers cannot effectively transmit and receivers cannot perceive signals.

The Landscape Ecology and Conservation of Hawaiian waterbirds
van Rees, Charles - Tufts University

The Hawaiian island of Oahu is home to four endangered native waterbirds, all of which depend to varying degrees on brackish and freshwater coastal wetlands. Among these, the Hawaiian stilt (*Himantopus mexicanus knudseni*), coot (*Fulica alai*), and gallinule (*Gallinula galeata sandvicensis*) are threatened by wetland loss, habitat fragmentation, and introduced mammalian predators. This mini-talk complements my submitted abstract on the population structure of Hawaiian gallinules, and discusses broader collaborations using an automated telemetry network to track inter-wetland movements in these three species, as well as plans for community-organized conservation efforts specifically directed toward the Hawaiian gallinule. My USGS and USFWS colleagues and I have erected six automated telemetry towers at key wetlands on Oahu, and are deploying coded radio transmitters to assess habitat connectivity for these species. I will also discuss developing plans to investigate population structure among Hawaiian gallinules using the population genetics of chewing feather lice.

Elevational Movements of Songbirds After the Breeding Season
Wiegardt, Andrew - Klamath Bird Observatory

Migratory species employ a variety of strategies to meet the energetic demands of post-breeding molt. A few western Neotropical migrant species are known to undergo short-distance upslope movements to locations where adults molt feathers. Given inherent difficulties in measuring subtle movements of songbirds, altitudinal molt migration may be a common yet poorly documented phenomenon. We used bird capture data in a series of linear models for nine species. Our results indicated that long-distance migrants, e.g. Orange-crowned Warbler (*Oreothlypis celata*) moved higher in elevation, and Audubon's Warbler (*Setophaga coronata*) moved inland to molt. For resident and short-distance migrants, birds remained on the breeding grounds until they finished molting, such as Song Sparrow (*Melospiza melodia*), or made small downslope movements, such as American Robin (*Turdus migratorius*). Our results suggest that altitudinal molt migration may be a common and variable behavior amongst western birds.

Evolutionary consequences of dispersal and migration in birds
Winger, Benjamin - University of Michigan

From local adaptation to global patterns of diversity, ecological and evolutionary processes are profoundly influenced by how organisms disperse throughout the landscape. I employ a diverse toolkit to study the evolutionary causes and consequences of avian movement ecology — seasonal migration and dispersal — with the broader goal of addressing fundamental questions in biodiversity science including the evolution of geographic range, the process of speciation and the assembly of ecological communities. Here, I showcase three directions that my research will take over the near future: 1) bridging phylogenetics with macroecology to examine range evolution in migratory birds, 2) using comparative genomics to understand the speciation process in Neotropical montane birds and 3) testing the relationship between avian dispersal and migration in boreal songbirds. I also discuss the important

role that museum collections will play in answering some of our most pressing questions in avian ecology, evolution and conservation.

Using long-term bird capture data to identify climate change winners and losers

Wolfe, Jared - USDA Forest Service

Habitat and climate change can dynamically interact to affect landbird populations resulting in demographic winners and losers. To disentangle effects of climate and habitat interactions on landbirds, we used 25 years of bird capture data from 60 stations in southern Oregon and northern California in combination with climate and habitat covariates to examine variation in survival. Our results suggest that avian survival varied at landscape scales, where birds captured in drier habitats further from climatic refugia (e.g. perennial sources of water) were subject to lower estimates of survival. This study provides evidence that certain landscape features buffer sensitive landbird populations from deleterious effects of climate change in the western United States.

Poster session abstracts

Land snail bottom up control of avian diversity and Harpy Eagle (*Harpia harpyja*) nesting in the Bladen Nature Reserve, Belize

Abbott, James - University of North Carolina at Wilmington; Dan Dourson - Belize Foundation for Research and Environmental Education; James Rotenberg - University of North Carolina, Wilmington

We present a gastropod bottom up control of avian diversity and Harpy Eagle (*Harpia harpyja*) nesting in the Bladen Nature Reserve (Bladen), Belize. The Bladen is one of the finest examples of intact rainforest in Northern Central America. Located 30km from the Caribbean and 80km north of Guatemala the Bladen hosts plant diversity more closely associated with sites in Southern Central America. March surveys recorded 67% of total known avian diversity in the Bladen. It was also determined to be very high in gastropod diversity with 61 species recorded in quadrat surveys of .03 hectares of forest. Harpy Eagle were confirmed nesting in the Bladen in 2010. This represents their northern most known nesting range Their main documented prey sources include common opossum (*Didelphis marsupialis*) and white-nosed coatimundi (*Nasua narcia*). Known food sources for these species include Neocyclotidae and Orthalicidae snails which constituted 28% of total sampled individuals. We recorded several “breaking stones” which are used by many bird species to specifically feed on land snails. The karst topography of the Bladen provides significant source of available soil calcium which allows for greater gastropod abundance and diversity (H = 2.636) than observed in other similar studies. Slope soil heterogeneity and water availability create unique and complex plant assemblages crucial for high land snail and bird diversity. Abundance and diversity of arboreal and terrestrial gastropods exerts low trophic level population control on key Harpy Eagle prey species. This could factor in nesting presence and cycling.

The Effects of Anthropogenic Activity, Social Instability, and Social Behavior, on the Transmission of an Infectious Bacterium in a Songbird Host

Aberle, Matt - Virginia Tech; Dana Hawley - Virginia Tech

Social stability and behavior can alter an animal’s exposure and physiological response to disease. Thus, it is critical to understand how anthropogenic factors such as supplemental feeding alter social stability, as well as the consequences of these changes for disease dynamics. Since the mid-1990s, house finches (*Haemorhous mexicanus*) have been subject to infection with a contagious bacterium that causes debilitating conjunctivitis. House finches flock in the non-breeding season and congregate at bird feeders where the majority of transmission occurs. Therefore, House finches are an ideal system to examine how anthropogenic food supplementation influences social stability, and the consequences of social instability for disease transmission. Here we present the results of a pilot analysis characterizing social stability in free-living, wintering house finches in Blacksburg, VA using data collected from radio-frequency identification devices (RFID) attached to bird feeders. We examined whether individual social status predicts the extent of social stability in house finches, and how rates of aggression at feeders varied with social stability. From Oct 2016-Feb 2017, we will alter bird feeder density across several sites while using RFID to track changes in house finch contact networks and social group stability. Pathogen prevalence will be measured via eye swabs at capture and by swabbing bird feeders across density treatments. By altering the density of feeders, we will quantify the effects of anthropogenic food supplementation on this disease system

via changes in the contact networks of house finches, social group stability, and the prevalence of Mycoplasma gallisepticum.

Hormone and melanocyte signaling in a social feather ornament
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Bird feathers are one of the most striking examples of variation in nature. Some of the variation in feather ornaments has been shown to act as a signal of the quality or status of an individual. To understand why and how particular ornaments are used as social signals, we must understand the factors that regulate their development. Hormones, such as estrogen and testosterone, have been shown to regulate sex differences in feather color. Here we asked if feathers that form a melanin-based ornament used in attracting mates and signaling status – the white outer tail feathers of Dark-eyed junco (*Junco hyemalis*) – are sensitive to testosterone and estrogen, and if hormonal signaling explains variation in the extent of white in junco tails. We used qPCR to measure the expression of androgen receptor (AR) and estrogen receptor (ER), and compared receptor abundance among males that showed different amounts of tail white. Furthermore, we asked if hormone receptor expression was correlated with expression of key melanocyte signaling markers agouti signaling peptide (ASIP) and melanocortin 1 receptor (MC1R). Our results show individuals with more tail white express more MC1R and marginally more ASIP. While individual variation in feather color was not directly related to hormonal sensitivity, ASIP expression was significantly positively correlated with both AR and ER expression. Our results show that developing feathers that form social ornaments are sensitive to hormones, and provide a mechanistic hypothesis for the link between the size of the ornament and the status of an individual.

Relationship of Invasive Berry Producing Plants on Bird Communities and Observer Bias
Adams, Zachary - Juniata College

I compared avian feeding guild structure between two wetlands with differing abundance of invasive berry producing plants in Huntingdon County, Pa in the fall of 2015. Two transects at each of the two wetlands were surveyed six times and bird species and counts were recorded. Vegetation was sampled once per transect and a total number of native and invasive berry producing plants was determined. Average abundance, bird density, and conservation scores were calculated for each site. Very few invasive berry producing plants were found at one wetland, while high numbers of berry producing invasive plants such as Autumn Olive (*Eleaegnas umbellatum*) were found at the other wetland. Average abundance at the wetland with no invasive berry producing plants (12.42 birds per visit) did not significantly differ from the wetland with abundant invasive (12.04 birds per visit) ($t=.04$, $p=.48$). However, these results differ dramatically from an identical study conducted the previous year showing that short term datasets are inadequate to address research question. Observer bias, particularly related to low detectability species, can have large impacts on results.

Large Area Survey for Habitat Analysis by Low Cost UAV Technology
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Unmanned Aerial Vehicles (UAV) present a powerful new approach to studying avian environments, as they can gather high-resolution data over large areas at low cost. We present such a system and its workflow, enabling the capture of visual and near-

infrared (NIR) imagery covering many square kilometers in tropical lowland forest of Belize. Compared to satellite data (i.e. Landsat), our approach is more temporally relevant, cloud-free and has higher resolution (10cm versus 30m). Flight mission products include canopy height models (CHM), Normalized Difference Vegetation Index (NDVI), and even tree crown delineation. These datasets are useful in bird studies to relate habitat attributes and resource heterogeneity with rare bird species in remote areas with poor quality satellite coverage. For example, Harpy Eagles (*Harpia harpyja*) are classified as extremely endangered in Belize, with only one known nesting pair. We used a small fixed-wing UAV to gather data over 700 hectares in and around the Bladen Nature Reserve, to survey the breeding territory for comparison with a nearby location where birds are not found. The hypothesis is that forest structure varies between the breeding site and nearby site as detected by our data. We conducted surveys during three days of flights, and created georeferenced maps in post-processing. The map data was comprehensive and accurate to 10cm resolution in visible and 18cm resolution in NIR spectra, showing differences between the two locations. We believe that UAV technology will be far-reaching for the future of bird study and conservation.

Cattle Grazing and Grassland Birds in the Northern Tallgrass Prairie

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With the loss of over 70% of North America's grasslands (Samson et al. 2004), grassland birds increasingly rely on habitat that is privately owned and managed for livestock production. Therefore, it is critical to understand how livestock grazing influences grassland bird abundance and community structure. We evaluated the response of 4 obligate grassland bird species to grazing intensity, vegetation structure, ecological site description, and burning across a landscape including pastures with no recent grazing to pastures experiencing grazing intensities similar to that for private livestock production operations. We evaluated models using a binomial N-mixture model implemented in the R package unmarked. Overall, 3 of the 4 obligate species included positive relationships with grazing intensity in the top abundance model (i.e., grasshopper sparrow [*Ammodramus savannarum*], bobolink [*Dolichonyx oryzivorus*], and upland sandpiper [*Bartramia longicauda*]), suggesting the range of grazing intensities evaluated (0–4.57 animal months/ha) did not negatively affect the abundance of these species. Marbled godwit (*Limosa fedoa*) abundance, however, was higher with greater variability in litter depth but was not directly related to grazing intensity. Finally, the effect of year was correlated with decreasing precipitation over the course of the study and had the greatest influence on community composition with some community separation by grazing intensity. Our results suggest that cattle grazing can positively influence the abundance of some grassland bird species but annual variation in weather patterns can influence community composition at sites regardless of management decisions.

Leks on the Landscape: Variation in lek structure in four manakin species along a strong rainfall gradient the Panama Canal Zone

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Because of their lek mating systems and courtship displays, manakins (Pipridae) are intensively studied as examples of sexual selection, female choice, and social networks. Between species, lekking behaviors range from simple displays on "exploded" leks to complex coordinated dances by multiple males. However, how lek structure and display behavior vary within species has not

received much attention. For four months in 2016, we located and monitored leks of four species of manakin (*Ceratopipra mentalis*, *Lepidothrix coronata*, Manacus vitellinus, and Chiroxiphia lanceolata) across 12 study plots in large forests distributed across an intense rainfall gradient in the Panama Canal Zone. Across these sites, we found variation in lek size, lek density, intersexual interaction, and display intensity, particularly for C. mentalis. Previous research has demonstrated that dry conditions have strong effects on population dynamics of several species of manakins. How drought precipitates these effects is largely unknown, but likely is related to changes in fruit availability. To test for this, we used seed traps on our study sites to measure fruit availability with declining rainfall. In a landscape where demography, population density, and resources are variable, we predict that there is selection on lek structure in response to female behavior, reflecting individual males' attempts to increase mating success. While our results are preliminary, we believe that understanding how local ecology dynamically affects the strength sexual selection and mating strategy will deepen our understanding of lek mating systems.

Habitat Selection by American Woodcock during Fall Stopover on Cape May Peninsula, New Jersey

Allen, Brian B. - University of Maine; Daniel McAuley - USGS Patuxent Research Center; Erik Blomberg - University of Maine; Ray Brown - USFWS Moosehorn National Wildlife Refuge; Chris Dwyer - Northeast Region, U.S. Fish and Wildlife Service

Migration may expose birds to hazards at intensities greater than those during any other life stage, and effective conservation of migratory species requires an understanding of space use during migration. From 2010 to 2012 we conducted a radio-telemetry study of American woodcock (*Scolopax minor*) on the Cape May Peninsula, New Jersey, which is an important stopover site for migratory woodcock in the eastern flyway. Our research objectives were to 1) describe diurnal cover-type characteristics used by woodcock, and 2) evaluate second-order habitat selection during the fall migration period. We nightlighted fields to capture birds and attach VHF radio-transmitters. Ten to 15 individuals were marked each week, and we located birds twice weekly until departure, death, or the end of the field season. Over four years we radio-marked 271 woodcock and collected 1,949 point locations from these birds (Range = 0 - 21 points per individual). We used GIS and resource selection functions in the form of a generalized linear mixed model to compare land cover-type attributes at the marked locations (used) to attributes at random locations distributed across our study landscape (available). We used results from this analysis to develop a predictive model of habitat distribution at Cape May. Our study improves our understanding of American woodcock habitat selection during this critical life stage, which to date has been generally understudied, particularly in the eastern U.S. Furthermore, our results may provide insight to important habitats for other short-distance migrants that rely on early successional habitat.

Is Wetland Restoration All It Is Quacked up to Be? A Waterbird Community Perspective

Anderson, Daina - University of Waterloo; Rebecca Rooney - University of Waterloo

We rely on restoration to compensate for extensive wetland losses, but do restored wetlands really support similar waterbird communities as natural wetlands? New policy in Alberta, Canada has created a conservation offset program where the restoration of drained wetlands is considered adequate replacement for destroyed natural wetlands. I compared the waterbird community composition in natural and restored marshes in the Parkland region of Alberta. I conducted avian surveys at 24 wetlands restored by ditch-plugging within the

last 11 years and 36 natural wetlands spanning a gradient in the extent of agricultural disturbance. I found that avian community composition differed significantly between natural and restored wetlands (MRPP: A=0.05, P < 0.001). I found that waterbirds in wetlands of moderate disturbance (25-75% non-natural land cover) represented a midpoint in a gradient of community composition between the least and most disturbed wetlands. However, the theory that ditch plugging can reverse an undesirable trajectory is not supported by my results. Rather, restored wetlands comprise a unique assemblage of waterbirds (pairwise MRPPs: A=0.02-0.056, P < 0.001). Using ordinations, I found strong support for an association of the waterbird community with both local- and landscape-level habitat variables. Restored wetlands were larger, deeper, more permanent wetlands on average, with higher proportions of open water, and more crop and pasture land surrounding them. Consequently, they supported more habitat generalists and more waterfowl. My work will guide restoration practices and highlights the risk posed to the biological integrity of Alberta's wetlands by adoption of a conservation offset program.

The Effects of Ambient Temperature on Morning Incubation Behavior of Hooded Warblers (*Setophaga citrina*)

Anderson, Rachel - Ohio University; Brandan Gray - Ohio University; Kelly Williams - Ohio University

Breeding birds with altricial young must balance self-maintenance with parental care. Because embryonic and nestling development is sensitive to nest temperature, females that are able to alter the timing and duration of the first off bout each morning in response to morning temperatures may have increased reproductive success. We examine variation in the first off bout each morning during the incubation and early nestling period in female hooded warblers (*Setophaga citrina*) during the 2014 and 2015 breeding seasons. Using temperature loggers (iButtons) in and below each nest, we recorded time of first off bout in relation to sunrise, off bout duration, drop in nest temperature during the first off bout, and ambient morning temperatures. All nests were monitored to determine fledging success. We found that females left the nest earlier on colder mornings; however, females did spend less time off of the nest during the first off bout when morning temperatures were colder. We found that ambient temperature was negatively correlated with heat loss during the first morning off bout. Off bout duration was related to fledging success: nests with longer morning off bouts were more likely to fail than nests with shorter morning off bouts. Our results suggest that female hooded warblers are energy limited, which indicates a trade-off between self-maintenance and parental care. Understanding behavioral responses to variation in ambient temperature during nesting provides insight into how individuals manage the energy constraints of reproduction and may help predict an organism's response to environmental variation.

Fire seasonality influences some aspects of reproduction, but not overall productivity, of the endangered Red-cockaded Woodpecker

Angell, Emily - Archbold Biological Station; Robert Aldredge - Archbold Biological Station; Reed Bowman - Archbold Biological Station

Red-cockaded woodpeckers (*Picoides borealis*; RCWs) are an Endangered cooperative breeder endemic to the fire-dependent pine ecosystems of the southeastern United States. Historically, these ecosystems burned every two to four years with most fires occurring during the transition between the winter dry season and the summer wet season. Frequent fire is crucial for RCWs, but little is known about how frequency and seasonality interact to

influence reproductive output. We examined how fire seasonality and time since fire influenced reproduction over eighteen years (1997-2015) in a small, well-managed, population of RCWs from south-central Florida. Because burns occurred in a mosaic over each breeding territory, we calculated the relative time since fire (in days) and season of fire based on the proportion of available foraging habitat burned during each prescribed fire. Time since fire had no significant effect on RCW productivity overall. In areas burned predominantly during the transition period, clutch size was larger for groups with helpers, but not for those consisting only of a breeding pair. In areas burned during the dry season, rates of total hatching failure and partial brood loss were lower, even when we controlled for clutch size. However, despite these differences overall fledgling production (fledglings/breeding group) did not differ with fire season. The seasonal timing of fire has known effects on the composition and structure of groundcover in pine flatwoods and this may, in turn, influence the arthropod community, resulting in subtle effects on various aspects of reproductive performance without affecting overall productivity.

Avian Use of a salt marsh island following a trial beneficial reuse of dredged material project

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In response to degraded conditions, a multi-partner restoration project was initiated in August 2014 to restore a coastal salt marsh in southern New Jersey with locally dredged material. Two thin-layer placement (TLP) plots, 0.2 hectares each, were raised 12-22 cm. A higher elevation nesting habitat plot (1.6 m x .77 ha) was also created. Following material placement we employed two monitoring approaches in order to better understand use of the marsh system by nesting and migratory birds. Point count surveys of all species, with call playback for secretive marsh birds, captured avian usage in the spring, summer, and fall at points encompassing areas proximate and distal to TLP plots. In 2015, 29,310 birds were counted, representing 61 species and 8 guilds. Overall, species richness was greatest during the spring and fall seasons near the constructed plots. Intensive breeding monitoring of placement and control plots demonstrated use by at-risk species of birds and other taxa, including American Oystercatcher (*Haematopus palliatus*), Least Tern (*Sternula antillarum*), diamondback terrapins (*Malaclemys terrapin*), and horseshoe crabs (*Limulus polyphemus*). The elevated habitat proved beneficial for nesting species in 2015, with 100% productivity for all nesting pairs. Continued post-construction monitoring will allow us to assess how metrics of bird use change over time at this significant salt marsh island and, more broadly, in response to salt marsh restoration projects. As more restoration projects are initiated for coastal wetlands in response to rising sea levels, it is critical that avian use be incorporated into planning, construction, and post-construction stages.

EVOLUTIONARY BIOGEOGRAPHY OF THE WHITE-BROWED LAUGHINGTHRUSH IN CHINA'S SICHUAN BASIN

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It is widely accepted that geographic complexities have influenced the evolution of distinct lineages by periodically isolating populations during historical climatic fluctuations. The Sichuan Basin is a globally recognized biodiverse eco-region characterized as a continental island isolated by mountainous topography. Such geo-

physical complexity creates a unique landscape feature that has likely facilitated the present patterns of biodiversity in and around the Sichuan Basin. While the topography of neighboring regions has been recognized as factors shaping biodiversity, the Sichuan Basin has received little attention regarding its role in influencing local biogeographic patterns. The White-browed Laughingthrush (*Garrulax sannio*) is both abundant and widely distributed throughout much of southern Asia, making this species an appropriate model organism to demonstrate the role of the Sichuan Basin in influencing biogeographic patterns in this region. Through phylogenetic analysis of mitochondrial and nuclear DNA I will investigate the genetic structure and estimate periods of historical isolation among populations of *G. sannio* in and around the Sichuan Basin. I will utilize morphological data to detect patterns in geographic variation in morphology within this species. To demonstrate the historical response of *G. sannio* to extreme climate fluctuations I will generate contemporary and paleo-distribution models to estimate periods of range expansion and contraction. This research will provide the scientific community with a better understanding of the factors shaping contemporary biogeographic patterns while allowing for predictions toward species' response to future climate fluctuations providing us with the tools to maintain biodiversity in one of the world's most biologically rich regions.

Impacts of illegal logging on tropical forest birds in a biodiversity hotspot
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Illegal logging accounts for an estimated 50-90% of timber in many tropical forest countries, posing significant threats to tropical biodiversity. We present results of a long-term (>15 years) comparison of its impacts on tropical forest birds using empirical data from the Upper Guinea rain forests of West Africa, a global priority biodiversity hotspot under intense anthropogenic pressure. Between 1995 and 2010, officially-reported legal logging intensities increased ~600%, while illegal logging, which now accounts for 80% of timber extraction in Ghana, has helped drive logging intensities to 6 times greater than the estimated maximum sustainable rate. We collected data in 2008–2010 and used a comparable dataset from 1993–1995 to assess impacts of recent logging on understory bird communities. Overall forest understory bird abundance declined by >50% during this period, with some species declining >90%. Moreover, many rare species detected in 1995 were not detected in 2010, though confirmation of species' extinctions would require additional sampling effort. Whereas analysis based on data collected in 1993–1995 estimated a partial post-logging recovery of the understory bird community, data from 2008–2010 showed no indication of post-logging recovery, likely due to ongoing illegal logging following intensive legal logging operations. Forest generalist species and sallying insectivores declined significantly in logged compared to unlogged forests. These severe declines of Upper Guinea forest birds indicate the rapidly deteriorating conservation status of a biodiversity hotspot and signal the urgent need for intervention to mitigate continued declines due to illegal logging and related forest degradation.

Sibling play preferences: Brood size effects on sibling social networks and later cognitive development in a wild parrot population.
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The Social Intelligence Hypothesis (SIH) posits that increases in social group size selected for an increase in brain size because

the neural processing required to navigate social networks becomes cumbersome as the number of interactants increases. SIH originally focused on adult primates; however, birds have received less attention despite sophisticated social prowess and large brains in corvids, songbirds, and parrots. It is also not clear what developmental mechanisms might have fostered increases in brain growth or sociality that are consistent with SIH. Because juveniles of species with sophisticated cognitive abilities often engage in complex and pervasive bouts of social play, changes in brood size might also increase the complexity of the social environment with cascading effects on later cognitive development. To gain insights into how SIH might apply to birds, we studied the ontogeny of early sibling social interactions in a wild population of green-rumped parrotlets (*Forpus passerinus*) that have been marked and followed for decades. Parrotlets offer a unique opportunity to test for sibling influences on cognitive development because they have large variation in brood size, are extremely altricial, and exhibit complex social learning during the nestling period. Video made inside nest cavities showed that nestlings engage in an extensive exploratory phase that involves tactile allo-feeding and allo-preening behaviors that likely qualify as play. We quantified the number and strength of sibling play partnerships, as a proxy for social bonds, in order to calculate metrics of social connectedness and to compare to broods of different sizes.

Flamingo die-off in the Andes: did a shifting mosaic of wetlands reach a tipping point?

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In December 2015, a mass flamingo mortality was reported in Laguna Grande, Catamarca, Argentina. Our team visited this remote site to conduct surveys and collect samples. In 5 of the 6 wetlands surveyed we counted 433 dead flamingos and identified 416 as Puna Flamingos (*Phoenicoparrus jamesi*). We could not identify the rest but are presumed to have been the same species. We also observed several live flamingos appearing lethargic, not vocalizing, and responding slowly to disturbance. We conducted necropsies on 7 individuals and collected samples for histopathology, virology, toxicology, and parasitology analyses. Four of the seven wetlands surveyed had lower water levels and reduced surface area compared to previous surveys. We did not find toxic cyanobacteria in water samples, but counts of organisms that are the food base for flamingos were up to 75% lower than in previous sampling periods. Dead individuals appeared emaciated; showing diminished pectoral muscles, protruding keel, and absence of subcutaneous and abdominal fat. Dead body weight was 40-60% lower than mean live weight known for this species. Histopathological examination only showed damage by high parasite. Parasites found in the digestive tract were dominated by cestodes. Toxicological and viral analyses are pending but current evidence suggests starvation contributed to the die-off. Flamingos use multiple wetlands over the course of their life cycle, tracking resources as they change in space and time. Several wetlands were reported to have dried out, potentially contributing to a reduction in food availability for flamingos.

Avian Knowledge Northwest and eBird Northwest: engaging professionals and the public in data collection, citizen science, storage, and analyses

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There is a wealth of existing avian data that can be applied to meet our most pressing conservation challenges, but datasets from numerous entities are inevitably in disparate formats and not easily consolidated. Additionally, in the absence of regional and national data centers it is difficult to fully understand data gaps. Avian Knowledge Northwest, a regional node of the Avian Knowledge Network, provides information from current and comprehensive datasets on birds and the environment for scientists, natural resource managers, and other individuals interested in conservation science in the northwestern United States. The regional node has been used to consolidate over a million data records that have contributed to distribution modelling and climate change projections. eBird Northwest, a regional node of Cornell Laboratory of Ornithology's international eBird program serves as the primary citizen science application of Avian Knowledge Northwest. It was developed through regional and state partnerships and works to (1) expand participation in eBird and citizen science efforts that can support conservation through informed natural resource management, (2) engage the birding community, (3) provide a news and information service that enhances recreational wildlife viewing and links such recreation with science-based conservation efforts, and (4) increase the coverage and availability of citizen science data for conservation and education purposes. In combination, information from both Avian Knowledge Northwest and eBird Northwest will increase our understanding of bird population distributions and trends and will help inform ecological planning and advance ecosystem conservation.

Opportunities and challenges of using leukocyte profiles to determine an individual's health

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Leukocyte profiles, or the number and types of various white blood cells, have been shown to be a reliable measure of stress in vertebrates. Given that white blood cells are also involved in the immune response, leukocyte profiles may also reflect an individual's health. We sought to link leukocyte profiles to individual health and reproductive success in two species – the House Wren (*Troglodytes aedon*) and the Lesser Prairie-Chicken (*Tympanuchus cupido*). Leukocyte profiles were conducted by counting 100 white blood cells and determining which proportion were heterophils, lymphocytes, basophils and eosinophils. Heterophils and lymphocytes are common and inversely correlated, so the ratio of heterophils to lymphocytes (H:L ratio) was calculated. H:L ratios varied by species, with 3.2% of wrens (N=95) and 5.9% of prairie-chickens (N= 17) showing elevated ratios (> 2 standard deviations from the mean for their species). These birds were otherwise healthy (normal mass, behavior, and reproductive success). Birds with known infections did not have abnormal H:L ratios, but did have elevated numbers of eosinophils. H:L ratios in both prairie-chickens and wrens did not relate to reproductive success. However, nesting success was lower in wrens that had high numbers of eosinophils. Eosinophils increase as part of an allergic reaction or as a response to parasitism. We conclude that H:L ratios alone are not reliable indicators of individual health. However, other hematological measurements, such as the numbers of eosinophils, may reflect the health of an individual.

Breeding Biology of House Crow (*Corvus splendens*) at Hazara University, Mansehra, Pakistan

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A study on the nesting biology of the House Crow *Corvus splendens* was conducted at Hazara University, Garden Campus (50 hectares), Mansehra, during the 2013 breeding season (June to September). Details about nest locations, tree characteristics, nest and egg characteristics were recorded. The mean nest density of House Crow was 0.9 nests/ ha. Mean tree and nest heights were 14.8±6.30 and 11.8±5.42m. The mean tree canopy spread 9.5±2.48m. The mean maximum and minimum nest diameters were 42.3±2.08 and 39.0±1.73cm respectively, while maximum and minimum diameters of nest cup were 15.6±1.52 and 13.3±1.15cm respectively. Nest depth and nest cup depths were measured as 19.3±2.08 and 8.3±1.15cm respectively. The mean nest weight was 1.4±0.24 kg while the mean clutch size was 4.0 (range 1–6). The mean egg length was 38.6±0.69mm, breadth 26.0±0.69mm, egg volume 13.3±0.83cm3 and egg shape index 1.42±0.83. The mean egg weight was 12.3±0.70g. Egg and nest success were calculated to be 55.1% and 69.0%. Hatchlings and fledglings produced per nest were 2.20 and 1.44 respectively. The main reasons for reproductive failures were unhatched eggs, poor nest construction, bad weather conditions and observer's disturbance.

Occurrence of Newcastle Disease Virus Vaccines in Free-ranging Wild Birds

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The presence of live poultry vaccine viruses within non-target, free-ranging wild bird populations is a largely unexplored phenomenon due to the ephemeral nature of viral spillover events. . In the summer and fall of 2012, a field study performed in the metro Atlanta, Georgia area on the prevalence of Newcastle disease virus in Rock Pigeons (*Columbia livia*) instead yielded the presence of the Hitchner B1 Newcastle disease vaccine. This live vaccine is most commonly associated with the vaccination of young commercial chickens, however, it is easily obtainable for purchase at feed stores or via the internet. Of the 72 banded wild Rock Pigeons in Atlanta swabbed for virus, nine were positive by reverse-transcriptase Real-Time PCR for a prevalence of 12.5%. To determine the frequency by which vaccine virus spillover events have been reported in wild avian hosts, we performed a meta-analysis of Newcastle disease vaccine-like virus strains which have been historically isolated from free-ranging or zoo avifaunal species. Using GenBank, an international database containing nucleotide sequences for thousands of organisms including viruses, we confirmed 54 instances of Newcastle disease vaccine-like viruses detected in wild birds from 1997 to 2014. While at least 17 distinct species from ten Orders were recorded, the most frequently reported isolates were detected among individuals in the Order Columbiformes (n = 23), followed in frequency by the Order Anseriformes (n = 13).

Breeding bird communities in sites created by Natural Resources Conservation Service (NRCS) conservation practices targeted for Golden-winged Warbler

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The identification of surrogate species whose targeted management may benefit multiple species will help make better use of conservation dollars to recover ecosystems. Over 3 seasons (2012-2014), we conducted 780 point count surveys across 90 sites in NC, TN, WV, and PA where NRCS conservation practices were implemented to create Golden-winged Warbler breeding habitat. We described the community of bird species detected at these sites and estimated density of three species (Golden-winged Warbler, Indigo Bunting, Field Sparrow) and modeled associations between density and covariates (e.g., management scenarios, elevation, latitude, vegetation). We detected 121 bird species of a wide range of guilds across all sites. Species richness was similar across management scenarios but sites that had Golden-winged Warblers had 1.5x the species richness of sites without Golden-winged Warblers. Species composition differed by management scenario and this was likely caused by local (e.g., vegetation) or larger-scale (e.g., latitude and distributional patterns) factors. In particular, Golden-winged Warbler density was similar across management scenarios and increased with elevation at southern sites but decreased with elevation at northern sites. Field Sparrow density was most greatly influenced by management scenario where densities were greatest in grazing management sites. Indigo Bunting density exhibited a curvilinear latitude trend. Furthermore, Golden-winged Warbler density increased with sapling count but the other two species showed a negative response to sapling count. Management techniques within the NRCS WLFW practices that were most successful in attracting Golden-winged Warblers will likely benefit the largest suite of bird species.

Phylogeographic Analysis of the Green Violetear (*Colibri thalassinus*)

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The Green violetear *Colibri thalassinus* is a highland neotropical hummingbird distributed from Bolivia to central Mexico in temperate pine-oak forests. There have been isolated reports north of its distribution in some parts of northern Mexico, United States and Canada. We collected 27 specimens, from 2001 to 2014, across its distribution and representing three of the five subspecies: in México and Guatemala (*C.t. thalassinus*), Panamá (*C.t. cabanidis*), and Bolivia (*C.t. crissalis*). A Bayesian analysis was performed using the obtained ND2 sequences of *C. thalassinus* and the GenBank sequences of *C. delphinae*, *C. coruscans*, *C. serreostris and Schistes geoffroyi* as outgroups; the priors used were a lognormal relaxed molecular clock, a median of 0.0125 substitutions/site/linage/million years

(SD=0.1) for 50 million generations, and samples every 1000 generations. Alternatively, a parsimony method to produce a median joining network was used to visualize genetic diversity and geographic associations among haplotypes. According to the results, the phylogenetic relationships are in accordance with the subspecies denominations. Specifically, *C.t. thalassinus* lineage diverged from the others about 3.3 million years ago, during the Pliocene, when the uplift of Panama formed a land bridge between North and South America and allowed the “Great American Biotic Interchange” to take place. The evidence suggests that *C. thalassinus* was part of this phenomenon, as the species expanded northward from South America, where it had originated.

Estimating Breeding Origins and Stopover Patterns of Four Migrant Songbird Species in Northern Alabama Using Stable Isotope Analysis
Bartkovich, Mercedes - Alabama A&M University; Yong Wang - Alabama A&M University; Keith Hobson - Environment Canada

Determining the breeding, or natal, origin of migratory birds is essential for understanding factors that could be responsible for population changes. Migratory bird species have different migratory and energy reserve strategies that can vary based on age class and breeding origin. This research examined the breeding origins and stopover patterns of four Neotropical migratory songbird species (n=407): Wood Thrush (*Hylocichla mustelina*; n=85), Eastern Wood-pewee (*Contopus viren*; n=79), Gray Catbird (*Dumetella carolinensis*; n=123), and Ovenbird (*Seiurus aurocapilla*; n=120). Target species were captured, banded, measured, aged, and had two rectrices collected during the fall of 2007 and 2008 in the Walls of Jericho, Jackson Co., AL. Molt origin of these individuals was estimated using stable hydrogen isotope (deuterium, depicted as δ2H) analysis of the feathers. Results indicated that the Ovenbird had the most negative δ2H of the four species, corresponding well to their more northerly breeding distributions, while the Wood Thrush, Eastern Wood-pewee and Gray Catbird had more positive δ2H. The Wood Thrush and Ovenbird exhibited strong correlations between breeding origin and body condition with capture date, suggesting individuals from the southern breeding ranges and lower body conditions preceded their northern and larger conspecifics during fall migration. After hatch year Ovenbirds and Eastern Wood-pewees were captured on average 10 days earlier than hatch years. Repeated tracking of the same species during consecutive years helped improve the understanding of the spatial and temporal variability and connectivity of the four focal species. Further investigation of the robustness of these patterns would be useful.

Estimating population density of a Magnificent Frigatebird (*Fregata magnificens*) colony in St. Giles Islands, Tobago using photographic surveys
Bath-Rosenfeld, Robyn - University of the West Indies/UC Riverside; Darshan Narang - University of the West Indies, Trinidad & Tobago

The St. Giles Islands Important Bird Area off the north-eastern end of Tobago comprising one main island (St. Giles, c.29 hectares of steeply-sloping land rising to just over 100 meters) and several outlying rocks support one of the most important seabird breeding colonies in the southern Caribbean. From October, 2014 to April, 2015, we circumnavigated St. Giles Islands and remotely photographed the seabird colonies using a handheld SLR camera with a telephoto lens. Photographs were analyzed using ImageJ software and counts of Magnificent Frigatebirds (*Fregata magnificens*) indicate that their numbers have increased at >1000% from the last survey 15 years ago with an estimated population density of 10.91 individuals/100m2 within the

colony. This study introduces a novel approach to analyzing photographic surveys for inaccessible seabird colonies.

Stress response in Florida scrub-jays (*Aphelocoma coerulescens*) predicts behavioral response following capture
Bebus, Sara - University of Memphis; Blake Jones - University of Memphis; Stephan Schoech - University of Memphis

Behavioral plasticity allows individuals to respond to variable levels of predation risk by adjusting their behavior based on current conditions. An individual's response to an increase in predation risk can be predicted by their personality type. Additionally, predation events cause a physiological stress response in which levels of circulating corticosterone or cortisol (both termed CORT) become elevated. Because an individual's personality (behavioral phenotype) interacts with their recent experiences to influence risky behavior in response to predators and individuals exhibit a stress-induced CORT responses to predators, we hypothesized that physiological phenotype will influence the way in which individuals respond to risk. To address this question we trapped young Florida scrub-jays (*Aphelocoma coerulescens*), subjected them to a standardized capture and restraint protocol, and subsequently compared their degree of neophobia to that of controls. We used capture and restraint to mimic a predation event and increase perceived risk of predation. We assessed neophobia with novel object tests in situ. We predicted that treated (previously captured) individuals would be more neophobic than controls, and that jays with the highest stress-induced CORT responses to capture and restraint would be the most neophobic. We found that treated individuals had longer latencies to approach a novel object than controls. However, treated individuals with low stress-induced CORT were more neophobic than treated individuals with high stress-induced CORT. Our results demonstrate that experience can affect individuals differentially based on their glucocorticoid profiles.

Molecular Systematics and the Realignment of the Avifauna of the New Guinea Region
Beehler, Bruce - Smithsonian Institution; Thane Pratt - Bernice P Bishop Museum

For half a century, the systematic treatment of the New Guinea avifauna was defined by Ernst Mayr's List of New Guinea Birds (Mayr 1941). Changes to this treatment were first offered by Sibley & Ahlquist (1990) through the use of DNA-DNA hybridization. More substantial alterations to the familial and ordinal treatment were the product of molecular sequencing studies carried out by several laboratories (e.g., Barker et al. 2004, Driskell & Christidis 2004, Irestedt & Ohlson 2008, Christidis et al. 2011, Jonsson et al. 2011, Joseph et al. 2012, Andersen et al. 2015). These analyses realigned species and generic sequences and identified a number of novel families endemic or near-endemic to the New Guinea region (e.g., the Melanocharitidae, Machaerirhynchidae, Rhagologidae, Eulacestomatidae, Ifritidae, and Melampittidae). Beehler and Pratt (2016) synthesized these findings and have now provided a realigned treatment for that of Mayr (1941). The number of bird families increases from 74 to 100. The avifauna increases from 649 to 769 species. The breeding land and freshwater list rises from 568 species to 630 species. Molecular systematics research has reversed understanding of the origins of important New Guinean bird groups, most notably the passerines. Mayr believed New Guinea to be populated by bird lineages immigrating from Asia. Molecular research has instead shown that while this is true for some minor components of the New Guinean avifauna (e.g., drongos, cisticolas, sunbirds), the major families (honeyeaters, warblers, robins, etc.) appear to be deeply distinct and to have originated on the Australian plate.

Latitude-dependent tradeoffs between investment in molt and reproduction in Fork-tailed Flycatchers (*Tyrannus savana*)
Bejarano Alegre, Vanesa - Universidade Estadual Paulista; Marcela Benavides Guzmán - Universidade Estadual Paulista; Ivan Celso Carvalho Provinciato - Universidade Estadual Paulista; Joaquin Cereghetti - Universidad Nacional de La Pampa; Jose I. Giraldo - Aves Internacionales-Colombia; Alex Jahn - Universidade Estadual Paulista; Jose Sarasola - Universidad Nacional de La Pampa; Diego Tuero - Universidad de Buenos Aires

Songbirds face multiple, conflicting demands throughout the year, including reproduction and molt. Breeding is energetically costly, due to the investment required for incubation, defending the territory and in feeding nestlings. Molting feathers is also energetically expensive and can affect a bird's ability to fly efficiently, reproduce successfully and regulate body temperature. We tested the hypothesis that a tradeoff exists in molting and breeding simultaneously and that it is mediated by energetic condition in Fork-tailed Flycatchers (*Tyrannus savana*), in Argentina, Brazil and Colombia.We found significant site-dependence between clutch size and energetic condition, with the largest clutches in Argentina and also the lowest energetic conditions in Argentina, such that there was a significantly negative relationship between clutch size and energetic condition. There was also a significantly negative relationship between level of body molt and clutch size. However, flycatchers with no body molt had the highest energetic condition, opposite to our expectation that those with a higher energetic condition should molt more. These results support a latitude-dependent tradeoff between investment in reproduction and molt, but not that it is mediated by energetic condition in Fork-tailed flycatchers. Factors other than energetic condition may mediate the relationship between reproduction and molt during the breeding season. Further research on molt timing and how life history strategies are related to molt strategies in birds breeding in different regions of the planet offers important insights into avian life history tradeoffs, as well as a comprehensive evaluation of their vulnerability to such potential threats as global climate change.

Environmental Conditions Explain Multimodal Signaling in the Northern Cardinal (*Cardinalis cardinalis*)
Belman, Dianna - George Mason University; David Luther - George Mason University

Social communication requires that signals be successfully transmitted through the environment and detected by receivers. Interference from both biotic and abiotic sources can distort signals. We tested the hypothesis that signal interference in the environment would change the frequency with which northern cardinals (*Cardinalis cardinalis*) use acoustic and visual signals, thus increasing multimodal signaling when the environment provided more interference. We expected that cardinals at locations and in situations with more environmental noise would be more likely to use multiple modes of communication than cardinals at relatively quieter sites. We measured sources of signal interference, anthropogenic noise and wind, which can moves leaves and branches, in cardinal's territories to determine their effect on cardinal long distance communication signals. While previous research has looked at how individuals modify their use of multimodal signals in an environment, the literature has not examined how individuals modify their use of multimodal signals across environmental gradients. We broadcast previously recorded songs of male cardinals near the center of a male's territory and observed frequency and time latency of acoustic and visual behavioral responses. Both acoustic and visual responses were delayed with increasing ambient noise, which suggests that increasing levels of signal interference from the environment affect

either signal detection or discrimination and the timing of the response in two modes of signaling. The results may have consequences for territorial males that are defending their territory from potential rivals or attempting to attract a mate on particularly loud or windy territories.

Effect of PIT tags on survival of adult Carolina Chickadees

Bennett, Breanna - Villanova University; Rebecca Garlinger - Villanova University; Robert Curry - Villanova University

Radio frequency identification (RFID) technology facilitates study of many bird behaviors, but safety merits scrutiny. We investigated effects of gluing 12 mm x 2 mm passive integrated transponder (PIT) tags to color bands on annual survival of adult Carolina Chickadees. In one population (GM) we attached PIT tags to nearly all breeding chickadees in 2012 and 2013; for this population, we analyzed variation in survival using program MARK in these years relative to all other years (1998 - 2015) when we used no PIT tags. In a second population (NF), we attached PIT tags to some breeders in 2012 and 2013; for this population, we compared survival for birds with and without PIT tags. Survival at GM from 2012 to 2013 and 2013 to 2014 respectively was 25% and 3% for males and 20% and 0% for females; survival in all other years averaged 38% for males and 42% for females. Overall, survival (10%) was significantly lower in PIT-tag years than in years when we used no PIT tags (38%). Among NF birds with PIT tags, 47% and 0% of males and 39% and 14% of females survived in 2012 and 2013 respectively; rates among birds without PIT tags were 53% and 17% for males and 58% and 21% for females. In both populations, we directly observed problems (swollen feet, missing limbs) among birds with PIT tags. We conclude that our RFID methods negatively affected chickadee survival, and that investigators should consider alternative methods including use of smaller/lighter PIT tags.

Impacts of free-ranging domestic cat abundance on avian survival and breeding success

Bennett, Kevin - Fordham University; Brian Evans - Smithsonian Migratory Bird Center; J. Alan Clark - Fordham University; Peter Marra - Smithsonian Migratory Bird Center

Free-ranging domestic cats kill an estimated 1.3 to 4.0 billion birds annually in the United States, and multiple studies suggest similarly high levels of predation globally. Cat predation on birds is particularly impactful on isolated islands, where cats have been implicated in the extinction of 13 bird species and the endangerment of many others. However, whether cat predation has population-level impacts on birds at mainland sites is unknown. My goal is to address this data gap by evaluating the impact of cat abundance on avian survival and nesting success along an urban-rural gradient. First, I will derive avian survival and nesting success estimates from more than a decade of data collected at sites in the Washington, D.C. area through a long-term citizen science project. Second, I will estimate cat abundance at these sites by combining data from camera traps, point and transect counts, and questionnaires. I will then use these data to estimate the impact of cat abundance on avian survival and nesting success. This study will contribute critical data to an area of active debate on impacts of free-ranging cat populations and how to best manage them for conservation purposes. I will be presenting preliminary data from this ongoing research.

Predictors of attack in an aggressive vocal display by satin bowerbirds (*Ptilonorhynchus violaceus*)

Bergen, Elizabeth - Cornell University; Sara Schroer - Cornell University; Jenélle Dowling - Cornell University

Intra-sexual aggression may be encoded in birdsong via a variety of acoustic and structural features. Changes in acoustic properties including frequency, amplitude, bandwidth, and trill rate predict aggression or occur in more aggressive contexts in a variety of songbird taxa. Elements of song structure such as timing and syllable choice may also encode information about aggressive escalation and intent. Satin bowerbirds (*Ptilonorhynchus violaceus*) are polygynous Australian passerines in which dispersed males build and defend bowers that serve as arenas for solo courtship displays. Male intruders at bowers may damage the bower structure or steal decorations placed in front of the bower by the owner male. Consequently, male bower owners are highly aggressive toward male intruders. In escalated intra-sexual aggression, male satin bowerbirds perform stereotyped “whistle-grunt” songs consisting of a string of tonal “whistle” elements each punctuated by a terminal broadband “grunt.” Whistle-grunt songs typically conclude with a series of vigorous buzzes followed by a body waggling display and physical attacks. We describe the acoustic characteristics and syntax of agonistic whistle-grunt vocal displays sampled at Bunya Mountains National Park in Queensland, Australia during mirror-elicited contests at male bowers. We further assess how certain elements may encode aggressive intent by testing whether the intensity of a male’s attack against his reflection is predicted by the acoustic properties, syntax, or repertoire size of the preceding song elements.

Citizen science provides insights into the decline of House Sparrows in North America

Berigan, Liam - Cornell University; David Bonter - Cornell Lab of Ornithology

The House Sparrow (*Passer domesticus*) is native to the Eurasian continent but was spread across the world in the colonial era. In the last century, House Sparrows began to undergo a severe decline in almost all parts of their native range, prompting numerous studies and the addition of this bird to the United Kingdom’s Birds of Conservation Concern Red List. While many studies have focused on determining the reasons for population declines in Europe, very few studies have tracked population changes in North America. This study describes changes in House Sparrow populations in North America, and explores some of the factors potentially contributing to worldwide population changes. By analyzing Project FeederWatch data from 1994-2014, we quantify declines in the mean size of House Sparrow flocks since the 1990s. Geographically, larger flocks are found in Western North America, but no relationship was found between flock size and latitude. House Sparrow flock size increases when an Accipiter hawk (a predator of House Sparrows) was present at the count site, demonstrating behavioral changes in response to predation risk.

Breeding ecology of the Blue-crowned Parakeet (*Thectocercus acuticaudatus*) in the Argentinean Chaco

Berkunsky, Igor - UNCPBA-CONICET; Rosana Aramburu - División Vertebrados. FCNyM - UNLP; Roman Ruggera - Facultad de Ciencias Agrarias, Universidad Nacional de Jujuy; Federico Kacoliris - División Vertebrados. FCNyM - UNLP

The main argument that supports harvesting parrots is that harvested nestlings are nestlings that would not survive. A local community based harvesting program in

Argentina regulates the harvest and commercialization of Blue Crowned Parakeets (*Thectocercus acuticaudatus*). We determined the main factors that affect the reproductive success of Blue-crowned Parakeet in the Chaco region of Argentina. Parakeets used cavities wide and deep in live and mature trees with high entrance holes. Clutch size was 4.2 eggs and it decreased along the breeding season. Number of eggs at the end of incubation was 3.9 and number of chicks hatched was 3.4. We observed brood reduction in 20% of the nests and it was more frequent in broods of three and four chicks. The length of the chick's period was positively associated with brood size. Male chicks reached a higher body mass and size than females. On average 3.0 chicks fledged per nest. Nest survival varied between 47% and 61% depending of the year. Seventy-nine percent of the nests found during construction and early laying completed the incubation and 61% produced at least one fledgling. Most nests failed during the incubation and the first 10 days of the chick's period. Daily survival rates varied between 98.9% and 99.3%. The best models to explain survival included as covariates height of entrance hole. Nest site fidelity was 75% and cavity reoccupation was 55%. This information is particularly relevant for estimating the impact that harvesting could have on parakeet wild populations.

Marine and hydrokinetic energy development and potential impacts to diving birds: a regulatory perspective

Bernick, Andy - Federal Energy Regulatory Commission; Stephen Bowler - Federal Energy Regulatory Commission

Marine and hydrokinetic energy (MHK) projects generate electricity from wave action or the flow of tides, ocean currents, or inland waterways. MHK devices vary greatly in form, function, and location within the water column. Non-federal projects in coastal and inland waters are under the jurisdiction of the Federal Energy Regulatory Commission (FERC), whereas Outer Continental Shelf projects are under the jurisdiction of both the Bureau of Ocean Energy Management (BOEM, for lease issuance) and FERC (for the review of environmental effects and license issuance.) Initial risk assessments identified various potential interactions between diving birds and MHK devices (i.e., collision with dynamic devices, prey population effects, disorientation from lighted structures). These potential risks were assessed during the environmental review for several tidal, wave, and inland projects licensed by FERC, an MHK test facility lease issued by BOEM, and test centers for wave, tidal, and ocean current energy developed by federal entities, national laboratories, and universities. Presently, no collisions with single or small arrays of MHK devices have been documented for diving birds or other wildlife (Copping et al. 2016), although the potential effects of larger arrays require further examination. Efforts to understand diving bird use of tidal channels suitable for MHK development (Waggitt et al. 2016), large-scale surveys of seasonal bird distribution and abundance in the OCS, and studies associated with U.S. offshore wind energy development will support a refined understanding of the effects of MHK development on diving birds.

Wild birds and high pathogenic avian influenza

Bevins, Sarah - National Widlife Research Center

The challenges of designing a plan to monitor newly emergent pathogens in wild birds at a national-scale are not insignificant. Data are needed on pathogen prevalence and on the size of the population being tested; however, these data are often not available and when they are, they are often not available at a national-scale. Population size and pathogen prevalence help determine how many samples need to be collected in order to determine pathogen presence or absence with confidence. We describe the methods

used to design a highly pathogenic avian influenza monitoring plan in wild birds across the continental United State and Alaska. Methods include estimating wild bird populations using two different wild bird datasets, using prior estimates of low pathogenic avian influenza as a proxy for high pathogenic influenza prevalence, and developing a metric to determine priority sampling areas based on temperature constraints, wild bird movement, and historic avian influenza hotspots. This effort resulted in a flexible framework to monitor influenzas in wild bird populations. Nearly 41,000 wild bird samples were collected in 2015-2016 in the United States. Results reveal the establishment and rapid disappearance of multiple novel high pathogenic avian influenza viruses in wild birds. Conclusions highlight both the assumptions that come along with using existing bird population and pathogen prevalence datasets and the insight the results can provide.

Avian Response to Insect Damage on Jack Pines (*Pinus banksiana*)

Bjornen, Katie - Northern Michigan University; Brandon Canfield - Northern Michigan University; Alec Lindsay - Biology Department, Northern Michigan University

Studies have repeatedly shown that insectivorous birds preferentially feed on trees with insect infestations, but foraging cues remain elusive. When phytophagous insects forage on trees, the tree often shows visual signs of distress. Leaves may show damage or insects themselves may be visible on the plant, but many trees also release volatile organic compounds (VOCs) when infested. Jack pine (*Pinus banksiana*) release VOCs in response to damage and insect infestation. In this study, I examined the potential recruitment of omnivorous and insectivorous birds to conifers via their release of VOCs in response to phytophagous insect foraging activity. I investigated the VOC release of undamaged, manually-damaged, and insect damaged jack pine and foraging response of insectivorous birds. Considering multi-level trophic interactions together can be an important step towards understanding the dynamics of communities and ecosystems.

COMPARISONS OF HABITAT SELECTION AND BEHAVIORS BETWEEN MALLARD (*Anas platyrhynchos*) AND AMERICAN BLACK DUCK (*Anas rubripes*) IN THE FINGER LAKES REGION DURING WINTER

Bleau, Adam - SUNY ESF; Jonathan Cohen - SUNY College of Environmental Science and Forestry; Michael Schummer - SUNY Oswego; Bryan Swift - NYSDEC; Justin Droke - SUNY ESF; James Eckler - NYSDEC; Thomas Bell - NYSDEC

Mallards (*Anas platyrynchos*) and American Black Ducks (Black Ducks, *Anas rubripes*) are closely related species with little niche separation, increasing likelihood of competition. In the 1950's, Mallards started colonizing eastern regions, filling the functional niche of Black Ducks. The Finger Lakes region (FLR) of New York remains one of few remaining interior wintering Black Duck strongholds. Thus, our goal is to identify management actions that could be applied throughout the FLR during winter that will benefit Black Ducks more than Mallards. We used walk-in traps to capture female Black Ducks (n=20) and Mallards (n=19) at Owasco and Cayuga Lakes and attached GPS/GSM backpack transmitters to compare their habitat selection. Occupancy surveys were conducted weekly to determine if the distribution and abundance of Mallards and human structures/disturbances affects the distribution and abundance of Black Ducks. Preliminary results indicate that of Cayuga Lake surveys where at least one species was present, Black Ducks occurred independently of Mallards on just 17% of surveys while Mallards occurred independently on 41% of surveys. Activity budgets will be compared between the two species and among habitat types using multiresponse permutation procedure to determine behavioral

differences between Mallards and Black Ducks. We will present preliminary results. We hypothesize that Mallards compete with Black Ducks during winter in the FLR and that we will be able to detect measurable changes in habitat use and behavior of Black Ducks in the presence of Mallards and human structures/disturbance.

The Effect of Winter Weather Variation on Long-Distance Migratory Behavior
Bobay, Lia - Indiana University–Bloomington; Dawn O'Neal - Huyck Preserve and Biological Research Station; Adam Fudickar - Indiana University; Ellen Ketterson - Indiana University

Climate change is projected to have profound and permanent consequences on ecosystems and their animal inhabitants in the near future, but it is unclear how individuals and populations will respond to a rapidly changing climate. Long distance migratory animals are particularly vulnerable to climate-induced ecological change because of their broad annual geographic spread. Many long-distance migrants breed together in northern territories, and winter in sex-biased geographic distributions outside of the breeding season: females tend to migrate further south than males, resulting in latitudinal variation in sex ratios. However, the degree to which variation in annual winter temperatures affect migratory distance and winter sex distributions is not known. In this study, we investigated the relationship between mean winter temperature (December – February) and the sex ratio of winter flocks of a broadly distributed migratory passerine, the Dark-eyed Junco (*Junco hyemalis*). We analyzed data from birds caught over four decades (1966-2009) in south central Indiana, and compared the annual sex ratio for each year with multiple climate measures. Our data, still under analysis, will advance understanding of how migrants may adapt their migration patterns in a future of increasingly warmer winters. Migrant life may become increasingly challenging as the changing climate alters seasonal temperatures, leading to potentially profound effects on ecosystem health and balance, the spread of disease, and the survival of many migratory species.

Long-term ecosystem health monitoring using avian indicators: Implications of experimental design
Bohannon, Meredith - University of Maryland, Department of Environmental Science and Technology; Tyler Pittman - Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission; Latice Fuentes - Fish and Wildlife Service; William Bowerman - University of Maryland

This current study compares the traditional longer-period study method (Period) for monitoring environmental contaminants to a stratified and annual monitoring method (Annual) in order to investigate temporal and spatial trends in 4,4'-dichlorodiphenyldichloroethylene (DDE) and the sum of 22 polychlorinated biphenyl (PCB) congeners in 1172 nestling bald eagles from the Michigan Bald Eagle Biomonitoring Project data, from 1994 to 2014. A random stratified sub-sample of nestlings were selected from this dataset based on eight Great Lakes watershed categories, thereby creating an Annual study design (n=794). We analyzed the Period data set using traditional methods to test for differences between temporal periods at four different spatial scales. We analyzed the Annual data set using a new approach of trend models as opposed to differences between temporal periods. The Period study design indicated concentrations of 4,4'-DDE and Sum PCBs increased significantly between periods at two of the four spatial scales we examined. In contrast, analysis of the Annual study design indicated that linear trends were decreasing over the same period and that there was considerable annual fluctuation in concentrations of 4,4'-DDE and Sum PCBs. Results of the Annual analysis suggest that increases observed in the Period analyses

were likely due to annual spikes in concentrations that are associated with environmental variables instead of contaminant loads. We can conclude that study design can significantly influence the inferences that can be made from monitoring projects. This information can further provide management recommendations for the effects of climate or diet such as fisheries management.

Flight initiation distances of nesting Piping Plovers (*Charadrius melodus*) in response to human disturbance

Bomberger Brown, Mary - University of Nebraska-Lincoln; Joel Jorgensen - Nebraska Game and Parks Commission; Lauren Dinan - Nebraska Game and Parks Commission

Birds frequently interact with people when they occur in anthropogenic landscapes which can make the protection of legally protected species a challenge. Flight initiation distances (FIDs) are often used to inform development of appropriate buffer distances required for human exclusion zones used to protect birds nesting in these landscapes. Piping Plovers (*Charadrius melodus*) are protected by the Endangered Species Act in the United States and often nest in areas used by humans. Studies evaluating Piping Plover FIDs are limited and implementation of exclusion zones has been inconsistent across the species' range. We measured Piping Plover response and FIDs to naturally occurring stimuli on public beaches at Lake McConaughy, Nebraska, USA. Piping Plover FIDs differed most by stimulus class (vehicle, human, dog, human with dog), Julian day, and hour of day. Piping Plover FIDs were greatest for dog and human with dog compared to humans and vehicles. For all types of stimuli, Piping Plover FIDs decreased over time during the nesting season and increased slightly during each day. In the majority of instances in which Piping Plovers left their nests, return times to the nest were relatively short (less than three minutes). These results suggest Piping Plovers become habituated to the presence of human-related stimuli over the course of a nesting season, but other explanations such as parental investment and risk allocation cannot be excluded. Additional research and improved guidance regarding the implementation of exclusion zones is needed so managers can implement effective protection programs in anthropogenic landscapes.

The Role of Mercury in Oxidative Stress: an Analysis Using Exercised Zebra Finches

Botero, Juan - The College of William and Mary; Daniel Cristol - The College of William and Mary; Eric Bradley - The College of William and Mary

A majority of avian mercury(Hg) research has focused on piscivorous birds, however, comparable levels of Hg can occur in insectivorous songbirds in terrestrial landscapes. Hg inflicts damage on parameters as diverse as the immune system, reproductive success, and cognition. However, a limited understanding of the molecular mechanisms through which Hg induces deleterious effects leaves us with an incomplete picture of Hg toxicity. One proposed mechanism is mercury-induced oxidative stress (OXS), a shift in the pro-oxidant to antioxidant ratio towards the former. OXS, and in particular cumulative oxidative damage, is known to impose extensive physiological costs to longevity, immune response and physical activity. Our research addressed two questions: (1) What is the relative potency of Hg in inducing OXS when compared to physical exercise, another well-studied cause of OXS? (2) Will lifetime Hg exposure compound the extent of OXS when individuals go through intense exercise? Zebra Finches were put on a two-day exercise regimen through flight induction; half had been exposed to a 1.2 ppm methyl-Hg diet and the other half had not. Blood samples before and after exercise were taken to assay for glutathione ratio and protein

carbonyls, two known biomarkers of OXS. We compared the exercised birds to a non-exercise control group (also half Hg-exposed and half never exposed), to determine whether Hg affected the availability of reduced glutathione or increased the concentration of protein carbonyls in the blood. We also examined organ tissue to validate our use of blood to study OXS in an avian system.

What 55 Years of Bald Eagle Population Data Tells Us About Environmental Changes

Bowerman, William - University of Maryland; Latice Fuentes - U.S. Fish and Wildlife Service; David Best - U.S. Fish and Wildlife Service; Teryl Grubb - U.S. Forest Service; Tyler Pittman - Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission; Jennifer Bloodgood - College of Veterinary Medicine, University of Georgia

Bald eagle population studies in Michigan began in 1961 and have continued with annual statewide monitoring for 55 years. Eagle populations have recovered from a low of 31 occupied breeding areas in 1963 to 786 in 2015. Reproductive outcomes are known for 14,207 occupied breeding attempts from 1961-2015 and 13,536 fledged young were produced. Trends in organochlorine pesticides, mercury, PCBs, and other environmental pollutants have been determined using unhatched eggs, and blood and feathers of nestlings collected during banding. Nestlings are banded at 6-9 weeks post-hatch from selected nests. A qualitative observation based on when nestlings were in this age range found that banding was occuring 6 weeks earlier in 2010 than in 1965. Using nestling morphometric measurements and back calculating for first eggs laid in over 2,400 breeding attempts over 16 years, it was found that eagles nesting along the Great Lakes (-0.7d/yr) and Great Lakes tributaries (-0.9d/yr) were nesting earlier each year. Inland nesting eagles were not experiencing a significant change in lay date. However, there are indicators that nestling size may be declining, potentially indicating adaptation based on Bergmann's Rule. Eagles are the sentinels of both the effects of environmental pollutants, and the recovery of aquatic systems after many of these compounds were banned. They are now indicating that global climate change is altering their lay dates and may also be leading to adaption to increasing inland summer temperatures.

Breeding productivity, phenology and habitat use of two co-occurring aerial insectivores

Boynton, Chloe - Simon Fraser University; Olga Lansdorp - Simon Fraser University; Nancy Mahony - Environment and Climate Change Canada; Tony Williams - Simon Fraser University

Farmland and grassland bird species, including aerial insectivores, have been declining for decades in Europe and North America. Recent studies have cast doubt on the idea that there is a single, global cause for all population declines. In co-occurring aerial insectivores, for example, there is only weak cross-correlation in population trajectories. This suggests there are highly variable, and complex, spatio-temporal patterns of population change, perhaps related to region-specific environmental conditions such as changing weather or land use. We obtained data over 4-years (2013-2016) on breeding biology for two species of aerial insectivores, barn swallows (*Hirundo rustica*) and tree swallows (*Tachycineta bicolor*) co-occurring in 11 different locations, and three different habitats (livestock, agriculture and non-agriculture) around Vancouver, British Columbia. We will present data on a) variation in breeding productivity (laying date, clutch size, fledging success, nest predation rates) among habitat types, and b) habitat use and post-fledging survival in juvenile barn swallows, using radio telemetry, as this period is suggested to be

the most sensitive life-cycle stage to the population growth rate. Preliminary results show chicks primarily foraging over crop agricultural fields (26%), forest patches (23%) and salt-water bodies (18%), relatively close to their natal sites. These results will contribute to our knowledge of the effect of landscape and weather on region-specific variation in aerial insectivore population changes and provide the opportunity to compare drivers of population change to other regions to elucidate causes of such widespread population declines.

Conservation and Management of Common Terns (*Sterna hirundo*) in the North American Great Lakes

Bracey, Annie - University of Minnesota; David Moore - Canadian Wildlife Service; Cynthia Pekarik - Canadian Wildlife Service; Fred Strand - Wisconsin Department of Natural Resources (retired); Sumner Matteson - Wisconsin Department of Natural Resources; Gerald Niemi - Natural Resources Research Institute U of MN; Francie Cuthbert - University of Minnesota

The Common Tern (*Sterna hirundo*) is declining globally, and in the North American Great Lakes, is one of the most vulnerable and legally protected species. Throughout the Great Lakes region, loss and modification of habitat and predation have been identified as two significant issues facing Common Terns during the breeding season. However, knowledge of factors that negatively impact Common Terns during the non-breeding season are limited. It is critical that non-breeding season locations are identified to prioritize areas of conservation and assess threats. We used light-level geolocation and global positioning system (GPS) tags to identify foraging, staging, and wintering locations of Common Terns breeding in the western Great Lakes. A total of 96 geolocators were deployed between 2013 and 2015. In June 2016, we will deploy GPS tags on birds breeding in Lake Superior, to identify important foraging locations and to validate non-breeding season locations estimated from geolocators. Results from geolocators (n=23) reveal autumn migration along the East Coast of North America, through Central America, to the west coast of South America. Spring migration movements were through Central America, along the Gulf of Mexico, and the East Coast of North America. Individuals wintered throughout Central America, in northern South America, and along the west coast of South America, with >50% of individuals wintering in coastal Peru (n=14) . These results provide support of segregation of eastern and central North American breeding populations and have important implications for management and focus of future research.

Using Codispersion Analyses to Examine Temporal Variation in Distributions of Three Louisiana birds

Brady, Matthew - Louisiana State University, Museum of Natural Science

The biotic and abiotic factors that shape species' distributions is a critical, yet poorly understood, aspect of community ecology. Migratory birds may experience different stressors during the breeding season, while on migration, and during the non-breeding season, while resident birds face their own suite of challenges. Comparisons of bird distributions across a landscape during the breeding and non-breeding seasons can yield valuable clues as to the factors that determine their broader ranges. Recently developed, codispersion analyses show great promise as a tool to test hypotheses about the environmental variables that determine species distribution, especially when those variables are spatially auto-correlated. In this study, I apply these tools to distribution and abundance data collected during the Louisiana Bird Atlas Project. I compared the breeding and wintering ranges of three residents and short-distance migrants using codispersion analysis. demonstrating the utility of the method when applied to vertebrate systems. These analyses allow me

to draw conclusions about the factors that play an important role in bird distributions, and how those factors relate to the life histories and ecology of individual species.

Evaluation of Population Monitoring Strategies for Greater Sage-Grouse (*Centrocercus urophasianus*) in Northwestern Colorado: Genetic Mark-Recapture as an Alternative to Traditional Lek Counts

Brauch, Jessica - Colorado State University; Brett Walker - Colorado Parks and Wildlife; Barry Noon - Colorado State University; Sara Oyler-McCance - United States Geological Survey; Jennifer Fike - United States Geological Survey

Recent declines in greater sage-grouse (*Centrocercus urophasianus*) populations and substantial restriction of pre-settlement distribution of the species have been observed nationwide. To better understand the status of greater sage-grouse and effectively manage the species and its habitats, researchers, managers, and policymakers require accurate and defensible population estimates based on sound monitoring techniques. For this reason, the development of innovative methods to evaluate the lek count index and monitor greater sage-grouse populations has been called upon as a focus for researchers. We employed a non-invasive, genetic mark-recapture (GMR) method to estimate abundance and pre-breeding sex ratio of a small, low-density population of greater sage-grouse in northwestern Colorado. Surveys to locate and sample flock locations were conducted during two consecutive winter seasons from 2012-2014. We collected nearly 2,500 fecal pellet and feather samples to identify individual birds and their recapture histories using DNA extraction, polymerase chain reaction (PCR), and fragment analysis methods developed by the USGS Molecular Ecology Laboratory in Fort Collins, CO. Analysis will be performed using closed mark-recapture models in Program MARK. We are currently in the final proofing stages of our genetic analysis and will be reporting amplification success rate statistics, preliminary estimates of abundance, and preliminary evaluation of GMR methods used in this study for estimating abundance and sex ratio of pre-breeding populations of sage-grouse.

Habitat Use and Distribution of Sandhill Crane (*Grus canadensis*) on The Southern High Plains of Texas And New Mexico

Brautigam, Kathryn - Texas Tech University; Blake Grisham - Texas Tech University; William Johnson - US Fish and Wildlife Service; Nicole Anthearn - US Fish and Wildlife Service; Daniel Collins - US Fish and Wildlife Service; Shaun Oldenburger - Texas Parks and Wildlife Department; Jude Smith - US Fish and Wildlife Service; Warren Conway - Texas Tech University

Winter distribution of the Mid-continent population (MCP) of Sandhill Crane (*Grus canadensis*) extends across western Texas, New Mexico, western Arizona, and as far south as central Mexico, with some migrating as far east as the Gulf coast. Approximately 80% overwinter on the Southern High Plains of Texas and New Mexico, making this region critical to the persistence of the population. We have completed the first year of a multi-year collaborative research project to investigate the response of MCP cranes to Southern High Plains habitat and landcover types. We captured and tagged 27 Sandhill Cranes at Muleshoe National Wildlife Refuge (MNWR) and surrounding areas, Texas, 2014–2016. We fitted each individual with a Platform Transmitter Terminal (PTT), and locations were estimated using Argos satellite tracking system (n=4) or by both Argos and a Global Positioning System (GPS, n=23). Nocturnal locations were most often at shallow saline lakes while diurnal locations were mostly at row-crop fields (e.g., sorghum, Sorghum bicolor). Landcover was defined using National Land Cover Dataset (2011) qualified with Cropland Data Layer

(Cropscape 2014 and 2015) for crop-specific data. Our sample included individuals from breeding affiliations in western Alaska-Siberia (WA-S), west-central Canada-Alaska (WC-A), and northern Canada-Nunavut (NC-N). Combining previous and current data, our research will assist land managers by providing specific habitat use relationships of Sandhill Crane on the Southern High Plains and modeled potential responses to multiple climate and land use change scenarios.

Insights into full-annual cycle population modeling using the Louisiana waterthrush

Brouwer, Nathan - National Aviary in Pittsburgh; Steve Latta - National Aviary in Pittsburgh

Models for migratory birds will ideally provide insights into how populations are limited through the full annual cycle (FAC). This can be accomplished by incorporating carry over effects and the impacts of habitats that vary in quality. Managers are particularly interested in using FAC models to understand the effects of changes in habitat quality and quantity at different points during migration. It is generally assumed that data availability has limited the development of FAC models and that demographic theory can be directly applied to complex migration systems. We test these assumption using data on the Louisiana waterthrush from Pennsylvania where they breed on two habitat types: acidified streams impacted by mine drainage and high quality circumneutral streams. We also utilize information from the Dominican Republic where waterthrush winter on streams of varying quality. We built models of varying structure by including features such as multiple types of habitat, carry over and density dependence (DD). Ecological realistic models can be built but analyses must be carried out carefully. For example, we found that in DD models the sensitivity of equilibrium population size to increases in habitat quality depended non-linearly on habitat quantity. Model assumptions and the meaning of parameters therefore need to be carefully defined to maintain the logical consistency and relevance of the models. In addition to collecting FAC data, there appears to be an opportunity for avian ecologists to contribute new analytic approaches for modeling complex population dynamics.

Heterospecifics influence parental behaviors and nest survival in a mixed-species colony on Alcatraz Island, California

Brussee, Brianne - U.S. Geological Survey; Peter Coates - U.S. Geological Survey-Western Ecological Research Center; Roger Hothem - U.S. Geological Survey; Michael Casazza - U.S. Geological Survey-Western Ecological Research Center; John Eadie - University of California, Davis

Variation in nest survival, a critical demographic process in avian population dynamics, among individual birds has been explained by differences in parental incubation behavior. Thus, in-depth studies that identify sources of explained variation in incubation behavior are needed to advance our understanding of avian population ecology. We examined nest survival and parental incubation behavior of black-crowned night-heron (*Nycticorax nycticorax*; hereinafter, night-heron) using video-monitoring techniques in a mixed-species colony with California gulls (*Larus californicus*) and western gulls (*L. occidentalis*) on Alcatraz Island, California. We modeled nest survival as a function of both extrinsic factors as well as intrinsic incubation behaviors over a two-year period (2011–2012). This analysis indicated that night-heron nest survival increased as a function of greater incubation constancy (% of time spent incubating eggs within a 24-h period). Additionally, night-herons experienced increased nest survival with increasing distance from gull colony boundaries. We also employed linear mixed effects models to investigate environmental and temporal factors as sources of variation in incubation behaviors using 126 nest days

across two nesting seasons (2011–2012). We found decreased incubation constancy evidence in those night-herons nesting in close proximity to the more aggressive gull species. To our knowledge, this is the first empirical evidence of the influence of one nesting species on the incubation behavior of another. Our results contribute to our understanding of mechanistic relationships between nest survival, incubation behavior, and mixed-species colony dynamics in an island setting.

Is Louisiana Waterthrush habitat selection and fitness related to Eastern Hemlock decline in Great Smoky Mountains National Park?

Bryant, Lee - Arkansas State University; Tiffany Beachy - Great Smoky Mountains Institute at Tremont; Than Boves - Arkansas State University

Eastern Hemlock (*Tsuga canadensis*) is declining throughout the eastern U.S. due to the invasive Hemlock Woolly Adelgid (*Adelges tsugae*). In the southern Appalachians, hemlock is concentrated in moist ravines and its decline threatens riparian ecosystems. Previous research has focused on adelgid control and the effects of hemlock loss on macroinvertebrate assemblages, stream characteristics, vegetation composition, and forest processes such as transpiration. In relation to birds, the majority of research has examined changes in avian community diversity. Few studies have evaluated a single species' capacity to respond to hemlock-decline induced habitat changes. Louisiana Waterthrush (*Parkesia motacilla*; LOWA) is an obligate riparian avian species that could be sensitive to hemlock condition in the southern Appalachians. LOWA behaviorally adjusts to environmental changes such as habitat fragmentation and stream acidification, but it is currently unclear how it responds to hemlock decline. Taking advantage of a pseudo-experimental design (with some hemlock inoculated for protection from HWA infestation), we examined the relationships between hemlock condition and LOWA habitat selection behavior and fitness in riparian areas across a range of hemlock conditions, and evaluated possible mechanisms underlying any relationship that may exist. Preliminary analysis suggested a negative relationship between nest success rate and hemlock vigor (β = -1.134, 95% CI = -2.121, -0.146) indicating that, scaled up, hemlock decline could have negative impacts on LOWA populations.

Variation in DNA methylation and mercury exposure in urban and rural dwelling songbirds

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Urban environments impose novel stressors on wildlife; to survive, urban wildlife must adapt to these new sources of stress. To avoid or mitigate stress, wildlife may adapt by changing their ecology. Individuals may also respond to stress through physiological or molecular changes, such as epigenetic processes. Epigenetic changes may be especially important for responding to toxin exposure, such as heavy metals, which are a common by-product of urban industry. DNA methylation is the most widespread epigenetic process, can directly influence gene expression, and importantly, can be influenced by environmental exposure. In this study, we assessed how songbirds respond to urban stress by evaluating differences in DNA methylation and mercury exposure between rural and urban Northern Cardinals (*Cardinalis cardinalis*) and Carolina Wrens (*Thryothorus ludovicianus*) captured in southern Louisiana. We constructed genome-wide methylation profiles with reduced representation bisulfite sequencing and tested blood for total mercury (μg/g, dw), to

determine if: 1) methylation profiles varied between urban and rural sites; 2) mercury exposure varied between urban and rural sites; and 3) methylation differences were associated with mercury exposure. Using a data set generated by Louisiana Bird Observatory, we also included disease exposure (malaria), age, sex, and condition as covariates in models assessing genome-wide methylation associations. Results indicated methylation profiles and mercury exposure varied by species and location. Results from this study help us better understand how wildlife respond and persist in urban matrixes, ultimately contributing to our understanding how biodiversity is maintained in a human dominated world.

Detecting broad-scale regime shifts using the North American Breeding Bird Survey

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Identifying abrupt changes in the structure and functioning of systems, or system regime shifts, in ecological and social-ecological systems leads to an understanding of relative and absolute system resilience. Resilience science provides a framework and methodology for quantitatively assessing the capacity of a system to maintain its current trajectory (or to stay within a certain, and often desirable regime). If and when a system's resilience is exceeded, it crosses a threshold and enters into an alternate regime (or undergoes a regime shift). We will use Fisher Information to detect regime shifts in time and space using avian community data obtained from the North American Breeding Bird Survey within the Central Breeding Bird Survey region (east of the Rockies and west of the Mississippi River). We will complement these analyses with a suite of discontinuity analyses on body masses to achieve the aim of identifying individual species that best serve as early-warning indicators of regime shifts. Identifying early-warning indicators of regime shifts in ecological systems allows management efforts to focus on a single or a small number of species that inform us about ecosystem resilience and trajectory. Additionally, identification of such species may afford us the ability to predict system regime shifts in time. In summary, our research will: (1) identify locations of regime shifts in time and space, (2) identify early-warning (avian) indicator species of regime shifts, and (3) estimate the vulnerability of ecosystems in the Central Region of the Breeding Bird Survey to impending regime shifts.

Estimating Habitat Suitability and Breeding Success of a Migrant Songbird in New Hampshire

Burns, Christian - Plymouth State University; Leonard Reitsma - Plymouth State University

In recent years, Canada Warblers (*Cardellina canadensis*) have declined throughout their breeding range, and are considered threatened in Canada. Assessing habitat quality across its breeding range is important in implementing a management plan for the species. This study tests and indexes breeding success within habitat patches by catching and recording ages of males and observing food provisioning in adults. On five separate days during the summer of 2015, birds were observed on 4 different plots in Canaan, New Hampshire. Plots were dominated by herbaceous material ($df = 6$, $F = 140.8$, $p < 0.01$). Playback of Canada

Warbler vocalizations were used to draw males in. Following procedures established by Corbani et al (2014) and Mackenzie et al (2002), parental status was indirectly assessed through observing food carrying and provisioning in 42 adult warblers. Chi-square analysis revealed that older ASY birds had significantly more breeding success than SY birds ($df = 3$, $\chi 2 = 7.89$, $p = 0.484$). A two-state hierarchical model, executed using R Unmarked, was used to estimate the proportion of adults successfully fledging young. A total of 50% of the adults observed showed evidence of food provisioning. The predicted probability of offspring being produced in all monitored breeding sites is 0.66, whereas the observed probability is 0.5. Vegetation-based analysis was also performed, in order to complete a habitat suitability analysis. This suggests that this model may be used to accurately show the probability that a given site is a suitable environment for this species.

The Effectiveness of Barrier Island Saltmarsh Restoration in Creating Avian Habitat

Byerly, Paige - University of Louisiana at Lafayette; Hardin Waddle - USGS Wetlands and Aquatic Research Center; Paul Leberg - University of Louisiana at Lafayette

Louisiana barrier islands provide valuable wildlife habitat, particularly for breeding and migratory birds. The erosion of back barrier marsh on these islands has become a major focus of restoration efforts; however, these restorations often prioritize preventing island erosion over protecting wildlife habitat. Furthermore, there has been little assessment of the effectiveness of restoration in creating avian habitat. We deployed 43 Autonomous Recording Units (ARUs) and 20 camera traps on two barrier islands in order to monitor the use of restored marshlands by marsh and shore birds in the Gulf of Mexico and assess the success of recent restoration efforts. We divided sampling efforts evenly between recently restored areas and older, intact marsh areas, which served as reference habitat. ARUs were placed 150-300m apart and 75m from habitat edges in order to avoid sampling from adjacent habitats, and set to record 30 minutes a day during primary vocalization periods for target species. Targeted species included Clapper Rails, Seaside Sparrows, Red-winged Blackbirds, and Marsh Wrens. Vegetation plots were taken at each sampling location in order to facilitate comparisons between microhabitats, which can influence bird occupancy. Occupancy was estimated using combined data from ARUs and camera traps. ARU data was analyzed using Song Scope analysis software and unique vocalization recognizers developed for over 11 species. Our results show that marsh restoration on barrier islands has had mixed success in creating habitat for birds, and highlight the utility of ARUs as a substitute for point counts in collecting data from remote areas.

Restore the Call: Multiregional Translocation of Common Loon (*Gavia immer*) Chicks

Byrd, Allison - Biodiversity Research Institute; David Evers - Biodiversity Research Institute; Jim Paruk - Biodiversity Research Institute; Michelle Kneeland - Biodiversity Research Institute; Kristin Kovach - Biodiversity Research Institute; Mark Pokras - Biodiversity Research Institute; Vincent Spagnuolo - Biodiversity Research Institute; Nina Schoch - Biodiversity Research Institute; Lee Attix - Biodiversity Research Institute; Jeff Fair - Biodiversity Research Institute; Virginia Stout - Biodiversity Research Institute

Avian chick translocation and reintroduction are common conservation methods for maintaining or restoring viable populations. Little is known, however, as to how transferrable methods are among species and populations. We implemented a pilot study to assess multiple translocation methods using two different source populations of the Common Loon (*Gavia*

immer). In 2014, we began a collaborative five-year translocation project to re-establish breeding populations in both southeastern Massachusetts and southern Minnesota and serve as a basis for future loon translocation projects in the West, where the species is imperiled. As loons are long-lived and slow to reproduce and colonize new areas, chick translocation may be a viable method to restore loons to areas of their former breeding range. To date, we have translocated 21 wild-caught Common Loon chicks (14 from northern to southern Minnesota and 7 chicks from New York to Massachusetts) using two methods: 1) rearing younger chicks in an aquatic enclosure prior to release (~6 weeks old) and 2) direct release of older chicks (~10 weeks old). We aim to: 1) evaluate the effectiveness of Common Loon chick translocation as a conservation strategy, 2) determine the most effective translocation strategy (captive rearing or direct release), 3) establish baseline health parameters for Common Loon chicks, and 4) develop and refine methods and protocols for future loon translocation efforts.

A survey of insects and arachnids found in the nests of Carolina Wrens (*Thryothorus ludovicianus*) in urban and rural environments

Byrd, Faith - Sam Houston State University; Diane Neudorf - Sam Houston State University

As urban sprawl increases, the need for better understanding of anthropogenic effects on songbirds also increases. We evaluated how plant community and human dwellings impact arthropod communities found in the nests of a cavity-nesting songbird species, the Carolina Wren (*Thryothorus ludovicianus*. Avian nests are important habitats for arthropod species that live and reproduce in nesting material. Alteration of native plant communities, combined with urbanization may cause shifts in the community structure of nest-dwelling arthropods including parasitic mite and louse species that are known to decrease the fitness of nestlings. We compared nest-dwelling arthropod populations between and among nests collected in urban and rural environments. Nest boxes were placed in the yards of Huntsville, Texas residents, and at a field research station belonging to Sam Houston State University. Shortly after the nestlings fledged, nests were removed and placed in a sealed container so that all arthropods could be collected and identified. Species richness and abundances of arthropods in each nest were compared between the urban and rural study areas. Plant cover and native and non-native plant predominance was assessed to determine if plant community structure in areas near a nest related to a measurable difference in the arthropod community. Preliminary results suggest species richness was greater in the rural habitat.

Ecology, Behavior, and Reproduction of Invasive Egyptian Geese (*Alopochen aegyptiaca*) in Texas

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We utilized a citizen science invasive bird project in order to collect biological data on Egyptian Geese throughout Texas. Lake/Pond was the most commonly recorded habitat (69.9%) followed by golf courses (15.6%), and rivers (9.2%), and geese were present on land more often than in water. Resting (27.3%) and foraging (26.0%) were the most commonly recorded behaviors, and aspects of thermoregulation are provided. The diet includes grass, aquatic vegetation, and a variety of items offered by humans. They commonly occur (24%) with other

waterfowl species with few cases of agonistic behavior, and one case of hybridization with a domestic duck is documented. Mean flock size was 5.1 (range: 1-53), with largest flocks occurring May, June, and September, and smallest during April and August. The geese are permanent residents, with short-distance movements common throughout the year. Breeding occurs from January to July, peaking March to May. Nesting was recorded on the ground (n = 3) and in trees (n = 2), and number of goslings ranged 2 – 11. Information is also provided for reproductive chronology and life cycle. Ultimately, the Texas geese appear to be generalist in nature, as they are throughout their native and nonnative ranges. Although we do not explicitly document any negative impacts to native wildlife, we feel that the potential threats this species poses throughout its introduced range warrants further investigation.

To feather one's nest: the relationship between nest type and the avian early microbiome.

Campos Cerda, Felipe - University of Oregon; Brendan Bohannan - University of Oregon

Animals host complex microbial communities that not only affect their health but also interact intimately with their growth and development. This community (known collectively as the host's microbiome) greatly increases in complexity after birth or hatching, and the acquisition of microbes is a key event in juvenile development. For birds, nests are the initial environment encountered after hatching. Different nest types provide different environmental conditions, and by constructing a certain nest type parents would be providing an environment that may impact the microbiome of their offspring. Nestlings with more controlled microbial environments might allocate resources mainly to growth and development rather than to immune responses against potential pathogens. Therefore, nest type could affect nestling's survival by selecting and determining its early microbial associations. In order to know if different nest types harbor different microbiomes, we sampled 37 nests from 21 species in 14 families of tropical birds in southern Mexico. Three different nest types were included: cup, basket and cavity. Variation in nest conditions was determined via continuous monitoring of within-nest temperature and humidity by iButton sensors. The relationship between microbial abundance and within-nest temperature and humidity was determined by comparing these environmental data with the results of culture-independent microbial quantification (qPCR). Variation in microbiome composition across nest types will be determined via PCR amplification and sequencing of bacterial 16S rDNA extracted from nest materials.

Effect of mesquite removal on grassland birds at Grassland Priority Conservation Area Janos.

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Grassland birds are one of the most vulnerable group of species in North American. The most important cause of their declines are habitat loss and degradation, such as woody encroachment. It is estimated that between 25-50% of current shrubland extension in the Chihuahuan Desert of Mexico were former grasslands. Bird

grassland specialists cease to occur or diminish their abundance in grasslands where woody vegetation has invaded former open grasslands. We conducted mechanical mesquite removal in 135 ha of grasslands in GPCA Janos, in three different private ranches. A total of 25 500m-transects were sampled in control and treatment areas in October, before removal, and in December-January, after treatment. Changes in treatment areas after removal were notorious, where Brewer's sparrow relative abundance diminished from 23.20 to 15.20 inds/km. Also, chestnut-collared longspur, eastern meadowlark and Baird's sparrow increased from 3.60, 1.30, and to 24.67, 21.47, and 0.53 inds/km. In control areas, chestnut-collared longspur and eastern meadowlark showed little or diminishing change between sampling periods, with 3.60 and 1.80 against 3 and 0.4. Such rapid changes in wintering grassland bird communities are an important indicator of the positive effect of mesquite removal in degraded grasslands of the Chihuahuan Desert. Both, control and treatment areas also showed a 22 and 33% decrease of species richness during the second sampling period, mostly due to the absence of migrants and apparent seasonal movements of resident species.

Makengue Reserve, Nicaragua: education and outreach opportunities for bird diversity, behavior and evolution

Carr, Jennie - Washington College; Christopher Tudge - American University

Established in 2006, the Makengue Reserve is a 190-acre private rainforest reserve along the San Juan River in Southern Nicaragua with the goals of education, preservation, and community involvement. American University, Washington DC and Washington College, Maryland, are two institutions that have developed partnerships with Makengue, providing educational and outreach opportunities for their students and educators alike. The Makengue Reserve provides an especially valuable opportunity to immerse undergraduate students in first-hand experimental design and research execution in a tropical ecosystem, particularly with regards to the exploration of bird diversity, behavior, and evolution. Although the short-term nature of these immersive experiences presents unique pedagogical challenges, such experiences provide invaluable opportunities for scholarly development. Since its inception, significant strides have been made to characterize bird diversity and to begin systematic scientific research on the local bird species, including a bi-annual BioBlitz, bird surveys, creation of a property-specific field guide, and studies on avian antipredator mobbing behavior. These opportunities also involve outreach and education of local Nicaraguan communities, specifically with regards to programming that assists local Nicaraguan teachers develop lesson plans and activities that expose their classes to the natural world around them. Due to its location, the Makengue Reserve provides an excellent opportunity for the provision of both community services as well as abundant research opportunities.

Genetic, morphological and ecological differentiation of the Squirrel Cuckoo in Mexico

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The Squirrel cuckoo (*Piaya cayana*) is a polytypic species with a widespread distribution in the Neotropics, from México to northern Argentina. Of the 13-14 recognized subspecies two parapatric and phenotypically differentiated subspecies are distributed in Mesoamerica (Mexico to Panama). Subspecies mexicana resides in the dry tropical forests of the western Pacific slope; subspecies thermophila inhabits in humid forests of the Gulf slope, including the Yucatán Peninsula. Based in mitochondrial DNA sequences (ND2, 1041 bp, and CytB,

622 bp), we found strong genetic differentiation between these two subspecies; in addition, these Mesoamerican lineages grouped in a well-differentiated clade regarding South America samples. Divergence dating based in secondary calibrations suggests that differentiation in the two Mexican groups may be related to climatic changes occurred in the Pleistocene. On the other hand, we suggest that the Plio-Pleistocene divergence between Mesoamerican and the South American samples is probably linked to the uplift of the Northern Andes. Morphological and ecological differentiation in the Mexican groups is significant with clear differences in the sizes of beak and tail; while preliminary results on ecological niche modeling suggest a constriction of the ecological niche for the western Pacific slope clade. Based in overall evidences, we suggest that Squirrel cuckoo subspecies mexicana and thermophila should be recognized as two different species.

Amplification of Toll-Like Receptor extracelular región in grassland sparrow in the Desierto Chihuahense grassland.
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Grassland in North America is considered as the most endangered environment world-wide, and the bird species that live there are seriously threatened. Because of small effective sizes and inbreeding, bird populations might show low genetic diversity that compromise the survival of the species. We propose the use of adaptative genes as molecular marker for genetic diversity such as Toll-Like Receptors. These genes are a family codifying for immune system receptor that binds and recognize to Pathogen-Associated Molecular Patterns (PAMP), then send a signaling pathway to combat possible infections. They are under considerable positive selection due to coevolution with pathogens. We expect to find correlation between heterozigocity and weight in grassland endangered. We have designed specific primers and amplified a part of the codifying sequence of the Leucine-Rich Repeat (LRR) domain of the TLR1LA, TLRLB, TLR3, TLR4 and TLR7 genes (which is the domain that binds with PAMPs) in diverse grassland sparrow species (*Ammodramus savannarum*, *Ammodramus bairdii*, *Passerculus sandwichensis*, *Peucaea cassinIi*, *Zonotrichia albicollis* and *Zonotrichia leucophrys*), in order to evaluate the efficiency of this novel molecular marker of adaptative diversity in endangered species of sparrows and the effect of heterozygosity. We were able to amplify and sequence all 5 genes for the species: *Z. albicollis*, *Z. leucophrys*, *P. sandwichensis*, *A. bairdii*, *S. wortheni*, *P. cassinii*, *A. savannarum*.

Mitochondrial DNA suggests recent origins in two coastal avian subspecies in northwestern North America.
Cheek, Rebecca - University of Alaska Museum; Kyle Campbell - University of Alaska Museum; Robert Dickerman - University of Southwestern Biology; Berry Wijdeven - Ministry of Forests, Lands and Natural Resource Operations; Kevin Winker - University of Alaska Museum

Genetic studies of subspecies endemic to Haida Gwaii (Queen Charlotte Islands), British Columbia and the Alexander Archipelago of southeast Alaska have frequently found genetic corroboration for these phenotypically based taxa. Divergence and speciation are common among island populations of birds, and evidence suggests this region has fostered such divergence during previous glacial maxima. We examined genetic divergence in mitochondrial DNA (mtDNA) of two coastal subspecies endemic to this region: sharp-shinned hawk (*Accipiter striatus perobscurus*) and great blue heron (*Ardea herodias fannini*). Genetic

diversity in both species was remarkably low, with both coastal subspecies possessing only the most common haplotype found in continental populations. We found low but significant population divergence between *A. s. perobscurus* and continental populations of sharp-shinned hawks and no significant population divergence in the herons. The refugial history of the region suggests that these subspecies may have arisen relatively recently compared with other regional endemics for which genetic and phenotypic data both show divergence. Alternatively, species-wide selective sweeps of mtDNA prior to divergence may have rendered this genetic marker less useful for tracking that divergence

Modeling survival and recruitment of Black-throated Blue Warbler (*Setophaga caerulescens*) populations at warm-edge range margins

Chitwood, Ryan - University of Georgia; Richard Chandler - University of Georgia; Robert Cooper - University of Georgia

Species' ranges are shifting poleward and to higher elevations in response to climate change, and populations at the warm-edge (low-latitude, low-elevation) of a species' range are expected to be affected by this environmental change the greatest. Many hypotheses have been proposed to explain how species' ranges change in response to environmental change, but few have been tested in the field. By measuring the demographic rates (e.g. survival, recruitment, and movement) of warm-edge populations, ecologists can gain further insight into how warm-edge populations respond to environmental changes like climate change. This study uses count data to describe trends in density of adult male Black-throated Blue Warblers (*Setophaga caerulescens*) from 2002-2015 observed near the warm-edge of their range across three sites of varying elevation near the Coweeta Hydrologic Laboratory in Otto, NC, USA. Capture-mark-resight data from these sites were used to estimate BTBW apparent survival and recruitment rates over the same period. Male warbler density declined for all three sites from 2002-2015 with the low elevation site reaching near local extinction. Estimates of apparent survival showed differences across sex with survival for females being higher than males, but no differences across time. Recruitment rate estimates varied widely over time meaning that differences in recruitment are likely driving the declines observed in this region. Further study should assess what ecological processes result in decreased recruitment in this species (e.g. movement or reproduction).

An Investigation of the Effect of Environmentally Relevant Methylmercury Exposure on Thyroid Hormones in Zebra Finches

Clifton, Kalen - The College of William and Mary; Daniel Cristol - The College of William and Mary; Eric Bradley - The College of William and Mary

Mercury, an abundant pollutant introduced into the environment anthropogenically, has historically been studied as a neurotoxicant and research on mercury and birds has been largely focused on fish- eating species. Less well studied is the effect of mercury on the endocrine system of terrestrial species of birds. This pilot study investigates the effect of environmentally relevant low-dose mercury exposure on the endocrine system of zebra finches, a model terrestrial songbird, via measurement of the circulating plasma thyroid hormones thyroxine (T4) and triiodothyronine (T3). Because thyroid hormones regulate metabolism, the implications of their disruption could be extensive. This experiment was performed on a population of male zebra finches in captivity with a range of ages. For their entire lifetime, birds in the mercury treatment had food dosed with 1.2 ppm methylmercury. Birds in control treatment had no dietary exposure to mercury. The effect of mercury on the concentration of T3 was dependent on age.

For older birds, those in the mercury treatment had a lower mean concentration of T3 than the birds in control treatment. For younger birds, those in the mercury treatment had a higher mean concentration of T3 compared to control birds. Further research should determine how levels of thyroid hormones correlate to metabolic function in zebra finches. In general, both low and elevated levels of T3 can indicate illness. Learning more about the effect of mercury on the avian endocrine system will allow better predictions of the effects on birds of expected climate-induced increases in mercury pollution.

Tidal marsh birds as indicators of human disturbance: Constructing multimetric indices (MMIs) that integrate avifaunal response with wetland vegetation and geomorphic monitoring variables to assess the ecological condition of tidal marshes and their specialist bird communities

Cline, Brittany - Saltmarsh Habitat & Avian Research Program (SHARP); Dept of Entomology & Wildlife Ecology, University of Delaware; Chris Elphick - The University of Connecticut; Brian Olsen - The University of Maine; Susan Adamowicz - U.S. Fish & Wildlife Service (USFWS); Maureen Correll - Bird Conservancy of the Rockies; Whitney Wiest - USFWS; Elizabeth Tymkiw - University of Delaware; Thomas Hodgman - Maine Department of Inland Fisheries & Wildlife (IF&W); W. Gregory Shriver - The University of Delaware

The birds associated with tidal marshes of eastern North America constitute some of the highest monitoring and conservation priorities at state, federal and provincial scales. This phenomenon is linked to the magnitude of habitat change associated with centuries of human alterations to these productive ecosystems, including physical modifications, species invasions, surrounding land-use, and (increasingly) sea-level rise and extreme storms. Because the sources or history of marsh disturbance are often unknown or occurring at multiple spatiotemporal scales, there is urgent need to devise a sensitive, one-dimensional index of ecological integrity for measuring and predicting marsh condition while simultaneously comprising component metrics that are easier to measure than the disturbance itself. Using data collected for the U.S. Fish & Wildlife Service's Saltmarsh Integrity Program (SMI), we integrated vegetation, geomorphology and invertebrate data with bird distribution and abundance data collected by the Saltmarsh Habitat and Avian Research Program (SHARP) to develop multimetric indices (MMIs) for evaluating marsh condition at local and regional scales. We used existing GIS datasets to generate candidate disturbance metrics that quantified the land-use and physio-chemical properties identified as stressors, and subsequently applied a theory-based algorithm for constructing MMIs given candidate metrics. The result is a model-driven bioassessment tool that is maximally sensitive to human disturbance and incorporates higher (avian) trophic-level responses with existing monitoring metrics to convert to a common utility scale. Ultimately, these MMIs will be tested on independent datasets to ensure robustness for regional applications aimed at maintaining or restoring marsh integrity.

Comparing Waterbird Communities of Two Created Wetlands in West Virginia

Clipp, Hannah - West Virginia University; Michael Peters - West Virginia Division of Natural Resources; James Anderson - West Virginia University

In recent decades, thousands of hectares of wetlands have been created in the United States to compensate for wetland destruction. However, information on how wetland creation impacts migratory and wintering waterbird communities in the central Appalachian region is limited. The purpose of this study was to compare annual and seasonal waterbird species richness,

diversity, and density of a wetland created in 2013 (CW2013) and a nearby wetland created in 2001 (CW2001), both located within the Pleasant Creek Wildlife Management Area, WV. We conducted surveys at each wetland 2–4 days per week from September to May 2013–2014 and 2014–2015. We split seasons into fall migration (Sept–Nov), winter (Dec–Feb), and spring migration (Mar–May). During the study period, we observed 20 and 31 waterbird species at CW2013 and CW2001, respectively. Species richness and diversity were consistently higher at CW2001, while average species density did not significantly differ. Densities of buffleheads (*Bucephala albeola*), lesser scaup (*Aythya affinis*), and ring-necked ducks (*Aythya collaris*) were higher in CW2001, while densities of green herons (*Butorides virescens*), mallard (*Anas platyrhynchos*), and wood duck (*Aix sponsa*) were higher in CW2013. The greatest difference in species richness and densities occurred during spring migration. Differences in two waterbird communities are likely explained by differences in wetland size and water depth. The results of this study provide insight into the potential impacts of created wetland habitat on waterbird species in the Central Appalachians.

State Uncertainty Models For Understanding Nonbreeding Site Use By The Piping Plover

Cohen, Jonathan - SUNY College of Environmental Science and Forestry; Sidney Maddock - National Audubon Society; Melissa Bimbi - USFWS; Walker Golder - Audubon North Carolina; Olivia LeDee - Minnesota Dept. Natural Resources; Francie Cuthbert - University of Minnesota; Dan Catlin - Virginia Tech; Jim Fraser - Virginia Tech; Cheri Gratto-Trevor - Environment Canada

Beach-nesting shorebirds contend with human disturbance and habitat development throughout the annual cycle. Thus far, most research has occurred on the breeding grounds. Repeatable estimates of nonbreeding demographic rates (such as arrival and residency) are generally lacking, which hinders the study of limiting factors outside of breeding areas. We estimated fall migration demographic rates of endangered Piping Plovers at four sites in South Carolina in 2006/7 and 2007/8 using mark-recapture models, taking advantage of birds marked on the breeding grounds. We used a robust design state uncertainty model to account for heterogeneity in arrival and departure rates between fall transients and winter residents. Cumulative probability of arrival was >40% by the end of July for both residents and transients, and reached 95% for both groups by the ends of September. Estimated residence time of transients was approximately 22-54 d in the first winter depending on stage class, and 10-54 d in the second. High resight probabilities allowed us to make fairly precise estimates with small sample sizes. Our results imply that habitat protection intended to benefit wintering Piping Plovers at our sites should be in effect by late summer, as many birds are resident from July through the end of winter. If banding programs on the breeding grounds continue, long term monitoring programs can permit separation of demographic variance from sampling error, which is crucial for further research into population regulation and limiting factors.

Avian haemosporidian prevalence and its relationship to host traits

Collins, Michael - Rhodes College; Mitchel Trychta - Rhodes College

Parasites can influence the dynamics of ecological communities through their effects on host host fitness, population size, and behavior. Haemosporidian parasites of the genera Plasmodium and Haemoproteus are common blood parasites of birds and are transmitted by dipteran insects. We analyzed blood samples from 625 individuals of 60 bird species sampled from five habitats in west Tennessee to understand the relationship

between the local bird community and their blood parasites. We examined individual- and species-level traits associated with increased prevalence of avian malaria. We extracted DNA and used PCR to amplify a section of the parasite mitochondrial cytochrome b gene to detect infections, which were then sequenced for lineage identification. We found 272 individuals of 35 species to be infected with haemosporidian parasites (overall prevalence of 44%). We identified 36 genetic lineages, 16 in the genus Haemoproteus and 20 in Plasmodium. Total prevalence differed significantly among 19 species with a sample size 10 or more individuals. However, infection status did not vary with habitat or with any individual-level trait (age, sex, or body condition). Across species, total infection prevalence increased with abundance. Prevalence was unrelated to host survival, species mass, nest type, nest height, foraging height, or degree of sexual dimorphism. Our research demonstrates that this complex parasite-host system includes both specialist and generalist parasite lineages, host species vary in prevalence and richness of their haemosporidian parasites, and across-species variation in prevalence is not readily explained by host traits.

Connecting Breeding and Winter Locations of a Migrant Songbird through Population Genetics

Connell, Eileen - University of Maryland, Baltimore County; Kevin Omland - University of Maryland, Baltimore County; Peter Marra - Smithsonian Migratory Bird Center; Colin Studds - University of Maryland, Baltimore County

Determining migratory connectivity patterns is important for a number of basic and applied research questions, including the evolutionary dynamics of migratory species. Previous analyses of neutral genetic markers in the American Redstart, *Setophaga ruticilla*, revealed a unique haplogroup in breeding populations in Newfoundland, but the tropical non-breeding areas of these populations remain unknown. We sequenced the mitochondrial control region in 180 blood samples collected at 9 locations across the non-breeding range. We discovered that the haplogroup common in breeding populations from Newfoundland was restricted to non-breeding populations in Puerto Rico and the eastern Dominican Republic. These results suggest that migratory connectivity in this species occurs over finer geographic scales than previously recognized. Identifying genetically unique populations in both the breeding and nonbreeding seasons will improve our knowledge of migratory connectivity, which is crucial to understanding population ecology, evolution and conservation priorities for migratory species.

Using Next-Generation Radar technology to study avian migration in relation to light pollution

Contina, Andrea - Oklahoma Biological Survey - University of Oklahoma; Kyle Horton - University of Oklahoma; Jeffrey Kelly - University of Oklahoma; Eli Bridge - Oklahoma Biological Survey

Light pollution is a global issue that affects people and wildlife across continents. In particular, migratory birds might suffer from excessive light pollution during fall and spring migration. Some of the negative effects that birds might experience when migrating above city areas with strong light pollution include disorientation and, consequently, higher energy consumption. Because a long distance migratory journey is energetically costly, any extra metabolic depletion might result in exhaustion and eventually death. Therefore, a closer analysis of the effect of light pollution on migrants is highly recommended. We used Next-Generation Radar (NEXRAD) data to assess the impact of light pollution on migratory birds in Oklahoma, USA. We focused on the impact of the illumination system of a large football stadium in Norman – OK during fall migration and tested the use of NEXRAD technology in relation to conservation biology research

questions. Our preliminary work focuses on detecting biomass in proximity of the illuminated stadium and our approach highlights the potential of adopting NEXRAD technology to monitor wildlife in the aerosphere. To validate our radar inferences, we are also planning to match radar reflectivity data analysis with direct field observations from the ground.

Birds of theTejar-Garnica City Park Complex And The Role Of eBird and gray literature in understanding Avifaunulas
Contreras-Cuevas, Gustavo - Universidad Veracruzana; Nidia S. Hernández-Arriaga - Universidad Veracruzana; Mariana Hernández-Soto - Universidad Veracruzana; Oscar Manuel Salcedo Jimenez - Universidad Veracruzana; J. Alberto Lobato-García - Universidad Veracruzana; Ernesto Ruelas Inzunza - Universidad Veracruzana
Tejar-Garnica is a 320-ha cluster of contiguous city parks in Xalapa, Veracruz, Mexico, host to at least 219 bird species. We compiled and compared records submitted to eBird, gray literature, formal publications, and our own data. In this paper, we: (1) Propose the use of the term ‘avifaunula’ for short-duration studies done in small areas, (2) Apply simple criteria to validate gray literature and citizen science data, and (3) Report our own findings in Tejar-Garnica. We use the term ‘avifaunula’ for studies done in areas of less than 1000 ha carried over at least 1 yr. Avifaunula is inspired in the term ‘florula,’ coined at the beginning of the 19th. century. The use of simple criteria allowed us to eliminate 6.9% of the records that we consider erroneous following simple filters of ample use such as (a) geographic distribution, (b) seasonality, (c) erroneous identifications, and (d) perceived observer experience. Presence-absence data reported by different sources, compared to our own, range in discrepancies from modest to substantial. Our own data has important omissions; we cover 84.5% of the species that are reported in these parks. The term avifaunula serves the purpose of differentiating modest investigations from those of a broader scope. The extensive knowledge of the distribution and ecology of birds worldwide has received the inputs of hundreds of thousands of avifaunulas. We think the criteria proposed can contribute to improve the quality of unpublished and citizen science data.

Spatio-temporal dynamics of hummingbird (trochilidae), in pine-oak post-fire forest in Western Mexico
Contreras Martinez, Sarahy - University of Guadalajara

This research analyzes the relationship between the dynamics of hummingbirds and their environment at different spatial scales under a macroecological approach. In this context, we describe the impact of fire on a hummingbird community and for the first time functional groups are defined according to their response to fire. The research was conducted at landscape, regional and local scales. We measured parameters of abundance and survival in different successional stages to define post-fire habitat criteria for selected species. These three measurement at different scales allowed the creation of models and recommendations for management and conservation of temperate forest hummingbirds. We incorporated in our results the information generated from 20 years of hummingbird banding and monitoring.

Female white crowned-sparrows (*Zonotrichia leucophrys*) show preference for high minimum frequency songs

Coomes, Casey - Tulane University; Jennifer Phillips - Tulane University; Dana Moseley - The College of William and Mary; Julie Danner - Tulane University; Raymond Danner - UNCW; David Luther - George Mason University; Elizabeth Derryberry - Tulane University

Urbanization is a rapid environmental change that affects many ecosystems. With urbanization comes increasing anthropogenic noise, which masks some parts of bird songs. This has caused an upshift in the minimum frequency of songs to allow for better signal transmission in many species. Bird song is an important signal in oscines, and plays a large role in mate choice and sexual selection. While natural selection selects for high minimum frequency songs in urban environments to allow for better signal transmission, some species have been shown to prefer songs with a lower minimum frequency. In cases where urbanization selects for high minimum frequency songs, and females select males with lower minimum frequency songs, natural selection and sexual selection oppose each other. White-crowned sparrows (*Zonotrichia leucophrys*) are found in many urban environments and are an important species for studying song and sexual selection. Therefore, it is important to know whether sexual selection and natural selection oppose each other in this system. To test this, we hand-reared 10 white-crowned sparrow females and tutored them using high minimum frequency songs. This design simulates the early experience environment of urban female birds. Each female underwent operant conditioning with a choice between high and low minimum frequency songs. The majority of females preferred high minimum frequency songs. This finding supports previous studies that early experience shapes female preference in oscines. Furthermore, our findings suggest that sexual selection and natural selection do not oppose each other in this system.

Prey Species and Size Selection by Snail Kites in the Everglades

Coppola, Philip - University of West Florida; Philip Darby - University of West Florida; Michel Therrien - Florida Fish & Wildlife Conservation Commission

The endangered ‘Florida’ snail kite (*Rostrhamus sociabilis plumbeus*) is a dietary specialist, historically relying exclusively on native Florida apple snails (*Pomacea paludosa*). Within the last decade, exotic apple snails (*P. maculata*) have become established in wetlands throughout South Florida, and in some areas are the primary prey for kites. Though these two snail species are superficially similar in color and overlap in size during intermediate growth stages, exotic *P. maculata* frequently grow to twice the size of native *P. paludosa*, which causes handling difficulties for kites. The objective of this study was to determine selection behavior of snail kites foraging on native and exotic apple snails of various sizes within the Everglades. Prey items available to foraging kites (sampled using throw traps) were compared to prey items consumed (sampled from feeding perches). Chi-squared, adjusted residuals, and forage ratio indices were used to determine when observed values deviated from expected. Results clearly indicate that kites consumed the two snail species at a frequency equal to their potential availability, though differences in size selection were observed. Snail kites consumed snails < 30 mm at a lower frequency, snails 31-60 mm at a higher frequency, and snails between 61-80 mm at the expected frequency given their availability. This ‘preference’ for intermediate-sized apple snails (regardless of species) may be a result of kites weighing the benefit of caloric value (greater for larger snails) with the cost of handling time (higher for larger snails).

Broad-scale post-fledging movements of two closely related warbler species with opposing life-history strategies.
Cormier, Dominic - Acadia University

For juvenile migrant songbirds the post-fledging period presents a critical survival challenge. During this period, juveniles must avoid direct threats of predation, starvation, and exposure, while undergoing physiological changes, calibrating their internal compasses and timing their departure for successful arrival on the wintering grounds. An individual's success in navigating these challenges can have important consequences on overall population productivity. The most common explanatory factor for these movements is that juveniles seek habitats that limit direct threats to their survival. Such movements have typically been observed on small spatial and temporal scales, but more recently, it has become apparent that many occur at broader scales. We compared patterns of broad-scale post-fledging movements of juvenile Blackpoll Warblers with "Myrtle" Yellow-rumped Warblers, two sympatric species with contrasting life-history strategies. Individuals of the two species were affixed with VHF tags on offshore islands in Nova Scotia and tracked across the Gulf of Maine region for up to 2 months after fledging using the Motus automated telemetry array (www.motus-wts.org). Blackpolls left their breeding grounds earlier, made more daily flights, explored more coastlines, and were less directional in their movements than Myrtles. These results suggest that Blackpolls are exploring their natal region on a broad-scale and that Myrtles are simply leaving the region in a direction appropriate for migration; differences that may be related to their respective migratory strategies.

Declines in Butterflies and Insectivorous Birds in Areas of High Pesticide Use in California's Central Valley
Cousens, Bruce - Western Purple Martin Foundation; Robert Meese - Department of Environmental Science & Policy, University of California; **Heidi van Vliet** - York University; Arthur Shapiro - Center for Population Biology, University of California; Matthew Forister - Biology Department, University of Nevada; James Thorne - Department of Environmental Science and Policy, University of California; David Waetjen - Department of Environmental Science and Policy, University of California; Kayce Casner - Biology Department, Colorado State University; Daniel Airola - Northwest Hydraulic Consultants

A diverse group of butterflies and two colonial insectivorous bird species have recently declined dramatically in California's Central Valley, an area of intensive agricultural production and pesticide use. Valley floor butterfly populations monitored over a 42-year period show declines across a broad array of species, while populations outside of agricultural areas show no consistent declines. The Central Valley's last population of the western Purple Martin (*Progne subis* arboricola), an aerial insectivore, occurs in urban Sacramento. The population remained stable or increased through the 1990s and into the early 2000s, but by 2014 had declined by 83%. The near-endemic, colonial-nesting Tricolored Blackbird (*Agelaius tricolor*) was once widespread and abundant in Central Valley wetlands and some agricultural habitats but declined by 63% between 2008 and 2014. We contrast recent monitoring results from the Central Valley with data from adjacent foothill populations, where pesticide use is minimal, showing that foothill populations have not declined. The declines in these taxa are prominent in agricultural and urban areas of the Central Valley with documented increases in use of neonicotinoid insecticides in the last decade. These relationships are consistent with the possibility that insecticide use (along with land development and a shifting climate) is affecting non-target insects and indirectly affecting Purple Martins and Tricolored Blackbirds by reducing their insect food supplies. More intensive study is needed to

quantify the effects of insecticides on non-target species of insects and possible food chain effects on insectivorous bird species.

Tag-Team Takeover: Usurpation of Woodpecker Nests by Western Bluebirds
Cowell, Sammy - Utah State University; Hannah Domgaard - Utah State University; Phil Fischer - U.S. Forest Service; Teresa Lorenz - U.S. Forest Service; Sara Lorscheider - Utah State University; Mariah Panoussi - Utah State University; Lindsey Parrish - Utah State University; Taryn Rodman - Utah State University; Kim Sullivan - Utah State University

Woodpeckers provide important ecological services by excavating nesting cavities that are subsequently used by secondary cavities. The Black-backed Woodpecker (*Picoides arcticus*) is one species of woodpecker of special concern and is now listed as an endangered species in several states. The failure of Black-backed Woodpeckers to find the appropriate habitat and nesting snags needed to reproduce can lead to a decline of available nesting cavities for secondary cavity nesters as well. The Western Bluebird (*Sialia mexicana*) is one such secondary cavity nester found concurrently with the Black-backed Woodpecker. Bluebird species are notoriously aggressive and have been known to usurp active nests from conspecifics, other secondary cavity nesters, and even woodpeckers. However, the process by which bluebirds might take over nests from larger woodpeckers and, consequently, its ecological significance has not been well documented. We analyzed videos from six Black-backed woodpecker nests located in the Okanogan-Wenatchee forest in Washington, two of which were usurped Western Bluebirds. We then analyzed 112 hours of footage from both failed nests to document the usurpation process. Initially, both members of the bluebird pair physically assault the woodpecker. The male and female bluebird then maintain control of the nest through a cooperative effort of taking turns chasing off the returning woodpecker and guarding the nest. The entire takeover process seems to take approximately 24 hours. This information will be useful to forest managers in charge of monitoring Black-backed Woodpeckers, especially if usurpation rates are as high as our data seems to suggest.

Exploring Migratory Connectivity in North American Caspian Terns
Craig, David - Willamette University; Keith Larson - Abisko Natural Resource Station, Umeå University, Sweden

Using a multi-marker approach we demonstrate the utility of combining ad hoc and limited satellite tracking data, field-readable band resightings, and metal band encounters in the study Caspian Terns (*Hydroprogne caspia*) marked in North America between 1955 and 2007.
Using remote tags (i.e. satellite telemetry, N = 6) we successfully tracked adult migrating Caspian Terns for the first time and have data for fall migration from the Columbia River Estuary north to the Puget Sound of Washington and British Columbia, then south through interior valleys of the West into western Mexico. This general pattern of adult fall migration was supported using proximity tags (i.e. field readable bands, N = 225) but also allowed us to describe movement patterns of hatch-year birds and spring migration. Finally in hand tags (i.e. metal federal bands, N = 3466) allowed us to explore population movement patterns at the continental scale and better define the geographic limits of the Pacific or western population. We propose hypotheses for future population research on Caspian Terns with interest in eventually building a global population model of movement ecology for this cosmopolitan species.

The Economic Role of Birds in Final Housing Sale Prices in a Suburban Environment

Cristol, Daniel - The College of William and Mary; Nicholas Newberry - College of William & Mary

It has long been understood that landscaping and greenspaces contribute to a buyer's perception of a house's price. However, the complex economic relationships between birds and the suburban housing market remain poorly understood despite the strong role the housing market has on suburban bird populations. We examined the relationship between a house's sale price and the bird diversity and the habitat integral to individual suburban properties around Williamsburg, Virginia. In the desert American southwest a similar study found a $32,028 increase in a house's sale price per desirable birds species. We replicated this study in a different ecosystem with a much higher diversity of birds and a very different set of environmental variables to see if those results may be extrapolated. A total of 66 houses sold since 2013 in 22 neighborhoods near the Williamsburg, Virginia were surveyed during the summer of 2015 to determine the richness and evenness of birds on a property by property basis. Additionally, the microhabitat around each house is analyzed using GIS with data from LiDAR, LANDFIRE and other databases with information on small-scale land cover. Point counts, GIS and real estate data were compiled to create hedonic pricing models in order to quantify the economic relationship between birds and housing prices. While results are thus far inconclusive awaiting summer 2016 data, a positive trend between a house's sale price and the diversity of birds present on the property has already been observed when bird diversity is regressed against a house's sale price.

Bird diversity conservation in riparian urban parks at the Lake Chapala, Western Mexico.

Cuevas Gonzalez, Jesus - University of Guadalajara; Sarahy Contreras Martinez - University of Guadalajara

Lake Chapala is the biggest lake of Mexico and there aren't any monitoring avian studies. This study is the first to integrate a systematic survey. The main threat of its riparian vegetation is the elimination and reduction due to different human pressure. Urban parks represent an important strategy for maintaining biological diversity and provide habitat for resident and migratory birds. We evaluate seasonal dynamic and diversity of birds in six different riparian urban parks around the Lake Chapala. From February to July of 2016 we survey 25 (150) different point count that were stablished among the park. We characterize the wooded areas of each park. We have registered 2731 individuals from 14 different orders, 35 families, 35 genus and 100 species. Of all species, 68 were residents, and within these 3 were endemic and 7 semiendemic, while 31 were migratory and one of them was transient (*Pheucticus ludovicianus*). Three species are included in the Mexican list of species at Risk. We highlight the presence of *Rallus longirostris*, a resident and endemic specie to central-western Mexico and has the higher vulnerability value.

Geographic and genomic clines, population structure, and range expansion in a temporally complex titmouse (Paridae) hybrid zone

Curry, Claire - University of Manitoba; Michael Patten - Oklahoma Biological Survey, University of Oklahoma; Jason Weir - Dept. of Ecology and Evolution and Dept. Biological Sciences, University of Toronto

Analyzing patterns of gene flow between species and populations with partial reproductive isolation is important to our understanding of how speciation progresses,

especially examining zones over time or multiple zones within the same species complex to see how introgression changes with continued contact. Black-crested (Paridae: *Baeolophus atricristatus*) and Tufted Titmice (*B. bicolor*) are phenotypically differentiated populations that hybridize in two regions: an older zone in Texas and a younger zone in southwestern Oklahoma. We examine patterns of genetic introgression and diversity in these two zones by comparing mtDNA cytochrome b and genome-wide single nucleotide polymorphisms (SNPs) between the populations. We ask four questions: (1) are the cline widths of introgressing loci and hapolotypes the same in both zones, i.e., has introgression changed with continued contact? We examine the loci using geographic clines. (2) Are patterns of selection (as measured with genomic clines) similar in both zones? (3) Do morphometric and plumage traits correspond with geographic clines and with loci? (4) Does population structure reflect the postulated hybrid zone ages (previously based only on occurrence records and habitat changes)? We examine this using mismatch distributions and haplotype networks for cytochrome b. Few studies examine multiple transects within hybrid zone, so our data are valuable in providing comparisons of the genomic architecture of reproductive isolation with continued contact.

The effect of capture method on microbial abundance in plumage of Eastern Yellow Robins (*Eopsaltria australis*)

Cutshaw, Larynn - Ohio Wesleyan University; Nadya Sotnychuk - Ohio Wesleyan University; Christa Beckmann - Deakin University

Bird plumage is an ecosystem of microbes within the avian host. Most of these organisms are soil-dwelling bacilli so birds with more soil contact tend to have higher microbial loads. While investigating whether bacillus species are present in plumage of Australian birds, we questioned if trapping method influenced microbial loads. We expected microbial abundance on birds caught with mist nets, a device used on birds in flight, would be of a lower abundance than those captured with snap traps, a tool which restrains the bird in the soil. The abundance of Bacillus spp. on Eastern Yellow Robins (*Eopsaltria australis*) captured in both trap types was compared by sampling each bird with Tryptic Soy Agar contact plates at the back, tail, and venter. After statistical analyses using t-Tests in SPSS, the data were significant overall ($p = 0.004$), but when comparing data from specific parts of the bird, capture method was only a significant factor on the back ($p = 0.039$; $p = 0.055$ and 0.125 on tail and venter, respectively). We assume that our methodologies have created a detection limit in our data, leaving our results inconclusive to whether or not method of capture is a factor in microbial abundance.

Feather growth bars as an indicator of social status in the Island Scrub-Jay (*Aphelocoma insularis*)

Daggett, Elena - The Ohio State University; Christopher Tonra - The Ohio State University; Scott Sillett - Smithsonian Migratory Bird Center

Ptilochronology uses growth bars visible in feathers as a means of determining the rate at which a feather was grown. Larger growth bars indicate quicker feather growth and, given the energetic costs of molt, suggest a difference in condition of an individual. I compared feathers of territory-holding and non-territory-holding, or floater, Island Scrub-Jays (*Aphelocoma insularis*) to test if feather growth rates were correlated with social status. I predicted that territory-holding birds would be capable of growing feathers more quickly than floaters. Results generally supported my prediction on four plots across Santa Cruz Island, although feather growth rates varied annually, and tended to be lower in drought years.

Using thermal infrared cameras to detect avian chicks at various distances and vegetative coverages: A pre-field assessment

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Population monitoring of waterbird colonies typically involves frequent entries into the nesting area. Thermal infrared (TIR) cameras mounted on small unmanned aircraft systems (sUAS) may provide a cost-effective way to remotely survey birds and their nests more effectively and with less disturbance than traditional methods. Here, we evaluate the ability of two TIR camera systems suitable for mounting on a small sUAS to detect an avian chick under varying vegetative cover and distances. Seven “bio-boxes” were created to simulate a range of natural vegetation types and densities for the common tern (Sterna hirundo), a species of interest in the Chesapeake Bay. A juvenile chicken (*Gallus gallus*, a surrogate for a tern) was placed in each box, and cameras were tested at five elevations —12 m. We hypothesized that the ability of the camera to detect the chick would decrease with increasing vegetative cover and distance from the substrate. Digital thresholding of the resulting images successfully distinguished the chick in 88% of 139 images. Our tests determined that elevation did not significantly affect the area of chick detected by the camera. Vegetative growth form reduced detection more than the overall plant volume. Notable differences were observed between cameras including visual resolution of detected temperature differentials and image processing speed. Results of this controlled study show promise for the use of sUAS-mounted TIR systems in detecting small cryptic species in vegetation. Next steps are to combine TIR and visual sensors with an sUAS in a field application.

Prey delivery to Golden Eagle nests in Baja California, Mexico

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The golden eagle prey mainly on lagomorphs and squirrels. Most information on its diet has been described in USA and Europe. One report on its diet exists in all Mexico, and nothing for the Baja California peninsula. Using camera traps we determine the diet of four eaglets at two nests during the rearing and parental care. Prey delivery was documented from April 25 to May 15, 2014 in Valle de Guadalupe nest (VG), and from May 16 to June 12, 2015 in Santo Domingo nest (SD), for a total of 45 days and 1004 h of continuous monitoring. All the cameras were installed on nests when nestlings were 4 and 5 wk old. The programming was three photographs and video, function with 24 hrs. Preys delivered to VG nest were black tail hares (*Lepus californicus*, 30%), rock squirrels (*Otospermophilus beecheyii*, 25%) and cotton tail rabbits (desert cottontail, 19%); prey delivered to SD nest were black tail hares (*Lepus californicus*, 70%), cotton tail rabbits (desert cottontail, 20%), and rock squirrels (*Otospermophilus beecheyii*, 10%). Other preys were Red tailed hawk (*Buteo jamaicenesis*), American crow (*Corvus brachyrhynchos*), snakes (*Lampropeltis getula* and *Masticophis flagellum*), and weasel (*Mustela frenata*). We discuss on the differences in diet between nests that seems to be due to prey availability at each site. Determining the type of prey and parental care will provide information for future conservation programs of this species.

Evaluating remote camera picture frequency to estimate incubation patterns
Deaner, Lauren - Georgia Southern University; Ray Chandler - Georgia Southern University

Incubation patterns have long been studied in birds as they provide insight into the evolution of mating systems. Quantifying these patterns has progressed from long observation hours in the field to the use of remote cameras. While remote cameras elevate long observations in the field, they are replaced with long hours of sorting through camera footage to manually determine incubation patterns. We monitored 20 Wilson's Plover (*Charadrius wilsonia*) nests on Cumberland Island National Seashore in 2012 and 2013 using Reconyx game cameras that captured an image of each nest every minute throughout the life of the nest. Half of the sampled nests failed during the incubation period. Using a one minute frequency of picture capture as the true incubation pattern at each nest, we evaluated the accuracy of using 5, 10, 15, 30, and 60 minute frequencies to establish incubation patterns of male and female Wilson's Plovers.

Identifying habitat preferences of Cerulean Warblers (*Setophaga cerulea*) in southern Indiana
Delancey, Clayton - Ball State University; Garrett MacDonald - Ball State University; Claire Nemes - Ball State University; Kamal Islam - Ball State University

The Cerulean Warbler (*Setophaga cerulea*), a Neotropical migratory songbird, is listed as a 'Species of Special Concern' by the US Fish & Wildlife Service and state-endangered in Indiana. We have been monitoring Cerulean Warbler breeding populations in Yellowwood and Morgan-Monroe state forests in southern Indiana since 2007 as part of a 100-year project called the Hardwood Ecosystem Experiment (HEE). This long-term study aims at determining the effects of different forest management practices on plant and animal communities. The HEE consists of study units with different forest management practices; there are 3 even-aged, 3 uneven-aged, and 3 control research units where many taxa are studied by researchers from multiple universities. The HEE started in 2006 and harvests were completed in 2008-09, which allowed for pre-harvest data collection. Based on previous research, many mature forest-dependent Neotropical migrant fledglings move from mature forest habitat into areas of thick vegetation such as clear-cuts. We are interested in determining where fledgling Cerulean Warblers disperse after leaving their nests, but before migrating to their wintering grounds. We are also interested in determining roosting locations of adults during the nesting period to identify the preferred roosting habitat of Cerulean Warblers. Here we give preliminary results on our research findings. Information gathered from our study can potentially be used to suggest forest management prescriptions that provide Cerulean Warblers with all of their required habitat needs during the breeding season.

Camera Trap Sampling and *Lagopus spp.* Habitat Use
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Non-invasive wildlife sampling techniques such as acoustic monitoring, camera traps, and radar are growing in popularity. Camera traps, in particular, are increasingly relied upon for the detection of terrestrial mammal species with infrequent or anecdotal sampling directed towards avian communities (O'Brien and Kinnaird 2008, Li et al. 2010). Many bird species are too small to trigger camera traps; however, with the incorporation of time-lapse photos, detections of some bird species could

be increased. We utilized a camera trap array installed in the alpine foothills of the Alaska range to analyze ptarmigan (*Lagopus sp.*) habitat use and to test if coupling triggered with time-lapse images increased detections. Camera traps operated continuously for 26 months and captured 1.54 million photos. Ptarmigan were detected throughout the year with most detections during the winter season. Willow Ptarmigan (*L. lagopus*) were the most common species; however, three ptarmigan species used the study site and not all photos could be identified to species. Time-lapse photos provided the majority of unique detections (n=123), versus motion triggered photos (n=24). Occupancy model estimates of habitat use were imprecise, potentially in part due to a low probability of detection (p = 0.05 SE 0.01). The inclusion of time-lapse images appears to be a viable technique for increasing detections of ptarmigan and potentially other gallinaceous species. Multi-method detection-nondetection sampling, that includes time-lapse photos, could increase the precision of occupancy estimates and elucidate patterns not observed by direct human observation.

Do tree swallows buffer their offspring against ectoparasites?

DeSimone, Joely - Amherst College; Elizabeth Black - Amherst College; Sarah Knutie - University of South Florida; Ethan Clotfelter - Amherst College

Hematophagous ectoparasites are known to induce anemia in their avian hosts and in some cases can impair skeletal growth and muscular development. We investigated ways in which adult tree swallows (*Tachycineta bicolor*) may improve their offspring's ability to avoid and tolerate ectoparasites. To assess avoidance, we quantified nest architecture and box orientation to determine if adults select and construct nests less susceptible to infestation. To assess nestling tolerance, we first manipulated parasite intensity by spraying half the nests with permethrin—a broad-scale insecticide—to eliminate blowfly larvae (*Protocalliphora sialia*). We then measured the nestlings' skeletal growth and hemoglobin levels. Nestlings from parasitized nests had lower hemoglobin levels than unparasitized nestlings, but there were no significant differences in nestling skeletal size or mass between treatment groups. Food provisioning is one mechanism by which parents may improve offspring parasite tolerance, though an increase in energy expenditure may be costly to adults. We evaluated changes in adult female hemoglobin and mass to quantify the direct costs of parasitism on the parent, as well as the potential indirect costs of compensatory feeding. Our results suggest that increased food provisioning in parasitized nests may offset the costs of parasites on nestling condition, but that parents do not always increase feeding rate in response to parasitism, possibly depending on female age, condition, and breeding date.

Are annual and seasonal variation in energetic condition in parulids during spring stopover due to weather?

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Although variation in energetic condition of migratory parulids during stopover is dependent on season, sex, and arrival date, significant intraseasonal and annual variation in energetic condition is not accounted for by these variables. Because local and regional weather, as well as indicators of global climate, are known to influence migratory behaviors (e.g. arrival date), we analyzed the relative influence of weather variables on the energetic condition of 3 warbler species (*Setophaga striata, S. magnolia, and S. coronata*) during spring stopover at the Braddock Bay Bird Observatory (BBBO) near Rochester, NY. BBBO is near the breeding range (relative to total migratory distance),

and therefore is a likely location to show carry-over effects between migration and breeding. General linear models and AIC of daily and seasonal temperature and precipitation were used to evaluate the influence of weather on condition. In all 3 species arrival date and sex were found to best explain the variation in energetic condition (in *S. magnolia* and *S. coronata*, age was also significant). Local daily temperature was found to be the most influential weather variable on energetic condition. Arrival date and daily temperature were positively correlated, but paradoxically had opposite effects on energetic condition; condition was positively associated with arrival date and negatively associated with daily temperature. Indices of annual variation in weather did not explain annual variation in condition. These results suggest direct effects of daily temperature influence the condition of warblers during spring stopover.

Use of Soundscape Recordings to Analyze Daily Temporal Variation in Avian Vocalizations in Western New York
Doser, Jeffrey - SUNY Geneseo; Kristina Hannam - SUNY Geneseo

Analysis of soundscapes may provide a way to quantify the biodiversity and examine the impact of anthropogenic noise on an area. Because birds use vocalizations as a primary channel of communication, avian biodiversity assessments can now be done, in part, through the use of soundscape recordings. The effectiveness of using soundscape recordings in this way will be dependent on the proportion of bird vocalizations within the biophony, and also how much anthropophony and geophony is present. To begin to understand this, we were interested in examining how time of day influences these measures. We present analyses of the daily temporal variation of soundscapes in Western New York, specifically looking at how the proportions of avian vocalizations changed throughout the day in relation to these other (geophony, anthropophony and other biophony) measures in order to better understand the role of birds in the soundscape. We recorded soundscapes in 8 different forest patches across Western New York in 2016, at three different time periods each recording day (6am--8am, 11am--2pm, and 6pm--9pm). We used Raven Pro to determine the proportion of biophony composed of avian vocalizations, what and how many species were performing the vocalizations, and how much anthropophony and geophony also contributed to the soundscape in each time period. We will present our findings to provide insight into how soundscapes, and the contribution of avian vocalizations to them, change with time, and how soundscape analysis can be used to assess the composition of avian species in a given area.

Synthesizing Natural History and Citizen Science Yields Insights into the Life History and Distribution of the Spot-fronted Swift (*Cypseloides cherriei*)
Dreelin, Andrew - Cornell University; Nicole Büttner - Un Poco del Choco; Graham Montgomery - Cornell University; Benjamin Van Doren - Cornell University

Spot-fronted Swift (*Cypseloides cherriei*) is a poorly known Neotropical swift (Apodidae) currently evaluated as Data Deficient by the IUCN. We present the discovery of a non-breeding roost of the species from northwestern Ecuador on 6 January, 2015. This represents the first description of a nonbreeding roost from the west slope of Ecuador and the third record of a roost in the nonbreeding season for *C. cherriei*. Subsequent breeding at the locality was later confirmed when a completed nest with one egg was discovered in late March. Additionally, we report the observation of a flock of ~40 *C. cherriei* on 13 January, 2015 in extreme southern Ecuador, representing the southernmost record for the species and extending the known range limit south by 27 km. We analyze theis natural history data in conjunction with occurrence data from the

citizen program eBird, concluding that the species is largely resident throughout its range but utilizes dispirate habitats on daily foraging trips during the nonbreeding season. We recommend that the species be provisionally assessed as “Of Least Concern” by the IUCN.

Nesting Success of Hooded Warblers: The Influence of Foraging Territories
Driscoll, Hannah - Ohio University

Hooded warblers require sex-specific habitat characteristics during the breeding season. This study aims to show how the female and male warblers foraging territory size, territory overlap, and female distance from nest influence nest success. Females use the understory to forage and protect nests, while males use the midstory to forage, attract mates, and fend off other males. Traditionally, it is thought that males defend a territory and females use space within her social partner’s territory. Intraspecific territory overlap can cause competition resulting in resource partitioning (spatial or prey). Females may benefit by decreasing territory overlap with her social mate through increased access to food resources and extra-pair mates. The distance a female forages from her nest may affect time and energy budgets and have an impact on nest success. Increased foraging distances can affect the ability to defend the nest from predators. This then can lead to a change in nest survival of the young. We recorded male and female territory size (m2), farthest distance a female travels from a nest to forage, and territory overlap will affect nest success.

Spatiotemporal variation in hatching success and nestling sex ratio in chickadee populations across a moving hybrid zone
Driver, Robert - Villanova University; Valentina Ferretti - Cornell Lab of Ornithology; Robert Curry - Villanova University

Hybridization is often accompanied by genetic incompatibilities resulting in reduced fitness. In birds, this may be evidenced by reduced hatching success and biased sex ratios in hybrid offspring (Haldane’s Rule). Black-capped Chickadees (*Poecile atricapillus*) hybridize with Carolina Chickadees (*Poecile carolinensis*) along a narrow zone of parapatric overlap. The area where the two species interbreed is moving north at rates correlating to increased winter temperatures. We investigated hatching success (percentage of eggs hatching in clutches still intact 15 days after clutch completion) and nestling sex ratio through time at four Pennsylvania sites to compare hybridizing and pure species populations. At Great Marsh (GM, pure Carolina Chickadee population) hatching success did not change (94%, 2000-2003; 88%, 2012-2015). Similarly, at Tuscarora (TU, pure Black-capped Chickadees) hatching success was consistent (90%, 2008-2010; 91%, 2012-2015). At Nolde Forest (NF), formerly within the hybrid zone but now inhabited by pure Carolina Chickadees, hatching success increased (78%, 2000-2003; 87%, 2012-2015); in contrast, hatching success at Hawk Mountain (HM) decreased as hybridization increased (88%, 2000-2003; 63%, 2012-2015). Nestling sex ratio was even at sites without hybridization (e.g., GM, 1998-2000, 53% male) but more male-biased at sites of active hybridization (HM, 2015, 58% male). These patterns of change in hatching success and nestling sex ratio show that fitness consequences of hybridization are not associated with particular geographic localities, but can move as the distribution of interbreeding changes.

Comparison Between Spring Migration Strategies of Mallards and American Black Ducks Wintering in the Finger Lakes Region

Droke, Justin - SUNY ESF

American Black Ducks *Anas rubripes* were once the most abundant waterfowl in eastern North America, but they have declined substantially in the last century concurrent with increases in Mallards (*Anas platyrhynchos*). There is limited knowledge of ecological separation during spring migration between Black Ducks and Mallards. We aim to determine if differences in habitat selection and foraging behaviors have carry over effects (COEs) influencing rate of spring migration and timing of settling on breeding areas of Black Ducks and Mallards that winter in the Finger Lake region of New York. Our objectives are to determine difference in habitat selection, foraging behaviors, migration rate, and timing of settling of Black Ducks and Mallards that winter in the Finger Lakes region (FLR) of central New York. In Jan -Mar 2016, we captured adult female Black Ducks and Mallards in the FLR to monitor with GPS/GSM backpack transmitters. We estimated spring habitat selection of our sample of ducks by comparing used habitats relative to available habitats throughout migration until settling on breeding areas. We will use multiresponse permutation procedure with repeated measures to determine if habitat during spring migration differs between our sample of Black Ducks and Mallards. For our preliminary analysis we will present, descriptive statistics for Black Ducks and Mallards on habitat use, departure date, migration rate, settling dates, and settling locations. Our study is the first to standardize marking of Black Ducks and Mallards on a wintering area to estimate how they migrate during spring.

Comparing Two Genetic Markers used in the Identification of Diving Ducks (Aythyinae) Involved in Birdstrikes

Drovetski, Sergei - Smithsonian Institution; Faridah Dahlan - Smithsonian Institution; Carla Dove - Smithsonian Institution; Damani Eubanks - Rochester Univeristy

Knowing the species of birds involved in damaging collisions with U.S. military and civil aircraft (birdstrikes) is paramount to understanding and preventing human-wildlife conflicts in this field. The Feather Identification Lab, Smithsonian Institution, identifies over 9,000 birdstrike cases each year using feather morphology and DNA barcoding. While the DNA barcode marker (CO1) is successful at identifying many species of birds, it falls short in species that are very closely related or hybridize frequently. This project tested the effectiveness of two mitochondrial genetic markers, cytochrome oxidase 1 (CO1) and NADH dehydrogenase subunit 2 (ND2) used for identifying species of waterfowl within the genus Aythya. Because these diving ducks are commonly involved in damaging birdstrikes, the most reliable method of DNA identification is needed for species designation of damaging birdstrike samples. To compare CO1 and ND2 markers, we sequenced 19 specimens from the 9 different species of Aythya that are commonly involved in birdstrikes. We obtained additional sequences from GenBank to increase sample size and geographic coverage. We then constructed gene-specific phylogenetic trees and compared genetic distances between closely related species and support for monophyly of species-specific clades. While neither genetic marker was 100% effective at DNA identifications of all taxa within this group, ND2 was significantly more effective than CO1 at genetic separation of *A. nyroca* (Ferruginous Duck), *A. australis* (Hardhead Duck), *A. americana* (Redhead), *A. collaris* (Ring-neck Duck), *A. affinis* (Lesser Scaup) and *A. marila* (Greater Scaup). *Aythya*

valisineria (Canvasback) and *A. ferina* (Common Pochard) formed a single clade and could not be distinguished in either tree. CO1 alone was only able to distinguish *A. fuligula* (Tufted Duck) confidently to species level. Although some of these species may be identified using feather morphology, understanding the reliability of the two genetic markers in this group of birds improves lab efficiency and DNA identification success of diving ducks involved in birdstrikes.

How social are ornithologists?
Dudley, Steve - British Ornithologists' Union (BOU); Jen Smart - RSPB

Social media is a fast-moving technology and now plays an increasing role in research, including ornithology. Researchers who have embraced social media have discovered that it is much more than a social networking opportunity, but it can be an important tool for their research needs at the research, publishing and networking levels. Social media is now an important tool to disseminate research results. The arrival of individual article metrics now means there are developing metrics which will allow researchers, institutes, funders and others to measure the outreach and public impact of individual pieces of research. Ornithology, more than many other research areas, requires the input of the wider ornithological and birding communities. These communities are social and many exist as clubs or societies. Social media has seen these groups, as well as many more individuals traditionally outside of these groups, move online en-masse, embracing social media and web-based technology for information exchange, bird recording and data collection. Social media enables ornithologists to engage with, and mobilise, this online community for research projects. Our poster will look at the use of different social media and network platforms by researchers and how social media is being used to promote citizen science projects and published research, and how it is driving individual article metrics in scientific publications.

Compensatory measures for wildlife conservation: testing the effect of deadwood and cavity supply on cavity users in managed boreal forest
Dufour-Pelletier, Samuel - Université du Québec à Chicoutimi; Jacques Ibarzabal - Université du Québec à Chicoutimi; Junior A. Tremblay - Environment and Climate change Canada; Thibault Lachat - Bern University of Applied Sciences

Second-growth forests reduce dead tree recruitment and consequently diminish habitat availability of a large set of deadwood associated species (among these primary and secondary cavity nesting birds and saproxylic insects). Our project aims to test ecosystem-based management strategies to benefit and support deadwood associated species by providing supplement of standing deadwood and cavities. In spring 2015, we experimentally created standing deadwood (by girdling black spruces [distributed uniformly vs. in patch]) and added cavities (nest boxes [6 different types and disposed at 3 distances from a forest edge]) according on a BACI design in 50-70 years old coniferous forest stands embedded in a managed landscape. We surveyed birds with point counts and sampled saproxylic insects before and after deadwood creation. We observed significantly more saproxylic beetles in patchy distributed deadwood than in control plots. The proportion of artificially created snags used for woodpecker's alimentation increased with seasons. The avian community was more diversified post-treatment with more detections of woodpeckers in deadwood treatments while secondary cavity users were associated with cavity supply. Nest boxes use depended on species, nest boxes size and distance from the forest edge. The overall maximum diversity (all taxa combined) was observed in treatments that combined patchy distributed deadwood and cavities. The knowledge gained on the response of

biological diversity to the availability of deadwood and cavities will provide a solid ecological basis for an assessment of the current planning and, in context of adaptive management, a more effective planning of ecosystem management in the future.

Female Spruce Grouse Habitat Selection during the Brood-Rearing Season in Managed Conifer Forests

Dunham, Stephen - University of Maine; Daniel Harrison - Department of Wildlife, Fisheries, and Conservation Biology, University of Maine, Orono, ME

Species near geographic range boundaries are vulnerable to extirpation resulting from a variety of stressors including habitat loss and climate change. The northeastern U.S. intersects the southeastern extent of spruce grouse (*Falcipennis canadensis*) range and Maine has the largest share of potential habitat with about 2.7 million hectares of conifer-dominant forests, and where most lands are commercially managed for a variety of forest products. Thus, conservation of spruce grouse in the region depends on understanding how forest harvesting will influence habitat. This study investigated habitat selection for female spruce grouse during the brood rearing season (June-October). During the summers of 2012, 2013, and 2014 we conducted repeated call-back surveys in 30 stands representing four different forest conditions (mature reference sites, regenerating clearcuts, pre-commercially thinned stands, and selection harvests), and captured 30 females, which we equipped with VHF transmitters. Vegetation was measured within surveyed stands and at 15 randomly selected radio locations for each female. We constructed resource selection functions as general linear mixed models comparing use (radio locations) to availability (surveyed stand) in program R with package lme4. Our results indicate that spruce grouse are selecting for stands with abundant low vegetation structure (< 0.5m), pruning heights 3-9 m, and tree densities < 1000 /ha. Based on 80% ADK home range estimates, appropriate scales for managing female spruce grouse averaged 38.9 ha (range 9.1-96.9 ha). Pre-commercial thinning and herbicide application to promote conifers after clearcutting can promote structural conditions favorable to spruce grouse in northeastern Acadian forests.

Pairing Bioacoustics with Traditional Avian Survey Methods to Assess the Status and Breeding Habitats of an Endemic Vireo

Dvorak, Tyler - Catalina Island Conservancy

Obtaining site-specific information on species of conservation concern is a core objective in land management. Island bird species have proven particularly vulnerable to extinction, and habitat specialists are considered at greater risk than habitat generalists. Catalina Hutton's Vireo (*Vireo huttoni unitti*) is endemic to a single 194 km2 island (Santa Catalina) in the Channel Islands archipelago off the coast of southern California, USA. It is currently listed as a Bird Species of Special Concern by the state of California. I investigated the distribution of this species across habitats and percent oak cover with autonomous recording units at 25 sites simultaneously. I also conducted human field surveys island-wide to gauge general habitat occupancy and breeding season behavior. I found a high level of breeding habitat specialization for vireos on the island, focused on large contiguous groves of *Quercus pacifica*. Given declines in these oaks (likely attributed to multiple stressors, mainly of anthropogenic origin), this information is especially informative for conservation. Vireos were also notably absent or much reduced in distribution within habitats ostensibly considered important for the species. The multi-year severe drought conditions on the island during the study could have impacted distribution and breeding behavior. If the vireos are expressing a drought driven contraction in suitable breeding habitat, it remains important to identify which habitats

are critical in buffering such a range-restricted species from climate extremes. The establishment of a bioacoustics survey method will aid in continuing the study as future conditions vary.

Sex-Ratio Bias of Northern Saw-whet Owl (*Aegolius acadicus*) Spring Captures at Whitefish Point Bird Observatory

Dykema, Zachary - Northern Michigan University; Emily Bertucci - Northern Michigan University; Alec Lindsay - Biology Department, Northern Michigan University; Chris Neri - Whitefish Point Bird Observatory; Nova Mackentley - Whitefish Point Bird Observatory

Northern Saw-whet Owls (*Aegolius acadicus*) are banded across the United States, yet neither migration nor dispersal of Northern Saw-whet Owls are completely understood. In 2007 and 2008, the banding station at Whitefish Point Bird Observatory in Michigan's Upper Peninsula began using male and female (respectively) audiolures at some owl capture sites to complement the passive mist netting that had been underway since 1994. We analyzed data from spring owl captures (1994-2015) that used either male "advertising call" audiolures, female "tssst" audiolures, or no audiolures. From the analysis of 6600 birds captured in that period, we demonstrated that 1) there was a substantial female bias in the owls caught in the passive and male audiolure nets, 2) a more extreme female bias was caught in the male audiolure nets, and 3) a nearly equal proportion of male and female owls were caught in the female audiolure nets. The results of this analysis can be used by other researchers to provide higher capture rates of male Northern Saw-whet Owls at their stations, and should be considered when making inferences about Northern Saw-whet Owl demographics based on banding records.

Filling the gap: Emerald ash borer canopy damage affects avian community composition in urban woodlots

Ehnes, Mandy - Nipissing University; Rebecca Schroeder - Algoma University; Joe Meating - BioForest Technologies Inc.; Jennifer Foote - Algoma University

Urban woodlots can provide important stopover and breeding habitat for many avian species. These woodlots become increasingly important habitat in highly-developed and fragmented landscapes typical of urban environments. Emerald ash-borer is an invasive phloem feeding insect that kills North American ash trees creating gaps in the upper canopy of forests including urban woodlots. We investigate how canopy damage from ash mortality influences the avian community composition in Oakville, Ontario woodlots where ash mortality is nearly 100%. We used automated recording to sample the species breeding in 27 woodlots that differed in ash mortality. We identified all species vocalizing in each plot by visually scanning recordings and comparing sounds to reference files. We used an unmanned aerial vehicle to take photos of the canopy above the recording sites and calculated percent mortality of upper canopy trees using Photoshop. Woodlots were divided into those with >10% (high) and < 10% (low/no) ash mortality. We found shifts in community composition among woodlots of high and low mortality but not in the number of species present. Woodlots with >10% ash mortality had communities with higher proportions of resident species, insectivores, bark foragers, and air salliers but lower proportions of upper canopy foragers compared to woodlots with < 10% ash mortality. We show that mortality due to emerald ash borer damage can alter habitat for urban birds resulting in less suitable habitat for upper canopy foraging and/or nesting species but the increase in insect availability in these plots is beneficial for some species, at least temporarily.

Time-activity and energy budgets of Eared Grebes at Salton Sea, California

Ellis, Hugh - University of San Diego; San Francisco, Samantha - University of San Diego

Time-activity budgets have been a widely accepted way of approximating the daily energy expenditure of many species, including waterbirds. For this study, focal animal sampling was used to study Eared Grebes (*Podiceps nigricollis*) at their post-wintering stopover site, Salton Sea. Observations occurred over the course of 2014 from late winter to early spring. All observations were made from the shore. Daylight time-activity budgets were converted to energy budgets using energy equivalents for diving, preening, swimming, and resting on water developed for Eared Grebes previously by H. I. Ellis (1994). Post-wintering Eared Grebes arrive at Salton Sea in waves at differing times in the spring. As a result, there can be individuals in a variety of physiological states during the same time period. For example, some grebes may be actively feeding and putting on fat at the same time others are no longer feeding and are preparing to migrate. Dive bout behavior was highest when the majority of the grebe population was still arriving, and decreased throughout the period of time that the population was present. As grebes dived less, they spent more time in non-diving activities, except for the maintenance behavior of preening, which did not change among the five observational periods. The grebes expended a similar amount of energy throughout each observational period even though they have different patterns of behaviors. Assuming that grebes spend most of their time at night resting, the 24-hour daily energy budget ranged from 2.36 - 2.49 x BMR.

Avian community structure as a bio-indicator of habitat disturbances in wetland areas

Elmore, Jared - Oklahoma State University; Ylenia Chiari - University of South Alabama

This study evaluates the highly understudied topic of avian community and guild response to land use change in coastal wetland areas. Avian point counts were carried out over the course of one year at six sites along the Mobile-Tensaw Delta and Mobile Bay in Mobile and Baldwin Counties, Alabama as well as Jackson County, Mississippi to document avian species presence and abundance. Land use was characterized into five categories (developed, agricultural, wetland, forested, and water) using United States Geological Survey National Land Cover Database in the ARCGIS program. Avian diversity and richness were compared with sites and seasons using one-way anovas. Birds were classified into feeding, nesting, and resident guilds and the abundance of each guild was compared with disturbed land cover percentages using logistic regressions. Diversity and richness were significantly lower during the winter season. Guilds in general all showed trends of decreasing abundance with increasing disturbed land use but few were significant. There were also few exceptions exhibiting opposite trends. Conclusions are that diversity and richness are lower in the winter due to the location of the study. Fewer birds migrate the area for the winter than those who migrate from the area. While most guilds show a negative response in abundance to increasing disturbed land use, further future studies are needed to fully evaluate the impacts of land use on avian guilds in this area.

The conservation status of tidal marsh birds in the northeastern United States

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Since 2010 the Saltmarsh Habitat and Avian Research Program (SHARP) has been studying the status of tidal marsh birds from Maine to Virginia, USA. Our work involved both extensive surveys to assess the distribution and population sizes of species that use tidal marshes, and intensive demographic studies of tidal marsh specialists. Our design-based survey of 1780 point locations has produced the first comprehensive population estimates for this region for five tidal marsh specialists (clapper rail, willet, and saltmarsh, Nelson's and seaside sparrows) and estimates of tidal marsh use by another 18 species recognized as being of greatest conservation need. Comparison between our surveys and historical data suggests that tidal marsh birds have undergone serious declines since 1998, with per annum losses of 4.6% for clapper rail, 9.0% for saltmarsh sparrow, and 4.2% for Nelson's sparrow. No regional population change was detected for willets or seaside sparrows. Demographic data from 23 sites, from Maine to southern New Jersey, further suggest that saltmarsh sparrow populations have consistently negative growth rates throughout their range. Data from the northern range limit of clapper rail and seaside sparrow also point to falling nest densities, suggesting the possible beginnings of range collapse. Tidal restrictions appear to have played an important role in causing saltmarsh sparrow declines, and models suggest that sea-level rise will exacerbate future declines. Demographic projections indicate a high chance that saltmarsh sparrows will go extinct within 50 years and that Nelson's and seaside sparrows will experience range contractions over the same timeframe.

On the edge of extinction: Can the Tricolored Blackbird (*Agelaius tricolor*) persist in Mexico?

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The highly colonial Tricolored Blackbird is of extreme conservation concern. In Mexico, the species is resident in northwestern Baja California and was generally considered common 100 years ago. We conducted nesting surveys throughout the Mexican range in 2007, 2008, 2013, and 2016. During this period, nesting was confirmed at six locations but annual averages were 2.75 (range 1-4) occupied sites and approximately 425 (range 80-850) nesting birds. Some relief from extreme drought appeared in the northern portion of the range prior to the 2016 season, when the largest number of birds was recorded. However, it remained dry to the south and no nesting was found >20 km south of the US border. Only four birds were seen at El Rosario in 2016, where the southernmost "population" appears to be increasingly at risk. The species has not been seen at any season anywhere else south of Heroes de la Independencia (170 km to the north) since 2012. With ongoing residential/industrial and unfavorable agricultural development (e.g., viticulture), increasing groundwater pumping, and predicted reductions in annual rainfall, Mexican Tricolored Blackbirds have obvious challenges ahead. Measures that would

benefit the species include official designation as endangered; protection of nesting areas through land purchase and appropriate agricultural zoning and allocation of water rights; creation and maintenance of wetland nesting habitat at farm ponds and elsewhere; and public education. With sufficient attention, the Tricolored Blackbird may persist another 100 years in Mexico.

A Swift New Predator: Herring Gull Predation at a Chimney Swift Communal Roost

Evans, Dean - Algoma University; **Brandan Norman** - Algoma University; Jennie Pearce - Pearce & Associates Ecological Research; Jennifer Foote - Algoma University

Many aerial insectivores, including Chimney Swifts (*Chaetura pelagica*), have undergone steep population declines over the last several decades. While declines are largely attributed to habitat loss, other factors, such as predation can also play a role. We describe a new predator-prey relationship between Herring Gulls (*Larus argentatus*) and Chimney Swifts at a communal roost in Sault Ste. Marie, ON, Canada. This roost sees peaks of up to 2400 swifts during spring migration. Historical video footage of the roost over the last decade suggests that this predator-prey relationship first emerged in 2009 and has likely been increasing in frequency. In a season-long study in 2015, we observed the roost each night and counted the number of Herring Gulls and Swifts present and all successful Herring Gull predation events. We document 38 instances of predation on 16 of 86 evenings, an estimate which likely underestimates the extent of total predation pressure. We observed up to 15 Herring Gulls hunting swifts. Predation events involved swifts being captured on-the-wing by gulls. Gulls often perched on the chimney ledge; however, they were not successful in capturing swifts from the perch. Maps of range overlap and population trends suggest that this predator-prey relationship is likely to have the largest impact in the Great Lakes region where the populations overlap, Chimney Swift populations are declining, and Herring Gull populations are increasing.

Chimney Swift Communal Roosting Varies with Atmospheric Conditions and Season

Evans, Dean - Algoma University; Jennie Pearce - Pearce & Associates Ecological Research; Jennifer Foote - Algoma University

Aerial insectivores are one of the most threatened groups of birds in North America and have experienced serious population declines since the 1960s with the cause for these declines remaining largely speculative. The Canadian population of Chimney Swifts (*Chaetura pelagica*) has shrunk by 91.2% between 1969 and 2014 and it is designated as threatened. Monitoring initiatives in Ontario are primarily focused in the southern portion of the province and little is known about northern populations. We examined a video data set ranging from 2006-2015 documenting Chimney Swift roost attendance in Sault Ste. Marie, a city at the center of the Great Lakes in Northern Ontario. Roost attendance was highly variable during spring migration peaking at just over 2400 swifts. Following the spring migration, the number of swifts was less variable and declined in the post-breeding season. Generalized Linear Models were used to determine the best model explaining the number of swifts roosting at this Chimney during 2014-2015. During spring migration more swifts were observed on nights where wind was blowing from the South, and both temperature and visibility were low. During the breeding season, more swifts were observed roosting with lower wind speeds. Lastly, during fall migration the number of swifts attending the roost declined with increasing date and increasing temperature. The Sault Ste. Marie roost is possibly the largest roost in Canada, hosting up to 20% of the swift population. Understanding roost attendance can lead to new insights into this threatened species near the edge of it range.

A test of the early stress hypothesis using mercury exposure and spatial memory in Zebra Finches

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Stress during early development should have disproportionate effects on important aspects of the adult phenotype due to rapid development of important brain areas during this period. We used stress from mercury exposure to test this early stress hypothesis. Zebra finches were exposed to 1.2 parts per million mercury during development either early (in ovo until 50 days post hatching, n=9), later (50-114 days post hatching, n=12), continuously through developmental period (n=10), or not at all (controls, n=9). Long after sexual maturity and discontinuation of mercury exposure, the finches were given a week-long spatial memory assessment involving relocating which one of four possible locations contained food. Control treated birds mastered the training in fewer days than those in the 3 mercury treatments, which did not differ from one another. Controls also successfully solved the test in fewer trials and less time than mercury-exposed birds, which did not differ consistently from one another. Thus, it appears that mercury exposure during development reduced the ability to remember spatial information later in life, but the timing and duration of exposure (early, late, entire period) did not lead to detectable differences in spatial memory. This is just one of many endpoints being studied to test the early stress hypothesis using mercury exposure. One implication of these findings is that wild birds exposed to mercury on their natal territories, but spending the rest of their life at less contaminated sites, would bear lifelong cognitive effects of mercury, regardless of when the developmental exposure occurred.

Identifying key demographic attributes for recovery of the endangered Nightingale reed-warbler via population viability analysis

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The Nightingale reed-warbler (*Acrocephalus hiwae*), an endangered songbird of the Mariana Islands is the last of four reed-warbler species that historically inhabited the islands. Recent population estimates of total population is 2,915-3,742 pairs distributed over Saipan (n=2,742) and Alamagan (n=173-1,000). Though data on life history parameters like survival rates are not widely available, other parameters such as clutch size and nest success have been studied. Given recent significant declines in the larger Saipan population and increasing threats faced by the species, it is critical to determine what additional life history information is needed to aid management decisions. Using Vortex and RAMAS, we developed stochastic population models to represent current reed-warbler population dynamics and used sensitivity analysis to identify life history parameters to which the model was most sensitive. Baseline models without inbreeding in both Vortex and RAMAS indicated declines of Nightingale reed-warbler numbers on Saipan and Alamagan as well as the overall metapopulation. Including inbreeding decreased growth rates further. Parameters such as initial population, carrying capacity, and male mortality/survival have relatively little influence on reed-warbler metapopulation models, while female and juvenile mortality/survival and, to a lesser degree, fecundity measures exhibit strong influence on the reed-warbler's population dynamics. We recommend effort be placed on collecting additional, updated survival data for all life stages, but particularly females and

juveniles. If current survival estimates prove to be reasonable, we recommend management actions that would increase survival of juveniles and females.

Improving Detectability Studies in Avian Tropical Cloud Forest Communities
Farley, Kathleen - Rutgers University - Newark; Claus Holzapfel - Rutgers University - Newark

In tropical cloud forests, avian communities are poorly understood due to limited systematic programs and infrastructure, making it vital that employed methods maximize diversity detection while minimizing effort. Since 2007, Operational Wallacea (Opwall) has led conservation research through recruitment of ecologists to conduct fieldwork in tandem with teaching tropical ecology techniques to volunteers in the Honduran cloud forest. Opwall's initial protocol required three consecutive days of point counts once per season and mist-netting twice per season at one site on each transect along 28 transects of varying lengths. Results were scrutinized by Martin et al. [Ornitologia Neotropical, 21 (2010)] to determine effectiveness leading to the following methodological changes for subsequent seasons: point counts along each transects thrice per season over non-consecutive days, and mist-net operations to be conducted six times per camp per season. Martin et al.'s revised protocol for both methods was implemented in 2011. Here I follow Martin et al.'s methodology to verify modifications increased detections. Comparing 2007 data to 2015 data, point count species accumulation curves now saturate while mist-net operations never saturate. I believe the discrepancy is the product of increased effort: 2015 had 208 additional point counts and net-meter-hours increased from 9,360 to 22,200. Recognizing that increased effort leading to decreased detection is counter-intuitive, I propose that a combination of net-shyness and oversampling of six sites (down from 26 sites) limited mist-netting effectiveness to detect diversity. Future monitoring programs should ensure mist-netting operations are spread throughout the research sites rather than concentrated.

Coastal Bermudagrass Suppression in Texas Grasslands for Native Bird Habitat Restoration
Farthing, Trevor - Tarleton State University; James Muir - Texas AgriLife Research - Stephenville, Texas A&M University; Don Cawthon - Texas AgriLife Research - Stephenville, Texas A&M University; Darrel Murray - Tarleton State University

Coastal bermudagrass [*Cynodon dactylon* (L.) Pers.] [BG] is an invasive grass dominating southwestern U.S. grasslands, and has been linked to decreased northern bobwhite [*Colinus virginianus*] survival. The grass forms a dense sod that impedes chick movement and quail in bermudagrass-dominated areas reach lethal-temperature thresholds more quickly than in native habitats. To preserve quail populations and increase area wildlife habitat value through native-grassland restoration projects, it is first necessary to remove invasive BG. I evaluated five BG removal methods in four Texas ecoregions, seeking to determine which most effectively suppresses BG growth in varying environmental conditions. I applied treatments to 355-m2 plots throughout summer 2015, and measured plant biomass, groundcover, C, and N content within plots in April-May 2016. Management practices are considered successful if 1) BG mass and groundcover are reduced compared to control plots; and 2) non-BG plant species to BG ratio increases compared to control plots. In addition to assessing BG-suppression, I measured soil pH, NO3-N, P, K, Ca, Mg, Na, S, DTPA Zn, Fe, Cu, Mn, and organic-matter content within plots. By utilizing my results, pastures that are presently poorly managed, or unsuccessfully converted from exotic monocultures, can become sustainable rangeland and prairie ecosystems supporting

an array of native Texas plant and animal species.This research is part of an ongoing 6-year study funded largely by the Texas Parks and Wildlife Department. I am presenting analyses of data collected during the first year.

Response of beach-nesting birds to beach elevation enhancement post Hurricane Sandy

Ferguson, Lisa - The Wetlands Institute; Nellie Tsipoura - New Jersey Audubon Society; Todd Pover - Conserve Wildlife Foundation of New Jersey; Christina Davis - Endangered and Nongame Species Program, NJ Division of Fish and Wildlife; Allison Anholt - The Wetlands Institute; Larry Niles - LJ Niles Associates LLC; David Mizrahi - New Jersey Audubon

Flooding during high tides and storms is a primary cause of nest loss for beach-nesting bird species. Following Hurricane Sandy, we implemented a novel beach restoration and enhancement project at Stone Harbor Point, New Jersey to improve nesting conditions at the site. Providing elevated habitat to prevent nest failure due to flooding was a main aim of our project. In 2015 and 2016, we harvested sand from accretional areas of the site to construct elevated nesting habitats (0.3 -1.8 ha; 4.5-6 ft NAVD88) and a runnel for foraging. The response of American Oystercatcher (Haematopus palliates) to the elevated habitats was immediate in both years of the study. In 2015, 10 of 21 pairs nested on elevated habitats. Pairs nesting exclusively on elevated habitats had greater success hatching chicks (100%) but lower fledging rates (0.83 fledged/pair) compared to pairs on unaltered habitat (73% and 1.18 fledged/pair, respectively). A response by Piping Plover (*Charadrius melodus*) was less apparent; in 2015, only one renest attempt from six pairs was documented on the habitats. Perhaps the best indicator that the elevated habitats met our objective was the reestablishment of a mixed-species colony of Black Skimmer (*Rynchops niger*), Common Tern (*Sterna hirundo*), and Royal Tern (*Thalasseus maximus*). No nest failure due to flooding occurred in 2015, though nests were lost to flooding on elevated habitats in 2016 and on unaltered habitat in both years. Monitoring continues to determine the nesting response of birds to the elevated habitats and the effect of elevation on nest survival.

Assessing Habitat Quality for Migratory Landbirds in Southeastern Pennsylvania

Fetterman, Alison - University of Pennsylvania

Declines of migratory landbird populations in North America have often been attributed to habitat loss on the breeding and wintering grounds. However, fewer studies have reflected the importance of the migratory period and the conservation of stopover habitat. During the migratory period, birds experience extreme energy demands as they encounter obstacles such as predator avoidance, inclement weather, resource competition, navigation of unfamiliar habitats, and finding suitable food resources to refuel and continue on their journey. Identifying areas of adequate habitat for migratory landbirds is essential for their survival, which challenges conservation planning to focus on land connectivity throughout their migratory period. This study examined the use of habitat through capture rates, and fitness consequences, by evaluating rates of mass change, of landbirds using Rushton Woods Preserve (RWP), located in Newtown Square, Pennsylvania, during fall migration. My results demonstrate 1) high capture rates compared to other study sites, 2) most individuals using the site are young hatching year birds, and 3) all species either gained or maintained mass. Although these results demonstrate that RWP provides important stopover habitat for many migrating landbirds in the fall, this site may not be a high quality refueling area for some species.

CUMULATIVE PROBABILITY OF NEST SURVIVAL EXPLAINS TERRITORY USE IN ORANGE-CROWNED WARBLERS (*Oreothlypis celata*), ARIZONA.

Fierro-Calderon, Karolina - Wildlife Biology Program. University of Montana; Thomas Martin - USGS - University of Montana

Habitat selection is expected to be adaptive. Yet, we often observe individuals actively selecting habitats associated with low reproductive success, even when better habitats are available. To explain this surprising pattern, we proposed the multiple nest-sites hypothesis which affirms that nest survival probability across nesting attempts is highly variable in territories used by low-quality individuals. Such variation may yield similar cumulative nest survival probability to territories used by high-quality individuals. In contrast, the Ideal Despotic Distribution hypothesis states that the cumulative nest survival probability is higher in territories used by high-quality individuals. Identifying variation in the survival probability of multiple nests is a major gap of knowledge in habitat selection studies. We tested our hypothesis using orange-crowned warblers in Arizona. We identified high- and low-quality pairs, experimentally interrupted nest building prior egg-laying, and force them to re-nest. Previous work showed that nest survival probability positively correlates with the number of maple stems. Thus, we used number of maples as a proxy for nest survival, and the sum of maples across nesting attempts as the cumulative nest survival probability. High-quality pairs tended to nest around more maples in every consecutive nesting attempt, while low-quality pairs did the opposite. The variation in number of maples between nesting attempts was higher in low-quality pairs. Consequently, the cumulative nest survival probability was similar between high- and low-quality pairs. Our results contradict long-standing theory and suggest that natural selection may favor different habitat selection strategies that allow high- and low-quality individuals to achieve similar fitness.

Density surface modelling of seabirds in the Labrador Sea

Fifield, David - Wildlife Research Division, Environment and Climate Change Canada; April Hedd - Wildlife Research Division, Environment and Climate Change Canada; Stephanie Avery-Gomm - School of Biological Sciences, The University of Queensland; **Greg Robertson** - Wildlife Research Division, Environment and Climate Change Canada; Carina Gjerdrum - Canadian Wildlife Service, Environment and Climate Change Canada; Laura McFarlane Tranquilla - Bird Studies Canada

The Labrador Sea is important to marine birds year-round, however, spatial information on seabird distributions had been limited by patchy marine survey coverage. From May 2006 to November 2014, observers surveyed 13,785 linear km and counted 34,508 seabirds. Detection probability (to 300m) was 38% for all seabirds, ranging from 31% for Dovekie to 54% for Atlantic Puffin. Density surface modelling efforts were generally successful, although depending on species and season, reasonable predictions of density were not possible for significant areas. Models explained 21.7% to 68.3% of the deviance, and position, sea surface temperature, sea surface height, bathymetry, distance to the shelf edge and eddy kinetic energy were important predictors in most models. The Labrador Sea was particularly important during fall and winter, when average densities in areas of acceptable precision were 15.5 and 12.8 birds/km2, respectively. Northern Fulmar had the highest predicted densities in fall and winter (29.8 and 62.9 birds/km2), followed by Black-legged Kittiwake (13.8 and 20.6), although confidence intervals were large for these species. Dovekie (17.1 and 14.8) and murres (4.9 and 2.2) were also numerous in fall and winter, and modeling efforts, especially for murres, led to reasonable prediction

throughout the study area. Gulls, Atlantic Puffin and shearwaters were present in the study area at lower densities. Although density surface modeling proved powerful to expand the geographic scope of prediction beyond the available data, gaps in survey coverage remain. Future work should consider filling these gaps, and improving modeling efforts in the Labrador Sea and adjacent regions.

Ultra-lightweight (400 g), Lithium Polymer Batteries for Avian Research
Fischer, Phil - U.S. Forest Service; Teresa Lorenz - USDA Forest Service, Pacific Northwest Research Station

A large number of research studies require remotely-powered field equipment, such as automated sound recording and nest video monitoring studies. Lightweight, affordable, and long-lasting power supplies can be a limiting factor to field data collection in these studies. Traditionally, many researchers used deep cycle batteries what weigh >13,000 g. As part of a study monitoring woodpecker nests in Washington State, we devised a system to power video cameras for up to 88 continuous hours using lightweight (400 g) lithium polymer batteries (also called Polymer Li-Ion batteries; model 1055275-2C, Mogen Industrial Limited). A single lithium polymer battery supplied a nominal potential of ~3.7 volts (3.2 - 4.2 volts), from which we obtained 30 hours of record time. When we used three batteries in parallel, we obtained 88 hours of record time. Lithium polymer batteries were also less costly (52 USD) than deep cycle batteries (~74-275 USD). In 2015 and 2016 we used lithium polymer batteries to power video cameras at 42 nests of northern flicker (*Colaptes auratus*), black-backed woodpecker (*Picoides arcticus*), white-headed woodpecker (*P. albolarvatus*) and hairy woodpecker (*P. villosus*) for >13,000 hours. We encountered no failures from batteries and batteries charged to full capacity in 6-18 hours depending on charging regime. We suggest lithium polymer batteries offer a lightweight, affordable, and practical method for powering field equipment in remote settings.

Comparing migration phenology using bird-window collision rates on a university campus in Indiana
Fischer, Sarah - Ball State University; Kamal Islam - Ball State University

Windows can be problematic for birds because of their reflectivity. Birds have difficulty in detecting glass and often collide with windows. Though it is difficult to estimate exact numbers, these collisions may account for up to one billion avian mortalities in the U.S. each year. Many buildings on university campuses can be fatally harmful to a diverse array of species. We conducted research over a two-year period at twelve buildings on the Ball State University campus in Muncie, Indiana, to compare migration phenology, determine which species and families are most affected, and determine which windows are the most problematic in terms of collision rates. From August 2014 through May 2016, 131 carcasses representing 39 species from 16 families were collected during daily surveys. The highest mortality rates occurred in the Turdidae (thrushes; n=34), Parulidae (wood-warblers; n=32), and Emberizidae (sparrows; n=24) families. Collision rates were higher during fall migration than during spring migration during both years, and peaks occurred between September-October and in May. There were three “hotspots” on campus that caused the highest collision rates: Worthen Arena (n=34), Bracken Library (n=34), and the College of Architecture and Planning (n=32). We plan to use the results to recommend methods that can reduce collision rates at the most problematic “hotspots” on campus. Additionally, these data, as well as results from similar studies, can provide future insight for architects to help promote bird-safe buildings and communities.

Using Operant Conditioning Methods to Measure Song Perception in Birds
Fishbein, Adam - University of Maryland; Shelby Lawson - University of Maryland; Robert Dooling - University of Maryland

Bird vocalizations are some of the most complex biological signals in the natural world. Much more is known about the acoustic structure and temporal delivery of bird song than is known about how birds listen to song. A long history of both field and laboratory data suggests that birds may be acutely sensitive to certain features of these complex species-specific vocalizations. Here we used operant conditioning procedures to measure the perception of natural song and song-like stimuli in several species of small birds: canaries, zebra finches, and budgerigars. We trained birds to respond to a change in a sound pattern by pecking a key in order to obtain food reinforcement. Results show that birds can discriminate between both spectral and temporal alterations in natural songs and calls and are sensitive to ordering effects in both song syllables and phrase-length patterns. Though we found some evidence of species-specific perceptual abilities, budgerigars in general performed better than finches and canaries at detecting violations in repetitive, complex syllabic sequences. Our results help detail how birds perceive acoustic features in conspecific and heterospecific vocalizations, and raise interesting questions about how auditory discrimination has been shaped in different species of birds.

Breeding bird and plant associations with urban residential land management practices in Columbia, Missouri
Fishel, Eric - University of Missouri; Charles Nilon - University of Missouri; Robert Pierce - University of Missouri

We have examined current land management practices of residents of Columbia, Missouri, and hope to assess how they might be altered due to changing climate, and what their potential impacts are to the plant and bird community. Management practices have the potential to influence the values residents place on their property, the biodiversity associated with residential land use, and ultimately the well-being of the residents. We have conducted avian counts along transects throughout residential areas in Columbia. Vegetation surveys were conducted, and mail in surveys were distributed to the land managers associated with the properties to determine management practices. On our plots, 83 bird species, and 80 species of trees and shrubs were identified, with greater plant diversity and canopy cover in older neighborhoods further from the urban center. Bird communities differed between plots, with those characterized by lawn predominantly occupied by grassland birds and plots characterized by canopy cover and more diverse tree and shrub species were predominantly occupied by forest birds. Our survey of land managers revealed variations in frequency of watering, weeding, and application of chemicals between properties. Land managers values varied in the importance of wildlife use of the yard, a yard consisting of open grass, and a yard without weeds. We will be able to use this data to determine how management strategies are effecting associated plant and bird communities. We will then develop scenarios to determine how land managers might change their management practices with climate change.

Teaching Evolution with a Museum Zoology Collection: The Moore Laboratory of Zoology Online Woodpecker Module
Fornari, Ella - Moore Laboratory of Zoology, Occidental College; James Maley - Moore Laboratory of Zoology, Occidental College; John McCormack - Moore Laboratory of Zoology, Occidental College

Museum zoology collections are important tools for describing and understanding biodiversity. The general public rarely has the opportunity to visit zoology collections and

thus has little understanding of the scientific value and various uses of specimen collections. We created an online module using 40 Hairy Woodpecker (*Picoides villosus*) specimens from the Moore Laboratory of Zoology (MLZ) to teach students about concepts in evolutionary ecology and the utility of museum collections. The module is designed to test simple hypotheses related to Bergmann's and Gloger's ecogeographic rules. Here, we describe the module and its reception by students in an introductory-level biology course "Organisms on Earth" and an upper-division course "Avian Biology" at Occidental College. The module was successful in making specimen collections accessible online and teaching students about zoology collections as tools for describing biodiversity and studying evolution. The module is also important for digitizing the collection and making an important scientific resource more publicly available.

Assessing individual variation in parental care using multiple physiological metrics
Fowler, Melinda - Springfield College

One of the central tenets of parental investment theory is the cost of reproduction, incurred as a trade-off between care of current offspring and decrement in parental health/quality/future fecundity. It follows that parental care should be 'hard work', or require increased activity or energy expenditure. However, levels of parental care vary widely and the question of the mechanism that, or indicates a 'good' parent remains elusive. We set out to test how multiple physiological variables, including aerobic/metabolic capacity, oxidative stress and muscle damage, intermediary metabolism and energy supply, and immune function, are associated with current and future reproductive events in the free ranging female European starling (*Sturnus vulgaris*). We analyse individual variation in physiological state during chick-rearing in relation to parental care in female starlings, for first-and second-broods in two years. We tested whether physiological traits were related to workload ability, current reproduction, future fecundity, survival and cumulative productivity. We found few significant relationships. Increasing corticosterone predicted provisioning rate and non-esterified fatty acids were negatively associated with mean fledge mass. Reactive oxygen metabolites was negatively associated with both the number of chicks fledged in the first brood and the yearly total of chicks fledged. Despite testing a comprehensive suite of physiological predictors, few relationships to current or future reproduction are apparent. The lack of clear patterns support the idea that even for components of the same physiological system, perhaps birds can adjust individual components of their physiology independently, making finding a single signal indicative of quality very difficult.

Assessing Population Structure and Hybridization in Migratory and Resident Species of the genus Pipilo
French, Cooper - University of Washington Dept. of Biology; John Klicka - Burke Museum of Natural History

We explore phylogenetic relationships and biogeographic patterns of speciation and hybridization in the North American genus Pipilo. Double digest restriction site-associated DNA sequencing was used in conjunction with previous mitochondrial sampling in 127 specimens from four species. Of particular interest in this work is the characterization of genetic structure within the eastern towhee and the lack of support for strong divergence between the peninsular Florida white-eye subspecies, *P. erythrophthalmus allenii*, and Northern populations. We also identify several zones of hybridization between collared towhee (*Pipilo ocai*) and spotted towhee (Pipilo maculatus) populations in the highlands of Central Mexico, with varying degrees of introgression and mito-nuclear discordance, indicating a

complex evolutionary history of allopatry and sympatry.

Power analysis of shorebird survey data from Chaplin and Reed Lakes, Saskatchewan

Frey, Matthew - Environment and Climate Change Canada; Steven Van Wilgenburg - Canadian Wildlife Service / Environment and Climate Change Canada / Government of Canada; **Ann McKellar** - Environment and Climate Change Canada

During the summers of 2014 and 2015, shorebird survey points were established at Chaplin and Reed Lakes, Saskatchewan, both important stopover and breeding sites for many shorebird species. One purpose of the Chaplin and Reed Lake Shorebird Survey is to monitor shorebird populations for trend estimation. We ran a series of power analyses to assess the effectiveness of different sampling designs and monitoring durations to detect species declines, assuming a 30% decline over 10 years (criterion for listing species as Threatened in Canada). Power and precision to detect declines increased with both monitoring duration and number of survey points, although they were more sensitive to monitoring duration. Using the current survey design of 24 survey points, a monitoring duration of 20 years would not achieve 80% power to detect declines for any species. Increasing the monitoring duration to 25 years achieves 80% power for three species out of nine evaluated, while increasing monitoring duration to 35 years achieves 80% power for six species. Of the nine species evaluated, 80% power to detect declines was only achieved for six under the sampling scenarios we tested. We recommend 1) maintaining current sampling effort at 24 sites, 2) examining the feasibility of combining survey data from Chaplin and Reed Lakes with other stopover sites within the International Shorebird Survey to increase power to detect trends for migrant species, and 3) continually updating simulations and power analysis in future years to enhance the accuracy and precision of estimates.

Roof-top Nesting in a Declining Population of Herring Gulls (*Larus argentatus*) in Portland, Maine, USA

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A number of colonial waterbird species have been documented nesting on roof-tops throughout Europe and North America. The most common hypothesis explaining why gulls (Laridae) select roof-tops for nesting has been that population growth rates are higher than territory vacancy rates in traditional (island) habitat, suggesting that roof-tops are a non-preferred habitat. Roof-top habitat may actually be equal to or higher quality than island habitat as anthropogenic food is abundant and lower nest density may lead to lower intraspecific aggression and predation. During 2011-2012, reproductive effort and success was monitored in a regionally declining population of Herring Gulls (*Larus argentatus*) nesting on roof-tops in Portland, Maine, USA, and a nearby island-nesting colony on Appledore Island, Maine. Clutch size was lower in the roof-top colony, but egg volume did not differ between sites. Herring Gulls in the roof-top colony had lower hatching success but greater survival to day 30 for chicks that hatched than for those breeding in the island colony. The average number of chicks per nest to reach day 30 was 0.72 on the roof-tops and 0.84 on the island. This shows, therefore, that roof-top nesting may be an adaptive reproductive strategy even under scenarios with reduced competition for nesting territories on traditional nesting islands.

Use of the University of North Georgia, Gainesville Campus, and Tumbling Creek Woods by Birds of Prey: February - April 2016

Frizzell, S.L. - University of North Georgia; Kate Morgan - University of North Georgia; D.E. Lubeski - University of North Georgia

Habitat availability and quality can influence fluctuations within bird populations by determining survival during migration and during breeding. Home ranges of raptors often span several acres and are often correlated with prey preferences, availability of nesting sites, presence of predators, and presence of competitors in the area. We conducted an observational study on the presence of birds of prey during the transition from winter to spring at the University of North Georgia's Gainesville Campus and adjacent Tumbling Creek Woods. During January-April 2016, we documented a total of ten different raptor species, and twenty-three individual birds. Of those species, six were residential species, two were wintering species, one was a spring/summer breeding species and one was a spring migration species. Migratory species appeared to choose sites where there is probably a higher abundance of food, and thus a higher likelihood of available resources to meet their energy requirements. We made two sightings of a spring/summer breeding species, and observed two residential species' nesting, indicating the potential this study site has in supporting these predators. The information gathered during this study can have future applications when considering management and maintenance practices for the habitats birds of prey live in or visit, as well as serve to be a source of education of the diversity of important predators in local habitats. Preserving local habitats would be beneficial in providing space and other resources for both residential and migratory species, for whom those resources are critical for their continued survival.

Do House Wrens use spider egg cases as a way to control ectoparasitic mites in their nests?

Gable, Connor - Kutztown University; Todd Underwood - Kutztown University; Gregory Setliff - Kutztown University

House Wrens (*Troglodytes aedon*) are known to regularly seek out and add spider egg cases to their nests, but the purpose of this unusual behavior is unknown. This behavior may be an example of heterospecific cleaning, which involves one animal encouraging another to remove parasites from their nests. The addition of juvenile spiders from spider egg cases may facilitate the reduction of ectoparasites that are harmful to the nestling health. We tested this ectoparasite reduction hypothesis by collecting House Wren nests and counting the number of spider egg cases and mites in nests during the 2015 breeding season in Kutztown, Pennsylvania. No significant relationship was found between the number of spider egg cases and mites in nests. Mite numbers did not influence the body condition of House Wren nestlings. When examining nests from the first part of the breeding season to later nests, no significant difference was found between number of mites, but significantly more cases were added to late season nests. Overall, we found no support for the ectoparasite reduction hypothesis to indicate that House Wrens add spider egg cases to their nests to reduce mite populations and produce better quality offspring. The purpose of spider egg cases in House Wren nests remains a mystery.

Changes in warbler migration over ten years of standardized monitoring at McGill Bird Observatory, Quebec

Gahbauer, Marcel - McGill Bird Observatory, Migration Research Foundation; Simon Duval - McGill Bird Observatory, Migration Research Foundation; Barbara Frei - Migration Research Foundation

McGill Bird Observatory (MBO) has conducted annual standardized migration monitoring programs for 10 weeks in spring and 13 weeks in fall since 2005. Located near the west end of the island of Montreal, Quebec, MBO occupies 22 ha of old pasture, mature deciduous forest, and small wetlands. Over the first 10 years of operation, 51959 birds of 120 species were banded, and 210 species were observed. Warblers are the most abundant group, with 26 species banded, comprising 35% of all individuals; 6 warblers are among the top 15 species banded overall, and several of the common warblers have shown considerable changes in timing of migration or abundance since 2005. Tennessee and Cape May Warblers have increased in recent years, coinciding with a major spruce budworm outbreak in central Quebec. Northern Waterthrush and American Redstart numbers have also increased over time, although underlying factors are not apparent. Yellow-rumped Warbler fall numbers spiked by more than an order of magnitude in 2008 and 2010, but have returned to more average levels. The peak of migration has advanced by one week for Nashville Warbler and Northern Parula in spring and by 2-3 weeks for American Redstart in fall, but Magnolia Warbler fall migration now peaks 3 weeks later than a decade ago.

Molt patterns in relation to breeding phenology for a tropical bird species, the Hispaniolan Woodpecker (*Melanerpes striatus*)

Garrod, Holly - Villanova University; Joshua LaPergola - Cornell University

Molt patterns are often useful for determining age of individuals and hence demographic structure of a population, but molt patterns of resident Neotropical birds are generally poorly known. Neotropical woodpeckers are no exception to this latitudinal bias. Our present study has two objectives: (1) to provide the first description of the Hispaniolan Woodpecker's (*Melanerpes striatus*) molt pattern, and (2) to determine how molt fits into breeding phenology for this species. For four consecutive breeding seasons (March - July) beginning in 2013, we monitored a color-banded population of the island's endemic Hispaniolan Woodpeckers in mid-elevation (~600 m above sea level) altered habitat (agricultural fields) in Piedra Blanca, La Vega province, Dominican Republic. For this study, we analyzed standardized photos taken during banding sessions to characterize patterns of retained and replaced feathers. Because we band a substantial of birds as chicks each year, analyses are pending while we continue to recapture known-aged birds in the current field season. In the future we anticipate using these results to compare patterns of temperate and tropical picids to better understand the evolution of molt patterns in the family.

Population monitoring, ecology, and habitat relationships of sora and Virginia rails in northwestern Ohio

Gates, Bob - Ohio State University; John Simpson - Winous Point Marsh Conservancy; **Brendan Shirkey** - Winous Point Marsh Conservancy; Laura Kearns - Ohio Dept Nat Res - Division of Wildlife; Mike Picciuto - Winous Point Marsh Conservancy

Effective management of any wildlife species is aided by the ability of wildlife managers to estimate abundance and track changes in abundance over time. Interest in secretive marsh birds including rails, bitterns, coots, and gallinules has increased in recent years, culminating in the implementation of the spring secretive marsh bird survey. Rails

(sora and Virginia rails in particular) are of special interest in Ohio and many other states because of their status as harvestable game birds. Rail bag limits are relatively liberal in Ohio but harvest is assumed to have little impact on rail populations because hunting pressure is light. Due to their secretive nature, no current estimates of rail abundance exist for the state of Ohio, nor do measures of population parameters that might indicate the health of Ohio's rail populations such as nest success or survival rates. We plan to equip both sora (n=50) and Virginia rails (n=50) with radio transmitters after spring migration in 2016, 2017, and 2018 to estimate breeding season vital demographic rates, breeding habitat use, and migratory timing. We also intend to model factors affecting callback rates and other components of the standardized Marshbird Monitoring Protocol. Lastly, we intend to use a trail-camera trap array to develop estimates of occupancy and untimely abundance by habitat type.

Chemicals in Eggs of Cavity-Nesting Passerine Species at and around Los Alamos National Laboratory Lands

Gaukler, Shannon - Los Alamos National Laboratory; **Charles Hathcock** - Los Alamos National Laboratory; Leslie Hansen - Los Alamos National Laboratory; Philip Fresquez - Los Alamos National Laboratory; Jeanne Fair - Los Alamos National Laboratory

We evaluated concentrations of metals, radionuclides, chlorinated insecticides and their metabolites, and polychlorinated biphenyls (PCBs) in eggs of two passerine species, the Western Bluebird (*Sialia mexicana*) and Ash-throated Flycatcher (*Myiarchus cinerascens*) at Los Alamos National Laboratory (LANL). Decades of science and technology research has resulted in releases of metals, radionuclides, and organic chemicals at different times and locations. Eggs in this analysis were collected at both LANL and a reference site, and were collected over an 18-year span. Based on PCB congener data, toxicity equivalents (TEQs) for dioxin-like compounds were calculated. This study revealed a number of differences between concentrations of constituents in eggs observed at LANL and the reference site, between species, and over time. Western Bluebird eggs collected at LANL were compared with eggs collected at a reference site and copper was higher; however, Western Bluebird eggs from the reference site contained greater concentrations of dieldrin, oxychlordane, and trans-nonachlor. Western Bluebird eggs had higher levels of barium than Ash-throated Flycatcher eggs, while Ash-throated Flycatcher eggs had higher levels of copper, mercury, selenium, and TEQs. No changes were observed over time in the concentrations of chlorinated insecticides and their metabolites, PCBs, and most metals in eggs of both species; however, iron, mercury, and selenium decreased over time in Western Bluebirds. Levels of constituents detected in this study were typically within the range of other passerines and/or below levels that are associated with adverse effects, suggesting that these levels do not appear to be of biological or ecological concern.

GENOMIC INSIGHTS INTO NATURAL SELECTION IN THE COMMON LOON (*Gavia immer*): EVIDENCE FOR AQUATIC ADAPTATION

Gayk, Zach - Biology Department, Northern Michigan University; Alec Lindsay - Biology Department, Northern Michigan University

No previous studies have focused on the adaptive significance of gene evolution in freshwater aquatic birds such as loons. To investigate this, we used Illumina paired-end reads from a female common loon to produce a fragmented assembly of the common loon (*Gavia immer*) genome. We identified fragments of 13,821 common loon genes and another 348 coding sequences of unknown function, for a total of 14,169 common loon genes. Based on estimates from published avian genomes, this figure represents 80.7%

of common loon genes. We used branch-site models between common loon, chicken (*Gallus gallus*), red-throated loon (*Gavia stellata*), northern fulmar (*Fulmarus glacialis*), Adelie penguin (*Pygoscelis adeliae*) and rock pigeon (*Columba livia*) for a high confidence set of 10,106 gene fragments to find genes under positive selection. We found 490 positively selected genes in the common loon that were enriched for a number of protein classes, including those involved in muscle tissue development, immunoglobulin function, hemoglobin iron binding, G-protein receptors, and ATP metabolism. The signature of positive selection in these areas suggests common loons may have adapted for underwater diving by (1) compensations of the cardiovascular system and oxygen respiration, (2) low-light visual acuity, (3) and improved metabolism. We discuss the evolutionary implications of selection on several key genes, which may have implications for future ecological studies of the common loon.

Nocturnal Flight Behavior of Migratory Songbirds in Relation to Wind Along the Southwest Coast of Lake Erie
Gesicki, David - Bowling Green State University; Verner Bingman - Bowling Green State University

Identifying migratory pathways is critical for understanding the potential risks affecting migratory birds. The Great Lakes are an important stopover area along the migratory pathway of millions of nocturnally migrating songbirds. However, large expanses of open water are a potential challenge during migration as a consequence of increased mortality and the energetic cost of flight “detours”. However, it may indeed favor a bird to deviate their flight paths along coastlines under seasonally opposing head winds as long as the orientation of coast does not differ markedly from the preferred migratory direction. We utilized a passive infrared camera to observe the flight tracks of nocturnally migrating songbirds under varying wind conditions at two sites along the southwestern coast of Lake Erie. Observations were made from civil sunset through civil sunrise when conditions permitted. Generally, mean track directions of birds observed along the coast differed from the prevailing migratory direction observed inland on greater than 60% of the nights. Birds observed migrating on nights with northerly head winds displayed orientations that more closely followed the direction of the coastline, birds observed under seasonally appropriate southerly winds differed significantly from northerly winds, being more oriented out over open water suggesting a lake crossing. Observed mean track directions did not differ significantly between locations, except under easterly crosswind suggesting local topographical features may influence orientation behavior. The results suggest birds actively shifting their migratory orientation in an energetically meaningful way depending on the prevailing wind conditions present upon arrival to the Lake Erie coast.

A Mobile Avian Survey Data Collection Software Application (SeaScribe)
Gilbert, Andrew - Biodiversity Research Institute; Iain Stenhouse - Biodiversity Research Institute; Emily Connelly - Biodiversity Research Institute; Matthew Merrill - Tilson; Josh Wadlington - Bureau of Ocean Energy Management

Offshore seabird, marine mammal, and sea turtle surveys are necessary to collect baseline and project-specific data for offshore development. Previously, there were only a couple of computer applications designed to collect such data in the field. These programs are antiquated and sometimes difficult to use with little or no ability to be run using current handheld computing infrastructure, such as tablet computers and smart phones. However, tablet computers and smart phones are now ubiquitous, usually have onboard GPS, Wi-Fi, or cellular connectivity, are relatively low cost, and are easy to weather-proof. We created a freely available, modern

survey data collection program (SeaScribe) with enhanced data standardization and improved performance for deployment to those performing marine animal surveys. We designed this program to have built in on-the-fly data checking, improved data standardization across surveys, improved data entry, and readily available quality-controlled data. The application was designed to collect core data but also to give users the flexibility to add data fields as necessary to satisfy research needs. In order to achieve a modern application for this environment, we built SeaScribe from the ground up to best use the most current hardware and software. We also used a cross-development platform to allow for development in one language to be deployed across both Android and Apple iOS operating systems, dramatically reducing the time to release to both platforms and future updates.

Influence of Land Use on Aquatic Subsidies to a Terrestrial Consumer
Gonzalez, Sara - Cornell University; Cornelia Twining - Cornell University; Alexander Flecker - Cornell University

Streams and the terrestrial areas that flank them, called riparian zones, are connected through fluxes of energy and nutrients (subsidies) such as leaf litter and insects. Emergent aquatic insects that become prey for terrestrial insectivores provide linkages between streams and riparian zones. Previous studies suggest that agriculture can affect insect abundance and diversity, but it remains unclear how aquatic insect subsidies to terrestrial habitats vary with land-use and affect diets of terrestrial consumers. I investigated insect abundance and spatial foraging habits of the Eastern Phoebe (*Sayornis phoebe*) near streams across an agricultural land-use gradient to address: 1) How do aquatic and terrestrial insect abundance and biomass vary across a land-use gradient? 2) How does land-use affect phoebe foraging patterns? and 3) How do phoebe diets vary across land-uses? I quantified emergent aquatic insect and terrestrial insect abundance, and conducted phoebe foraging observations and stable isotope analysis (d2H) of aquatic insects, terrestrial insects, and phoebe chicks at seven stream sites. I found that phoebes foraged over streams more frequently at sites with less tree cover, and d2H signatures suggested that phoebes foraged on a mixture of aquatic and terrestrial insects, but generally more terrestrial insects. Phoebe d2H values were significantly higher (signaling increased terrestrial insect consumption) at sites with more tree cover, and also tended to decrease with increasing agricultural land-use, though not significantly. This study highlights the potential impacts of agricultural land-use on connections between stream and riparian food webs through changes to both prey availability and predator foraging preferences.

Regional and post-breeding movements of Black Skimmers nesting in the Peruvian Amazon
Goodenough, Katharine - Oklahoma Biological Survey/University of Oklahoma; Lisa Davenport - James Cook University; Torbjorn Haugaasen - Norwegian University of Life Sciences

The Amazon Basin has some of the greatest animal diversity in the world that is due in part to pulsed flooding regimes. Water levels in the Amazon may vary at a site by as much as 20 m between low and high water. As the main channel of the Amazon River integrates these various sources, there is considerable variation in availability of beach habitat along the rivers. Birds that are dependent upon low water, exposed beaches for nesting and roosting purposes must find alternative habitats and time their migrations appropriately to river hydrologic regimes. In 2014, we began a tracking study to document Black Skimmer (*Rynchops niger*) movements within the Peruvian Amazon. A total of eight Black Skimmers were captured by mistnet along the Rio Manu in Manu National Park,

Peru and released with platform transmitting terminals (PTTs). Individuals were tracked via the ARGOS system from 20-356 days. Local movements within the Amazon Basin were surprisingly wide ranging with several individuals making trips greater than 700km roundtrip. The majority of movements were associated with river tributaries with little forest crossing. Migratory movements were surprisingly diverse with individuals setting out in various directions including Brazil, Paraguay, Bolivia, and Chile. The most amazing journey documented was the trans-Andean crossing of two individuals at altitudes of 5000m (16,404 feet) above sea level.

Implications of Emerging Diseases for the Conservation of Declining Populations: A Case Study of West Nile Virus and Lesser Prairie-Chickens

Gould, Geoffrey - The Ohio State University; Jacqueline Augustine - Ohio State University

Infectious diseases can have detrimental effects on wildlife populations, especially among species experiencing habitat fragmentation and inbreeding depression. However, the role of pathogens in the ecology of threatened species is often poorly understood. West Nile Virus (WNV) has caused devastating effects on avian populations. Human modification of ecosystems and persistent warm and dry conditions favor WNV vector (mosquito) proliferation and increase host-vector contact. WNV has caused high mortality in non-migratory species far from disease epicenters including close relatives of the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*, hereafter LPC), a declining species of conservation concern. Due to ecosystem modification, current climate conditions, and its highly social mating system, this species will likely experience increased incidence of WNV. The LPC population has experienced severe declines associated with widespread habitat loss and fragmentation. However, data regarding the effects of WNV on the LPC are scarce. In April 2016, a test on serum I collected yielded the first evidence of WNV presence in the LPC in the Shortgrass ecoregion which contains 60% of the species population. Thorough exploration of the dangers posed by all potential threats to the LPC is essential due to its vulnerable status, and serological testing represents an important first step in evaluating WNV prevalence in the Shortgrass ecoregion. Assessing the threat WNV poses to the LPC can determine appropriate management responses ranging from vector control to vaccination. With the discovery of WNV in the most populated part of the LPC's range, evaluating the population dynamics of this host-disease system is crucial.

Density-dependence and changes in carrying capacity in Alaskan seabird populations

Goyert, Holly - University of Idaho, Dept. of Fish and Wildlife Sciences; Edward Garton - University of Idaho; Heather Renner - Alaska Maritime National Wildlife Refuge; Brie A. Drummond - Alaska Maritime National Wildlife Refuge; Aaron J. Poe - Aleutian and Bering Sea Islands LCC

The Alaska Maritime National Wildlife Refuge is an expansive network of islands and coastal sites that support breeding colonies of over 30 seabird species across 3.4 million acres. We provide the first comprehensive assessment of refuge-wide kittiwake (*Rissa spp.*) and murre (*Uria spp.*) population trends, over the past four decades. We reconstructed historic population size estimates by calculating annual rates of change from sampled counts at 19 colonies. We scaled these estimates to total population size by integrating probability-proportional-to-size estimators, from recent counts, with population data from the Beringian Seabird Colony Catalog. Using the resulting time-series, we evaluated a set of models that allowed for either density-independence or density-dependence, with or without a time trend in carrying capacity. The best-fit model

indicated that these seabird populations are negatively density-dependent, and additionally that the carrying capacity of Black-legged Kittiwakes (*R. tridactyla*) has decreased in the last four decades. Colonies in the Gulf of Alaska appear to be the source of these declines. Negative density dependence can help to sustain a declining population's probability of persistence on the long term. Therefore, it is important to include demographic factors in determining the ecosystem-wide drivers of seabird population trends in Alaska.

What drives altered signaling in noise? A study of male House wren (*Troglodytes aedon*) note use and song composition across a noise gradient

Grabarczyk, Erin - Western Michigan University; Sharon Gill - Western Michigan University

Anthropogenic noise has diverse effects on wildlife, including disrupting foraging and predator detection, and for birds, overlaps signals males use to defend breeding areas and attract mates. To minimize signal masking, male songbirds increase the frequency, amplitude, or duration of their song. For birds with complex song, shifts in temporal or spectral characteristics may be driven by altering the type of note elements used to compose a song, however little is known about whether birds select note type in relation to their noise environment. Thus, the objective of our study is to 1) analyze the spectral and temporal adjustments male songbirds use to minimize masking in noise, and 2) determine if adjustments are driven by note type selection, or by altering the spectral characteristics of an individual note. We recorded song of breeding male house wrens, (*Troglodytes aedon*), whose lower portion of song overlaps with low frequency anthropogenic noise in southwest Michigan. Using cluster analysis we quantified house wren notes based on three-dimensional peak frequency measures, and used machine-learning techniques to semi-automate template to note matching. Our study is an essential step towards understanding how birds construct and use complex song based on variation in noise in their environment.

Evaluation and Guidance for Riparian Restoration in Coastal California Using Birds as Indicators of Restoration Success

Grady, Kathleen - Sonoma State University; Derek Girman - Sonoma State University; Thomas Gardali - Point Blue Conservation Science

Marin and Sonoma counties are both places where wildlife and people come into close contact and often have seemingly opposing demands on the landscape. As the population of the San Francisco Bay Area expands, managed landscapes become more important for birds and other wildlife, and for the human population. The Students and Teachers Restoring a Watershed program has been working to address erosion and water quality issues by conducting riparian restorations—often on private ranchland—for over 20 years. We examined these restored areas using birds as indicators of habitat quality and restoration success. We compared historic (2001-2009) avian use at 25 sites using the area search protocol to evaluate the bird community response to riparian restoration on private lands. We found a diverse community of birds using the restored areas during the breeding season suggesting that these projects have been successful beyond the intended goals of improving water quality. Our results suggest that riparian restoration helps people by improving water quality and reducing erosion, and can simultaneously create suitable habitat for wildlife. Additionally, our future plans involve including data from the 2015 and 2016 seasons to further examine bird response over time. Further, by understanding site and landscape level components that contribute to avian

response, we can make recommendations about future restoration projects to help ensure success.

Intraspecific variation in morphology and foraging behavior in a Neotropical migrant
Gray, Brandan - Ohio University; Kelly Williams - Ohio University; Donald Miles - Ohio University

The hooded warbler (*Setophaga citrina*) is a Neotropical migrant species which breeds throughout the eastern United States and southeastern Canada. Habitat segregation between the sexes has been well documented in the tropical wintering grounds as well as the temperate breeding grounds. Male hooded warblers tend to forage in the canopy and midstory and females tend to forage in the understory. The canopy and understory differ in foraging substrate complexity and present each sex with different locomotion challenges and unique insect prey bases. We sought to determine whether the difference in ecology observed in this species corresponds to differences in morphology and foraging behavior. During the 2015 breeding season, all adult hooded warblers breeding in three , forty hectare forest plots in southern Ohio were captured using mist nets and uniquely marked with a USGS aluminum band and three color bands. Eleven morphological measurements were collected from each bird before release. Adults were followed throughout the breeding season to obtain territory boundaries, habitat use, foraging and parental care behaviors, and reproductive success (fledging rates and fledgling condition). Birds with long hindlimbs tended to forage in structurally complex habitat and exhibited a greater hop rate. Birds with high aspect wings and wide bills exhibited a greater proportion of aerial foraging behaviors. This study links variation in ecology and morphology with behavior and incorporates reproductive success. Such studies may further our understanding of species' responses to habitat change and ultimately inform habitat management and improve habitat and species conservation protocols.

The Effect of Mercury Exposure on Mate Choice in Birds
Greene, Virginia - College of William and Mary; Daniel Cristol - The College of William and Mary; John Swaddle - The College of William and Mary

Choosing a high-quality mate is an important component of reproductive success. Female birds assess quality in males via condition-dependent signals such as songs, plumage, and displays—all of which contribute to their attractiveness as potential mates. This attractiveness can be disrupted, however, by environmental stressors such as toxins. One such toxin is mercury, a globally-increasing pollutant recently found in terrestrial systems. Mercury exposure has been shown to affect condition-dependent signals in birds, but the effect of exposure on the process of mate choice itself is unknown. We sought to assess the potential effects of mercury exposure on male attractiveness through short-term female preferences and ultimate pairing outcomes with a captive colony of zebra finches. Males were either exposed to dietary mercury (1.2 ppm) or unexposed (0.0 ppm) for their entire lifetime and assessed by unexposed females in three types of trials: song-only phonotaxis trials, two-choice initial preference trials, and aviary pairing trials. In 11 of 20 song-only phonotaxis trials, females preferred the song of unexposed males. In 6 of 15 initial preference trials, females preferred to spend time with unexposed males. During 14 aviary pairing trials, 7 females paired with unexposed males. While mercury exposure is known to reduce reproductive success in paired and breeding birds, these results suggest that the effect of exposure on male attractiveness is not enough to deter potential mates prior to pairing. Examining this potential avenue for reproductive disruption in a lab is an important precursor to understanding how mercury may affect wild bird populations.

Variation in body composition affects refueling performance and basal metabolic rate in Grey Catbirds (*Dumetella carolinensis*) during migratory stopover

Griego, Michael - University of Massachusetts Amherst; Mariamar Gutierrez Ramirez - University of Massachusetts Amherst; Joely DeSimone - Amherst College; Alexander Gerson - University of Massachusetts, Amherst

The Grey Catbird (*Dumetella carolinensis*) is pervasive across the eastern United States during the summer breeding months and has a wintering range that extends from the southern US Gulf States down to Panama. Each spring, birds that have wintered in Central America fly across the Gulf of Mexico during their northern migration to breeding grounds and in the process burn significant lipid and protein reserves for fuel. Barrier islands provide the first opportunity for landfall after crossing the gulf, so birds concentrate in these habitats to refuel and replenish both fat and lean stores before continuing migration. The aim of this study is to better understand how refueling performance and metabolism in migratory catbirds are affected by body condition- specifically lean mass- during migratory stopover immediately after a trans-Gulf flight. Migratory catbirds were caught on St. George Island, FL over the course of five weeks during Spring migration in 2016. Total fat and lean mass were determined using non-invasive quantitative magnetic resonance (QMR) technology prior to measuring basal metabolic rate (BMR) using standard flow-through respirometry techniques. Blood samples were taken immediately upon capture to assess refueling rate using plasma metabolite profiling. We predict a positive relationship between lean mass and metabolic rate and lower plasma triglycerides in lean birds reflecting a physiological limitation on refueling rate. However, a decreased BMR resulting from depleted lean mass- and thus less metabolically active tissue – may allow birds to refuel faster due to reduced maintenance costs allowing faster assimilation rates.

An Evaluation of Early Successional Habitat Management for Breeding Bird Communities at Great Swamp National Wildlife Refuge

Griffin, Meta - Frostburg State University; Sean Knox - Frostburg State University; Dorothy Wells - U.S. Fish and Wildlife Service; Frank Ammer - Frostburg State University

Early successional habitats are used by a wide range of bird species during the breeding season. This habitat is of conservation importance as early successional bird species are declining, especially in the northeastern United States. Great Swamp National Wildlife Refuge (GSNWR), Morris County New Jersey, manages 1,128 acres of early successional habitat in grassland management units (GMU) and brushland management units (BMU). The objectives of this study are to a) evaluate bird communities using early successional habitats during the breeding season at GSNWR, b) evaluate habitat characteristics to determine potential correlations with species presence and nesting success, and c) provide management recommendations for select GMU and BMU. Fixed radius single observer point counts were conducted May through July of 2014-2016 at 41 points in GMU and 38 BMU points. Vegetation surveys following a modified Breeding Biology Research and Monitoring Database protocol were conducted from June to August of 2015 and 2016 at point count and nest site locations. A total of 69 bird species have been detected. Among the most commonly detected species in both grassland and brushland management units, were the Eastern Towhee and Blue-winged Warbler which are focal species for the Refuge. During the breeding season, 14 nests were identified and monitored for six bird species. Data obtained

from this study will assist in addressing specific management objectives in the Refuge's Habitat Management Plan and provide management recommendations, such as identifying which rotational cuts provide the most benefit to Refuge focal species.

The Evolution of Tarsal Spurs in Galliformes

Griffith, Emily - University of Florida; Rebecca Kimball - Department of Biology, University of Florida

Galliformes (chickens, pheasants, and turkeys) are an interesting and diverse group of birds. One trait found in many galliforms (yet not found in any other avian order) is the presence of tarsal spurs. These structures can vary in size, shape and number between species. Although spurs are known for their role in male-male competition (e.g., cockfighting), spurs are present in the females of several species (always species where males have spurs) and absent in other species that exhibit strong male-male competition.

Darwin suggested spurs evolved in males due to male-male competition, but remarked that female spurs were nothing more than a byproduct of selection on males. G.W.H. Davison hypothesized that spurs arose from a common ancestor and his analyses show a strongly association with polygyny (where male-male competition may be high). He also concluded female spurs were more associated with monogamy and may be due to female-female competition. However, his analyses lacked phylogenetic control (and ignored clades where all species lacked spurs).

We used a phylogeny including 90% of galliform species to assess gains and losses of spurs, and to test hypotheses regarding their presence in males and females. Although spurs have been gained several times in both sexes, the number of losses is significantly greater than gains in both sexes. There was no clear relationship between mating system and spur presence, and the analysis was influenced on how mating systems of some poorly studied species were classified (in some of these species, different sources suggest different mating system).

Falcon Song: Size Matters

Griffiths, Carole – LIU Brooklyn and the American Museum of Natural History; Neil Aaronson - Stockton University

The ability of birds to learn and produce complex songs depends on brain structure, neural connections, and on a complex syrinx. Two of the three clades that contain vocal learners, the psittaciforms and passeriforms, are sister taxa. Current systematics proposes that the Falconidae are related to this cluster. Presumably falcons are not vocal learners, do not have syringeal modifications analogous to oscines, and do not have the necessary neural connections. Therefore for these birds, song should not be a selective factor in the evolution, and variation in song structure should be relatively minor. We examined sound and syringeal structure in six falcon species and hypothesized that if these species were not vocal learners, then syringeal size would be the major factor in song variation.

Reproductive success of a neotropical migratory bird in response to a changing climate

Grupenhoff, Ashley - Virginia Commonwealth University; Lesley Bulluck - Virginia Commonwealth University

Climate change is of rising concern especially due to how and if this changing climate affects individual species and their fitness. Migratory species, especially long-distance migrants, are ideal models for exploring the relationship between warming temperatures on temperate breeding grounds and decreased precipitation on tropical wintering

areas. Few studies have long term data sets to observe species-specific assessments of fitness in relation to changing precipitation and temperature patterns, and those that have assessed these relationships show inconsistent results. We analyzed long-term data of a neo-tropical migratory songbird (*Protonotaria citrea*) to assess the potential relationships between indices of reproductive success and variation in tropical rainfall and breeding season temperature. We found that the species tended to have longer breeding seasons in years with increased annual temperatures and increased rates of double brooding with increased precipitation in the wintering grounds. Prothonotary warblers had smaller first clutches in stronger El Nino years, though this relationship was weak. Breeding ground precipitation was not correlated with any index of reproductive success. Results suggest that a combination of breeding ground temperature and wintering grounds precipitation play a role in the timing of spring breeding and the prevalence of double brooding, respectively. These findings are important for predicting the sensitivity of long-distance migratory birds to changes in climate, and provides additional evidence for carry over effects between portions of the annual cycle in migratory songbirds.

Seasonal Movements of Double-crested Cormorants (*Phalacrocorax auritus*) in Urban and Rurual Colonies

Guilfoyle, Michael - U.S. Army Engineer Research and Development Center; Brian Dorr - USDA/WS/National Wildlife Research Center; Katie Hanson-Dorr - USDA/WS/national Wildlife Research Center; Richard Fischer - U.S. Army Engineer Research and Development Center

We used satellite telemetry on Double-crested Cormorants (*Phalacrocorax auritus*) at two breeding colonies in Illinois, USA. One colony was located in an urban setting at Baker's Lake, Barrington, Illinois, which is located in the Chicago metropolitan area. The second colony was located along the Illinois River in a rural setting at The Nature Conservancy Emiquon Preserve, near Peoria, IL. We monitored movements of 30 birds (15 from each colony) to compare seasonal movement frequency, distance, direction, and home range estimates during the breeding (May-July 12; n=29), migration (July 13-October 30; n=16), and winter (November-December; n=8) seasons. Our objectives were to determine if urban and rural breeders differed in seasonal behavior or the use of the landscape and to determine any role as vectors of Asian carp eDNA in the Chicago area. Rural cormorants exhibited larger home ranges, moved longer distances and had higher frequency of movements than did urban cormorants during the breeding season. With the exception of a few outliers from the urban colony, no differences were observed in the measured parameters during the non-breeding seasons. Cormorants from both colonies migrated south towards the Mississippi Delta region, and most wintered along the Louisiana Coast, or remained in the delta. Urban cormorants tended to remain in and around the colony during the breeding season, suggesting ample foraging resources; perhaps taking advantage of stocked ponds and lakes in the Chicago area. Rural cormorants moved more frequently and longer distances, suggesting an increased need to expand foraging range to meet daily requirements.

Ashtabula Harbor Breakwater Restoration: An Approach for Creating and Attracting the State-listed Common Tern (*Sterna hirundo*) to New Nesting Habitat

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During a breakwater restoration effort in the Ashtabula Harbor, Ohio, pre-cast cement blocks (8 ft x 5 ft x 3.5 ft) modified with a 6-in deep recess, were filled with gravel substrate suitable for nesting by the stated-listed Common Tern (*Sterna hirundo*). Sixteen of these blocks were deployed on the breakwater; 8 during the fall of 2013, and another 8 during the fall of 2014. Each 8-block section provides 320 ft2 of potential nesting habitat for the tern. We used 2 Murrmaid® solar-paneled call boxes to broadcast tern calls, plus 8-10 decoys to attract nesting terns. In addition, up to 6 motion-censored cameras were set up at the site to document use of the habitat by terns or other birds outside of our monitoring efforts. We developed a biweekly monitoring protocol that incorporates the Department of Defense Coordinated Bird Monitoring approach and recorded all birds utilizing the breakwater and surrounding habitat during 10-min counts. Beginning in 2015, 30 min. spotting-scope surveys from privately owned land along the shore were incorporated into the protocol to permit monitoring when weather or harbor conditions prevented access to the breakwater. We observed an increase in the detections of Common Terns during each monitored breeding season, with birds finally utilizing the nesting area during the 2016 breeding season. Our approach demonstrates the value of simple modifications to existing structures during harbor restorations that could be used to attract breeding Common Terns and to promote the population recovery in the Great Lakes region.

Refueling performance of spring trans-Gulf migrants and the influence of lean body mass on stopover duration

Gutierrez Ramirez, Mariamar - University of Massachusetts Amherst; Joely DeSimone - Amherst College; Michael Griego - University of Massachusetts Amherst; Christopher Heckscher - Delaware State University; Alexander Gerson - University of Massachusetts Amherst

Annual migration in songbirds is one of the most demanding life-history stages. It represents a period of high mortality, yet much remains unknown about the ecological correlates that influence its successful completion. Migratory flights are fueled primarily by fat; however, lean tissue is also utilized resulting in significant reductions in muscle and organ masses. After crossing large ecological barriers reduced organs and muscles may impose a physiological limitation on refueling rate. Rebuilding lean tissue is costly, and occurs prior to fat deposition; thus, muscle catabolism during flight may impact stopover duration and overall migration timing. On St. George Island, a barrier island located on the southern edge of Apalachicola Bay, Florida, refueling rates of Catharus thrushes and Gray Catbirds were low and not significantly different, indicating both species may be experiencing constraints on refueling rate – possibly as a result of poor body condition. Thus, we have sought to better understand how body condition after crossing a significant ecological barrier affects stopover duration and habitat use. In 2016, we used plasma metabolite profiling and Quantitative

Magnetic Resonance body composition analysis to accurately and non-invasively measure body composition of spring migrants arriving on St. George Island. To determine localized and landscape-level stopover duration and migratory behavior we used an automated radio-telemetry array as part of the Motus Wildlife Tracking System. After determining refueling rate and body condition, we tracked Northern Waterthrush, Yellow-billed Cuckoo, and Swainson's Thrush to further investigate the relationship between lean mass and stopover ecology.

Decision support framework to inform fire and land management planning with woodpecker habitat dynamics

Haas, Jessica - Rocky Mountain Research Station, U.S. Forest Service; **Quresh Latif** - Rocky Mountain Research Station, U.S. Forest Service; Victoria Saab - Rocky Mountain Research Station, U.S. Forest Service

Forest managers must balance post-fire rehabilitation, economic recovery, and safety with maintaining wildlife habitat. Black-backed Woodpeckers (*Picoides arcticus*) specialize on recently burned forest habitats, and represent a focal species for informing post-fire forest management. Information is needed to minimize negative impacts of salvage logging on woodpecker habitat, and to meet conflicting socioeconomic objectives. Managers need to determine habitat to conserve at individual wildfire locations, while considering habitat suitability of recent, nearby fires. Because populations are maintained by colonization of new wildfires, persistence depends on habitat dynamics across landscapes rather than at individual wildfire locations. We developed a decision support framework to bridge this gap between ecological process and management planning. Under this framework, we compare current and near-term projected availability of suitable habitat with average historical trends to compare habitat suitability over the past 28-yr average. For proof of concept, we applied published habitat suitability models for Black-backed Woodpeckers across the Malheur National Forest (Oregon, U.S.A.) to examine habitat dynamics during 2007–2014. We compared these habitat dynamics to longer term (1984–2012) trends. During this period, we identified years of above and below average habitat suggesting varying needs for habitat conservation. Additionally, by overlaying current habitat with projected burn probability, we identified areas where allowing wildfires to burn could compensate for habitat deficits. These results suggest how decision support tools can inform forest management to support Black-backed Woodpecker population persistence.

Urbanization shapes the effect of building size on bird-window collisions

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Building characteristics and land cover surrounding buildings affect variation in the number of bird-window collisions (BWCs). However, little is known about whether BWCs are associated with regional land use. We assessed how BWCs depend on building characteristics and land use patterns at local and landscape scales. In fall 2014, researchers at 40 sites (N = 281 buildings) throughout North America used standardized protocols to document collision mortality and evaluate building characteristics. We also measured land cover at local (50-m around each building) and landscape (5-km around each study site) scales. We found 324 carcasses (range = 0–34 per site) representing 71 species and 23 families. Mortality in several species was relatively widespread, such as Common Yellowthroat, Ovenbird, and Ruby-throated Hummingbird. An information theoretic approach revealed that building size had a strong positive effect on BWCs. However, the strength of the effect of building size on mortality depended on urban land cover. The positive relationship between BWCs and building size was significantly greater in rural areas characterized by few structures and high levels of landscaped grass compared to urban areas characterized by many structures and high levels of impervious surfaces. BWCs were generally uncommon at small buildings. These results shed new light on how the magnitude of mortality at the local level depends on land use at a larger scale. Acknowledging spatial variation in the magnitude of mortality focuses conservation efforts aimed at reducing window collisions to high-risk buildings in urban landscapes and is broadly applicable across North America.

Using Ornithology Class Census Data to Track Avian Use of a Suburban Park Facing Development Pressures
Halkin, Sylvia - Central Connecticut State University

A. W. Stanley Park, a largely forested suburban park in New Britain, Connecticut, has faced development pressure since at least the 1970s. Proposals to raze the forest have ranged from expanding the adjacent

golf course to providing parking for a nearby wholesale store. In the 1990s, Friends of A.W. Stanley Park, a local citizens group, worked with the state's urban forester, local university faculty and businesses, and city, state, and federal government support, to develop a nature trail and trail guide for the park's forested area. The trail opened with federal White House Millennium Trail designation in 2000; in 2014, trail guide stops and descriptions were updated. In 2015, the city leased a concession in the park to a developer of ropes and zipline courses. The course, constructed in late spring 2015, was open in summer and early fall, with sites through the forested area and ziplines over the large pond bordered by the forest. In summer 2015, forested land was also shaved off one side of the park to widen the adjacent road. My Ornithology class conducts winter to spring censuses in the park in alternate years. We found no marked decrease in number of species using the park in Spring 2016, compared to earlier years. Heavier use of the ropes/zipline course and development of a multi-use loop trail are anticipated in coming years. Point count sites and protocol have been developed for consistent collection of comparative data.

Comparing models of avian abundance from citizen science and professional survey datasets

Hallman, Tyler - Oregon State University; Jenna Curtis - Oregon State University; W. Douglas Robinson - Fisheries and Wildlife/ Oregon State University

Quantifying avian response to changes in our dynamic planet requires large datasets across vast regions. The scale of the citizen science project eBird, is mouth-watering to spatial ecologists. Lack of standardized count protocol, however, makes working with eBird data messy at best. In particular, associating eBird count data to specific habitat characteristics and evaluating observer ability can be challenging. Oregon 2020 is a statewide project with the goal of benchmarking Oregon's breeding birds through extensive standardized point counts. In 2014, Oregon 2020 completed point counts within the Willamette Valley, Oregon. The Oregon 2020 dataset provides a comparison for eBird counts in the Willamette Valley ecoregion. Before use, eBird data must be evaluated for inclusion in a dataset. Such data evaluation can result in a reduction of more than 90 percent of the total observations for a given species. In this study, we developed abundance models with boosted regression trees for three stationary count datasets: 1) eBird, 2) Oregon 2020, and 3) the combination of both. We chose to model one common habitat generalist (Song Sparrow), and one less common habitat specialist (Western Meadowlark). We evaluated each model's predictive performance on each dataset. Models from the combined dataset consistently performed better than either independent dataset. Research on using professional surveys to calibrate eBird data to account for imperfect detection would further increase their value.

With multiple ways to respond to masking anthropogenic noise, is a species' characteristic response similar across populations? An examination of Song Sparrows, American Robins and Red-winged Blackbirds.

Hannam, Kristina - SUNY Geneseo; Juliana Merluccio - SUNY Geneseo

Birds that change their song when singing in habitats with high levels of anthropogenic noise are adaptively decreasing the masking effects of that noise. This is important because noise pollution can affect animals' fitness by hindering communication critical to mate attraction, territory defense and danger alerts. Birds can adapt by changing the frequency, timing or types of songs used when confronted with masking anthropogenic noise. Recent studies of songbirds in both Europe and North America have shown that some species commonly found in both rural and urban areas change one or more of

these song characteristics to minimize the effects of anthropogenic noise. With multiple ways to respond to masking anthropogenic noise, is a species' characteristic response similar across its range? This study is examining whether song characteristics identified as changing in response to anthropogenic noise in other populations change similiarly in *Melospiza melodia* (Song Sparrow), *Turdus migratorius* (American Robin) *and Ageleius phonecius* (Red-winged Blackbird) populations in New York's Genesee River Valley. Preliminary analysis from 2014 recordings suggest Song Sparrows and American Robins in our population are responding similarly in some ways to other populations of the same species. However, Red-winged Blackbirds may not be responding to anthropogenic noise in the same way other studies have reported. We will present updated analyses of recordings from 2014-2016 to examine this question.

Fine-scale mapping of coastal plant communities: a step towards conservation of salt-marsh obligate birds
Hantson, Wouter - The University of Maine; Brian Olsen - The University of Maine; Brittany Cline - Saltmarsh Habitat & Avian Research Program (SHARP); Dept of Entomology & Wildlife Ecology, University of Delaware; **Maureen Correll** - Bird Conservancy of the Rockies

Salt marshes of the northeastern United States are dynamic landscapes where tidal flooding regime creates patterns of marsh plant zonation based on differences in elevation, salinity, and local hydrology. These patterns of zonation can change quickly due to natural and anthropogenic stressors, making them vulnerable to degradation and loss. Both high- and low-marsh zones provide foraging, breeding, and staging areas for many bird species. Changes in marsh zonation can therefore have a drastic effect on bird populations, especially those specialized to tidal marsh such as the saltmarsh sparrow (*Ammodramus caudacutus*). We compared several remote sensing techniques to develop a remote sensing tool that accurately maps high- and low-marsh zonation of the northeastern coast of the United States. We found that Random Forests, an advanced set of machine-learning algorithms, outperformed other classifier tools when applied to the most recent National Agricultural Imagery Program (NAIP) imagery, NAIP derivatives, and elevation data. We then classified a 500-m buffer around National Wetland Inventory marsh areas at a 3-m resolution. Preliminary results based on an independent validation dataset show classification accuracies > 80%. To increase repeatability of this effort, we also applied an adapted classification scheme to Landsat 8 imagery over the same spatial extent, with preliminary success. The detailed output is a continuous map of tidal marsh vegetation communities between coastal Maine and Virginia. This layer can be used in habitat modeling of marsh-obligate species, including the saltmarsh sparrow, or repeatedly quantifying marsh habitats to monitor changes in marsh communities over time.

An Assessment of Population Genetic Structure in Black Guillemots in North America
Harkness, Bronwyn - Queen's University; Greg Robertson - Wildlife Research Division, Environment and Climate Change Canada; Vicki Friesen - Queen's University

Identifying genetically differentiated populations can be important for successful species conservation. If local populations become genetically differentiated then the loss of a population can result in partial loss of a species' genetic diversity, which can affect a species' ability to adapt to stressors. Black Guillemots (*Cepphus grylle*) are seabirds that are highly vulnerable to climate change, but we have little knowledge of their population genetics and demographics. These birds remain close to their breeding

colonies year-round and exhibit strong natal philopatry. An analysis of variation in mtDNA sequences from seven colonies in the North Atlantic and Arctic Oceans suggested that regional populations of Black Guillemots differ genetically and that gene flow may be limited. Inferences based on a single mtDNA locus are limited, however a genome-wide approach can allow us to investigate genome-wide differentiation, estimate gene flow rates more precisely, and identify potentially adaptive loci. I am conducting a genome-wide survey of genetic variation using double-digest restriction-site associated DNA sequencing (ddRADseq) to test the hypothesis that colonies of Black Guillemots are genetically distinct. Alternatively, Black Guillemots might comprise one large population that mixes genetically and demographically. With the knowledge gained from this research, we will be able to recommend to the Canadian Wildlife Service whether or not Black Guillemots should be managed as one vs. multiple population units.

Seaside Sparrow (*Ammodramus maritimus*) nest success following the Deepwater Horizon oil spill

Hart, Megan - Austin Peay State University; Philip Stouffer - Louisiana State University; Sabrina Taylor - Louisiana State University; Christine Bergeon-Burns - Indiana University; Andrea Bonisoli Alquati - Louisiana State University; Stefan Woltmann - Austin Peay State University

In 2010, the Deepwater Horizon Oil Spill released an estimated 4.9 million barrels of oil into the Gulf of Mexico, some of which damaged coastal ecosystems along the Gulf Coast. The Seaside Sparrow (*Ammodramus maritimus*) is a year-round resident of the salt marshes of southern Louisiana; these marshes were among the most heavily impacted areas from the spill. We monitored Seaside Sparrow nests in Plaquemines Parish, Louisiana from 2012-2015 in initially oiled and unoiled areas within the salt marsh. Nests were located and checked every 2-3 days until the anticipated date of fledging. Nests that were empty or destroyed prior to this date were categorized as failed and those whose nestlings survived to this date were considered successful. Preliminary analyses suggest that there were differences between oiled and unoiled sites in terms of the number of nests and nest success and that the effects of oil have diminished since 2012. We also note high inter-annual variation in both sparrow abundance and nest survival that is independent of the Deepwater Horizon spill. Ongoing monitoring will further our understanding of how other variables, such as storm surges from hurricanes or more patchy variation in nesting habitat and predation, influence nest success in this salt marsh obligate.

The importance of the US Fish and Wildlife Service's wetland habitat grant programs for migratory bird conservation in North America

Hartley, Mitch - Atlantic Coast Joint Venture, US Fish and Wildlife Service, Hadley, MA

The US Fish & Wildlife Service (USFWS) supports migratory bird conservation through many different programs and activities. The North American Wetlands Conservation Act (NAWCA) is an important funding source dedicated to the protection, restoration, and enhancement of habitat for migratory birds associated with wetlands. The NAWCA program provides competitive matching grants to partners working collaboratively to conserve habitats, with appropriated funds dedicated to the US (50%), Canada (45%), and Mexico (5%). Annual NAWCA funding exceeded $90M before 2012; appropriations have since declined with funding ranging from $55-85M in recent years (including fines and other restricted funds). The NAWCA program has shared origins with the bird habitat joint venture program, which established dozens of regional partnerships to coordinate bird habitat delivery efforts. In the Atlantic Coast Joint Venture, from Maine to Florida, partners received an average of $12M in NAWCA

funds over each of the last five years. Grants were matched by an average of $38M in partner work within project areas, resulting in 42,000 acres of habitat conserved annually on average (and more than two million acres total since 1989). This presentation will describe how NAWCA conserves wetland and upland habitats for birds, and how it targets particular species and areas. I will also describe the somewhat similar National Coastal Wetlands Conservation Grant program, another USFWS competitive grant (>$20M per year) focused on broad ecosystem benefits, including birds.

Intraspecific variation in the nocturnal flight calls of migratory passerines
Hasson, Rachel - University of Windsor; Jennifer Foote - Algoma University; Daniel Mennill - University of Windsor

Several techniques facilitate research on the nocturnal movements of migratory songbirds, but only acoustic monitoring technology can distinguish between species. Nocturnal flight calls are species-specific vocalizations produced by birds during migratory activity. Although there has been an increasing interest in the applications of nocturnal flight calls for migration research, many aspects of these vocalizations have received little attention and there is a dearth of information on inter- and intra-individual variation in nocturnal flight calls. The objective of our research was to quantify intraspecific variation in the nocturnal flight calls of migratory passerines in eastern North America. We recorded flight calls from temporarily-captive birds held at banding stations in southern Ontario. We also recorded flight calls from actively migrating birds used a microphone array that spanned the Great Lakes. In this study, we focus our analysis of intraspecific variation in three common species: American Redstart (*Setophaga ruticilla*), Ovenbird (*Seiurus aurocapilla*), and American Tree Sparrow (*Spizella arborea*). We generated spectrograms for thousands of calls and conducted spectrographic cross-correlation and principal coordinate ordination to compare flight-call recordings among conspecific individuals. We quantify structural variation in the calls of each of these three species. American Redstarts and Ovenbirds exhibited substantial variation in fine structural properties of calls, within and among conspecific individuals. American Tree Sparrows, in contrast, displayed much less variation in the acoustic properties of flight-calls within and among individuals. Our investigation is among the first to quantify intraspecific variation in the nocturnal flight calls of migratory songbirds.

A comparison of morphological and physiological traits between males and females of three sexually monomorphic songbirds
Hatch, Margret - Penn State Worthington Scranton; Robert Smith - University of Scranton; Greta Niedermeyer - University of Scranton; Kishan Patel - University of Scranton; Glenn Slick - Penn State Worthington Scranton; Erica Lasek-Nesselquist - University of Scranton

For many bird species, sex differences in physical and physiological characteristics are commonly reported, even in species where sex cannot be determined from plumage. As part of an on-going study of individual variation in migratory and immunological ecology we examined whether males and females differed in a variety of traits. Red-eyed Vireos (*Vireo olivaceous*), Gray Catbirds (*Dumetella carolinensis*), and White-throated Sparrows (*Zonotrichia albicollis*) were genetically sexed from DNA extracted from blood samples. Physical measurements included mass, wing chord and a body condition index. Physiological measurements included hematocrit, total plasma protein, and Haemoproteus counts. We also tested whether mean time of capture and mean day of capture differed between males and females. Preliminary results from the spring of 2015 yielded a sex ratio (M:F) of 5:8 for

catbirds, 4:5 for vireos and 1:2 for sparrows. As expected, mass and wing chord did not differ significantly for any species between males and females. Date of first capture also did not differ between male and female catbirds or vireos, but male sparrows were captured earlier than females. Hematocrit did not differ between males and females for any species. These preliminary results indicate that sampling birds of unknown sex for Gray Catbirds and Red-eyed Vireos should not lead to a bias at our study site since no significant differences were detected. However, for White-Throated Sparrows, timing of capture needs to be considered although males and females did not differ in other attributes.

People of a Feather - A feature documentary about a unique Inuit community the eider ducks they rely on for subsistence

Heath, Joel - The Arctic Eider Society

The 16x award winning and critically acclaimed feature length documentary People of a Feather (www.peopleofafeather.com), the New York Times calls “Stunning… Lyrical… Tugs at the Heart” supports charitable programs of the Arctic Eider Society (www.arcticeider.com) Synopsis: Featuring stunning footage from seven winters in the Arctic, People of a Feather takes you through time into the world of the Inuit on the Belcher Islands in Canada’s Hudson Bay. Connecting past, present and future is a unique relationship with the eider duck. Eider down, the warmest feather in the world, allows both Inuit and bird to survive harsh Arctic winters.
Traditional life is juxtaposed with modern challenges as both Inuit and eiders confront changing sea ice and ocean currents disrupted by the massive hydroelectric dams powering New York and eastern North America. Inspired by Inuit ingenuity and the technology of the world’s warmest feather, the film is a call to action for environmental stewardship and implementing energy solutions that work with nature.
Learn more about the Arctic Eider Society and People of a Feather at this poster presentation, copies of the film will be available.

Reproductively unsuccessful female Veeries incur a seasonal carry-over cost: A full life cycle approach using remote tracking technology

Heckscher, Christopher - Delaware State University; Mariamar Gutierrez - University of Massachusetts, Amherst; Alan Kneidel - Delaware State University

Full life cycle monitoring of individual migratory songbirds has been made possible by recent advances in tracking technology. Since 2009, we have deployed geolocators on Veeries at a breeding site in Delaware, USA. These efforts have been supplemented by nest searching and monitoring of the same individuals. In any given population, a subset of adults is likely to fail to fledge young for various reasons. Using geolocator data, we tested whether adult Veeries that were reproductively unsuccessful incurred a temporal seasonal carry-over cost versus those individuals known to successfully fledge young. We found no differences between unsuccessful and successful males. However, we did find a difference between unsuccessful and successful females: females that were unsuccessful in a given year entered South America later, and arrived at their first winter sites later, than successful females. The timing of settlement at second winter sites did not differ between the two groups suggesting the carry over cost was “corrected” by mid-season. However, there was a trend for unsuccessful females to exit South America earlier the following spring perhaps in an effort to return to breeding sites earlier to maximize the potential for reproductive success. These data suggest that reproductive failure can have consequences that affect an individual’s full

annual cycle and that temporal aspects of seasonal movement may in part be affected by life history events in a former season.

NOAA Fisheries' National Seabird Program: Science and Management to Support Seabirds
Henry, Annette - Southwest Fisheries Science Center, NOAA Fisheries; **Mi Ae Kim** - Office of International Affairs, NOAA Fisheries

NOAA Fisheries has been working on a broad suite of seabird issues since the early 1980s, work that involves seabird bycatch monitoring and reporting, coordination with other Federal Agencies (USFWS, and USGS), addressing Endangered Species Act issues, and collaborating with industry and academia to develop seabird bycatch reduction approaches. In 2001, NOAA Fisheries' National Seabird Program was established to formalize this work and with an explicit purpose of implementing the, then new, National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries, and Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds). In the fifteen years since its establishment, the program has grown to include scientists and managers in each of NOAA Fisheries' five Regional Offices, six Science Centers, and Headquarters offices, so as to focus on two primary priorities: use of seabirds as indicators of marine ecosystems, and mitigation of seabird bycatch in US fisheries and internationally through representation on US Delegations and interagency working groups. We provide here a brief overview of activities, accomplishments, and plans for the future.

Abundance and Distribution of Non-breeding Mallards in the Lower Mississippi Alluvial Valley
Herbert, John - Tulane University; Avishek Chakraborty - University of Arkansas; Luke Naylor - Arkansas Game and Fish Commission; David Krementz - USGS Arkansas Cooperative Fish and Wildlife Research Unit

The management of wintering waterfowl in North America requires flexibility because of constantly changing landscapes and conditions, yet a gap in knowledge still exists regarding waterfowl habitat use at the large spatial scale. Many mallards (*Anas platyrhynchos*) use the lower Mississippi Alluvial Valley (MAV) for wintering habitat, making this an area of emphasis for improving management strategies. In this study, we used mallard observation data from 2009-2016 aerial surveys collected in the Arkansas portion of the lower MAV to explain the abundance and distribution of mallards. Using spatial hierarchical models and breaking covariate data to 2x2 km grid cells, we analyzed how covariates relate to the changes of abundance and distributions among years. Mallard abundance and distributions responded positively to surface water along with the land cover habitat inundated by that water. Among covariates in the top model, surface water, rice fields, wetlands, and fallow (uncultivated) fields were used most by mallards. Our models also showed a strong spatial pattern of mallard abundance across the MAV suggesting that covariates other than the ones used here may be important in better explaining mallard distribution. Biologists in the lower MAV can use these results to better conserve and manage lands for mallards.

Local scale vegetation change effects on forest bird dynamics in Mid-Atlantic National Parks
Higgins, Conor - University of Delaware; W. Gregory Shriver - The University of Delaware; John Paul Schmit - National Park Service

The mid-Atlantic region of the United States is experiencing high rates of population growth, expansion, and urbanization. This is greatly affecting our natural areas, especially species composition and vegetative structure.

Interior forest breeding birds that are not resistant to edge effects are especially hard-hit by these changes. Avian communities are changed by functional guilds' differing responses to local pressures. Assessing these changes and their drivers is vital for management and shows the importance of land conservation. The National Park Service (NPS) National Capital Region Network (NCRN) consists of eleven parks including Civil War battlefields, urban parks, and large natural areas. The NCRN Inventory and Monitoring program has implemented a forest bird monitoring effort annually since 2007. Long-term monitoring provides valuable information that can be used to assess changes over time. Detecting trends in forest breeding birds is important if we wish to understand the effects of increasing urbanization and changes in vegetation structure. By analyzing differences in vegetation over 9 years and 14 metrics and using these data as covariates in regression analysis, we will learn the drivers of interior forest bird abundance and their magnitude. We used 11 bird species representing differing functional guilds to determine the impacts of vegetation change on bird abundance at the point scale. We found that species respond uniquely to vegetation changes, and have varying effects dependent on location. This research shows that local-scale management can affect bird abundances and can designed for species of conservation concern.

The sound of fear: bioacoustics reveal fine-scale responses of songbirds to predator cues across a logging gradient in Borneo

Hightower, Jessica - University of Florida; Rajeev Pillay - University of Florida; Robert Fletcher - University of Florida

Singing is a conspicuous behavioral activity in breeding songbirds. It is critical for mate attraction and territory defense, yet may also attract the attention of predators. To avoid predators, songbirds may often seek protective vegetation cover when singing. When vegetation structure is modified, as in the case of habitat change, the risk of predation may be altered. In the face of altered predation risk and habitat change, songbirds may potentially modify singing behavior (e.g. by reducing singing rates) as an anti-predator strategy. However, such alterations to behavior may eventually have deleterious consequences for breeding success. Thus, habitat change and predation risk may have potential synergistic effects on animal behavior. We experimentally tested the effects of perceived predation risk on population and behavioral responses of eight passerine species along a logging gradient in Sabah, Malaysian Borneo. During the breeding season, we manipulated the cues of three avian predators that prey on adult passerines. We coupled this playback scheme with a novel, bioacoustic sampling design to estimate abundance and per-capita singing rates before and after playbacks. We did not find synergistic effects of habitat change and perceived predation risk on either population or behavioral responses. However, our results suggest that breeding songbirds may respond to perceived predation risk by evacuating territories (reduced abundance post-playbacks) and via cryptic behavior (reduced per-capita song rates post-playbacks). Our results suggest that the cost of fear may potentially have a negative impact on singing behavior in breeding songbirds via both population and behavioral responses.

The effect of incubation temperature on Wood Duck duckling behavior

Hope, Sydney - Virginia Tech; Michelle Beck - Virginia Tech; Robert Kennamer - Savnnah River Ecology Lab, University of Georgia; William Hopkins - Virginia Tech

Incubation temperature is a critical parental effect that influences offspring quality in birds. For cavity nesting Wood Ducks (*Aix sponsa*), slight temperature changes (< 1°C) affect duckling morphology and physiology, but it is

unknown whether incubation temperature affects offspring behaviors that may be crucial to survival. To investigate this, we incubated Wood Duck eggs at three different ecologically relevant temperatures (35, 35.8, 37°C) and assessed duckling behavior with multiple behavioral trials between 1-15 days post-hatch. We found that incubation temperature produced a bold-shy continuum of behaviors. On day 1, fewer ducklings incubated at the lowest temperature successfully exited a nest box in response to Wood Duck hen call recordings compared to those incubated higher temperatures, which would likely lead to abandonment by the mother in the wild. Additionally, ducklings incubated at the middle temperature moved less in a novel environment and took longer to leave a sheltered environment than ducklings incubated at the low or high temperature, which indicates that they exhibited overall shier behaviors. Shy behaviors may be beneficial for predator avoidance, while bold behaviors may increase foraging success, and our study suggests that incubation temperature influences which behavioral strategy individuals display. Our study provides evidence that the early developmental environment has an effect on avian neonate behavior and offers insight into how non-genomic factors may influence behaviors important to early survival.

Geolocator tracking of great reed warbler (*Acrocephalus arundinaceus*) identifies key regions of importance to migratory wetland specialist throughout the Middle East and Sub-Saharan Africa

Horns, Joshua - University of Utah; Evan Buechley - University of Utah; Mark Chynoweth - University of Utah; Lale Aktay - Kuzey Doga; Emrah Coban - Kuzey Doga; Mehmet Ali Kirpik - Kuzey Doga; Jordan Herman - University of Utah; Yakup Sasmaz - Kuzey Doga; Çağan Şekercioğlu - University of Utah

Wetland-dependent, migratory songbirds represent one of the most vulnerable groups of birds on the planet, with over 67% of wetland obligate species threatened with extinction. One of the major hurdles in conservation efforts is determining the migration routes, stopover sites, and wintering sites of these species. Geolocators now allow biologists to monitor the long-distance movements of many smaller species. Herein, we describe a unique annual life cycle revealed by geolocator tracking of great reed warblers (GRW; *Acrocephalus arundinaceus*) breeding in the Middle East. Because of their relatively larger size and breeding ground fidelity, GRW is an excellent candidate for geolocator studies and can serve as an indicator species for other wetland songbirds, many of which are particularly threatened with extinction in the Middle East. This study revealed three key wintering sites in South Sudan, on the Indian Ocean coast, and on the western shores of Lake Malawi, and a critical stopover site in central Iraq. We also identified an unexpected counter-clockwise migratory path into and from Africa. Throughout the year, these birds encountered nearly 500 Important Bird Areas, over half of which had little or no protection. Many species of wetland songbirds, particularly threatened species, may be too rare or small to be the focus of similar studies. Therefore, our report on GRWs not only offers an interesting contrast to studies of GRW in Europe, but also reveals previously unknown stopover and wintering locations to target conservation efforts that will help wetland-dependent bird species in the Middle East.

Evaluating the Influence of Forest Herbicides on Offspring Sex Ratio in an Early-Successional Forest Songbird

Houtz, Jennifer - Department of Biology, Millersville University; James Rivers - Oregon State University; Brent Horton - Department of Biology, Millersville University; Matthew Betts - Oregon State University

Birds breeding within early-successional forests have undergone marked declines throughout North America due to changes in the quantity and quality of regenerating forests. Herbicides used in these habitats may impact breeding birds directly via physiological effects or indirectly through changes in habitat, and either mechanism may lead to subtle changes in reproductive output, including offspring sex ratio. Information on this topic is lacking, but data indicate offspring sex ratio shifts towards males as forest harvest intensity increases. We examined if forest herbicide use had a similar effect on offspring sex ratio of the White-crowned Sparrow (*Zonotrichia leucophrys*), a species that uses early-successional forest for breeding. We experimentally applied four herbicide treatments (i.e., light, moderate, and intensive herbicide levels, and a no-spray control) to recently harvested Douglas-fir (*Pseudotsuga menziesii*) stands in Oregon to create a continuum of management intensity. Across the 2013-2014 breeding seasons, we located >800 sparrow nests from which we obtained >1600 genetic samples from sparrow nestlings close to fledging. Results to date indicate that herbicide intensity is not linked to sparrow offspring sex ratio, although there was a tendency for the sex ratio to be female-biased in control stands (proportion female = 60.0%, n = 105) and male-biased in light herbicide stands (proportion male = 57.8%, n = 64). Analysis of our complete data set will provide a strong test of whether herbicide application influences offspring sex ratio, and determine the degree to which sex ratios are influenced by markedly different disturbances associated with forest harvest.

Species-specific effects of the 2015-16 El Niño event on seabirds breeding at Isla Española, Galápagos

Howard, Jennifer - Wake Forest University; Sebastian Cruz - Max Planck Institute for Ornithology; David Anderson - Wake Forest University

In the tropical Pacific, climate change is predicted to increase the frequency of El Niño-Southern Oscillation warm events (El Niño), which reduce marine productivity, alter rain patterns, and have serious consequences for marine taxa. Seabirds vary in response to the same event, with some colonies entirely failing to reproduce while others are only mildly affected. We monitored reproductive success for a colony of >2,000 breeding pairs of Nazca boobies (*Sula granti*), a tropical seabird, on Isla Española, the Galápagos, Ecuador, between 1984 and 2016. We recorded attendance data of swallow-tailed gulls (*Creagrus furcatus*) and collected breeding data of swallow-tailed gulls and red-billed tropicbirds (*Phaethon aethereus*) prior to (2004-2014) and during the 2015-16 El Niño. Ninety-six percent of Nazca booby nests initiated in 1997 failed during the 1997-98 extreme El Niño and we predicted initially that the 2015-16 event would result in similar poor reproductive success for seabirds breeding on Isla Española. Sea surface temperature anomalies in 2015-16 rose to levels comparable to the previous extreme El Niño in 1997-98, with unusually warm waters overlapping with peak nest initiation of Nazca boobies in December. However, several of the usual effects, such as a decrease in the easterly trade winds and an increase in rain, did not materialize on Isla Española as in 1997-98. Results from a population-level analysis comparing non-El Niño and El Niño fledging success (Nazca boobies), attendance data (gulls), and timing of breeding (gulls and tropicbirds) will be presented.

Altitudinal Migratory Behavior of a Neotropical Resident Bird Species in Costa Rica

Hsiung, Angela - University of Georgia; Richard Chandler - University of Georgia

Studies of avian altitudinal migrations are lacking despite the ubiquity of this form of short-distance migration. Furthermore, many altitudinal migratory bird species are residents of tropical forests which continue to be converted to agriculture at a rapid rate. Thus, it is important to examine movement patterns of these species in order to gain a deeper understanding of their seasonal habitat needs. The objective of this study was to describe the altitudinal migration behavior of a Neotropical resident bird species, the Long-tailed Manakins (*Chiroxiphia linearis*) within agricultural landscapes of Costa Rica. Constant effort mist-netting was conducted at four higher elevation (1000m-1200m) and four lower elevation sites (600m-800m) in our study area within the Rio Aranjuez watershed, Puntarenas, Costa Rica between January and March of 2016. Additionally, VHF transmitters were placed on 12 manakins at the lower elevation sites and tracked between January and April. A total of 82 *C. linearis* were captured (50 male, 32 female). The results showed that the abundance of *C. linearis* decreased slightly at lower elevation sites and increased at higher elevations over the study period (see figure). Telemetry data provided additional evidence of altitudinal migration, with 5 individuals moving from lower to higher elevations during the study. The difference between mean elevations before and after migration ranges from 150-385m, averaging 235 ± 96m. Our study provides the first evidence of altitudinal migration for *C. linearis*, and emphasizes the need for connectivity between habitat patches for similar species that were previously thought of as sedentary.

The infusion of information from the literature to improve and support management decisions that affect grassland birds.

Igl, Lawrence - USGS Northern Prairie Wildlife Research Center

Grasslands often are described as simple and two-dimensional. Such a simplistic perspective has led to semantic misconceptions concerning the spatial, temporal, and structural complexity of these early-successional habitats, their management, and the bird species that occupy them. The revelation that many grassland birds were declining throughout North America triggered a revolution in grassland bird ecology at the end of the twentieth century. To many avian ecologists and managers working in grasslands, these population declines represented both an undesirable situation and a tremendous opportunity. In an unprecedented turn of events, grassland birds slipped from near-obscurity to become the focus of an enormous amount of attention. Although loss, fragmentation, and degradation of grasslands often were implicated in grassland bird declines, in reality, the causes of the population declines were largely unknown. Managers in the prairie regions of North America began to question whether their management practices were actually benefiting grassland birds. In the ensuing years, researchers and managers convened at several workshops and meetings. Although experts agreed and disagreed on what they knew, what they did not know, and what they thought they knew about grassland birds and their responses to management, the discussions typically ended with the same basic question: What information is in the literature? In the mid-1990s, the US Geological Survey initiated one of the largest literature syntheses on North American grassland birds in existence. This presentation summarizes insights that can be drawn from this long-term effort.

The relationship of species diversification and morphological evolution in New World oscines

Imfeld, Tyler - University of Minnesota; Keith Barker - University of Minnesota

Seeking macroevolutionary explanations for differences in species richness and ecological diversity among lineages has long been a goal of evolutionary biologists. Variation among lineages in the importance of ecological speciation, in which ecological divergence drives speciation, is one explanation. In this study, we tested for a relationship between ecological differentiation, measured as morphological “disparification”, to species diversification. We hypothesized that if speciation is generally tied to ecological differentiation, then rates of species diversification and morphological evolution should be positively correlated. We measured ten standardized morphological characters from natural history collections of New World oscine songbirds, which represent at least 26 independent lineages that dispersed into the western hemisphere and subsequently speciated. These lineages provide spatially-controlled replicates with which to test for the presence of the relationship described in the hypotheses above. We found a positive relationship between rates of speciation and overall rates of morphological evolution ($r^2 = 0.803$) when all clades were included in the analysis. Emberizoidea, the most species-rich clade, also showed the greatest rates of morphological evolution and speciation. For particular characters, other smaller clades had higher rates of evolution (Vireonidae was fastest for wing length, New World Jays for tail length, etc.). These results suggest that ecological diversification of oscine passerines (as approximated by morphological disparification) is correlated with species diversification at a hemispheric scale. More generally, they also point to the continuing importance of ecological diversification to species accumulation even in the oldest lineages.

Avian response to shade-layer restoration in coffee plantations in Puerto Rico

Irizarry, Amarilys - North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University; Jaime Collazo - U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University; Krishna Pacifici - Department of Applied Ecology, North Carolina State University

Shade coffee plantations have played a historical role in fostering persistence of avian species in Puerto Rico. Cultivation of sun-coffee has been promoted in recent decades, effectively undermining the capacity of shaded coffee to provide ecological services that sustain biodiversity. In the last 12 years, the US Fish and Wildlife Services and the Natural Resources Conservation Services, have provided landowners with financial incentives and native shade trees to restore the shade-layer and maximize yields in their farms. Here, we seek to quantify the response (impact) of this management action on the resident avian community. Specifically, we estimate occupancy as a function of time since the implementation of the restoration action. Farms were classified in three groups: recently restored (2011-2014), intermediate (2007-2010), and initially (oldest) restored (2003-2006). We hypothesized that occupancy of frugivores/nectarivores would be higher in farms restored at the outset of the program, as structural heterogeneity would increase with time. Insectivores and granivores would occur more likely in recently restored farms. Results from 2015 tend to support the hypothesis. For example, occupancy for the PR Bullfinch (*Loxigilla portoricensis*), a frugivore, was 0.74 ± 0.09 in recently restored farms as compared to 0.94 ± 0.05 on farms restored >5 years. PR Vireo (*Vireo latimeri*), an insectivore, was 0.58 ± 0.15 in recently restored as compared to 0.47 ± 0.15 on restored >5 years. We present results including 2016 surveys, and discuss

conservation implications of results in light of conservation design initiatives in Puerto Rico.

Lights Out Baltimore: The Impacts of Buildings on Birds
Jacks, Lindsay - National Aquarium

Lights Out Baltimore (LOB) is a non-profit organization of the Baltimore Bird Club striving to make Baltimore safe for migratory birds by encouraging businesses to turn decorative lighting off and advocate for bird-friendly building design. Building collisions kill up to 1 billion birds in the United States every year. Since 2008, LOB volunteers have monitored a 5 mile downtown route 4 months a year and found over 2500 dead birds (93 species), rescued over 500 birds, and rescued 30 bats (4 species). Rare birds such as Yellow Rail, Mourning Warbler, and Dickcissel have been collected. In addition, LOB has found 31 species listed on Maryland's Department of Natural Resources Species of Greatest Conservation Need and 3 bird species on the state endangered list. LOB in collaboration with the National Aquarium and U.S. Fish and Wildlife Services are encouraging local businesses to turn lights out. The National Aquarium's conservation mission has lead other buildings to participate in LOB thus reducing the number of bird collisions in Charm City.

Avian Response to Extreme Weather Events: A Case Study using MAPS data
Jaffe, Nicolas - Oklahoma State University; Timothy O'Connell - Oklahoma State University; Mona Papeş - Oklahoma State University

Extreme weather is among the most impactful aspects of climate change and is projected to increase in frequency in many regions of the world. Research studies across disciplines have linked extreme weather events to numerous natural processes, yet their ecological roles are not fully understood. Avian species are widely recognized as indicators of climate change due to their inherent sensitivity and responsiveness to weather patterns. Though the effects of weather extremes have been well documented in case studies with birds, few are conducted at broad spatial and temporal scales and fewer yet address more complex issues such as variability across species, functional groups, and ecoregions. The south central United States is uniquely suited to address these questions. The region is known for its severe weather, features diverse ecoregions, and is home to hundreds of species of breeding birds. We examine how the timing, magnitude, frequency, and combination of extremes affect different species of inland birds, specifically those native to Oklahoma and Texas. Through climatologically aided mapping, we derived various indices of temperature and precipitation extremes from 1992-2007, based on deviations from historical climate (1951-1980) data. Combined with demographic and vital rates data from the Institute for Bird Populations' MAPS program, we analyze how summer weather extremes impact bird population dynamics during the breeding season. Comparing variability across species, functional groups, and habitat type, we evaluate their vulnerability to extreme events and effectiveness as indicators of broader climatic impacts.

Does urbanization affect timing of bird migration in Brazil's Atlantic Forest?
Jahn, Alejandro - Universidade Estadual Paulista "Júlio de Mesquita Filho" - UNESP; Karlla Barbosa - Universidade Estadual Paulista "Júlio de Mesquita Filho" - UNESP

Landscapes across the planet have been changed rapidly due to human activities such as agriculture, livestock, forestry and urbanization. Although urban green areas are very important for many bird species, research from temperate regions shows that nest predation rates can be higher and resource levels lower in urban vs. rural areas, lowering reproductive success and survival.

However, little research on urban tropical avian ecology has been conducted, even though the tropics is where avian diversity is greatest and where cities are rapidly growing, invading native habitats. In southeastern Brazil, where urbanization is widespread in states such as São Paulo and Rio de Janeiro, research on diversity, population dynamics, ecology and behavior of migratory birds in urban vs. rural areas are scarce or non-existent. With a population of 20 million people, the city of São Paulo (Fig. 1) is the seventh most populous urban area in the world, and is located within the Atlantic Forest biome, one of the most threatened hotspots globally. Although only a fraction of intact Atlantic Forest remains, the forest fragments that are located both within and outside of the city of Sao Paulo provide breeding habitat to hundreds of species of migratory and resident birds. This poster will provide a review of what is known about the urban ecology of Neotropical birds and will outline my doctoral research on this subject in southeastern Brazil.

Do intra-tropical migratory Fork-tailed Flycatchers (*Tyrannus savana*) perform molt-migration in South America?

Jahn, Alex - Universidade Estadual Paulista; Vanesa Bejarano Alegre - Universidade Estadual Paulista; Marcela Benavides Guzmán - Universidade Estadual Paulista; Ivan Celso Carvalho Provinciato - Universidade Estadual Paulista; André Guaraldo - Universidade de Brasilia; Maggie MacPherson - Tulane University; Marco Pizo - Universidade Estadual Paulista; Nathaniel Seavy - Point Blue

Fork-tailed Flycatchers (*Tyrannus s. savana*) breed from central to southern South America from September to January, migrating to northern South America to overwinter. However, little is known of the migratory route of those that breed in Brazil. In 2013, we attached light-level geolocators to Fork-tailed Flycatchers breeding in São Paulo State, Brazil. Data for six male flycatchers recaptured in 2014 indicates that they exhibited two fall migration strategies. Some individuals migrated northwest to the wintering grounds (primarily Colombia, Venezuela and northern Brazil), while others first moved to spend several weeks (in January and February) in southwestern Brazil before moving to the wintering grounds. During a visit to southwestern Brazil (Mato Grosso do Sul State) in February 2016, we discovered a roost of >100 flycatchers and captured one female that was molting primary feathers. This is the furthest south that this species has been found molting flight feathers and provides evidence that flycatchers breeding in eastern Brazil move to southwestern Brazil to molt after breeding. A detailed understanding of the timing of migration and molt of birds that migrate within South America is essential to evaluate the evolution of their life history strategies, interactions between seasons and potential risks to their survival across a rapidly changing landscape.

Population Genetic Structure and Diversity of Ruffed Grouse

Jensen, Ashley - University of Lethbridge; Theresa Burg - University of Lethbridge; Andrew Iwaniuk - University of Lethbridge

Investigating population genetic structure can answer questions about a species' evolutionary history, including population connectivity. Moreover, identifying dispersal patterns is important due to the role sustained population connectivity plays in maintaining genetic diversity. The Ruffed Grouse (*Bonasa umbellus*) is a widespread galliform species that varies in color from gray to red. The frequencies of the color morphs throughout their range appears to be clinal, with red birds more common in warmer, more humid environments, and gray birds predominating the colder and drier regions. This cline is evidence of local adaptation to environmental conditions, and suggests isolation of Ruffed Grouse populations. To investigate potential genetic differentiation among populations of

Ruffed Grouse, we examined two nuclear genetic markers: Aldolase-B and Slc45a2. Allele frequency data for these loci show distinct patterns of differentiation between central and southern Alberta populations, which suggests limited dispersal between these populations. Possible causes are geographic or anthropogenic barriers, such as tracts of unsuitable habitat, agricultural development or urbanization. Further analyses with more samples and genetic markers (mitochondrial and microsatellite) are being conducted to aid in interpreting the population genetic structure of Ruffed Grouse, both locally in Alberta, and range wide. Our results will shed light on gene flow patterns, genetic differentiation and the evolutionary history of Ruffed Grouse.

Prealternate molt of the Western Tanager: age and sex differences in timing, latitude, and intensity

Johnson, Cecilia - The College of New Jersey; Michael Donahue - University of Washington; Sievert Rohwer - University of Washington; Luke Butler - The College of New Jersey

We describe the prealternate molt of the Western Tanager (*Piranga ludoviciana*) on the wintering grounds in Mexico and Central America. We collected body molt data from museum study skins and tested for the possibilities of sex and age-class differences in the timing, location, and intensity of feather replacement. Molt started and peaked slightly earlier in males than in females. Molters of both sexes were common in the southern portion of the wintering range in Central America, but males (molting and non-molting) were more common than females in the northern portion of the wintering range in northern Mexico. Within each sex, subadults and adults exhibited similar molt timing and location. Molt of subadult males started early and exhibited a broad peak in intensity, contradicting the hypothesis that female-like subadult plumage in male tanagers is an adaptation for the wintering grounds. Together these results suggest sex differences in winter molt dynamics that may reflect pressure on male Western Tanagers to return earlier to the breeding grounds to claim breeding territories.

Long-term trends in body condition of raptors during fall migration along the Kittatinny Ridge in Pennsylvania

Johnson, Chelsea - Kutztown University; Todd Underwood - Kutztown University; Laurie Goodrich - Hawk Mountain Acopian Center; Gerald Lahr - Little Gap Banding Station

Large seasonal migration movements offer unique study opportunities of animal populations and their health. In this study, we examined long-term trends in body condition indices of four raptors (Cooper's Hawk, *Accipiter cooperii*; Northern Goshawk, *Accipiter gentilis*; Red-tailed Hawk, *Buteo jamaicensis*; and Sharp-shinned Hawk, *Accipiter striatus*) during fall migration using a 37-year dataset from the Little Gap Banding Station in Danielsville, PA. A body condition index uses body measurement data to estimate fat reserves and represents an index to physical health of raptor populations. First, we determined whether body measurements differed by age and sex to determine how to group data for long-term analysis. Second, we created a body condition index by dividing body mass by wing chord. We found that average body mass and wing chord was significantly influenced by sex in all four species. By comparison, age significantly influenced body mass in all study species along with wing chord in three of four species. Because of these differences, we examined trends in body condition over time separately by sex and age within each species. A linear regression of annual body condition index by year showed significant increases only in male after hatch year Cooper's Hawks, female hatch year and after hatch year Cooper's Hawks, hatch year Red-tailed hawks, and male after hatch year Sharp-shinned Hawks. No decreases were found in

body condition over time for any of the study species. Our results provide further support that migratory raptor populations are stable and healthy.

Grazing-inducecd plant responses cascade to multiple trophic levels: implications for offspring quality of grassland songbirds

Johnson, Tracey - University of Idaho; Sandra DeBano - Hermiston Agricultural Research and Extension Center, Oregon State University; Patricia Kennedy - Eastern Oregon Agricultural Research Center, Oregon State University

Herbivory affects plant morphology and phenology and can result in changes to invertebrate communities. Altered prey availability may influence diet of insectivorous songbirds and ultimately offspring quality or quantity. While herbivory represents a complex disturbance, in managed systems stocking rate can determine effects on vegetation, and potentially, other trophic levels. To better understand relationships among stocking rates, songbird diet composition, and offspring quality, we examined nestling growth rates and diet composition of four grassland songbird species breeding in paddocks with experimentally-manipulated stocking rates in a Pacific Northwest bunchgrass prairie. We compared nestling diet composition with invertebrate abundance in paddocks to examine the effect of stocking rate on dietary preferences. All songbird species showed strong preferences for Lepidoptera, and preferences for Coleoptera and Araneae in some paddocks. Preferences did not change with higher stocking rates even though paddock-level abundance of Lepidoptera decreased. Western meadowlark and vesper sparrow nestlings had reduced dietary proportions of Lepidoptera and reduced growth rates with higher stocking rates. Nestlings of all species had reduced dietary proportions of Coleoptera, and all but western meadowlark nestlings had increased proportions of Homoptera with higher stocking rates. We hypothesize adult songbirds of some species were not able to compensate for reduced availability of preferred prey for nestlings in paddocks with heavier grazing. Our results suggest that high stocking rates as applied in our experiment may reduce suitability of breeding habitat for some grassland songbirds through a loss of feeding opportunities.

Using occupancy and natural population models to target regional grassland bird conservation.

Joos, Cara - Central Hardwoods Joint Venture; Chris Lituma - West Virginia University; David Buehler - University of Tennessee; Clark Rushing - Smithsonian Institute Migratory Bird Center

The Central Hardwoods Joint Venture (CHJV) is a partnership of state and federal land-managing agencies and non-governmental conservation organizations working together to insure the long-term viability of native bird populations across the Central Hardwoods Bird Conservation Region (CHBCR). Many CHJV priority grassland breeding bird species have experienced dramatic population declines since the inception of the Breeding Bird Survey. Targeting habitat conservation in areas most likely to be occupied by species of conservation concern and, further, in areas of greatest decline are two strategies we can use to reverse these trends. Here we demonstrate how the combination of regional maps of occupancy and natural population structure, exhibited by geographic patterns in population trends, may guide more effective and efficient on the ground habitat management activities across the CHBCR. First, we modeled occupancy of five priority grassland nesting species based on 5000 points counts conducted throughout the CHBCR. We then used the coefficients from the most supported model for each species to build spatially-explicit regional occupancy maps. Next we used Breeding Bird Survey data to delineate spatially explicit natural

population structure for these five species. Knowledge of how trends vary spatially helps planners to investigate which habitat factors may contribute to geographic variation in productivity and allows managers and practitioners to allocate limited resources most efficiently. This exercise demonstrates how science can be directly applied to the kinds of on-the-ground conservation needed to reverse declining population trends of migratory birds.

Molt-migration of thrushes, warblers and other passerines in eastern Canada.
Junda, James - McGill Bird Observatory, Migration Research Foundation; Marcel Gahbauer - McGill Bird Observatory, Migration Research Foundation; Simon Duval - McGill Bird Observatory, Migration Research Foundation

Molt and migration are two of the most energetically demanding life history events in the annual cycle of birds. Molt was traditionally believed to complete prior to migration in most North American passerines, but in recent years molt-migration has been documented for several species in western North America. In 2013 and 2015, extensive molt-migration was documented in four species at McGill Bird Observatory in Montreal, Quebec. Large proportions of adult Swainson's Thrushes (64%; N=53), Tennessee Warblers (69%; N=42), Nashville Warblers (67%; N=45) and Yellow-rumped (Myrtle) Warblers (49%; N=45) underwent part to all of their prebasic molt while stopping over at McGill Bird Observatory. The mean length of stopover for molt-migrants ranged from 4.95 days for Myrtle Warblers to 8.85 days for Swainson's Thrush, with some individuals staying for at least 47 days. Nonmolting migrants spent an average of 1.00 (warbler species) to 1.16 (Swainson's Thrush) days on site with only two recaptures in total. Molt migration was also documented at lower frequencies for seven additional species: Black-and-White Warbler (1), Blue-headed Vireo (2), Blackburnian Warbler (1), Cape May Warbler (1), Magnolia Warbler (1), Northern Parula (3) and Ruby-crowned Kinglet (1). Our findings suggest that a more concerted focus should be put on documenting molt-migration at other eastern banding stations. The large number of locations and ease of collecting these data could quickly expand our knowledge of the range of species undertaking molt migration in eastern North America and the spatial and temporal extent of this phenomenon.

Sing for your spouse: Acoustic paternity guarding in a duetting songbird
Kahn, Zach - University of Windsor; Daniel Mennill - University of Windsor

In many species of tropical birds, breeding partners combine their songs into coordinated vocal duets. Although duetting occurs in diverse avian families, and across as many as 15% of all songbirds, the functions of vocal duets remain contentious. One hypothesis that has received little empirical attention is the Paternity Guarding Hypothesis. This hypothesis states that duets are a product of competition between the sexes, where male birds advertise their partner's paired status by singing in response to female song. We tested the Paternity Guarding Hypothesis in a duetting songbird: the Rufous-and-white Wren. We presented a two-part playback experiment to territorial males. In part one, we simulated a neighbouring male seeking an extra-pair copulation. In part two, we simulated the songs of the playback subject's female partner, providing the subject with opportunities to create duets. We repeated this experiment to birds during the pre-breeding period and again during the female fertile period. Our results suggest that male Rufous-and-white Wrens change their duet responsiveness during periods of female fertility. Our results also suggest that male solo song output and male physical response to the loudspeaker changed with female fertility status. Our results provide support for the growing view

that duets can be conflict-based signals between breeding partners, and therefore provide new insight into the functions of song in duetting species.

Correlations Between Total Mercury (Hg) measured in whole blood (WB) and packed cell volume (PCV) in passerines with a focus on Northern Waterthrushes (Parkesia noveborensis)

Keenan, Patrick - Biodiversity Research Institute; Kevin Regan - Biodiversity Research Institute; Evan Adams - Biodiversity Research Institute; David Evers - Biodiversity Research Institute

Northern Waterthrush (*Parkesia noveborensis*) are recognized as indicators of environmental Hg contamination and existing data suggests there is exposure across the life cycle of this species. When collecting tissue samples, researchers should strive to maximize the utility of each sample. At a migration banding station, we collected blood samples from passerines for a mercury (Hg) monitoring study as well a serosurvey for Eastern Equine Encephalitis virus (EEEv). We collected two blood samples from a subset of birds captured to determine if Hg in the packed cell volume (PCV) is a good indicator of Hg in the whole blood (WB). We observed a strong correlation between Hg in total blood compared to PCV (PCV Hg=1.9865(WB Hg)-0.0266, r2=0.9743, n=17), suggesting that Total Hg in PCV is a relatable measure of Total Hg in whole blood and that Hg is highly retained in the PCV. Additionally, the proportion of PCV in the blood sample had a small effect on the amount of Hg in the whole blood. These results provide data that support the utility of the preservation of blood components for analyses that address different questions. These data also show that Northern Waterthrush are exposed to Hg on their breeding grounds or during migration at levels above the lowest observed effects level.

A reassessment of the systematics and biogeographic history of Troglodytes wrens.

Keith, Katrina - Texas A&M University; Sergei Drovetski - Smithsonian Institution; Gary Voelker - Texas A&M University

A recent phylogeographic study utilizing one mitochondrial gene (ND2) assessed relationships across the Holarctic distribution of the (former) winter wren (Troglodytes troglodytes). The study recovered six clades, and developed a historical biogeographic hypothesis. Lineage diversification can be explained by 5 vicariance events, and proliferation into the six clades corresponded with the Early and Middle Pleistocene glaciation which began periodic separations between and within the Nearctic, Palearctic, and Beringia. These cladescorresponded to six major geographic regions: Europe, Caucasus, Nepal, eastern Asia, western Nearctic, and eastern Nearctic. Based on these results, the winter wren was split to recognize T. troglodytes (Eurasia), *T. hiemalis* (eastern North America) and *T. pacificus* (western North America). Although rather well sampled, that study did not provide strongly supported relationships among most clades. Our present study incorporated 55 total specimens of T. troglodytes representing previously sampled localities, along with additional samples from Morocco, Lesvos and Crete, and Crimea. We also included 10 samples each of *T. hiemalis* and *T. pacificus*, along with several other wren taxa as outgroups. We utilized a combination of mtDNA (ND2) and nuclear gene loci (ACO1, 24206, TGFb, 12619, 12021, ACL) in conjunction with model-based analyses to construct a more robust phylogenetic hypothesis of relationships within T. troglodytes, interspecific relationships among Troglodytes. We used this phylogeny to reassess the biogeographic history of the genus.

Dispersal and behavior of post-fledging House Wrens

Kennedy, Dale - Albion College; Douglas White - Albion College; William Hart Davis - Albion College; Stephanie Thurner - Albion College

Our understanding of the population biology of many species is limited by lack of information on behavior and survival of post-fledging birds, largely due to difficulty in following them from when they leave the nest until they disperse or migrate. Working in Michigan in 2015 we color banded nestling House Wrens (*Troglodytes aedon*) to indicate brood. We documented locations of nest sites and sightings of fledged juveniles using a handheld GPS unit. Although some parents and young moved off our study area fairly quickly, we were able to find juveniles from 15 of 17 early nests for at least five days (range 5-83 days, mean = 26 days) after fledging. We located juveniles from 21 of 22 late nests for at least four days (range 4-71 days, mean = 28 days). In both early and late broods, juveniles were observed in natal groups, often with one or both parents, for 13-18 days. After that time, juveniles that were seen were either alone or in groups of young wrens from several nests, typically in shrubby edge habitats outside their natal territory. In addition, we recorded scold calls and subsongs of several juvenile wrens. Overall, we were able to monitor dispersal and behavior of some juvenile wrens much longer than we had expected.

Management of threats faced by avian fauna at Mangla Dam: A neglected wetland for migratory birds

Khan, Bushra - University of the Punjab

The Mangla Dam of Azad Jammu and Kashmir is the 9th biggest dam of the world. This deep fresh water lake is located (33.12 N, 73.39 E) 30 Km North West of Punjab province in Pakistan. The site was visited 42 times from 2011-2014 to access the ornithological fauna with point count method. During three years of birds population assessment highest count were 57,892 birds belongs to 188 species during 2011-2012, 54,311 birds of 186 species in 2012-2013 and 52,682 birds of 187 species in 2013-2014 steady decrease in avian population was observed. Among these birds *Sterna acuticauda* was endangered, *Prinia burnesii*, *Anhinga melanogaster*, *Aythya nyroca* and *Circus macrourus* were near threatened, and *Ficedula subrubra*, *Saxicola macrorhyncha* and *Haliaeetus leucoryphus* were vulnerable. Various threats like pollution, illegal hunting, agriculture runoff, poverty, illiteracy and poor law enforcement were observed at site. To address the issues a sustainable management plan has been proposed to conserve and protect the avian fauna with following recommendations:-

- Immediate need to conserve the threatened species
- Immediate ban on hunting.
- Strict law enforcement with implementation of wildlife act on equality basis.
- Awareness of community to value the biotic resources.
- To be declared as RAMSAR site to attract international organizations for involvement of conservation projects.

Androgen metabolite measurement in Eastern Bluebird (*Sialis sialis*) nestlings.

Khan, Memuna - Ripon College

Non-invasive measurements of androgen metabolites in bird droppings are employed as a valuable tool to correlate hormones with growth, plumage coloration, and behavior. However, evaluating androgen metabolites in bird droppings requires that analytical techniques be carefully validated. Hormone metabolite composition and concentration may be influenced by avian species, an individual's gut microbiome, diet, sex, and age. Noninvasive techniques to measure androgen metabolites have not been previously validated in the Eastern Bluebird (*Sialia sialis*). Blood plasma and droppings were collected from nestling bluebirds that

had been injected with either chicken GnRH or saline control. Blood plasma results indicate that the HPG axis was not mature in nestlings 10 days after hatch; a rise in testosterone was not detected in nestling blood plasma 30 or 60 minutes post-injection. The testosterone antibody used in this study cross-reacted with metabolites in nestling excrement. Nestlings injected with saline did not exhibit increased metabolite measurements suggesting that stress hormone metabolites were not interfering with the assay.

Do differences in female reproductive timing influence gene flow in seasonal sympatry?

Kimmitt, Abigail - Indiana University, Bloomington; Ellen Ketterson - Indiana University

Population differences in reproductive timing due to partial migration can limit gene flow. Some migratory and sedentary (resident) populations exhibit seasonal sympatry during winter and early spring prior to spring migration. If residents initiate breeding before the departure of migrants, interbreeding may occur during overlap. In dark-eyed juncos, a species that exhibits seasonal sympatry, migrant males have been found to lag behind residents in testis size and testosterone in captivity. Far less is known about the impact of migratory behavior on the reproductive development of females, despite the obvious importance of female timing to gene flow. We predicted that similarly to males, resident females would advance to reproductive condition earlier than female migrant juncos. We held 38 females in captivity and collected a blood sample at three time points: (1) mid-March, prior to migration, (2) early May, during migration and early breeding season for residents, and (3) mid-June, during allopatry. Blood samples were analyzed for triglycerides as indicators of VLDL, a female yolk precursor. Triglyceride levels remained low, so we could not detect a difference in timing of reproductive development between the migrants and residents. A second study was conducted in the field, in which blood samples were taken during the period of seasonal sympatry. By recognizing whether female reproductive readiness plays a role in the occurrence of interbreeding between seasonally sympatric populations, we will be able to better understand the role of migration in population divergence.

Waterfowl Migration Chronology and Associated Wetland Food Production at Great Swamp National Wildlife Refuge

Knox, Sean - Frostburg State University; Meta Griffin - Frostburg State University; Dorothy Wells - U.S. Fish and Wildlife Service; Frank Ammer - Frostburg State University

Waterfowl rely on a long line of stopover sites during migration between their wintering and breeding grounds. Along with naturally occurring wetlands, managed wetlands serve as valuable locations where waterfowl can rest and feed. To effectively manage wetlands for certain waterfowl species, knowledge of area-specific migration trends and wetland food production is key. This study documents the waterfowl migration chronology and associated food production of five managed freshwater wetlands located within Great Swamp National Wildlife Refuge, Morris County, New Jersey. To determine migration chronology, weekly ground surveys were conducted in the spring and fall of 2015 and 2016 using protocols based on the Integrated Waterbird Management and Monitoring Program for the North Atlantic Region. Food production will be quantified by sampling for aquatic invertebrates, seeds, and vegetation during spring and fall migratory seasons, and will be expressed in terms of biomass (kg/ha). Preliminary results from 2015 migration surveys show that 14 species were detected during spring and fall migration. The most common species include Wood Duck (*Aix sponsa*), Canada Goose (*Branta canadensis*), Mallard (*Anas platyrhynchos*), Green-winged Teal (*Anas*

crecca), and American Black Duck (*Anas rubripes*). Data collected in 2016 will include migration surveys, summer vegetation composition surveys, and spring/fall biomass sampling. Data from this study will serve as a baseline reference for the Refuge and will assist Refuge staff in management efforts to support the greatest diversity of migrating waterfowl.

Exploring the function of carotenoid signals using carotenoid- and ornament-free birds

Koch, Rebecca - Auburn University; Geoffrey Hill - Auburn University

Carotenoid-based coloration in bird species has become a classic example of an honest signal of male quality used in female mate assessment; however, the mechanisms linking carotenoid coloration to male immunocompetence and/or oxidative stress maintenance remain contested. The prevailing hypothesis to explain the honesty of carotenoid-based coloration posits that carotenoid pigments are a limited resource that must be differentially allocated either to ornamental coloration or to boosting beneficial physiological processes such that only healthy birds of good condition can afford to produce a high quality ornament. In this study, we use a novel system of canaries (*Serinus canaria*) with knock-out mutations to directly test the importance of carotenoid pigments to immune and antioxidant processes and to search for a "cost" of allocating pigments to ornamentation. During the annual molt—when yellow canaries are actively depositing carotenoids into their feathers—we compared measures of immunocompetence and oxidative stress in canaries with and without circulating carotenoids (carotenoid-rich vs. carotenoid-free birds), and canaries with and without ornamental feather coloration (yellow vs. white canaries). Interestingly, we found no significant differences in antibody production to a novel antigen (a measure of humoral immunity), whole blood bacterial killing capacity (innate immunity), or measures of blood-based oxidative damage and antioxidant capacity between canaries with different carotenoid availability or ornamental usage. Our results question the hypothesis that carotenoid pigments are essential to proper physiological function, and that the honesty of carotenoid coloration is maintained by the costs of allocating the pigments to coloration.

SWIFT: A small, low-cost acoustic recorder for terrestrial wildlife monitoring applications

Koch, Robert - Cornell Lab of Ornithology; Raymond Mack - Cornell Lab of Ornithology; Peter Wrege - Cornell Lab of Ornithology; Holger Klinck - Cornell Lab of Ornithology

The effectiveness of acoustic wildlife monitoring efforts is often limited by the total number of field-deployed recording units. Therefore challenging funding environments can significantly hinder species and habitat conservation relying on acoustic monitoring techniques. The goal of the SWIFT project was to develop a small and inexpensive (< $250) recording unit which allows weeks-long continuous acoustic data collection in harsh environments in support of conservation efforts. The SWIFT electronics are housed in a weather and climate proof enclosure and designed to be left unattended for prolonged periods of time. The recorders' small size and light weight allows for easy set-up and deployment. Settings such as audio sampling rate, gain, and recording start/stop time can be easily configured with the SWIFT configuration utility PC software. The recorder features selectable audio sampling rates between 8 and 96 kHz (16-bit resolution) and a single SD memory card slot (currently) allowing for up to 512 GB of data storage. The output of the exchangeable microphone can be amplified by up to 47 dB. The low power design allows for continuous data collection of up to 1.5 months (at 8 kHz sampling rate) while running on three D-cell alkaline batteries. [Project partially funded by

the Kenneth L. Harder Trust and the Cornell Lab of Ornithology].

Demographic history inferred from genome-wide data together with morphological analyses reveals two lineages of sheldgeese endemic to a glacial refugium in the southern Atlantic: Taxonomic and Conservation Implications
Kopuchian, Cecilia - Centro de Ecología Aplicada del Litoral (CECOAL)- CONICET; Leonardo Campagna - Fuller Evolutionary Biology Program, Cornell Lab of Ornithology and Department of Ecology and Evolutionary Biology, Cornell University; Adrian Di Giacomo - Centro de Ecología Aplicada del Litoral (CECOAL)- CONICET; Robert Wilson - Institute of Arctic Biology and University of Alaska Museum, University of Alaska Fairbanks; Mariana Bulgarella - Department of Entomology, University of Minnesota; Pablo Petracci - GEKKO–Grupo de Estudios en Conservaci_x0001_on y Manejo, Departamento de Biolog_x0001_ıa, Bioqu_x0001_ımica y Farmacia, Universidad Nacional del Sur; Juan Mazar Barnett - Aves Argentinas; Ricardo Matus - Centro de Rehabilitaci_x0001_on de Aves Leñadura; Olivia Blank - Centro de Rehabilitaci_x0001_on de Aves Leñadura; Kevin McCracken - Department of Biology and Department of Marine Biology and Ecology, Rosenstiel School of Marine and Atmospheric Sciences, University of Miami

Species endemic to archipelagos worldwide illustrate the importance of geographic isolation in the process of speciation. The Malvinas/Falkland Islands (MFI) constitute the largest archipelago in the Southern Atlantic, located ~450 km east of Tierra del Fuego (Patagonia); and harbor endemic lineages that evolved after ancestral populations became isolated during the Pleistocene glaciations. Various bird species have populations on the continent and the MFI that are not genetically differentiated, suggesting geographic isolation may not be enough to reduce gene flow, and thus allow diversification. Two species of sheldgeese, *Chloephaga picta* and *Chloephaga rubidiceps*, have populations that are co-distributed between the MFI and Patagonia and show opposing demographic trends: while insular populations are increasing in size, continental ones are in sharp decline, due mainly to anthropogenic causes. We combined a genomic approach with analysis of morphological data to quantify differentiation among insular and continental populations of both species, and used coalescent-based analyses to model their demographic history. Our results show that the MFI harbor independently evolving lineages of *C. picta* and *C. rubidiceps*,which diverged from their continental counterparts during the Pleistocene and have since experienced negligible gene flow. We conclude that the distance that separate the archipelago from the continent is sufficient to isolate populations of these vagile species. This implies that without appropriate conservation measures, the drastic decline of the morphologically, behaviorally and ecologically distinct continental population of C. rubidiceps, may lead to the extinction of an independently evolving taxon.

Monitoring Migrating Passeriformes of the Eastern Flyway for Avian Influenza
Korey, Heather - University of North Georgia-Gainesville; D.E. Lubeski - University of North Georgia; L. B. Purvis - University of North Georgia

The current threat of Avian Influenza on the health of commercial poultry is of major concern. The possibility of transmission from wild birds to domestic flocks is well documented. The main reservoir of Avian Influenza in wild bird population is believed to be in the Anseriformes and Charadriiformes, therefore these two groups have received ample attention. Avian Influenza has also been documented in several Passeriformes species, which migrate annually and cross paths with each other as well as the ducks and shorebirds.

Published studies about songbirds that migrate along the Atlantic coast, or Eastern Flyway is sparse, however. Songbirds using this migratory route are the focus for our research. We have evaluated the best sample collection methods and testing techniques accessible to us. The use of oropharyngial and cloacal samples is promising – resulting in consistent viral detection data while remaining relatively un-invasive for the birds. In-house culturing of the samples, at the University of North Georgia, is currently being explored for technique, feasibility, financial commitment and equipment availability. Documentation of Passeriformes of the Eastern Flyway that test positive for Avian Influenza is of importance. We hope to use such data to determine the species and regions that are at highest risk of transmission to the commercial poultry flocks in those areas.

The 2012-13 irruption of Razorbills into Florida

Kratter, Andrew - Florida Museum of Natural History

The usual winter range of the Razorbill (*Alca torda*) extends coastally from Nova Scotia south to North Carolina. Prior to the winter 2012-13, Razorbills were almost unknown in Florida, with fewer than 15 total records. Through a combination of events in the late fall of 2012 (high surface temperatures in the North Atlantic, Hurricane Sandy), unprecedented numbers of Razorbills moved south beyond their usual wintering areas. Unable to find adequate food, the birds continued moving south, eventually reaching Florida, and then the Florida Keys. Observations of over 400 Razorbills in one day off Miami-Dade County hint at the scale of this movement. Many birds then continued north along the Gulf coast reaching northwestern-most Florida, Alabama, and one making it all the way to Louisiana. The birds suffered considerable mortality in these unfamiliar waters. Carcasses were collected for the FLMNH through contacts in wildlife rehabilitation clinics and beach patrols. A total of 69 Razorbills specimens was prepared for the ornithology collection at the FLMNH. Through necropsies during preparation sex, age, condition, gut contents, parasitic infestation were documented. Of 66 individuals aged, 62 were birds that were hatched the previous summer. All birds were in poor physical condition, with atrophied flight muscles. Stomachs were empty. Macro-parasite levels were low or absent. It appeared that nearly all the mortality resulted from starvation.

Life History and Demography of the Mariana Crow (*Corvus kubaryi*)- Implications for Conservation

Kroner, Andria - Binghamton University; Sarah Faegre - University of Washington; Henry Fandel - University of Washington; James Ha - University of Washington; Renee Ha - University of Washington; Dacia Wiitala - University of Washington

The Mariana crow (*Corvus kubaryi*) is a critically endangered island endemic species, and managers are currently planning a formal rear-and-release program on the island of Rota, in the Northern Mariana Islands, where the last wild population of Mariana crows remain. Demographic parameters (e.g. age and sex-specific fertility and mortality) are critical values for accurate species-specific population modeling for wildlife and conservation managers in programs such as this. However, these models are only as good as the accuracy of the values used to calculate reproduction and survival for a particular species, and the demographic values themselves may change over time with changes in population management, the habitat , or population-specific characteristics such as inbreeding levels. Here we present both new and updated demographic parameters of the Mariana crow, including lifespan and lifetime reproductive success from 26 years of mark-resight records and 23 years of nest monitoring. Some of these values differ notably from prior estimates,

which were last evaluated in 1999, while others have not been previously reported. We also present results from 7 years of radio-telemetry on age-specific survival and mortality. These longitudinal records provide accurate parameters for future population modeling, and raise the question of whether demographic changes have occurred over time.

Assessing the evidence for a split repertoire in a tropical wood-warbler
Kulkarni, Apoorva - University of Lethbridge; David Logue - University of Lethbridge

Temperate-breeding new world warblers (Parulidae) are said to sing split repertoires because their song types fall into two distinct categories (type I and type II). The two categories are characterized by distinct usages and structures, and have been hypothesized to serve distinct functions. We tested for a split repertoire in Adelaide's warbler (*Setophaga adelaidae*), a year-round territorial tropical warbler endemic to the islands of Puerto Rico and Vieques. A previous study found subtle structural differences between songs sung before dawn (when temperate warblers sing type II songs) and after dawn (when they sing type I; C. Staicer, 1996, Acoustical features of song categories of the Adelaide's Warbler, The Auk 113: 771-783). That study leaves open the possibility that Adelaide's warblers do not sing split repertoires because it did not quantitatively test for discrete differences in usage among song types. We quantified several song-usage variables that typically characterize song classes, but we did not find evidence of two discrete song classes (n = 9499 songs, 9 males). We conclude that although both song usage and song structure vary over the course of the day, Adelaide's warblers do not sing split repertoires. This finding raises the question of whether tropical warblers generally lack the discrete song categories that typify their temperate cousins.

Monitoring House Finch movements across a variable landscape using radio-frequency identification technology
Kusack, Jackson - Thompson Rivers University; Matthew Reudink - Thompson Rivers University; Nancy Flood - Thompson Rivers University

Movement within a landscape is highly influenced by habitat loss and fragmentation, caused by urbanization. Small scale movements provide a means for facilitating gene flow, accessing resources, and avoiding predators, which are necessary components for healthy songbird populations. Traditional methods of recording movement events require an observer to monitor stationary points at different times. This process is a highly labor intensive process, and is limited by the detectability and timidity of your target species. The objective of this study was to develop and test a system in which movement events of songbirds could be monitored autonomously, in real time. To achieve this goal, we developed and implemented a radio-frequency identification birdfeeder system to autonomously track overwintering House Finch (*Haemorhous mexicanus*) movement events across the Thompson Rivers University campus. Passive integrated transponder (PIT) tags were placed on leg bands of overwintering House Finches, allowing for unique identification of visitation events. Using these data points, we determined movement events for tagged individuals through temporally sequential visitation events for a unique individual. Over a one month period of autonomous recording, this system recorded a total 817 movements between feeders by 23 banded House Finches. While this work represents a pilot study towards implementing a permanent network of RFID birdfeeders, this results demonstrates the power of an autonomously recording RFID birdfeeder system for collection of data.

Assessment of the Impact to Cranes from a Newly Constructed Transmission Line
Lacy, Anne - International Crane Foundation

Avian collisions are a human-caused wildlife conflict that can be reduced, saving the lives and preventing suffering of cranes and many other species. The International Crane Foundation is involved in a two year investigation of avian power line collisions and methods to reduce or eliminate risk to cranes. We have a unique opportunity to study crane use pre- and post-construction for a 345 kv transmission line. We have completed preconstruction bird counts to document crane use and flight corridors. Next steps involve analyzing these data to determine areas of highest risk and make recommendations to the utility for safer line heights and placement of marking devices. Post construction analysis will involve repeating bird surveys, recording bird behavior in response to the power line, and testing the effectiveness of different bird flight diverters. Many bird species are at risk for power line collision. As the demand for renewable energy increases, more power lines will be constructed in areas critical to migrating birds. This study will provide data for utility companies to reduce avian collisions by proactively lowering tower heights and marking lines with the most effective technologies available in important bird areas. Our goal is to reduce or eliminate the collision risk to migrating cranes and other large bodied birds resulting from this new construction in Wisconsin and apply what we have learned toward power line construction in other regions.

Intraspecific variation in the nocturnal flight calls of migratory passerines
Landsborough, Blaine - University of Windsor; Rachel Hasson - University of Windsor; Jennifer Foote - Algoma University; Daniel Mennill - University of Windsor

Several techniques facilitate research on the nocturnal movements of migratory songbirds, but only acoustic monitoring technology can distinguish between species. Nocturnal flight calls are species-specific vocalizations produced by birds during migratory activity. Although there has been an increasing interest in the applications of nocturnal flight calls for migration research, many aspects of these vocalizations have received little attention and there is a dearth of information on inter- and intra-individual variation in nocturnal flight calls. The objective of our research was to quantify intraspecific variation in the nocturnal flight calls of migratory passerines in eastern North America. We recorded flight calls from temporarily-captive birds held at banding stations in southern Ontario. We also recorded flight calls from actively migrating birds used a microphone array that spanned the Great Lakes. In this study, we focus our analysis of intraspecific variation in three common species: American Redstart (*Setophaga ruticilla*), Ovenbird (*Seiurus aurocapilla*), and American Tree Sparrow (*Spizella arborea*). We generated spectrograms for thousands of calls and conducted spectrographic cross-correlation and principal coordinate ordination to compare flight-call recordings among conspecific individuals. We quantify structural variation in the calls of each of these three species. American Redstarts and Ovenbirds exhibited substantial variation in fine structural properties of calls, within and among conspecific individuals. American Tree Sparrows, in contrast, displayed much less variation in the acoustic properties of flight-calls within and among individuals. Our investigation is among the first to quantify intraspecific variation in the nocturnal flight calls of migratory songbirds.

Going the distance: what drives within-winter movements of snow buntings?
Laplante, Marie-Pier - Université du Québec à Rimouski; Oliver Love - University of Windsor; François Vézina - Université du Québec à Rimouski

Seasonal bird migration between the breeding grounds and wintering areas is a well-described phenomenon. In addition to seasonal migratory activity, birds may also engage in other types of movements, notably during the wintering period. Weather and food availability are presumed to be the main drivers of winter movements in birds, yet these patterns remain poorly described in most species due to low banding recovery and challenges associated with tracking technology. The snow bunting (*Plectrophenax nivalis*) is a circumpolar Arctic-breeding songbird, whose North American populations winter in the central latitudes of the continent. In winter, this species is thought to have a highly nomadic behavior, although the environmental cues prompting snow buntings to perform long-distance movements are unknown. We analyzed historical banding and meteorological data from Eastern Canada to assess the role of weather and snow cover in driving winter nomadic movements in snow buntings. Preliminary results indicate that for a given location, the sex ratio of birds changes throughout the winter, with more males being present on colder and snowier days. These results suggest that females are forced to move out when conditions deteriorate, owing to temperature-mediated physiological constraints associated with their smaller body size. These results could also be explained in the context of male dominance over food resources, whereas females are forced to move in periods of severe weather because they are unable to feed.

Combining Doppler radar with eBird to quantify winter occupancy and autumn migration dynamics of an aerial insectivore
Laughlin, Andrew - University of North Carolina Asheville; Daniel Sheldon - University of Massachusetts Amherst & Mount Holyoke College; David Winkler - Cornell University; Caz Taylor - Tulane University

For seasonal migrants, non-breeding regions can play different roles in their annual cycles: as stopover habitat, overwintering habitat, or as a combination in which some individuals stop-over and others over-winter. Such functional variations can lead to variation in occupancy dynamics and migration phenology to these different regions. In this study, we used data from archived Doppler weather surveillance radar to compare site-occupancy and movement dynamics of a migratory songbird (Tree Swallow, *Tachycineta bicolor*) between two non-breeding regions: southeastern Louisiana and central peninsular Florida, USA. Specifically, in each region, we 1) quantified long-term (1996–2012) non-breeding season occupancy dynamics, 2) quantified variation in timing of autumn migration, and 3) tested which climate variables along their respective flyways were best correlated with variation in dates of arrival. Additionally, we cross-validated the dynamics from archived radar with data from eBird, a large-scale citizen science database that provides an independent measure of avian occupancy. We found strong and significant correlations between radar-estimated and eBird-estimated occupancy dynamics in both regions. Long-term occupancy dynamics suggest that Louisiana acts as a combined stopover and overwintering region, whereas Florida acts as a traditional winter region. Arrival to Louisiana during the study period was much earlier and took place over a much shorter arrival window than did arrival to Florida, which showed a gradual arrival

over the course of several months. At both sites, annual variation in mean arrival date was best explained by the amount of precipitation along the lower portions of their respective migration flyways.

Understanding migratory connectivity of Red Knots (*Calidris canutus*) in the northern Gulf of Mexico

LeBlanc, Delaina - Barataria-Terrebonne National Estuary Program; David Newstead - Coastal Bend Bays & Estuaries Program

Occurrence of Red Knots (*Calidris canutus*) in the western Gulf of Mexico has been poorly understood until the past decade. Marking and re-sighting efforts coupled with advancements in tracking technologies have begun to elucidate the migratory connectivity of the birds occurring in Texas and the importance of certain areas that appear to be critical for the species. Previously, reports of Red Knots in Louisiana were not considered of major importance to the species because numbers of birds were relatively low compared to other calidrids. We captured knots in south Louisiana in spring of each year since 2014, and conducted extensive surveys incorporating resights. The results suggest strong fidelity to the area at least during the spring season, while multiple reports from as far away as southern Chile indicate additional connections may be more common than previously considered. In spring of 2016, small VHF transmitters (nanotags) were applied to a number of birds in both Texas and Louisiana. These tags are designed to be detected by the widening MOTUS network of stationary receiver stations that have been placed along other parts of the gulf coast as well as sites in the Atlantic and Central flyways. The information from these tagging efforts is providing new information on the connectivity of these populations.

Space invaders: House sparrow density shifts along urban-agricultural landscapes in native and non-native cities

Lee, Jeffrey - UCLA; Ian MacGregor Fors - Inecol; Javier Quesada - Universitat Autònoma de Barcelona; Pamela Yeh - UCLA

One of the most successful urban wildlife invaders is the house sparrow (*Passer domesticus*). While many previous studies have examined house sparrow success there has been no direct ecological comparison of house sparrow success in different urban conditions in both native and non-native areas. Here, we estimated house sparrow densities at five different conditions in the urban-agriculture landscape of three cities, one where the house sparrow is native, Barcelona (Spain), and two where the sparrow is non-native, Los Angeles (United States) and Mexico City (Mexico). In addition, we measured habitat traits, including vegetation, urban structure, and human-disturbance levels. We used distance-sampling corrected density estimations, general linear mixed models, and regression trees to analyze the data. We found the highest density of sparrows in Mexico City and the lowest in Los Angeles. In both cities, we recorded the highest abundances in highly urbanized areas. In Barcelona, abundances did not differ among conditions. In non-native cities, the presence and abundance of house sparrows were primarily related to habitat traits associated with highly urbanized urban areas. In the native city, vegetation traits were the strongest predictor of house sparrow presence and abundance. Although this study only considers three urban-agricultural landscapes, our results suggest that the success of the house sparrow as an exotic invasive can vary among cities and is determined by habitat traits that differ from those found to shape their numbers in its native distribution.

Light-level geolocator data from a Mongolian population of Northern Wheatear (*Oenanthe oenanthe*) reveals further evidence of migratory connectivity

LePage, Heather - University of Oklahoma; Eli Bridge - Oklahoma Biological Survey; Nyambayar Batbayar - Wildlife Science and Conservation Center of Mongolia; Bolormunkh Erdenekhuu - University of Exeter

The Northern Wheatear (*Oenanthe oenanthe*) is a small, long-distance migratory passerine with a widespread breeding range across the northern hemisphere. Wheatears breeding in eastern Canada make a transoceanic flight to Greenland and down coastal Europe to winter in western Africa. Populations from western Canada and Alaska migrate over much of northern Eurasia to eastern Africa. Geolocators are miniature devices that are used to locate and track individuals at a global scale by recording light intensity levels several times daily. These recordings are downloaded upon recapture of the geolocator and translated into coordinates uncovering the individual's movements over an extended period of time. We recovered four light-level geolocators from a breeding population of wheatears in Mongolia. Data from the geolocators revealed that these individuals migrated west to Israel and south to their wintering area in the Central African Republic. This study, combined with the results of previous studies, reveals that wheatears have population-specific wintering sites across northern sub-Sahara Africa with little to no overlap, exhibiting a strong pattern of migratory connectivity. The study of connectivity has implications for conservation as environmental change in the wintering region of wheatears affects the entire arctic breeding population.

History of Vehicle Collisions on the Endangered Nene (*Branta sandvicensis*)

Lepczyk, Christopher - Auburn University; Jean Fantle-Lepczyk - University of Hawaii at Manoa; Kathleen Misajon - National Park Service; Darcy Hu - National Park Service; David Duffy - University of Hawaii at Manoa

Millions of birds in the US die annually due to vehicle collisions on roads, which is a concern for species of conservation concern. One species affected by vehicle collisions is the endangered Hawaiian goose (Nene) which is endemic to Hawaii. Using a 40-year data set of Nene mortality in and around Hawai'i Volcanoes National Park we ask: 1) has Nene mortality changed over time and space? 2) are there times of the year in which mortality is greatest and does it relate to specific events in the species lifecycle? and, 3) does mortality rate show any density dependence? A total of 92 Nene died from vehicle collisions, with mortality increasing over time. Mortality was greatest in December and November (breeding season) and lowest in June. Between 1995 and 2013 the Nene population size and mortality rates were not strongly correlated. These findings suggest vehicle collisions are a growing concern for Nene.

How well do local-scale cumulative effects models predict boreal bird abundance at larger spatial extents?

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Department of Biological Science; Fiona Schmiegelow - University of Alberta / Department of Renewable Resources; Samantha Song - Canadian Wildlife Service, Environment Canada

Analyses of cumulative effects on bird abundance are usually at smaller spatial scales like point counts for greater power to detect effects and control variation in environmental factors of interest. Accuracy of predicted abundance from these models at larger spatial scales must be validated before these predictions can be used in conservation planning. We used cumulative effects data (forestry and energy sector effects) from multiple point count studies to predict abundance of 64 boreal bird species at landscape scales (63-ha area within 150 m of nine point counts). While regionally abundant species and habitat specialists were better predicted at landscape scales by local-scale models, abundance of most species within individual landscapes was not accurately predicted or classified by local-scale models, as measured by R2 or proportion of explained dependent variable deviance (< 0.25 for most species). We ranked landscapes according to predicted abundances from models, divided landscapes into ten equally sized quantile groups, and calculated average observed and predicted abundances of each species per landscape in these quantile groups. There were strong relationships between the observed and predicted average abundances (R2 > 0.25 for most species), suggesting how we might apply predictions from local-scale models to conservation planning at landscape scales. While we cannot accurately predict abundance of most species in individual landscapes, the top 10% (or 20 or 30 %, etc.) of these ranked landscapes will have greater average abundance of species of interest, and can be prioritized for conservation planning.

Complex adaptation to high altitude: A case study using complete mitogenomes

Liang, Bin - Hainan Normal University; Ning Wang - University of Florida; Edward Braun - University of Florida; **Rebecca Kimball** - Department of Biology, University of Florida; Wei Liang - Hainan Normal University

High-altitude adaptation has been studied extensively in mammals and birds. As a widely distributed species that inhabit various altitude levels, the tree sparrow (*Passer montanus*) is a perfect model to study high-altitude adaptation. Since adaptation to lower temperature and hypoxia is essential to survivorship at high altitude, and mitochondria play an important role in aerobic respiration through oxidative phosphorylation, we sequenced complete mitochondrial genomes from 30 individuals of tree sparrow, ranging from North to South China and occupying areas with different altitudes (from sea level to ~ 4300 m). Two additional mitogenomes of tree sparrows from Anhui province (low altitude) from Genbank were also added to our dataset. The maximum likelihood tree for the two rRNAs and 13 protein coding genes largely clustered samples into two major groups. One comprised sparrows from Tibet and Hainan, which formed sister clades. The second clade included all other sparrows (except for one individual from Zhanjiang). It has been suggested that mutations in COX genes could influence the kinetics of cytochrome c oxidase that catalyzes oxygen transport capacity in oxidative phosphorylation. Thus, non-synonymous substitutions found in COX genes might play an important role in high-altitude adaptation in tree sparrows. Further analyses of positive selection will be conducted to discover whether the mitochondrial genome aids in adaptation to high-altitude in tree sparrows.

Breeding biology of Fire-tailed Myzornis in an alpine environment in Southwest China

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We studied the breeding biology of the *Myzornis pyrrhoura* in an alpine environment of the Gaoligong Mountains in southwestern China during the breeding seasons of 2013 and 2014. Nests were built by both sexes and mainly contained mosses and Rhododendron flakes. They were located on vertical banks or rock faces. This species was socially monogamous, and sexually dimorphic both in plumage and size. Egg-laying was mainly initiated in mid April and ended in early July. The clutch size averaged 2.91 ± 0.54 (n = 11) and fresh egg weighed 1.84 ± 0.19 g (n = 11). Males and females contributed nearly equally in all the breeding activities including incubating, provisioning, brooding, and nest sanitation. Incubation lasted for 15 d (n = 1) with a notably high nest attendance (eggs were incubated 99.48% of the time). The total provisioning rates were 6.52 ± 1.82 trips per hr, a rate that did not change significantly through the nestling period, whereas the percentage of time adults spent on brooding decreased. Nestlings fledged at 19.67 ± 0.33 (n = 3) days after hatching, when they were 19% heavier than the adults. Growth of nestlings followed logistic model except for the tail length. Overall, reproductive success was 42.86%. Compared with other lower-elevation confimilials, Myzornis had larger and heavier nests, fewer but larger eggs, and a longer nestling period. These life-history traits may facilitate reproduction in the cold, cloudy conditions that occur even during the breeding season, even in tropical alpine areas.

To swab or not to swab: Amplification of DNA using buccal swabs instead of blood in New World Warblers (Family Parulidae)

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Genetic studies have been used to investigate many aspects of avian ecology, evolution, and conservation for decades. Extracting DNA from blood and feathers from live birds has been effective, but can be painful to the bird, causing stress and decreasing survival. Buccal swabs, wherein cheek epithelial cells are collected, have been used in many (usually large) taxa. Despite a seminal work in birds in 2006, few studies have used buccal swabs in birds, and never in New World Warblers (Family Parulidae) in any of the 19 studies with blood or feathers extracted from more than 3000 warblers since 2007. In this study, we directly compared the utility of buccal swabs and blood for investigating two types of commonly studied nuclear DNA, microsatellite loci and sex-specific chromosomal DNA, in two species of warblers, Worm-eating warblers (*Helmitheros vermivorus*) and Ovenbirds (*Seiurus auracapilla*). We extracted 50 ul of blood from brachial veins and buccal swabbed the same birds. We subsequently attempted to sequence and score 12 microsatellite loci and sex chromosome loci. Using paired t-tests and Chi-squared tests, we found no difference in the number of successfully scored loci using either method of tissue collection in either species. Although further verification is warranted to ensure that other types of sequences, such as mitochrondrial DNA and SNPs, are amplified with buccal swab DNA, this study demonstrates that buccal swabs may be successfully used for genetic research in

birds as a less invasive means to obtain DNA.

Sundaland's east-west rainforest population structure: Variable manifestations in four polytypic bird species examined using RAD-Seq and plumage analyses

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A current model of rainforest population diversification in Sundaland specifies east-west vicariance during the early Pleistocene followed by dispersal and parapatric contact. To investigate the plurality of the manifestations of this divide, we studied genetic structure and plumage variation of two muscicapids (*Copsychus saularis* and *Kittacincla malabaricus*) and two babblers (*Mixornis gularis* and *Trichastoma malaccense*). All four species exhibit east-west genetic and plumage differences, but vary in degrees of differentiation, locations and shapes of secondary transition zones, and timing of divergence. *K. malabaricus* and *T. malaccense* each comprise two divergent Bornean lineages that replace each other abruptly in northeastern Borneo. In *K. malabaricus*, genetic transition coincides with a sudden plumage change, whereas in *T. malaccense* plumage change is clinal. In *C. saularis*, both plumage and genetic transitions occur gradually over a wide area of Borneo. *M. gularis* on Borneo consists of only one population; its east-west genetic break occurs between Borneo and western Sundaland (not inside Borneo), although it exhibits plumage variation across Borneo similar to *T. malaccense*. We hypothesize that clinal plumage variations of the two babbler species are driven by environmental gradients. The abrupt plumage transition in *K. malabaricus* is due to substantial reproductive isolation between two old lineages. *C. saularis* populations diverged much more recently and plumage forms from different parts of Borneo are meeting each other and becoming admixed.

Prevalence of avian haemosporidia across a hybrid zone in the western United States

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Avian malaria parasites are vector generalists and consequently have a wide geographic distribution and a broad range of avian hosts. Some studies have looked at prevalence of avian malaria among species and within species, but few studies have assessed malaria prevalence across sister species that hybridize. The Western Scrub–Jay (*Aphelocoma californica*) contains two lineages that differ ecologically and hybridize across a narrow hybrid zone in western Nevada. We assessed avian haemosporidian parasite prevalence in Western Scrub–Jays collected from the coastal and interior lineages and the hybrid zone. To determine infection status, we used nested PCR to amplify a well-characterized region of cytochrome b of both Plasmodium and Haemoproteus and Sanger sequencing to distinguish between types. Most of the avian malaria we detected was Haemoproteus. Of the 75 total individuals we tested, 53 were infected, with a much higher prevalence in the coastal lineage (95.8%) than the interior lineage (54.5%) or hybrid zone (66.6%). Niche models suggest that environmental conditions near the coast may be better suited for malarial vectors than the arid

conditions found in interior Nevada, which likely explains the higher prevalence of avian malaria in the coastal lineage.

Evaluation of a fine-grained landscape conservation planning tool for songbird conservation in the Northeastern United States.

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The Designing Sustainable Landscapes Landscape Capability (LC) models are fine scale (30x30m), broad-extent spatial models developed for use in conservation planning for vertebrate species. These models provide spatial maps of landscape capability for species of conservation priority in the 13 state northeastern region of the United States. The LC indexes relative ability of map cells to support territories or home ranges of focal species. While similar to habitat suitability indices, LC additionally explicitly incorporates relevant home-range scales, with blocks of suitable habitat arranged in suitable configurations of sufficient size ranked higher than isolated blocks. LC also incorporates climate and landscape change models to project forward to 2080 in 10-year increments. Use of LC for conservation planning is contingent upon understanding spatial scales and contexts in which models are useful predictors of songbird abundance and occurrence. We used a compilation of 35 independently collected point count datasets to assess LC-predicted presence/absence and abundance for seven forest bird species: Blackburnian Warbler (*Setophaga fusca*), Blackpoll Warbler (*Setophaga striata*), Ovenbird (*Seiurus aurocapilla*), Wood Thrush (*Hylocichla mustelina*), and Louisiana and Northern Waterthrushes (*Parkesia motacilla* and *P. noveboracensis*). We accounted for incomplete detection by modeling availability and perceptibility using conditional maximum likelihood. The DSL's LC score was correlated with occupancy and occurrence at a point-level, although results varied among species and metrics. Nonetheless, we found that LC provides a useful tool for assessing bird habitat at fine scale over a broad extent.

Comparison of sexual characters in two sister species of the genus Tachycineta that differ markedly in their mating system

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Sexual selection can favor the competitive ability of the individuals of one sex to fertilize individuals of the other sex (e.g., increased gonadal size and production of sperm cells, increased body size), or it can favor the development of characters in individuals of one sex that are attractive to the other sex (e.g., nuptial plumage, ornaments). Usually, the intensity of sexual selection is reflected on the reproductive behavior of individuals, resulting in different mating systems. In birds, extra-pair matings occur in the majority of species, leading to intense sperm competition, and the evolution of mechanisms of sexual selection. The objective of this work is to compare gonadal volume in males and intersexual differences in size within the context of the theory of sexual selection in two sister species in the genus Tachycineta, *T. meyeni* and *T. leucorrhoa*, that show substantial variation in extra-pair paternity as a result of extra-pair matings (13% and 61-78% of nests have mixed paternity, respectively). We collected data on testes and body size from museum voucher

specimens. The two species differed in size but we did not find significant differences in size between males and females for any of the two species studied. We failed to find differences in testes volume between species even after correcting by size. We did not find the expected relationship between intensity of sexual selection, and testes volume and body size. We hope this study will contribute to a better understanding of when and how evolutionary change in reproductive characters occurs.

Using feathers to monitor mercury: weak correlations to internal tissues suggest limitations

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Monitoring mercury exposure in avian populations is critical to understanding the effects of this neurotoxin. Avian mercury exposure is commonly evaluated by measuring mercury concentrations in internal tissues, blood, and feathers. Feathers are a popular sampling matric due to ease of sampling and limited stress to birds. However, it remains unclear if feather mercury is representative of the mercury load in the body, which is more relevant to toxicological evaluations. Furthermore, it is unclear which feathers should be sampled, given that mercury sequestration patterns across feather tracts are poorly understood. To better understand these patterns, we tested variation in mercury concentration across five feather tracts (crown, breast, belly, back, flank) in 37 salvaged songbird specimens in the Thrush (N=22) and Sparrow (N=15) families. We then compared feather mercury concentrations to those of internal tissues in the same birds, to test the relationship between feather and body mercury load. Preliminary results indicate high variability in mercury concentrations across feather tracts and reveal no discernable trend. Factors that may influence mercury sequestration across feather tracts include: species and feather size. Preliminary results also suggest a high correlation between liver and muscle mercury concentrations, but weak mercury correlations between internal tissues and feathers. These results suggest that feather sampling may not be reliable for monitoring mercury in songbirds. However, we show a stronger mercury correlation among internal tissues and another keratinaceous structure - toenails, which, unlike feathers, grow continuously. Further investigation into the viability of toenails as a mercury sampling method is needed.

The influence of habitat and landscape associations on breeding birds in managed grasslands of Southwest Michigan

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Grassland birds are nationally experiencing a significant population decline primarily due to conversion of habitat to agricultural and industrial uses. We conducted 7 weeks of point count surveys, vegetation surveys, and surrounding landscape analyses to determine what habitat characteristics, landscape features, and management practices act as attractors or detriments to grassland birds. Four management types were analyzed for their effect on grassland bird diversity: restored prairie, mixed management, Conservation Reserve Program (CRP), and mowed airport fields. We specifically surveyed the presence of Henslow's sparrows (*Ammodramus henslowii*), grasshopper sparrows (*Ammodramus savannarum*), bobolinks

(*Dolichonyx oryzivorus*), song sparrows (*Melospiza melodia*), field sparrows (*Spizella pusilla*), eastern meadowlarks (*Sturnella magna*), and savannah sparrows (*Passerculus sandwichensis*). Mowed airport fields had the greatest mean diversity (H' = 1.436) with CRP fields the second greatest (H' = 0.474). Restored prairies and mixed management sites had the smallest mean diversity (H' = 0.068 and 0, respectively). Among the dominant vegetation types found, fescue grasses (*Festuca spp.*) had the highest correlation with diversity at a magnitude 78.4% greater than goldenrods (*Solidago spp.*) and 123.8% greater than big bluestem (*Andropogon gerardi*). Edge effect was an important indicator of species found during point counts. Our models showed urban areas have a high correlation with diversity, including both fields surrounded by urban areas (1-km radius from center of each field) and fields directly adjacent to urban areas (R2=0.868 and R2=0.699, respectively).

Hábitat occupancy by the American kestrels (*Falco sparverius*) at the Mexican highland plateau: effects of vegetation structure, prey abundance, and landscape composition

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The Amercian kestrel is a widely distributed raptor within the American continent. Northern populations of the species migrate to central and south America in winter season. There are also year-round residents in Central Mexico. In recent decades, significant declines of kestrel population from USA and Canada have been recorded. Some potential causes include the use of pesticides for agriculture and habitat loss. Migration routes, and wintering grounds have not been studied, and the status of resident populations is not well known. We investigated potential effects of vegetation structure, abundance of prey, and landscape composition on occupancy patterns by the American kestrel at a semi-arid region in the central Mexican high plateau, where both resident and wintering populations are present. Five habitat occupancy models were fit to the data for each climatic season. Model support by the data was compared using the Akaike Information Criterion (AIC). Occupancy probability was smaller for the spring-summer season in comparison to the fall-winter period. During the spring-summer season, habitat occupancy was negatively related with shrub and herb height and cover, and increased with abundance of arthropods which may be an important source during the breeding season. Contrastingly, during the fall-winter (non-reproductive) season habitat occupancy increased with mice abundance and decreased with shrub and herb height. Overall, our results suggest that the maintenance of open fields with moderate plant cover in which prey are abundant would probably be a feasible management strategy to promote the presence of kestrel populations in semi-arid scrublands of central Mexico.

Conservation action implementation, funding, and population trends of birds listed on the Endangered Species Act

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Current rates of species endangerment and extinction are unprecedented in modern times. Conservation efforts aim to slow down, stop, and reverse threats to species and thus the current loss of biodiversity.

However, the extinction risk to species continues to rise. Thus far, research has examined the efficiency and the effectiveness of conservation actions individually, yet, the full suite of implemented conservation actions should be considered. We assessed all implemented conservation actions for avian species listed under the Endangered Species Act (ESA) in the United States. Using data available through the US Fish and Wildlife Service (USFWS) we assessed the relationships between conservation actions implemented, population trends, and financial expenditures for all listed species each year between 1996 and 2013. We found positive associations between the amount of funding allocated for a species and their population trend. Implementation of the conservation actions habitat protection and educational awareness were positively associated with annual funding for a species. Our results highlight the disparity in conservation action implementation and resource allocation between ESA listed species on the mainland and on islands in the USA. Together these results and the cause and effect relationships they suggest could provide a pathway toward more effective conservation programs.

Do Non-Native Birds Facilitate Seed Dispersal for Critically Endangered Hawaiian Lobeliads?

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Effective seed dispersal networks are crucial for functioning tropical plant populations. Land managers on Oahu, Hawaii have been attempting to establish self-sustaining populations of endangered lobeliads for decades, yet recruitment among restoration sites varies drastically. Mechanisms behind this variation may be associated with limited seed dispersal. Evidence suggests that non-native birds may be serving the missing role left vacant by extinct native birds. Still, the relative impact of introduced birds on rare native plants has not been fully studied. I investigated the use of restoration sites on Oahu by non-native birds and the consumption of lobeliad fruit. I conducted avian surveys and deployed game cameras in restoration sites. Preliminary evidence suggests that non-native birds are visiting and consuming fruits of *D. waianaeensis*, but not *C. superba*. Rat predation of lobeliad fruit is likely a limiting factor in plant recruitment. Additionally, many restoration sites have lower abundances of birds compared to surrounding areas. These findings suggest that frugivory of lobeliad fruit by non-native birds is species-specific with *D. waianaeensis* fruits experiencing higher rates of visitation than *C. superba*. Restoration sites for *C. superba* are likely underutilized by non-native birds, potentially contributing to reduced recruitment. More research is needed to determine if land managers can encourage use of restoration sites by birds. From May – July 2016 I will conduct conspecific attraction experiments using non-native bird vocalizations to attempt to artificially increase fruit removal rates of *D. waianaeensis*.

Improving our knowledge of species ranges: ecological niche modelling of a south american wren

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Henicorhina leucosticta is a neotropical wren species found on premontane forests from Mexico to Peru. This taxon includes some unrecognized lineages that show considerable genetic divergence, one of which is formed by populations distributed

along the lowland forests of the eastern slope of the Andes, rainforests of the Orinoco basin and Amazon river tributaries in the Guiana Shield. However, this lineage is absent from the northeastern slope of Colombian and Venezuelan Andes, a region with potential suitable habitat for this species. Since abiotic variables have been used extensively to assess the environmental suitability of areas of interest, we took an ecological niche modeling approach to address this issue. Three calibration areas were defined varying elevational boundaries to make several models with the Maxent algorithm using 19 bioclimatic variables and different partitions of 159 records. The eastern slope of the eastern Andes was predicted as suitable for the presence of leucosticta by all models, obtaining good performances on AUC ratio tests. Additionally, our results support recent eBird sightings on this region (not included in models). We suggest leucosticta inhabit the lowland forests adjacent to the eastern slope of Colombian Andes but its presence on Venezuelan Andes remains uncertain. These mountain ranges have few passerine records, which could be due to insufficient sampling, historical factors or anthropogenic pressures. We stress the need for sampling and sharing records appropriately in the Neotropics and highlight the relevance of models as tools for improving our knowledge of species' geographic ranges.

Surfing the Heat Wave or the Green Wave: Divergent Ecological and Evolutionary Consequences for Nearctic Neotropical and Austral Migrant Kingbirds

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Geolocation studies over the last five years have revealed that a surprising number of migrant passerine species of the Americas practice winter itinerancy. Winter itinerancy – moving from place to place across the winter season – is most known in the Palearctic insectivorous bird migration system and has been linked to the wet and dry seasons in African savannahs. One explanation of this type of frequent movement has been termed 'the Green Wave hypothesis', and has been shown in geese that follow a seasonal wave of new plant growth throughout their annual cycle. South America likewise has savannahs north and south of the equator that experience wet and dry seasons. However, due to its narrow shape, and position over the equator, South America has low seasonal variation in primary production (growing plants), and has high between-year variability in primary productivity due to El Nino cycles. So why do birds migrate there? A study by Renfrew et al. (2013) showed Bobolinks tracking Normalized Difference Vegetation Index (NDVI) during their winter movements between grasslands within South America. Using Ripley's K function present evidence that food limitation (energy-selected migration) is a stronger selection pressure for Austral migrants (Fork-tailed Flycatcher, Tropical Kingbird) in comparison to the time-limited strategies of Nearctic-Neotropical migrants (Eastern & Western Kingbird, Scissor-tailed Flycatcher). Austral migrants clustered around NDVI when molting (tracking emergence of food), while Nearctic Neotropical migrants clustered around high temperatures year round. Future research should focus on the influence of changing climate on these two divergent migration strategies.

Hudson Highlands West Important Bird Area: Harriman and Sterling to Black Rock and Storm King, New York
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A proposal, nominating the Black Rock Forest - Schunnemunk Mountain Biological Corridor in the Hudson Highlands region of NY for IBA designation, was submitted to the Audubon New York's Important Bird Areas Program in November 2014. The Important Bird Areas (IBA) program is an international bird conservation initiative whose goals are to identify and conserve important bird habitat. Survey participants were from the Black Rock Forest Consortium, Barnard College (of Columbia University), Orange County Land Trust and Mearns Bird Club.
Stationary counts (point counts) and traveling counts were conducted in spring and summer of 2012 throughout the nomination area. Sites included Black Rock Forest, Schunnemunk Mountain State Park, Houghton Farm, Clove Brook Farm, Black Rock Fish and Game Preserve, Hudson Highlands Nature Museum (Kenridge Farm), Hilmare, and Storm King Art Center. Surveys revealed that the proposed area meets all three criteria of the IBA program: significant populations of "listed" species, presence of all or most of the responsibility species , and large numbers of migratory birds. In particular, thresholds of key individual birds including Cerulean Warbler, Worm-eating Warbler, Wood Thrush, Blue-winged Warbler and Prairie Warbler were well above the required levels. In April 2016, IBA designation was awarded. This IBA is known as: Hudson Highlands West IBA: Harriman and Sterling to Black Rock and Storm King. It is a large contiguous forest site extending from Harriman and Sterling Forest State Parks in the south to Black Rock Forest and Storm King State Park in the north, with patches of grassland.

Initial testing of a minimally invasive surveillance system used to monitor a Maryland state endangered species, the common tern (*Sterna hirundo*)
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Common terns (*Sterna hirundo*) are a Maryland state endangered waterbird whose population has steadily declined over the past several decades. In order to determine the reason(s) for this decline, a surveillance system composed of iButton temperature sensors, video cameras, and a DVR powered by both marine batteries and solar panels was developed. Video cameras will be used to detect predation in the colonies while iButtons will to used to measure nest attentiveness. A pilot project was run in May 2016 to test the effectiveness of the system, determine footage analysis techniques and accuracy of the iButton sensors. A "predator" was modeled using a RC car driven throughout a "colony", an open field with varying heights of vegetation. Two small systems (one using wireless and one using wired cameras) composed of two cameras each were utilized for these tests. The ease of "predator" detection was determined through footage review. The iButton sensors were tested in lab using known temperature hand warmers to determine lag time of detection and accuracy of measurements. Various temperature-sampling intervals were also tested. The main issue encountered during these initial tests was correctly programming the iButton sensors to accurately record temperature readings of the hand warmer. The solar panels proved to be a highly effective tool that will prove especially useful in the field. Further testing of the camera models will allow for finalizing

the camera type (wired or wireless) for use in the field. Preliminary results from the field season will be included as well.

Avian community shift in a reclaimed mine landscape in southern West Virginia

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The coal mining technique known as mountaintop mining/valley fill (MTMVF) converts large areas of mature forest to early-successional habitat. These types of mines have the potential to negatively impact forest-dwelling songbirds by reducing and fragmenting mature forest. Concurrently, many species of grassland and shrubland songbirds have shown significant population declines over the last decade. Mountaintop mine complexes can be >2,000 ha in size and potentially provide breeding habitat for early-successional songbirds. We quantified songbird populations on three MTMVF mines in southern West Virginia from 1999-2000. Point counts were conducted in four habitats: intact forest, forest fragments, reclaimed grassland, and reclaimed shrubland. We assessed individual species' abundance using an open population N-mixture model, and community richness using redundancy analysis. We selected two species from each represented habitat and two synanthropic species for species-specific models. Model selection indicated habitat type was a strong determinant (present in all ten species-specific models) in developing best-fit estimates for species abundances. Individual species showed highest abundances in their respective a-priori habitat grouping. Community analysis showed reclaimed shrubland having the greatest species richness. These results indicate a shifting of the bird community from predominantly intact forest species towards early-successional species in the presence of mining and subsequent mine reclamation. Mountaintop mining has the potential to displace forest-dwelling birds as these areas shift from mature forest towards early-successional habitat. Management on MTMVF sites will require balancing habitat needs of grassland and shrubland vs. mature forest birds.

Using population and habitat analyses at three spatial scales to address New Hampshire statewide declines in Canada Warblers (*Cardellina canadensis*)

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The Canada warbler (*Cardellina canadensis*) is a Neotropical-Nearctic species of special conservation need currently experiencing declines across its breeding range, especially within New Hampshire, according to the Breeding Bird Survey (BBS). They are most abundant in forested wetlands and regenerating early-successional forests 5 – 20 years post-harvest. Aging forests and development in New Hampshire likely contribute to declines observed in the statewide census. BBS surveys occur along roadsides where development and forest fragmentation may bias sampling and overlook populations in more long-term suitable habitat such as extensive forested wetlands. Monitoring Canada warbler populations at various spatial scales may help determine whether statewide BBS trends disproportionately measure fragmentation effects. We examined approximately 10 years of population and vegetation data within a contiguous forested landscape across central New Hampshire at three spatial scales: individual territories (100 ha), local metapopulations (376 ha), and regional National Forest (3160 ha). Data analyses indicate that at these scales populations are not declining significantly. We compared

slopes and intercepts of the population analyses among territory, regional and BBS scales and found no significant difference among trends. While metapopulation scale data were excluded, independent analyses of those data corroborate findings at smaller spatial scales. Habitat characteristics at the territory scale indicate pockets of sustained suitable Canada warbler habitat with stable populations, which, may be underrepresented along BBS routes. Thus, population trends exhibit different profiles at varying spatial scales. Larger spatial scales may help identify species of priority, while smaller spatial scales may help determine areas of conservation priority.

Black-backed Woodpecker Abundance (*Picoides arcticus*) in the Black Hills of South Dakota and Wyoming

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Black-backed Woodpeckers (*Picoides arcticus*) are rare residents of northern conifer forests and are almost always associated with trees recently killed by fire, insects or disease. The Black Hills population has been petitioned to be considered a Distinct Population Segment under the Endangered Species Act because of their isolation and low abundance. Our objective was to determine relationships between environmental and habitat factors and the probability of detection and estimate abundance of Black-backed Woodpeckers. We conducted surveys on 124 transects across the Black Hills resulting in a total of 1,232 sampling points. We conducted point count surveys between April 1, 2015 and June 28, 2015 and visited each point 3 times to estimate detection probability. We measured percent and type of ground cover, tree basal area, dominant tree species, dominant size class, and canopy coverage at each point. We detected 300 Black-backed Woodpeckers across all visits. We fit models that accounted for detection and abundance covariates in the R package “unmarked” using GDISTSAMP and evaluated models using Akaike Information Criterion. We found support for effects of day of year and observer on detection probability and included these covariates to assess support for abundance covariates. We assessed 12 a priori models with abundance covariates and found support for a negative relationship between abundance and canopy cover. Future analysis will include geographic information system derived landscape variables and be used to map density and estimate population size of Black-backed Woodpeckers in the Black Hills.

Long-term trends in Nearctic-Neotropical warbler migration through a mountain pass in northern Venezuela.

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To identify and describe how migration routes are used is critical for understanding the biology and conservation of migratory birds. However, there is a paucity of these studies in nonbreeding grounds, particularly long-term studies. In Venezuela, the Paso de Portachuelo represents a mountain pass used by birds during their migration. We studied the migration pattern of migrant warblers in Paso de Portachuelo from 1990 to 2015. We used mist-netting data during fall migration (August-November), with a sampling effort of approx. 4300 hours/net and 5512 captures. A total of 22 species of Nearctic-Neotropical migratory warblers has been recorded. Four species were abundant (>25 individuals captured/year; *S. ruticilla*, *S striata*, *P. novevoracensis* y *G. agilis*), the most abundant being *P. noveboracensis* with captures fluctuating between 47 and

403 individuals/year. Six species were frequent (5-25 captures/year) and 12 uncommon (1-5 captures/years with many years without records). While some species have been consistently abundant (S. ruticilla, 22 individuals/year), others have become progressively rarer (*S. striata*; 1995, n=266; 2005, n=185, 2010-2015, n=33 individuals/year). Despite thousands of warblers being ringed, an unexpected lack of recaptures of these birds in Paso de Portachuelo. Our long-term sampling effort provides information about warbler migration patterns throughout the years, contributing significantly to the regional knowledge of Nearctic-Neotropical migratory warblers in winter grounds. Future studies focusing on migratory connectivity between breeding and wintering areas could contribute to the understanding of the migratory patterns of species that use the Paso de Portachuelo

Response of central Texas grassland birds to varying agriculture effort at a county level from 2013 to 2015
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Grassland birds are currently experiencing greater declines that any other avian guild in North America. This decline is associated with habitat loss due to conversion to agricultural lands and the alterations of natural disturbances such as fire, drought, and native herbivores. From 1969 to 2013, there was a 55 to 93 percent decline in several priority grassland bird species in Texas. As such, the goal of this research was to estimate the impact of different agriculture practices and their associated effort on grassland bird abundance at a county level. Ninety-five 24.5 mile routes were randomly selected on tertiary roads in 19 Texas counties. Five routes were created per county, with at least 30 five-minute point count stations separated by ≥0.5 miles. Surveys were performed once a year during May and June from 2012 to 2015. There were 15 focal grassland bird species that were noted in surveys. Cattle head and amount of farmland used per crop type amongst other data from the USDA Census of Agriculture (2012) and the National Agriculture Statistics Service (NASS) were used for analyses. A linear mixed-effects model was used to estimate predictive ability of each factor for species abundance within each county relative to county size. We detected 19,176 individual birds from 7,856 point count surveys during the first three years (2013-2015) of our long-term study. Abundance of each species varied across counties and by year. Results indicate that there may be a relationship between agricultural effort and relative abundances for some Texas grassland species.

The power and peril of nest boxes for managing and monitoring birds
McClure, Christopher J. W. - The Peregrine Fund; Benjamin Pauli - Boise State University; Julie Heath - Boise State University

Despite their common use, the efficacy of nest boxes as tools for managing and monitoring birds depends on the demography of the target population and the availability of natural cavities. Yet, no one has articulated the demographic or environmental conditions enabling nest boxes to be useful, or harmful, because simultaneous monitoring of nest boxes and natural cavities is rare. We use a simulation model for a hypothetical population of American Kestrels to show that providing nest boxes will only benefit populations if breeding sites are limiting or if nest boxes increase productivity or survival relative to other nest sites. We also demonstrate negative effects on populations if birds using nest boxes experience lower

reproductive success or survival. Further, trends in the occupancy of monitored nest boxes will be misleading if the number of unmonitored nest sites changes over time. Finally, breeding site fidelity can cause an initial lag in occupancy of newly installed sites that could be misinterpreted as an increasing population, even when the population is declining. There are therefore many situations where the installation of artificial breeding sites, and their use in monitoring, can be misinterpreted or have negative consequences.

Keeping birds away from food using sonic technology: a potential for protecting crops

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Pest birds cause billions of dollars in damages in the agricultural (crop loss) and aviation (collision with aircraft) industries annually in the US. Current methods to control problem birds are often ineffective. A new solution: A broadband spatially-controlled noise (termed a “sonic net”) will prevent birds from hearing each other and hearing predators, rendering an area unsuitable and making birds go elsewhere. The goal of the current project is to evaluate whether a “sonic net” is an effective way to deter wild songbirds from food sources. We recorded the behavior and inter-species interactions of birds at feeders located at two sites. The “sonic net” was deployed at one feeder at each site, while the other feeder served as a control without additional noise. Overall, birds spent approximately 35% less time at the “sonic net” feeders compared to control feeders. Dominant species’ duration per visit did not vary significantly (1.4%), while subordinate species were largely affected by noise (51.3%). Additionally, we assessed the inter-species interactions underneath noise and food manipulation (less access to food on control feeder). Socially dominant species spent only 4.45% less time at the “sonic net” feeder as compared to subordinate species (33.5%). This suggests that the “sonic net” may affect species differently depending on interspecies competition, meaning that protection of food crops may depend on species composition in the area. Nonetheless, the “sonic net” is a potential solution to reduce crop loss caused by pest birds from farms over long periods of time.

Occupancy Analysis and Density Estimation of Kori Bustards (*Ardeotis kori*) and Helmeted Guineafowl (*Numida meleagris*) for Use in Landscape Conservation Planning in the Northern Tuli Game Reserve, Botswana

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The goals of this project were to better understand 1) the factors that influence occupancy (ψ) and density of two iconic bird species in eastern Botswana, the kori bustard (Ardeotis kori) and helmeted guineafowl (*Numida meleagris*) and 2) how these factors may interact to affect landscape conservation and usage. We performed distance sampling for both species throughout the Northern Tuli Game Reserve, Botswana during June 2014-July 2014 and May 2015-July 2015. We found that kori bustard probability of occupancy was influenced by open canopies (ψ2014=0.373, SE±0.086; ψ2015=0.392, SE±0.061). Kori bustard densities were highest in 2014 in areas of sparse vegetation at higher elevations with 5.02 individuals/km2 (95% confidence interval: 1.04 – 24.2 individuals). In 2015 highest densities were found in areas of sparse vegetation at lower elevations with 2.20 individuals/km2 (95% confidence interval:

1.73 – 2.80 individuals). Helmeted guineafowl occupancy was most influenced by dense vegetation (ψ2014 =0.800, SE±0.103; ψ2015 =0.752, SE±0.116) and closed canopy (ψ2014=0.857, SE±0.132; ψ2015 =0.755, SE±0.181). In 2014, helmeted guineafowl were found at highest densities in areas of sparse vegetation at lower elevations with 828 individuals/km2 (95% confidence interval: 564 – 1217 individuals). In 2015, helmeted guineafowl were found at highest densities in areas of dense vegetation at higher elevations with 2,085 individuals/km2 (95% confidence interval: 905 – 4803). Habitat-specific information such as density and occupancy may be used to identify risks during landscape conservation planning within the range of the kori bustard and helmeted guineafowl.

Breeding Biology of The Black-Throated Tody-Tyrant (*Hemitriccus granadensis*) With Notes on Mating Displays

McCullough, Jenna - University of New Mexico; Gustavo Londoño - Universidad Icesi

There is little known about the breeding biology of Hemitriccus, a scarcely studied, highly speciose genus in Tyrannidae. Published nest descriptions exist for only six of its 22 species. The Black-throated Tody-tyrant (*Hemitriccus granadensis*) is a well-documented species within this genus. It inhabits humid cloud-forest in the northern Andes mountains with seven subspecies distributed from Venezuela to Bolivia. However, *H. granadensis* lacks information for almost all aspects of its breeding biology. Here, we provide the first nest, egg, nestling, and incubation behavior descriptions for the species with notes on its courtship behavior. We found three nests and observed one courtship display at different elevations in three separate areas: Farallones de Cali and Tatamá National Natural Parks in Colombia, and in the buffer zone of Manu National Park in southeastern Peru. The *H. granadensis* nest is an enclosed “purse-like” pendant pouch inside of a moss ball with a side entrance suspended from a small branch and obscured by vegetation. All nests had a clutch size of one egg/nestling. Egg morphology varied, presumably due to different subspecies. We cannot describe the full incubation and nestling period due to egg inviability and premature nestling death. We also provide observations and video footage of the courtship display. Overall, the nest resembles other species within Hemitriccus but clutch size differs from information published for the genus.

Mexican Jays and Western Scrub-Jays differ in quantity, but not quality of social interactions

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Quantifying animal social behavior is important for managing wild and captive populations, as well as for understanding conspecific and heterospecific interactions, evolutionary adaptations, and species ecological roles. Frequently, group size is used to quantify social behavior. However, it is possible for animals to live in large groups without engaging in interactions with the majority of group members. Complex social behaviors could be important for the evolution of cognitive abilities. Furthermore, group-living animals that demonstrate cooperative behaviors are assumed to experience more complex social interactions than species that are more solitary. Yet wild animal social interactions are rarely measured more precisely than group size. Here we tested the assumption that there is a relationship between social system and social interaction quality. We

conducted behavioral observations for social association behaviors on Mexican Jays and Western Scrub-Jays, two species that demonstrate extreme differences in social system. We considered the focal individual as “interacting” with another jay when they were at a distance of 10 meters or closer. We calculated “quality” by the proportion of an observation two jays spent at a certain distance divided by that estimated distance. Based on the extreme differences in social system, we expected Mexican Jays to show greater quantity and quality of social interactions. However, we found that interaction quality did not differ between the two species, but Mexican Jays did have far higher quantity of interactions. These results indicate that quality of social interactions cannot be inferred from group size measures or social system type.

Documentation of a Hybrid Bicknell’s Thrush (*Catharus bicknelli*) and Veery (*C. fuscescens)* using Morphological, Behavioral, and Genetic Data

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Combining data on morphology, behavior, and gene sequences, we document the first known case of hybridization within the thrush genus Catharus. During June of 2008, we observed a male bird at a montane forest site in south-central Vermont that repeatedly exhibited song characteristics of both Bicknell’s Thrush (*C. bicknelli*)and Veery (*C. fuscescens*). Handheld examination determined the bird to be a yearling male with plumage characteristics predominantly of Veery, morphometric traits within the ranges of both Bicknell’s Thrush and Veery, and a weight intermediate between the two species. While the hybrid vocalized only with Bicknell’s Thrush calls, its songs were reminiscent of both Veery and a mixture of Bicknell’s Thrush and Veery. Mitochondrial DNA (NADH dehydrogenase 2 and cytochrome b genes) revealed the bird’s mother to be a Veery, and nuclear data (b-finbrinogen 7 and myoglobin 2 introns) revealed DNA of both Veery and Bicknell’s Thrush, supporting Bicknell’s Thrush as the father of the hybrid. This hybridization is notable given that Bicknell’s Thrush and Veery generally breed in different habitat types at different elevations. This discovery is also important in light of the vulnerable conservation status of Bicknell’s Thrush and the decline in Veery populations across much of its range.

Climate and breeding effort explain annual variation of carotenoid content in female Prothonotary warblers (*Protonotaria citrea*)

McGhee, Amanda - Virginia Commonwealth University; Lesley Bulluck - Virginia Commonwealth University

The role of female ornamentation in avian speices is not well understood, and few studies have assessed annual variation in female plumage and whether that variation in correlated with climate and/or previous breeding effort. We assessed this using data from a long term study of reproductive ecology in the Prothonotary Warbler. We compared plumage variation as a function of temperature and precipitation during July and August, when their feathers are molted. We used two criteria to represent characteristics of crown and breast feathers - violet blue chroma (VBC) to represent carotenoid content, and yellow intensity. Feather samples were collected from 2010-2014 from 112 warbler females, 36 of which we have feather samples from more than one breeding season. At the population level, we found July precipitation the previous year to be positively correlated with crown yellow intensity, and August precipitation the previous year to be positively correlated with breast carotenoid

content. In a subset of females for whom we had consecutive years of data, females whose previous breeding season was prolonged (i.e., late last fledge date) were more likely to show a decline in breast carotenoid content than those whose last fledge date was earlier. These results suggest that feather characteristics at the population level may be the product of climate during the previous molt, and that individual level variation in feather reflectance is dependent in part on breeding effort the previous year which can influence the individual's timing of molt.

Using ultra-conserved elements to estimate gene flow in Beringian birds
McLaughlin, Jessica - University of Alaska Museum; Travis Glenn - University of Georgia; Brant Faircloth - Louisiana State University; Kevin Winker - University of Alaska Museum

Previous studies have found discord in divergence estimates from phenotypic, mitochondrial, and nuclear data among multiple lineages of Beringian birds, suggesting complex and heterogeneous genomic phenomena among lineages during divergence and speciation. Large-scale genomic data may help clarify aspects of divergence and gene flow between trans-Beringian populations of birds. Ultra-conserved elements (UCEs) are a class of genetic marker, anchored by slowly-evolving sections of nuclear DNA, that have been shown to be useful in phylogenomic analyses; however, their utility in population genomics applications is not known. The more variable regions flanking the ultra-conserved regions become increasingly variable with increasing distance from the element's core, suggesting that these markers should be useful across various time-scales of divergence. UCEs were sequenced in nine lineages of birds with a trans-Beringian distribution, including a pair of species, subspecies, and populations in each of three orders (Anseriformes, Charadriiformes, and Passeriformes). Divergence (Θ), effective population sizes (Ne), and rates of gene flow are compared with prior datasets, providing further insights into the demographic history of these diverging lineages and the genomic processes at work during speciation.

Discovery of an important migratory corridor for raptors in South America
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We conducted a systematically effort throughout the whole diurnal period for 18 consecutive days in 2015 during austral autumn at the Andean foothills in the extreme north of Chile, to document species composition, timing and average of migrating raptors using two different observation points (site 1 and 2). Red-backed hawk (*Geranoaetus polyosoma*) represented 57.7 % of the individuals, migrating at an average rate of 2.6 ± 0.6 birds·h-1. White-throated hawk (*Buteo albigula*) was the other regular species (N = 294, N groups = 6), at an average of 1.8 ± 0.5 birds·h-1. This corridor is used by 3 – 30 % of the *B. albigula* population (1,000 – 10,000 individuals) and an unknown percentage but higher than 4% of the *G. polyosoma* population (< 10,000 mature individuals). We document a higher migratory rate for both species compared to previous studies in S. America. The elevational of our study area fell well within the range previously described for both species observed migrating together by a common corridor (range: 1788 – 2865 m amsl). Our results show the importance of the corridor and provide conservative estimates of the numbers of birds that use this corridor, given that (1) surveys did not last for the entire migratory period and (2)

that the nine-day period spent at site 2 had reduced the final estimation since the majority of birds were registered at site 1.

Temporal and Spatial Patterns of Spring Northbound Veeries (*Catharus fuscescens*) from a single Delaware breeding population

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Songbirds require stopover sites along their migration routes to meet the high energy demands of long-distance migration. The Veery (*Catharus fuscescens*) is a Nearctic-Neotropical migrant that performs one of the longest migrations of all songbirds, yet the locations and relative importance of stopover sites are poorly known. The temporal and spatial aspects of migration are expected to vary depending on weather patterns and available resources; however, traditionally, we have expected individuals from a single breeding population to show some consistency in migratory behavior. From 2009 to 2014, we deployed light-archival geolocators on Veeries at a Delaware, USA, breeding site. From these geolocator data, we identified migratory routes and stopover sites (>1 day) that were used by >50 birds during the five spring migratory periods. The precise timing of large water crossings are evident using geolocators despite the fact these events typically occur around the spring equinox when day and night length are nearly equal. Combining known water crossings with longitudinal data (not affected by the equinox) and stopover sites evident outside the equinox period, we determined that Veeries from our population showed considerable variation in migratory routes and the use of stopover sites; however, certain regions were visited by multiple individuals suggesting that these areas are particularly important to northbound Veeries. Determining important stopover regions will enable ornithologists to more accurately identify areas for conservation and consequently will help determine the levels of connectivity among breeding, migratory, and wintering regions.

Hummingbird nesting response to restoration efforts in riparian habitats in arid lands

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Detecting how species respond to restoration efforts are critical for assessing the effectiveness of land management actions in recovering and maintaining viable populations for species of interest. In this paper, we evaluate responses of riparian-nesting hummingbird species at sites with restored riparian vegetation. Because hummingbirds are mobile, their abundance is highly correlated with nectar availability, and density of nests can vary dramatically based upon biological interactions, we assess vegetation structure near hummingbird nests to determine the vegetation characteristics used by hummingbirds for nest site selection. We then compare how the vegetation structure at the restored study sites differs from that chosen by hummingbirds. We also evaluate how nesting activity changes based upon the availability of nearby nectar resources. So, we conducted point counts, floral counts, nest searches and characterized the vegetation data at 140 study points at 7 sites, of which 2 are riparian habitat restoration sites. A total of 479 nest were monitored. Preliminary results suggest that the mid-canopy layer is important for the two hummingbird species studied and that nest activity is correlated with vegetation

characteristics. Nectar availability also influenced the timing and levels of nest activity. Thus, understanding how nesting hummingbird species respond to specific ecological variables in restored sites should help lead to better approaches to restoration.

Understanding the dominance hierarchy among North American feeder birds

Miller, Eliot - Cornell Lab of Ornithology; Luke Harmon - University of Idaho; David Bonter - Cornell Lab of Ornithology; Charles Eldermire - Cornell Lab of Ornithology; Benjamin Freeman - University of British Columbia; Emma Greig - Cornell Lab of Ornithology; Scott Nuismer - University of Idaho; Wesley Hochachka - Cornell University

Interspecific interactions may shape species' distributions across broad geographic scales, but data in support of this hypothesis are lacking. Unlike many organisms, for which competition must be inferred, birds sometimes compete in dramatic, readily quantified ways, and bird feeders are a particularly good place to observe these encounters. We employed the observations of citizen scientists, participants in Project FeederWatch, to study the frequency and directionality of interspecific displacement events at feeders around North America. Participants in our study of dominance interactions submitted 1,900 observations of displacements involving 90 species. Prior to using these data to investigate the role of competition in shaping distributions, we need to determine whether the observations capture information on broad-scale dominance interactions among the observed species: (1) How consistent is the directionality of these interactions? (2) Is there a strictly linear dominance hierarchy or are there cycles in the dominance network (e.g., cases in which species A displaces B, B displaces C, but C displaces A)? (3) What factors explain the directionality of dominance between species? We found that the dominance hierarchy was not strictly linear, but was nevertheless largely predictable. Mass was a good predictor of dominance, but clade-specific factors were also relevant. Lineages like doves were less dominant than expected based on their mass, while lineages like woodpeckers were more dominant than would be expected. We discuss some of the evolutionary implications of this continental dominance hierarchy, including the potential for the observed interactions to indicate mechanisms by which species' distributions are determined.

Mitogenomic Phylogeography of the Peacock-Pheasants Polyplectron of Southeast Asia

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Several phylogenies for Polyplectorn has been proposed over several decades. We sequenced the whole mitochondrial genomes of six Polyplectron, integrated existing single gene sequence data, and conducted phylogenetic analyses in an attempt to track the historical pattern of speciation. Our analysis strongly suggests the Sundaic origin of Polyplecton with *P. schleiermacheri* (Borneo) and *P. malacense* (Peninsular Malaysia) and *P. napoleonis* (Palawan) forming the basal clade and *P. bicalcaratum*, *P. chalcurum* and *P. inopinatum* as terminal taxa. The *P. inopinatum* of peninsular Malaysia and *P. chalcurum* of Sumatra sister-taxa relationship suggests allopatry, or secondary colonization to Sumatra, by ancestral *P. inopinatum*. The coexistence of *P. inopinatum* and *P. malacense* in the

same region does not suggest sympatry, but may have resulted from that secondary colonization event of the montane habitat during the Last Glacial Maxima. The isolation of *P. chalcurum* population in Sumatra and *P. inopinatum* of Peninsular Malaysia occurred following sea level rise and upland contraction of the montane vegetation at the end of the Pleistocene. Our analysis supports the Sunda shelf origin then spreading to the highland/montane region of mainland Asia. We suspect climate change and the rising sea levels during the Pleistocene drove this speciation pattern.

Host Associations and New Geographic Localities of Avian Chewing Lice from Benin

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Host associations of highly host-specific chewing lice (Insecta: Phthiraptera) across multiple avian species remain fairly undocumented in the West African country of Benin. Recent studies in the region have focused on ectoparasites of domestically important species such as chickens and turkeys. These associations are documented in domestic species, however, little is known about the chewing louse associations with the wild avian fauna in the region. The Texas A&M University Biodiversity Research and Teaching Collection currently houses approximately 200 scientific bird skin specimens that were collected from multiple localities throughout Benin. These host specimens are significant in that they represent a diverse range of avian families to observe louse associations. Lice were collected from these museum specimens and Identified to genus or species when possible. Molecular work involving DNA extractions, PCR of the mitochondrial COI and nuclear EF1alpha genes, and DNA sequence analyses was then used to confirm morphological identifications of lice. We have found several occurrences of new geographic localities for lice, as well as identified five species of lice new to GenBank, and possibly new to science. Given the lack of current data on chewing louse species distributions in Benin, this study adds to the knowledge of host associations and locality information of avian chewing louse species in western Africa.

Long term assessment of livestock removal on avian and vegetation communities of riparian habitats in a Great Basin wildlife refuge

Moen, Noelle - Oregon State University; Joan Hagar - USGS Forest and Rangeland Ecosystem Science Center; Tyler Hallman - Oregon State University; Susan Earnst - USGS

Riparian areas are hubs of avian abundance and diversity in the western United States, but have been significantly affected by land use practices, predominantly from agricultural livestock grazing. In 1990, cattle were removed from a 112,500-ha national wildlife refuge in southeastern Oregon that had been grazed more than 100 years. Changes in both vegetation cover and bird abundance were monitored, analyzed and published for 167 riparian plots over the course of 12 years since cattle grazing ceased. We later returned to these same riparian plots to record the long term changes of avian abundance and communities of these plots 20-22 years after all livestock were removed. Vegetation was sampled in 6 transects in 1.5-ha plots. During each breeding season, observers recorded all birds within 50 m to each side of the plot's 150-m centerline for 25 minutes three times for each of these transects. For 15 of the most frequently detected species, we adjusted abundance estimates based on factors we believed may influence detectability. We used adjusted abundance

in regression analyses to quantify the response of each species over the two decades since livestock removal. In addition, avian species composition and abundance will be compared among primary riparian cover types. Results will improve understanding of ecological relationships underlying avian response to cattle removal in riparian areas.

Description of putative zones of introgression between plumage morphs in *Lepidothrix coronata*
Moncrieff, Andre - Louisiana State University Museum of Natural Science

Highly unusual among manakins (Pipridae) is the case of *Lepidothrix coronata* in which adult males display either of two different color morphs: a green-bodied plumage and a black-bodied plumage. Of further interest are populations containing adult males with intermediate plumage characteristics such as dark green bodies or black bodies with olive bellies. Inspection of museum specimens suggests that the region of putative plumage introgression between male color morphs lies largely within Peru. Although the presence *of Lepidothrix coronata* color morphs and intermediate types has been previously noted in the literature, no study has conducted a description of the spatial distribution of male *Lepidothrix coronata* intermediates in Peru. This may be partly due to the difficulty of distinguishing such birds from subadults. The possibility of this confusion is amplified by the finding that male manakins may not acquire adult plumage until 1-3 years after hatching. Careful inspection of the 315 male *Lepidothrix coronata* specimens at the Louisiana State University Museum of Natural Science revealed patterns that allowed the author to propose a method for defining adult male plumage in *Lepidothrix coronata* and to describe where zones of plumage introgression occur in the complex. Based on the results from this description, future sampling efforts will be focused in two specific regions of Peru where turnover between black and green males occurs—an elevational transect across the Upper Ucayali River and a transect across the lowlands of the Madre de Dios department.

Relationship between nestling characteristics and blood hemoglobin concentration in Carolina Chickadees
Mones, Spyncer - Northern Kentucky University; Lindsey Walters - Northern Kentucky University

Hemoglobin is a protein responsible for the transportation of oxygen in the blood of vertebrates. Lower levels of hemoglobin in the blood show a deficit of red blood cells and indicate anemia or iron deficiency. Previous research in birds has found that larger nestlings tend to have higher hemoglobin concentration levels. The goal of this research was to determine whether hemoglobin concentration in nestling Carolina Chickadees (*Poecile carolinensis*) was related to the number of nestlings in a nest, the mass of the nestling, or the tarsus length of the nestling. We measured these characteristics on the tenth day after hatching for 66 nestling Carolina Chickadees that hatched at our field site in Melbourne, KY from 2013 to 2015. We found that the nestlings that had greater mass also had higher levels of hemoglobin in their blood. However, hemoglobin concentration was not significantly related to tarsus length or number of nestlings. A possible hypothesis to explain our results is that nestlings with greater mass are getting more food, so they are also able to make more hemoglobin. However, tarsus length and number of nestlings in a nest are probably not as directly related to nestling food consumption. This research is important for determining what causes higher or lower hemoglobin levels in Carolina Chickadees, which could affect the health and future reproductive success of the nestlings. Future research should investigate the health condition of nestlings

and the presence of parasites, which could also affect hemoglobin concentrations.

Pathogenic cloacal bacteria as a cost of testosterone in a tropical bird
Moore, Ignacio - Virginia Tech University; Camilo Escallón - Virginia Tech; Lisa Belden - Virginia Tech

Testosterone mediates reproduction in male birds. While the benefits of testosterone have been widely reported (e.g. increased territory size, extra-pair paternity), the costs have not been as well documented. Yet, there is a large variation in endogenous testosterone levels among males in any population suggesting that there are costs. Sexually transmitted disease could be one such cost that has not been well investigated. In birds, the cloacal bacteria are a complex community that includes sexually transmitted bacteria. During the breeding season, male testosterone levels are elevated and there is an increase in sexual activity. As such, we hypothesized that cloacal bacterial communities would be more diverse during the breeding season than in the non-breeding season and that individual males would accumulate bacterial species across breeding seasons. We surveyed the cloacal bacterial communities in free-living male rufous-collared sparrows (*Zonotrichia capensis*) through sequential breeding and non-breeding seasons and found that the bacterial community became more diverse with the onset of reproduction, increasing in OTU (operational taxonomic diversity ~ bacterial species) phylogenetic diversity and richness, and then decreased in diversity as males transitioned to non-breeding condition. Individuals sampled across sequential breeding seasons did not accumulate more OTUs or change their cloacal bacterial community composition across seasons. Among males, those with higher testosterone levels during their breeding season, had a more phylogenetically diverse cloacal microbiome. This study showed that the cloacal microbiome in birds is dynamic and sets the framework for understanding the links between testosterone, breeding behavior, and sexually-transmitted bacteria.

Quiet Violence: Do soft songs predict physical aggression in Savannah Sparrows?
Moran, Ines - Windsor University; Amy Newman - University of Guelph; Stéphanie Doucet - University of Windsor; D. Ryan Norris - University of Guelph; Daniel Mennill - University of Windsor

Many animals exchange signals to defend and maintain their territories against intruders. In songbirds, those signals can have different aggressive intensities and can be used to gradually escalate a territorial contest. Several signals in song birds have been associated with aggression, including song overlapping, song matching, soft song, wing waving, and other behaviours. Although the precise function of most aggressive signals requires further study, several recent studies point towards the importance of low amplitude songs, or “soft songs”, as potent aggressive signals. We used playback, accompanied by a taxidermic mount, to simulate an intruder into the breeding territories of Savannah Sparrows, to test the hypothesis that soft song is a signal of aggressive intent in this species. Our results show that male Savannah Sparrows’ use soft songs and other behaviours when they respond aggressively to intruders. Aggressive birds sang at higher rates, increased their level of song overlapping, produced more non-song calls, and often engaged in wing waving behaviour. Soft song, in particular, stood out as a predictor of aggressive response to the simulated territorial intruder. Our research furthers our understanding of aggressive signaling in territorial songbirds, providing further information about signals of aggressive attack, and the importance of soft songs in communicating aggression.

Feasibility of Three Types of Nesting Platforms for the Great Blue Heron (*Ardea herodias*) in North Central Georgia

Morgan, Kate - University of North Georgia; D.E. Lubeski - University of North Georgia

We assessed the feasibility of three different artificial nest design for use as Great Blue Heron (*Ardea herodias*) nesting platforms. We have observed a number of individual Great Blue Herons foraging in Tumbling Creek Woods, an area adjacent to the University of North Georgia's Gainesville Campus. However, despite what appears to be attractive heron habitat, we have not documented breeding or nesting. Therefore, we are investigating the feasibility of erecting heron nesting platforms in the hopes of initiating successful breeding on this site. Many nesting sites of the Great Blue Heron are compromised by both anthropogenic impact and even the heron's direct impact on their environment. An ongoing solution to this issue are man-made rookeries that help encourage Great Blue Heron nesting. Our current research initially examined two potential structural designs: the wood-based platform and the metal tripod. We are discovering that in spite of the ease in which we can find construction schematics, current nest platform designs are expensive and hard to replicate. Therefore, the building and maintenance of these structures is problematic. In an attempt to combine the best features of each of the two popular designs we researched, we are also considering a third nesting platform design – a modified tree-house platform, which uses existing trees to support man-made platforms. We hope that providing a variety of nesting platforms in our study site will result in attracting nesting Great Blue Herons.

The diversification of flux control at branch points in carotenoid metabolic pathways in birds

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The network structure of biochemical pathways influences the evolutionary lability of enzymes and metabolites. When branch points are present in biochemical networks, they can establish opportunities for the output, or flux, of the network to be redistributed among intersecting pathways in different ways. In this case, changes in the control of flux in pathways should occur at branch points in biochemical networks. Alternatively, the control of flux can be coordinated across the entire network and affect all enzymes and metabolites. Differences in the dynamic properties of flux can produce distinct patterns of diversification in the concentrations of the products of pathways, which can have consequences for adaptive evolution. If flux in a network varies due to partitioning among pathways at branch points, then changes in the carotenoid concentrations should be associated with the structural positions of compounds in the network. If flux is coordinated across the entire network, then carotenoid concentration of all compounds should change by similar magnitude. Here, we examined the association between correlated changes in the concentrations of 19 carotenoids expressed in the plumage of 1,100 male house finches (*Haemorhous mexicanus*) and the structural relationships of these compounds. We examined this relationship across 25 populations that differ in ecology and time of establishment. Our findings establish the influence of network structure on changes in carotenoid concentration in birds and the likelihood of these changes.

Population structure of Sanderling (*Calidris alba*) at a major stopover site in Chaplin Lake, Saskatchewan to determine pollutant threats

Morrissey, Christy - University of Saskatchewan; Carla Labarrère - University of Saskatchewan

Sanderling are a long distance migratory shorebird found across a large range throughout coastal North and South America. However, the migration ecology and connectivity are poorly understood which makes it difficult to determine the wintering origins and potential threats, that birds face during the annual cycle, particularly from organic pollution. This study aims to identify the population structure of a poorly studied Sanderling population that migrates northward and stops in large numbers at Chaplin Lake, Saskatchewan, Canada to ultimately determine the link between the migratory patterns and potential risks of exposure to dioxin-like compounds. Over 460 Sanderling have been captured, measured and banded in Chaplin Lake on spring migration from 2012-2015. A P5 covert feather was sampled for stable isotope (δ15N, δ13C and δ2D) analysis. Fall resightings of Sanderling banded at Chaplin Lake occurred throughout eastern Canada and the United States. Other sightings in late winter are concentrated in the Gulf of Mexico, Mexico, Panama, and El Salvador. Through a combination of isotopes, we could distinguish at least 4-5 groups of Sanderling in the Chaplin population that are of distinct wintering origin suggesting birds at this stopover winter over a broad geographic area. This research will guide future action to determine health and contaminant profiles of this migratory shorebird population which is using both coastlines in North, Central and South America that are frequently impacted by industrial pollution.

Common Tern and Arctic Tern Hybridization Produces Fertile Offspring

Mostello, Carolyn - Massachusetts Division of Fisheries & Wildlife; Derek LaFlamme - U.S. Fish & Wildlife Service, Maine Coastal Islands National Wildlife Refuge; **Patricia Szczys** - Eastern Connecticut State University

This study provides the first conclusive (molecular) evidence for hybridization of Arctic Tern *Sterna paradisaea* and Common Tern *Sterna hirundo*. We studied a mixed pair (P1; male Arctic Tern and female Common Tern) and its offspring on Penikese Island, Massachusetts, USA in 2007 – 2015. The pair maintained a long-term pair bond (8 yr); its reproductive performance was comparable to that of Common Terns and higher than that of Arctic Terns at the site. Molecular analyses confirmed that all young raised by the pair (at least 5 males and 4 females) were biological offspring. Although F1 hybrid young were intermediate between the parent species in certain characteristics, dark feathers extending below the eye gave them a distinctly arctic tern-like appearance. We detected one male F1 hybrid that returned to breed; it retained some features intermediate between the parent species, but we qualitatively judged it to be more common tern-like. It mated with a Common Tern and produced three backcross hybrid young (biological offspring) that closely resembled Common Terns. We speculate that rarity of Arctic Terns, especially females, at and near the study site and age/inexperience of the Common Tern parent were proximate mechanisms for the formation of the P1 pair. Further, we suggest that Arctic/Common Tern hybridization may occur more commonly than realized in the western North Atlantic Ocean.

Plastic responses of parents and offspring to nest predation risk differ across species.
Mouton, James C. - University of Montana; Thomas Martin - USGS - University of Montana

Plastic responses of life history traits to ecological factors such as predation risk have major implications for the persistence of populations and our understanding of life history evolution. In birds, such plastic responses to offspring predation risk pose an interesting dilemma. Parents are expected to reduce feeding rates and current reproductive effort to mitigate the risk of nest predation and allocate more resources to future young. However, increased nest predation risk favors faster growth and development in offspring, which may require additional resources provided by parents. How do parental and offspring responses to risk resolve this dilemma? Further, why do related species differ in how the respond to risk? To address these questions, we experimentally increased the perceived level of nest predation risk for four species of songbirds that differ in mean nest predation rates using playback experiments. Parental effort and offspring developmental trajectories were affected by increased nest predation rates, but the size and direction of responses varied between species.

Feeder density influences pathogen transmission in house finches *Haemorhous mexicanus*
Moyers, Sahnzi - Virginia Tech; James Adelman - Iowa State University; Damien Farine - Max Planck Institute for Ornithology; Dana Hawley - Virginia Tech

Competition for food resources can alter behavior in ways that influence disease dynamics. Resource competition can increase the frequency and intensity of intraspecific aggression, or alternatively, reduce the propensity for individuals to be social. Such changes in sociality could augment or diminish direct transmission of pathogens respectively. Limited resource availability can also increase indirect contact among individuals, thus facilitating environmental sources of pathogen transmission. Here we experimentally manipulated bird feeder density and assessed effects on host behavior and pathogen transmission in a naturally occurring host-pathogen system. We varied the number of bird feeders available to captive flocks of 8-9 house finches *Haemorhous mexicanus*, and inoculated one bird per flock with *Mycoplasma gallisepticum* (MG), a bacterial pathogen that is transmitted both via direct contact and indirect exposure at bird feeders. Birds were fitted with passive integrated transponders to continuously track foraging behavior and social interactions at radio-frequency-identification equipped feeders. We found that the likelihood of MG transmission was significantly higher within low-competition flocks (4 feeders/flock) than high-competition flocks (2 feeders/flock), despite a significantly lower rate of intraspecific aggressive interactions within low-competition flocks. Here we discuss possible mechanisms for this transmission discrepancy including pathogen tolerance, increased sociality, and the relative frequency of exposure at bird feeders harboring MG.

Ecological speciation of Gentoo Penguins (*Pygoscelis papua*) on a Southern Ocean island
Munro, Kathrin - University of Lethbridge; Theresa Burg - University of Lethbridge; Charles-Andre Bost - Centre d-Edues Bioligique de Chize

Phylogenetic studies suggest oceanographic features play a strong role in restricting gene flow among breeding colonies. For example, strong ocean currents and upwellings in the Southern Ocean have been hypothesized to be an

isolating mechanism for some seabird species, even over small geographic distances. Genetic differentiation is also thought to be affected by behavioral differences, often first identified by morphological differences among populations. The Kerguelen Islands are home to one of the major breeding areas for the Gentoo Penguin (*Pygoscelis papua*), which are classified as 'near threatened'. On the Kerguelen Islands, Gentoo Penguins employ two different ecological foraging strategies; either inshore or pelagic foraging (shallow dives vs. deep-sea dives). Colonies are separated by a small geographic distance, but the behavioral and morphological differences between colonies suggest genetic isolation. To determine how behavioral differences, glacial history and barriers to dispersal of Gentoo Penguins have shaped the current genetic structure we will use microsatellite analyses to examine differentiation between colonies that forage inshore versus those that forage pelagically. Understanding dispersal patterns and other behavioral processes affect gene flow is crucial to help predict the impact of climate change on this poorly understood population of penguins.

Crippling and Nocturnal Biases in a Study of Sandhill Crane (*Grus canadensis*) Collisions with a Transmission Line

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Collisions with power lines are a widely documented cause of avian mortality. Estimating total mortalities from counts of carcasses is usually accomplished by quantifying biasing factors, but neither crippling nor nocturnal biases are well understood. From 4 March through 13 April 2009, data were collected on Sandhill Crane (*Grus canadensis*) collisions involving a 69-kV transmission line crossing the Platte River in Nebraska, USA, at a major migration stopover area. The line was marked with devices designed to increase visibility to Sandhill Cranes, and thus reduce collisions. Numbers of carcasses detected via traditional searches beneath the line were compared to numbers recorded by visual observation through binoculars and night vision spotting scopes, and by electronic Bird Strike Indicators (BSI). Seventeen carcasses were found during traditional surveys, 117 collisions were observed visually, and 321 collisions were recorded by BSIs. Most collisions occurred at night, with crippled Sandhill Cranes departing survey transects. Total mortality including crippling and nocturnal biases, was 2.8 to 3.7 times greater than indicated by a traditional corrected-count mortality estimator. Neither crippling bias nor nocturnal bias were adequately considered by the traditional estimator. Consistent with other studies of avian collision, line marking was only partially successful in reducing collisions.

Hatch Date Timing in Response to Temperature in Two Secondary-cavity Nesting Birds

Musgrave, Maria - Los Alamos National Laboratory; Charles Hathcock - Los Alamos National Laboratory; Jeanne Fair - Los Alamos National Laboratory

In recent years northern New Mexico has been experiencing warmer and drier conditions on average. These climate trends could lead to changes in the timing and success of avian breeding. The objective of this study was to investigate whether

changes in the local climate affected the nesting phenology of two secondary-cavity nesting species in north-central New Mexico. Using data from an Avian Nestbox Network located at Los Alamos National Laboratory (LANL), we compared the average hatch dates from 1997-2015 for Western Bluebirds (*Sialia Mexicana*) and Ash-throated Flycatchers (*Myiarchus cinerascens*). Utilizing nestboxes allowed us to monitor nests routinely and record the hatch and fledge date for each clutch of nestlings. The average hatch dates for Western Bluebirds from 1997 to 2015 advanced approximately five days, a statistically significant change ($F_{1,556} = 16.51$, $p_{1,138} = 0.78$, $p = 0.38$). This suggests that the flycatchers are not as sensitive to subtle changes in local climate as Western Bluebirds. Annual data from a weather station located at LANL indicate that from 1997 to 2015 the average annual temperature increased approximately 2 degrees Fahrenheit. The months of March, April, and June showed increases in both the average nighttime and daytime temperatures over the duration of the project. May, however, did not show a clear trend. Higher temperatures before and during the breeding season may drive advancement in hatch dates for the Western Bluebird.

Applications of behavioral and morphological data across a hummingbird hybrid zone

Myers, Brian - San Diego State University; Christopher Clark - University of California, Riverside; Kevin Burns - San Diego State University

Hybrid zones have received significant attention in biology, but few studies have investigated how behavioral traits vary across these regions of interaction. In a hybrid zone in southern Oregon between the Allen's (*Selasphorus sasin*) and Rufous (*Selasphorus rufus*) Hummingbirds, we found that hybrids vary in morphology and behavior. Using a preliminary cline and a hybrid index, we describe the hybrid zone by characterizing variation in phenotype across the area of contact and study a novel courtship behavior in Allen's Hummingbird, the pendulum display. The courtship displays of both species involve a male hummingbird performing a J-shaped dive, during which the male produces a species-specific sound with his tail feathers. These displays can be broken into distinct elements, and some dive elements are analogous to those in the pendulum display. Hybrids perform courtship displays that incorporate different elements of the displays of parental species. Our data suggest the center of the hybrid zone is in Coos Bay, Oregon, spanning several miles inland and north into the range of Rufous Hummingbird, and south into the range of Allen's Hummingbird. A southern, Allen's-like population in Bandon, Oregon consists of multiple individuals containing behavioral and morphological characters diagnostic of Allen's Hummingbird in combination with Rufous-like dive sounds and tail feather morphology. A more northern, Rufous-like population near Reedsport, Oregon exhibits a Rufous Hummingbird phenotype with expression of few characters consistent with Allen's Hummingbird. No previous avian hybrid zone study has incorporated the variation of behavior across an area of contact.

Rangewide population genetic structure in three sapsucker species

Natola, Libby - University of Lethbridge; Theresa Burg - University of Lethbridge

Vicariance causes speciation by physically separating populations through forces such as continental drift or glaciation. During the Pleistocene era, advancing ice sheets pushed species into isolated refugia where differentiation occurred in response to selection, mutation, and genetic drift. An example of Pleistocene era speciation is evident in the Sphyrapicus genus, among

Red-Breasted (*S. ruber*), Red-Naped (*S. nuchalis*), and Yellow-Bellied (*S. varius*) Sapsuckers. Yellow-Bellied Sapsuckers are estimated to have diverged from the Red-Breasted and Red-Naped lineage approximately one million years ago, whereas the latter two species diverged from each other at the end of the Pleistocene as recently as 20,000 years ago. Though studies have investigated genetic structure in this species complex, they were limited in scope and none have examined range-wide population genetic structure. Using the control region and COI mitochondrial DNA markers, and the Z-linked CHD1Z gene, we have examined samples from across each of the three species' breeding ranges. Between species comparisons show the Yellow-Bellied Sapsuckers are genetically distinct from Red-Naped and Red-Breasted Sapsuckers, however, there is a high degree of genetic mixing between the latter two species. Within the Red-Breasted Sapsuckers, the Pacific Northwest populations seem to have a divergent genetic structure from other conspecific populations, which might suggest a Pleistocene refugium in this area, an idea we explored using spatiogeographic modelling. These findings contribute to our knowledge of sapsucker speciation, and to the suggestion that the Pacific Northwest served as a glacial refugium for many species during the Pleistocene era.

Tree diversity and identity mediates insectivorous bird communities and top-down suppression of herbivores

Nell, Colleen - University of California Irvine; Luis Abdala-Roberts - Universidad Autonoma de Yucatan; Kailen Mooney - University of California Irvine

Insectivorous birds are important predators of herbivorous insects, providing indirect defense to the plants they feed on. Simultaneously, plant traits and plant diversity are important determinants of the associated herbivore and predator communities within a community, thus having important consequences to indirect defense. The "Enemies Hypothesis" predicts that plant diversity has positive effects to predator diversity and abundance, which in turn indirectly suppresses herbivore abundance. In a forest diversity manipulation in the Yucatán Peninsula of Mexico, we tested this hypothesis by conducting a clay caterpillar experiment. Through visual surveys we documented over 80 bird species foraging throughout the forest diversity plots. Both bird abundance and species richness was higher in tree polyculture plots relative to monocultures. These differences in bird communities corresponded to higher rates of predation on clay caterpillars in the tree polyculture plots, indicating stronger herbivore suppression with plant diversity. Top-down effects from insectivorous birds were strongly driven by tree species identity. In particular, *Ceiba pentandra*, was documented to have the highest bird use in addition to the highest caterpillar predation. These effects extended to the surrounding trees such that plots containing *C. pentandra* had a higher abundance and diversity of birds, and greater predation rates relative to plots without *C. pentandra*. These results may be explained by the greater phylogenetic diversity of bird species observed using *C. pentandara* trees and polyculture plots, which may promote complementarity and reduce competition by foraging birds.

The effect of breeding experience on the reproductive success of female Carolina Chickadees

Nemec, Shelby - Northern Kentucky University; Lindsey Walters - Northern Kentucky University

Avian reproductive success is potentially impacted by parental experience. Gathered experience may improve breeding skills with practice, create familiarity with the breeding partner and territory, or help a bird adapt more easily to changing environmental conditions. We investigated the effect of breeding experience on nestling mass and

maternal provisioning rates in Carolina Chickadee (*Poecile carolinensis*) females that bred multiple years at our field site in Melbourne, KY between 2011 and 2015. We predicted that both nestling mass and provisioning rate would be higher for the second breeding attempt. Ten days after hatching, we banded and massed nestlings from each nest and observed provisioning visits made by the banded female parent for one hour. We compared the mean nestling mass and provisioning rates for the same females between their first breeding attempt and their second breeding attempt. We found that more experienced females had significantly heavier nestlings, which is consistent with data collected in other species of birds. However, provisioning rate did not differ between breeding attempts. A possible explanation for this could be that more experienced mothers brought more nutrient-rich prey in more experienced years. Another possible explanation is that the experienced parents visited nestlings more frequently at different times than when we observed them, such as later in the day or sooner after hatching. Future research should focus on examining these possible explanations. Determining the mechanism that allows experienced parents to produce heavier nestlings will further contribute to our knowledge of avian parental care behavior.

Common Nighthawk nesting ecology in an agriculturally dominated landscape and susceptibility to land-use change
Newberry, Gretchen - University of South Dakota Biology; David L. Swanson - University of South Dakota Biology

Grassland habitat in the Northern Prairie region has been greatly reduced since historical times, and this decline has recently intensified due to conversion to agricultural row-crop production. Common Nighthawk (*Chordeiles minor*) nesting habitat includes grasslands, open forests and urban rooftops, but data indicate disproportionate use of urban sites as nesting habitat in the study area. Recent studies of Common Nighthawk population ecology in the Great Plains region have been conducted in large continuous patches of grassland, but not in agriculturally dominated landscapes. Since 1980, aerial insectivorous birds as a group have declined in numbers throughout North America and have experienced a greater decline than songbirds. In the current study, we recorded landscape attributes (i.e. percent cover and distance to row-crops, water, wetlands, riparian areas, grasslands, hay crops, pastures, developed areas, gravel rooftops, and deciduous forest) at point count survey locations in southeastern South Dakota to determine if landscape attributes influence nighthawk occurrence. To compare presence/absence between point count sites, we used Generalized Linear Models (GLM) with binomial distributions to analyze the interaction of presence/absence (as the dependent variable) with land cover attributes as predictor variables. Our point count data suggest that the percent cover of grasslands, gravel rooftops, and deciduous forest in the area were positively associated with nighthawk occurrence ($P < 0.05$). This study predicts that continued conversion of grassland, gravel rooftop and forest habitat in an increasingly agriculturally dominant landscape will negatively impact nesting ecology and conservation for this at-risk species.

Climate Change Impacts and Productivity in Hummingbirds
Newcomb, Kira - Hummingbird Monitoring Network; Susan Wethington - Hummingbird Monitoring Network; Jessica Pollock - Intermountain Bird Observatory

Bird survival and productivity can be negatively impacted by extreme weather events such as drought, hail, and flooding during the breeding season. Increased occurrence of these events during the

breeding season due to climate change could lead to fewer juveniles being recruited into breeding populations and ultimately hinder population growth. Hummingbirds (Trochilidae), with their high metabolic rate and dependence on ephemeral resources, may be particularly susceptible to climate change impacts. Based on observations of Calliope Hummingbird (*Selasphorus calliope*) in Idaho, we predict that fewer juvenile hummingbirds will be observed in years with more extreme weather events. We will use environmental covariates and long-term banding data from Hummingbird Monitoring Network sites in the Western US to determine effects of extreme weather indices over 15 years and at three spatial scales on abundance of juvenile hummingbirds. The results of this project will be important for conservation planning in climate change scenarios. Though no hummingbirds species in the US or Canada are currently species of concern, impacts of climate change may lead to species being listed in the future.

Presence and Habitat Use of Secretive Marshbirds in Urban Marshes of the Washington, DC Metro Area

Nielson, Patrice - University of Maryland; William Bowerman - University of Maryland; Andrew Baldwin - University of Maryland; Jennifer Murrow - University of Maryland

Secretive marshbirds are in decline across their range and are identified as species of greatest conservation need in state Wildlife Action Plans. However, their secretive nature means there is relatively sparse information available on their ecology. There is demand for this information in the Washington, DC area for updating conservation plans and guiding wetland restoration. Using the Standardized North American Marshbird Monitoring Protocol, I surveyed 51 points in 25 DC area marshes in 2013, 2014, and 2015. I also collected data on marsh area, buffer width, vegetation/water interspersion, vegetation characteristics, amount of flooding, and invertebrate abundance. I used Program Presence to model the detection and occupancy probabilities of secretive marshbirds as a function of habitat variables. I found king rails at five survey sites and least bitterns at thirteen survey sites. Secretive marshbirds were using both restored and natural marshes, with and without invasive plants, and with a variety of dominant vegetation species. The top least bittern occupancy models included a positive association with tall vegetation cover and negative associations with woody vegetation and invertebrate abundance. The top king rail occupancy models included positive associations with plant diversity and invertebrate abundance and a negative association with persistent vegetation. Species-specific models were a better fit for the data than either a generic marshbird model or a comparison model based on important habitat variables from other studies. Based on my results, I recommend decreasing woody vegetation, increasing tall vegetation, and managing for a variety of co-dominant species to improve marshbird habitat.

Dealing with (un)seasonal drought: comparing two understory insectivores in Central Panama

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Rainfall regime, the amount and timing of precipitation, dominates seasonality in the terrestrial Neotropics and has significant impacts on animal populations. The onset of the rainy season influences arthropod abundance and the timing of breeding in understory birds. Prior analyses on 35 years of mark-recapture data from Central Panama showed that longer dry seasons have a significant negative effect on annual population growth rates in nearly a third of the common species considered. To investigate how resource availability may influence individuals' physiological condition

and potentially affect species' population trends, we examined individual nutritional status and body condition measures (e.g. plasma metabolite concentrations, haematocrit, body mass, fat stores) changed over the course of a dry season (2016) and during an unseasonal drought (2015). We found that Spotted Antbirds (*Hylophylax naevioides*), the more resilient focal species, delayed breeding while the majority of Song Wrens (*Cyphorhinus phaeocephalus*), in which population growth rate is sensitive to dry season length, did not nest before September. Song Wrens consistently had higher concentrations ($p < 0.01$) of β-hydroxybutyrate, a metabolite formed in the use of endogenous reserves, than Spotted Antbirds. How individuals and breeding pairs cope with food scarcity may lead to systematic differences in condition or nutritional status which may influence reproductive decisions. Predicting how and why species will respond to predicted changes in tropical rainfall regimes is fundamental to modern conservation efforts.

Mating systems, male territoriality and agility as predictor of sexual size dimorphism in hummingbirds

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Males and females exhibit differences in body size; this difference is sexual size dimorphism (SSD). In several taxa males are larger than females, whilst in others, females are larger than males. Although several hypotheses have been proposed to explain the evolution of SSD patterns, four functional hypotheses have received the greatest attention: sexual segregation, fecundity selection, mating competition and display-agility. Here, with the use of phylogenetic comparative methods, we tested whether i) hummingbirds exhibit Rensch's rule; ii) sexual selection (mating competition, male territoriality and display-agility) predicted the evolution of SSD; iii) sexual selection could account for allometry consistent with Rensch's rule. Our results showed that hummingbirds exhibit the full scope of Rensch's. In territorial species male–biased SSD increased with male, whilst it was unrelated to male agility in non-territorial species. Note that there was also a statistically non-significant trend illustrated by the interaction among mating system and territoriality, which suggests that SSD changed differently amongst lek-forming and non-lekking species when territoriality was considered. An inspection of the interaction term revealed that in territorial species, lek-forming species had a statistical non-significant tendency to exhibit more male-biased SSD than non-lekking . This relationship was less noticeable in non-territorial species. Finally, here we tested whether sexual selection explained Rensch's rule concluding that according to what our results suggested that Rensch's rule is cannot be explained by sexual selection, we suggest that other ecological variables must be tested in order to unveil the forces that shaped the evolution of such macroecological pattern.

Modeling Distributions of Disjunct Populations of Nelson's Sparrow (*Ammodramus nelsoni*)

Oakley, William - University of Oklahoma - Department of Biology; Eli Bridge - Oklahoma Biological Survey

Nelson's Sparrow (*Ammodramus nelsoni*) is a small, secretive, migratory North American songbird that breeds in three geographically distinct regions of Canada and the United States. With its unusual disjunct breeding distribution, Nelson's Sparrow provides an excellent opportunity to study speciation and range expansion/contraction. We used maximum

entropy modeling (MaxEnt) to estimate the ecological niche for this species using records from within each of the three breeding regions. We also used paleoclimate-based niche models to reconstruct the past breeding distribution for this species, aiming to infer patterns of range expansion. Our goal was to assess habitat suitability and habitat characteristics and potentially gain insight into the transition of a coastal breeder to an inland breeding species. Analyses are currently ongoing, but we anticipate that niche models generated from inland observations will not predict known coastal habitat and vice versa. We hope this work will provide new insights into the biogeography of this species and generate phylogeographic hypotheses that can be tested with genetic data.

Dispersal strategies of juvenile Bald Eagles (*Haliaeetus leucocephalus*) determined from satellite tracking

Obermayer, Brennan - Trent University; Debbie Badzinski - Stantec Consulting; Jody Allair - Bird Studies Canada; Joe Nocera - Ontario Ministry of Natural Resources & Forestry

Dispersing juveniles incur substantial mortality risk, which can be prolonged in species with delayed sexual maturity, such as the Bald Eagle. Natal dispersal influences individual fitness and population persistence through factors like maintaining healthy gene flow. Little is understood about the dispersal behavior of juvenile Bald Eagles individuals and how it relates to selection of, and survival in, wintering areas, stop-over sites, and future breeding grounds. From 2004-2014, we monitored dispersal of 18 juvenile Bald Eagles from southern Ontario, a development-prone region that is Canada's most densely populated region. . We used 80 gram battery-powered (deployed 2004-2006; N=9) and 65 gram solar-powered (deployed 2007-2009; N=9) platform transmitter terminals. Seven males and 11 females were tracked for an average duration of 1080 days (ranging from 154 to 2254 days). We used GIS and spatial statistical models to determine the distance and direction of dispersal, as well as temporal patterns of movement. We found that some individuals spent most of their time in their natal geographic region while others made long-distance movements far from their natal geographic region, which seemed to be concentrated on a north-south axis. These dispersal patterns suggest that conservation of Bald Eagles must occur at multiple spatial scales and management strategies for the species ought to consider state-based (seasonal) management units that can extend to 1400 km from breeding populations.

Conservation Biology of the Critically Endangered Bahama Oriole: Estimating Current Population Size and Evaluating Threats

Omland, Kevin - University of Maryland, Baltimore County; Shelley Cant - Bahamas National Trus; Scott Johnson - Bahamas National Trust/ BIrdsCaribbean; Matthew Jeffery - Audubon; John Tschirky - American Bird Conservancy; Holly Robertson - American Bird Conservancy; Melissa Price - University of Hawaii at Mānoa; Scott Sillett - Smithsonian Migratory Bird Center

The Bahamas and adjacent Caribbean islands are home to eight island endemic orioles, half of which are Threatened or Near Threatened. The Bahama Oriole (*Icterus northropi*) is listed by IUCN as Critically Endangered. This species is currently restricted to Andros, as it was extirpated from Abaco during the 1990s due to unknown causes. The only formal study of this species was a PhD thesis, which estimated that only 141-254 individuals remained (Price et al.J. Field Ornithology, 2011). First, we will estimate the current population size using distance sampling to

obtain census estimates with statistically robust confidence intervals. We will conduct both breeding season and non-breeding season counts to determine which habitats are crucial to the species throughout the annual cycle. Second, we will monitor breeding success and evaluate known threats including cowbirds, native nest predators, introduced feral predators and lethal yellowing disease of palm trees. Recent training of local residents provides the first steps toward community involvement and making ecotourism part of the recovery of this charismatic species. Ultimately, translocation of some individuals to Abaco could be an important strategy given the risks inherent in having the species restricted to a single island complex. The Bahamas National Trust and the University of Maryland (UMBC) are leading this collaborative effort, with the support of Audubon and the American Bird Conservancy. We are seeking additional funding to enable a comprehensive long-term approach to ensuring the survival of the Bahama Oriole.

Factors influencing habitat occupancy by the Golden Eagle (*Aquila chrysaetos*) in the Mexican high plateau region.
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Golden eagle (*Aquila chrysaetos*), whose populations in Mexico are threatened, face a number of risks related to human activities such as habitat loss and degradation, establishment of residential areas and industrial complexes within their territories, electrocution, etc.. The magnitude of these effects, however, has not been studied. Understanding the impact of human activities on Golden eagle populations is the first step towards successful implementation of conservations plans. Therefore, the objectives of our study included to determine effects on Golden eagle breeding territory occupancy of: 1) natural vegetation cover at local (1 and 3.5km from the nesting site) and landscape (5 and 15km from the nesting site) scales, 2) prey abundance at local scales (1 and 3.5km from the nesting site), 3) distance from nearest anthropogenic disturbance (i.e., industrial complexes, residential areas, agricultural fields, etc.), and 4)to determine the effect of plant cover at the local scale (1 and 3.5km from the nesting site) on the relative abundance of golden eagle prey. We visited Golden eagle nesting sites at different locations in the Mexican plateau. We quantified plant cover and relative of prey (rabbits and jackrabbits) abundance. We also measured distance from the nesting location to the nearest anthropogenic disturbance. Habitat occupancy models were fit to the data to estimate detectability and the relative effect of each independent variable on habitat occupancy. In addition, the effect of plant cover on relative abundance of Golden eagle prey was assessed through linear regression.

The role of incubation behavior in shaping developmental physiology in a wild Passerine
Ospina, Emilie - University of Illinois at Urbana-Champaign; Loren Merrill - University of Illinois at Urbana-Champaign; Thomas Benson - Illinois Natural History Survey, University of Illinois

The environmental conditions under which an organism develops can impact both short and long-term phenotypic expression. In birds, developing embryos may be particularly sensitive to changes in incubation temperatures, particularly those outside the range of optimal embryonic development. Variation in incubation temperatures may therefore have important effects on the development of key phenotypes, including critical physiological

systems such as innate immune defenses. Effects of incubation temperature on embryonic development are well documented in domestic birds, but comparatively little is known regarding such effects in wild bird populations. We experimentally manipulated the incubation temperature of American Robin (*Turdus migratorius*) eggs to better understand how thermal variation during this critical period can affect innate immune defenses in a wild passerine. A single egg per active nest was collected at clutch completion and randomly placed in one of two temperature treatments, 36°C (suboptimal) and 38°C (optimal). Hatched nestlings were returned to a foster nest of the same age. Blood samples were taken from each artificially incubated nestling and a natal sibling (to control for genetic or parenting effects). Collected blood samples were then used to assess bacterial killing ability (BKA). In 2015 we found that optimally incubated individuals had the highest BKA, natural individual had second highest, and suboptimal individuals had the lowest BKA. Based on preliminary results, it appears that incubation temperatures do play a discernable role in developing individual immunocompetence. Therefore, factors influencing incubation patterns of female birds may have lasting effects on development of juvenile birds.

The value of simplicity – do variant song types affect interactive signalling in white-throated sparrows?
Otter, Ken - University of Northern British Columbia; Stefanie LaZerte - University of Northern British Columbia; Scott Ramsay - Wilfrid Laurier University

White-throated sparrow song typically ends in a repeating triplet of notes, each repeat being one strophe. The number of strophes males add to their songs is flexible and may signal increased aggression during interactive song contests. However, lengthening songs by adding strophes creates a conundrum; longer songs can increases the prospect of being overlapped by rivals. As song-overlapping signals aggression in songbirds, males typically try to avoid being overlapped during contests. One possible solution would be adopting shorter strophes, which would allow males to increase strophe number while limiting the potential for being overlapped. A doublet-ending song variant has emerged among western populations of white-throated sparrows, which are shorter overall than triplets and may allow signalling of intent with less risk of being overlapped. We conducted playback studies on white-throated sparrows, measuring their response to songs with a low (two) or high (four) number of strophes. Half the males were played doublet-ending songs originating from the same western population as the subjects; the other males were played triplet-ending songs originating from an eastern population 5000km away. Males responded aggressively to stimuli with both high- and low-strophes, yet, despite all subject males singing doublet-ending songs, there was no effect of triplet/doublet stimuli on male response. Males truncated songs that were overlapped by reducing the number of strophes over non-overlapped songs. Males tended to be overlapped more during high vs low-strophe playback, but there was no difference between triplet and doublet playbacks.

Modeling Parrot Nest-Site Selection
Owen, Joel - University of Georgia; Richard Chandler - University of Georgia

Little is known about the nesting ecology of wild psittacids, even though many of these species are threatened with extinction. One reason for the lack of information on psittacid nest-site selection is that few methods exist for accurately estimating and modeling spatial variation in nest density. We developed a survey method and a spatial model that allows for inference about

the effects of landscape variables on nest-site selection. The survey method involves a modified distance sampling protocol suitable for sampling cliff-nesting species. The spatial distance sampling model is hierarchical, comprised of state and observation processes. The state process describes spatial variation in density, and the observation process describes how detection varies with distance and activity associated with nesting behavior. To evaluate model performance, we conducted a simulation study in which we assessed bias and precision of estimators under a range of parameter values representing plausible values of nest density and detection probability. Simulation results indicated high precision and low bias in the estimates of the true parameter values, with good agreement between actual and estimated density surfaces. Future work will involve applying the model to data on Red-and-Green Macaw (Ara chloropterus, Psittacidae) nest-site selection in Fazenda Boa Vista, Brazil. The model will be used to evaluate the degree to which nest-site selection is affected by multiple landscape factors, including elevation, slope, aspect, food availability, and distance from human activity. This novel modeling approach will advance knowledge of psittacid nest ecology and will be useful for guiding Red-and-Green Macaw conservation efforts.

Ascertaining the diversity and rate of evolution of mitochondrial genes in avian Haemosporidian parasites

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There is a renovated interest in avian haemosporidian parasites as they can inform about the demographic history and ecology of their hosts. Our understanding of these parasite diversity has been invigorated by the discovery of many cytochrome b (Cytb) lineages. Unfortunately, given the knowledge gaps on the parasite taxonomy, many sequences cannot be linked to a known species or it is hard to assess whether a given divergence may indicate a new species. In this study, we explored the rate of evolution of the mitochondrial genome (mtDNA) on a data set that included well identified parasite species using morphology. We analyzed 114 complete mtDNA of species belonging to three genera: Leucocytozoon, Haemoproteus (subgenus Haemoproteus and Paraemoproteus), and Plasmodium. We estimated phylogenies using mtDNA and each gene individually. We also estimated evolutionary rates by using nucleotide and codon base molecular clock approaches. We found no evidence of saturation on any of the individual genes. The mtDNA phylogeny shows a separation between H. Paraemoproteus of passerines and non-passerine birds, a pattern not observed in the other subgenus. There is extraordinary rate heterogeneity between genes and within taxa, in many instances single gene approaches could not rescue the mtDNA phylogeny. However, the Cytb allows the correct identification of morphologically distinct species on the available sample. Our data supports that Cytb is suitable for barcoding approaches, however, knowledge gaps on the parasite taxonomy still a limiting factor that needs to be addressed.

Conservation across a managed landscape: a full-annual-cycle approach to examining grassland bird communities in North America

Panjabi, Arvind - Bird Conservancy of the Rockies; Erin Strasser - Bird Conservancy of the Rockies; Nancy Drilling - Bird Conservancy of the Rockies; José Hugo Martinez - Universidad Juárez del Estado de Durango; Irene Ruvalcaba-Ortega - Laboratorio de Biología de la Conservación y Desarrollo Sustentable, Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León; Maureen Correll - Bird Conservancy of the Rockies

Migratory bird populations are declining across North America, contributing to the current global biodiversity crisis. As these populations continue to deteriorate it is clear that data from the breeding grounds, wintering areas, and migratory routes all need to be integrated into full annual cycle models (FAC) that can then fully inform pertinent questions about species persistence and conservation. Grassland birds are North America's steepest declining guild of birds, yet we lack even basic information on what limits these populations. Bird Conservancy of the Rockies, with the support of various funding agencies and collaborators, is focusing efforts on the conservation of declining grassland birds. On the wintering grounds, we have gathered data on grassland bird abundance and distributions and identified key wintering areas and habitat relationships. More recently we have explored the factors limiting overwinter survival of two declining grassland-specialist species, Baird's and grasshopper sparrows. In 2015 we also began monitoring demographic rates for these same species on their breeding grounds in the Northern Great Plains of North America. Our program aims to collect the data necessary to generate FAC models that can help identify where and when grassland birds are most threatened. In conjunction with our collaborators and stewardship presence in Mexico and the Northern Great Plains, this project has the potential to identify limiting factors for grassland bird species and disseminate and apply these findings through conservation recommendations across their range.

The Effect of timing of mercury exposure during development on breeding in adult zebra finches

Paris, Ohad - College of William and Mary

This study tested the so-called "early stress hypothesis" with rigor that has not occurred previously, with the additional goal of providing valuable insight for regulating the exposure of millions of songbirds to pervasive mercury pollution. Songbirds, a taxon of immense cultural significance, public interest, and conservation importance, have been shown in field and dosing studies to suffer profound mercury-related reductions in reproductive success and overall fitness. However the effects of mercury exposure during development on bird physiology and behavior in adulthood remain largely unstudied. Mirroring songbird exposures in the wild, this study compared the reproductive success of captive breeding zebra finches (*Taeniopygia guttata*) exposed to methyl-mercury at different stages of development. Birds were randomly placed in one of four exposure treatments corresponding to different stages in development: (1) "Early stress" exposure from conception through 50 days of life, (2) "Continuous Stress" from conception through 114 days of life, (3) "Late Stress" from 50-114 days of life, and (4) "Control" with no MeHg exposure. Response variables associated with reproductive success, which have been shown in previous mercury dosing studies to be affected by methyl-mercury ingestion, were monitored. Data collection began at the time of subjects' pairing and ended at offspring sexual maturity in order to examine the entire reproductive cycle. Data collection is

ongoing, with preliminary results showing an increase in clutch size with early stage exposure but no effect on overall reproductive success.

Fire Ecology and Birds: Biodiversity of Bird Species in the St. Olaf College Natural Lands

Patterson, Emily - St. Olaf College; Kathy Shea - St. Olaf College

Efforts to restore prairie grasslands often involve simulating natural burn cycles, frequently by burning small sections of prairie creating a mosaic of habitats ranging from primarily grasses to primarily forbs. While many post-burn studies of avian biodiversity focus on breeding birds, we focused on fall migrants. We mist-netted and banded birds for six weeks during the fall of 2014, on five sections of restored prairie burned in four different years (2010, 2012, 2013 and 2014). We then used Shannon diversity indices and contingency tables to compare avian biodiversity between the five sections and also between the three two-week time periods in which banding occurred. There was a significant difference in the Simpson index values between two sections both burned in 2010, and also between one section burned in 2010 and one in 2014. Several sparrows preferred the more recently burned sections, with 80% of savannah, 85.7% of song, and 100% of lincoln's and swamp sparrows being caught in the three most recently burned sections, but this preference was not significant. There was a significant difference in the number of birds caught in the various sections across time. Birds in the early fall preferred the most recently burned section, which also had the highest percentage of grasses. Birds in the middle and late fall preferred a less recently burned section (2012), which also had the highest percentage of forbs. Our results provide preliminary support for the importance of mosaic-burning patterns during migration.

Timing, Location, and Causes of Mortality in migratory Whooping Cranes

Pearse, Aaron - U.S. Geological Survey; David Brandt - U.S. Geological Survey; Barry Hartup - International Crane Foundation; Mark Bidwell - Canadian Wildlife Service, Environment and Climate Change Canada

Understanding where, when, and why animals die provides information for prioritizing conservation actions. Timing of mortality for migratory birds has been difficult to determine given their mobility and large annual range. Based on assumptions and some supporting data, past assessments of Whooping Cranes (*Grus americana*) of the Aransas-Wood Buffalo Population determined that 60-80% of mortality after fledging occurred during migration, 20% during winter, and ≤5% during summer. As part of a satellite tracking study, we identified 19 confirmed and suspected moralities of Whooping Cranes of various ages. Of these, more mortalities occurred during winter (42%) and summer (42%), compared with migration (16%). Summer mortalities occurred exclusively within Wood Buffalo National Park, and all winter mortalities occurred on the primary wintering grounds along the Texas Gulf Coast. Proximate cause of mortality was not known for the majority of the sample, and predation was the most common cause identified. Our results, based on stronger evidence, provide a different perspective from past assessments of mortality. Specifically, migration may be less risky and summering birds at a greater risk than previously assumed. The level of mortality during winter we found supports the notion that winter mortality increases during periods of drought, which occurred during our study. Conservation or management efforts to reduce mortality may have greater effect when focused during breeding and wintering periods, although feasibility and efficacy of these actions will need to be determined.

Relationship between habitat characteristics and nest survival in the Southwestern Willow Flycatcher
Pellegrini, Anne - SWCA Environmental Consultants; Mary Anne McLeod - SWCA Environmental Consultants

The Southwestern Willow Flycatcher is an endangered passerine that breeds in riparian habitat in the southwestern United States. Characteristics of suitable habitat have been described in multiple locations throughout the species range, but the relative importance of each individual characteristic for nest survival is relatively unknown. We monitored Southwestern Willow Flycatcher nests along the lower Colorado River and tributaries between 2003 and 2007. Data on surface soil moisture, temperature, relative humidity and several vegetation variables were collected at each nest. We modeled nest survival in Program MARK using the microclimate and vegetation variables as covariates and present the results of model evaluation.

Characterization of climate niche Baird's Sparrow (Aves: Emberizidae) during their migratory cycle
Peña-Peniche, Alexander - Instituto de Ecologia, A. C.; Irene Ruvalcaba Ortega - Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León; Octavio R. Rojas-Soto - Instituto de Ecologia, A. C.

In order to establish conservation strategies for migratory species, it is essential to understand how birds use their ecological niche. *Ammodramus bairdii* is a grassland specialist species that breeds in North America and winters in the Chihuahuan desert. It presents an decrease in its population and most of its biological processes in their winter areas is unknown. Therefore in this work the width and use of the ecological niche of *A. bairdii* was determined. Ecological niche models were made using GARP, for winter and breeding seasons; projections between those seasons and the migration months were also made. Minimun Convex Polygon (MCP) of the niches from both periods were calculated to compare, measure the width and the overlapping. Test of similarity and equivalence of niches were performed using PCA. Optimal and sub-optimal conditions were determined based on the distance to the centroid of the ecological niche. There were no geographical inter-predictions between seasons. Reproductive niche projections showed little representation in the migration months, contrary to the case of the winter niche. This suggests that the conditions of reproductive session are space and time exclusive. The area of the winter MCP was bigger than the reproductive one and they presented an overlap of 22.47% and 45.18% respectively. No equivalence was found between niches; however, they are similar. The migration month's conditions were found close to the sub-optimal conditions of the species niche. All this suggest that *A. bairdii* uses different conditions of their ecological niche during each stage of its migratory cycle.

Least Tern and Wilson's Plover Nesting Success in a Coastal Land Loss Crisis
Percy, Katie - National Audubon Society, Audubon Louisiana; Erik Johnson - Audubon Louisiana; Kacy Ray - American Bird Conservancy

Beach-nesting birds face a multitude of threats, both anthropogenic and natural. In coastal Louisiana, where land loss over the last 80 years has exceeded 1900 square miles, and where billions of dollars for coastal restoration are needed to reverse land loss and adapt to sea level rise, it is important to understand mechanisms that drive coastal bird population change. Our objectives were to identify factors that limit nesting success of Least Terns (*Sternula antillarum*) and Wilson's Plovers (*Charadrius wilsonia*) in this ever changing landscape, and to understand how habitat

change through natural successional processes and vegetation plantings affect inter-annual movements. Overall raw nesting success on two focal sites in coastal Jefferson Parish, LA was 20.1% (n=521 nests) for Least Terns between 2012 and 2015, and 58.3% (n=12) for Wilson's Plovers in 2014 and 2015. Protecting these sites from direct human disturbance was largely successful, but the greatest loss of Least Tern nests at 29.0% was caused by storm overwashing followed by 15.7% of nests lost to coyotes. For Wilson's Plovers, however, nest loss was primarily driven by coyotes (33.3%). In 2015, at four sites in Cameron Parish, LA and three sites in Jefferson Parish, LA, overall breeding productivity was 0.11 – 0.42 fledglings/pair for Least Terns and 0.37 – 0.92 fledglings/pair for Wilson's Plovers, which likely fall below rates needed to maintain a stable population. Our results reveal the need for managing coastal sites to provide elevated nesting sites that are relatively predator free.

Effect of endozoochory by birds on seed germination of plants of the cloud forest, Veracruz, México

Pérez Cadavid, Adelaida - Instituto de Ecología A.C (INECOL); Octavio R. Rojas-Soto - Instituto de Ecologia, A. C.; Martha Bonilla-Moheno - Instituto de Ecología A.C (INECOL)

Frugivorous animals play an important role in the regeneration of Neotropical forests. For example, the endozoochory dispersal of seeds that pass through the gut of animals may have an improvement on germination. In birds, it was found that after ingestion there an increase in germination, but also can be a negative effect. Despite this, there is limited studies that evaluate the effective contribution by birds on germination, particularly in cloud forest. We analyze the effective contribution by birds in terms of percentage and speed germination of pioneer seeds in a cloud forest in Veracruz, which is considered one of the most threatened ecosystems in Mexico. Besides, we evaluate the effect on germination considering the species of birds that eat the seeds. Thus, we offered ripe fruits of *Micona glaberrima*, *M. Mexicana* and *Conostegia xalapensis* to seven frugivorous species of birds (n = 123). Once the birds ate the fruits offered, we extracted the seeds from the excreta and put them in a germination camera under controlled conditions. The same number of seeds from the same fruits were used as a control group. Our results showed that the seeds that pass through the digestive tract, have and improvement in terms of percentage and speed of germination; however, these results varied by species. Birds can contribute differentially on germination depending on species and may catalyze the process of recovery of forests.

Using dried blood spots to assess mercury exposure in birds

Perkins, Marie - McGill University; Niladri Basu - McGill University

Mercury is a pervasive environmental contaminant that can impair bird physiology, behavior, and reproductive success, which may result in population declines. Evaluating mercury exposure is an important metric for assessing the heath of birds and ecosystems. Bird blood provides a good measure of recent dietary exposure to mercury, but blood collection and storage can be challenging and costly. Dried blood spots (DBS), blood collected on specialized filter paper, can provide an easy and cost-effective method for sampling bird blood to determine mercury exposure. Using a direct mercury analyzer (DMA) to determine DBS mercury concentrations offers an ideal analysis method with minimal sample preparation. This research aims to determine the accuracy of using DBS analyzed with a DMA to assess mercury exposure in birds. Whole blood, entire DBS, and sub-sampled DBS from experimentally

dosed chickens were analyzed with a DMA. Percent recovery was determined by comparing DBS concentrations with those of whole blood. Results indicate that using a DMA to analyze DBS provides an accurate measure of blood mercury concentrations. Recovery for entire chicken DBS was 102+/-5%, however, analysis of DBS sub-samples revealed lower recovery, 81+/-4%. Greater recovery was observed in sub-samples taken to incorporate the edge (93+/-9%) of the DBS compared to those from the interior (70+/-5%). There was little effect of time, temperature, and humidity storage treatments on mercury concentrations of entire chicken DBS (mean recovery: 99+/-5%, range: 94-107%, n = 10 treatments). Overall, results indicate that DBS analysis using a DMA can accurately evaluate mercury exposure in birds.

Critical Connections: Conserving Migratory Birds in Alaska's Parklands

Phillips, Laura - National Park Service; Carol McIntyre - National Park Service; Iain Stenhouse - Biodiversity Research Institute; Scott Weidensaul - Self employed

Although Alaska's National Parklands encompass 54 million acres of wildlife habitats, animals are not constrained by jurisdictional lines and many move seasonally across a patchwork of protected and unprotected lands. Land managers cannot meet their mission to conserve wildlife within parks without understanding the basic aspects of a species' life history including movements and habitat use outside park boundaries that affect these individuals. Many migratory birds range across extraordinary distances and encounter a wide range of risks to survival and reproduction throughout their lives. In many cases causes of declines observed in populations on breeding grounds are found either along migration routes or on wintering grounds. We initiated the Critical Connections Program to expand our knowledge of the year-round needs of migratory birds breeding in Alaska's National Parklands and to provide park managers and others with information essential for implementing effective conservation strategies for these migratory species. In summer 2015, we deployed light-level geo-locators on 12 Gray-cheeked and 19 Swainson's Thrushes in Denali National Park and Preserve to identify migration routes, stopover areas, and wintering grounds. Results provide insight into important use areas throughout the non-breeding period as well as connectivity of breeding populations across North America.

The Population Genetic Structure of the Red-Billed Tropicbird (*Phaethon aethereus*) in the Gulf of California, México

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The genetic structure in tropical seabirds is influenced by physical, ecological and behavioral factors while their populations generally exhibit highly structured metapopulations. The red-billed tropicbird (*Phaethon aethereus*) has a pantropical distribution and is considered "threatened" in Mexico. The species nests on the islands of the Gulf of California and Mexican Pacific. In the present study, the diversity and genetic divergence of the species was evaluated and its genetic structure was determined based on the analysis of 133 individuals from five colonies. To estimate the genetic structure and gene flow among the colonies, the control region of mtDNAand 5 microsatellite loci were amplified. Mitochondrial data showed no

variation since all individuals shared the same haplotype. However, data from microsatellite loci showed evidence of a slight genetic differentiation among the two most distant islands and among the central- and northernmost island. Connectivity among the islands was assumed because of their proximity and the very high identity probability (IP) of all genotyped individuals. Compared to the highly structured populations generally present in tropical seabirds, the red-billed tropicbird populations from the Gulf of California only showed slight genetic structure. This low level of genetic differentiation among the colonies in the Gulf of California could be due to the low genetic variation associated with a founder effect from the Caribbean or an abrupt downsizing of its population.

Use of select venous blood analytes to assess the effects of parasite load and habitat on bird health
Pistone, John - Texas A&M University; Jill Heatley - Texas A&M University; Gary Voelker - Texas A&M University

There has been minimal research done in the Rio Grande Valley of South Texas, with respect to the health of wild bird populations. To assess bird health, an iStat machine was used to record blood gas analytes for both migratory and sedentary birds. I also assessed external body condition, and whether birds carried ecto-parasites or malaria parasites. Blood samples were screened for malaria using polymerase chain reactions. Collectively, these measures can be a tool to determine overall health of an organism and its environment. Many of the analytes exhibited a normal distribution and were in accordance with previous studies conducted with this technique. We found that malaria did not have any statistically significant affect on any of the blood gas or electrolytes measured. Migration affected birds via increased hemoglobin, hematocrit levels, and oxygen values while exhibiting varying levels of electrolytes. Seasonality and locale were the two variables that had statistically significant influence on most haematological parameters recorded in this study. Louse parasitism had a negative impact on certain electrolytes, but more investigation is needed. Despite being infected with malaria, the birds in this area are not adversely affected based on the analytes we tested; suggesting a healthy population and ecosystem.

A comparison of bird communities in actively and passively restored tropical forests
Pizo, Marco Aurelio - Universidade Estadual Paulista; Carlos Gussoni - UNESP

Forest restoration is becoming increasingly common in the tropics. As a consequence, the need to evaluate its effectiveness as a tool to restore communities and provide habitat for extinction-prone species is urgent. With this goal, we used 10-min point counts to compare the structure of bird communities in actively (i.e., 5-60 year-old forests planted with native tree species; 9 areas with 8-305 ha) and passively (i.e., forests regenerated naturally in the last 50 years; 12 areas with 3-170 ha) restored areas in the Brazilian Atlantic forest. A total of 117 and 162 species were recorded at actively and passively restored forests, respectively. Frugivores, ground and understory species, and forest-dependent species were disproportionately more common at the latter. Similarly, species highly sensitive to disturbances were found only in passively restored forests. The planting of (i) a diversity of plants producing fruits attractive to birds all year round, and (ii) plants that increase the structural complexity of the forest understory are important measures to permit that actively restored forests become more rapidly habitat for extinction-prone bird species.

Differences in exploratory behavior as a personality trait between chickadee sister species

Polekoff, Sarah - Villanova University; Robert Curry - Villanova University

When species co-occur, behavioral differences between them may dictate the outcome of ecological and reproductive interactions. Exploratory behavior is an ecologically relevant measure of behavior associated with speed-accuracy tradeoffs: slow explorers are more thorough. We measured the exploratory behavior of wild Carolina and Black-capped chickadees, two sister species that hybridize in a northward-shifting zone of parapatric contact, using a mobile screen-tent assay. We released wild-caught adult chickadees into the tent, video-recorded movements and vocalizations for 5 min, and analyzed data using principle components analysis (PCA); we tested 79 individuals (56 Carolina and 23 Black-capped chickadees) during spring 2015 and fall-winter 2015-16 (n = 94 tests). Substantial within- and between-species variability emerged: PC1 scores depended on number of movements and conversely on latency to perch on walls. Black-capped Chickadees scored higher than Carolina Chickadees in PC1, suggesting that the former species is the “faster” explorer. Black-capped Chickadees spent 50% more time flying than Carolina Chickadees. Additionally, birds scored consistently in PC1 across separate measurements, suggesting that exploratory behavior is a consistent, repeatable personality trait. However, season also affected PC1 score: birds scored higher during the winter. Although Carolina Chickadees are the “invading” species and may be socially dominant over Black-capped Chickadees, they are not faster explorers, contradicting correlations in other species between exploration and dominance. Aspects of social environment such as the larger flock size and more apparent dominance hierarchy may explain the faster exploratory scores of Black-capped Chickadees.

Thermal physiology does not explain population declines of understory insectivorous birds in Neotropical forests

Pollock, Henry - University of Illinois at Urbana-Champaign; Jeffrey Brawn - University of Illinois at Urbana-Champaign; Zachary Cheviron - University of Montana

Forest fragmentation is increasing in the Neotropics and has profound effects on bird communities. Certain guilds (such as understory insectivores and frugivores) are disproportionately vulnerable and experience population declines following forest fragmentation, and several hypotheses have been proposed to explain this phenomenon. The microclimate hypothesis posits that physiological sensitivity to novel microclimates in fragments is the mechanism underlying population declines of understory species. An important assumption of the microclimate hypothesis is that low climatic variation in the forest understory has selected for narrow physiological tolerances in these bird species, yet this assumption has never been tested. Describing patterns of variation in physiological tolerances among Neotropical bird guilds is thus an important first step towards establishing a link between thermal physiology and population-level responses to forest fragmentation. We measured the thermal tolerances of 87 Neotropical bird species to examine the relationship between species’ ecology, thermal tolerances and population trends. Guild was not a significant predictor of variation in thermal tolerance breadth, and the tolerances of understory insectivores/frugivores were not significantly lower than other guilds. Furthermore, variation in tolerance breadth was not associated with species’ population trends, contrary to the primary assumption of the microclimate hypothesis. Therefore,

variation in thermal physiology is probably not responsible for the declines of understory species following forest fragmentation.

Determining the effects of anthropogenic noise on avian abundance and productivity at the landscape scale

Pontius, Michael - Calvin College; Amber Bingle - Calvin College; Matthew Link - Calvin College; Stacy DeRuiter - Calvin College; Darren Proppe - Calvin College

Anthropogenic noise has been linked to negative demographic patterns in both aquatic and terrestrial species, and because they rely on acoustic communication, songbirds are especially sensitive. Regional studies show that many species avoid noisy areas, and some studies suggest that species which remain experience reduced physical condition and reproductive success. While abundance is often used as a proxy for population persistence, the relationship between these two variables may be less clear-cut. Further, conflicting intraspecific information between studies may be due to localized processes that overpower or exacerbate the effects of noise. To address these issues, we paired large published datasets - from the MAPs program (Monitoring Avian Productivity and Survivorship) and the US National Parks Service noise map - to assess noise levels and bird demographics across the continental United States. We modelled effects of noise on songbird 1) diversity, 2) abundance, 3) reproductive success, and 3) physical condition (fat stores), accounting for temporal and spatial variation. At the continental scale, noise was predictive of decreasing diversity, but affected particular species differently. For example, least flycatchers become more abundant with increasing noise, but Western tanagers and red-breasted nuthatches become less abundant. Noise effects on fat and productivity also varied by species, with abundance trends not consistently matching productivity. Ecologists increasingly recognize heterogeneity of avian responses to anthropogenic noise between species, and between particular demographic measures, so landscape-scale models such as those presented here may facilitate range-wide conservation measures and help identify which species, or groups, are most at risk.

20-year Trends for Riparian Birds in Utah

Pope, Theresa - Utah Division of Wildlife Resources; **Keeli S. Marvel** - U.S. Department of Defense

Riparian systems make up < 1% of land area in Utah, but are arguably the habitat in greatest conservation need. Over 70% of Utah's birds use riparian habitat, yet little was known about population status and trends when Utah DWR initiated a 20-year riparian monitoring project. To get baseline data and evaluate trends, Utah DWR conducted point counts at 37 riparian sites from 1992 to 2011. I estimated statewide density of 38 species for each year of the study using Distance, then estimated trends using a Bayesian framework that provides estimated probability of a 25% change in density over 25 years. Yellow warbler (*Setophaga petechia*) had the greatest density with 4.5/ha (95% CI:4.3-4.6), followed by Spotted Towhee (*Pipilo maculatus*) with 1.6ha (95% CI:1.6-1.7) and Warbling Vireo (*Vireo gilvus*) with 1.6/ha (95% CI:1.6-1.7). Although there were annual fluctuations in density, Bayesian trend analyses indicated only 4 species had strong (0.7
22.5 cm dbh were selected more frequently compared to their availability, while smaller trees were avoided. The decay class was only significant on one site, where trees with blistering and resin on the trunk were preferred for foraging. Our results suggest that large to very large (22.5-142 cm dbh) Douglas-fir should be considered as critical foraging habitat for Williamson's

Sapsuckers. Overall, large coniferous trees, alive and dead, comprise critical habitat attributes required to support these endangered montane forest breeding sapsuckers in Canada.

How do seasonal birds get so fat? Investigating the physiological mechanisms driving fat gain
Power, Sean - University of Windsor; Audrey LePogam - Université du Québec à Rimouski; François Vézina - Université du Québec à Rimouski; Holly Hennin - University of Windsor; Oliver Love - University of Windsor

Variation in fat (i.e., lipid) reserves is an important ecological indicator of individual state and environmental stochasticity in free-living circumpolar birds. Resource accrual and storage into fat reserves provides pre-migratory and pre-breeding individuals with a fuel source for these predictable life-history stages that incur high energy costs. Although empirical evidence has highlighted marked changes in behaviours and individual state associated with seasonal fattening, we know little about the underlying physiological mechanisms that drive rapid fat gain. However, recent temporal studies in mammals have examined baseline glucocorticoids and ghrelin as proposed energy-regulating hormones, responsible for promoting voluntary food intake and adiposity, while in contrast, peptide YY and triiodothyronine mediate a decrease in food intake and adiposity. My research investigates these specific energy-regulating hormones as physiological drivers of fat gain during pre-migration in captive snow buntings (*Plectrophenax nivalis*) and pre-breeding in free-living, female common eiders (Somateria mollissima). Fine-scale temporal blood sampling and data collection allows for the quantification of plasma hormones using enzyme-linked immunoassays. Fat mass was measured using quantitative magnetic resonance in snow buntings, and plasma triglycerides as a proxy for fattening rate in common eiders. Preliminary results suggest a significant pattern of increasing baseline glucocorticoids over both pre-migration and migration in snow buntings (bivariate analysis: polynomial fit, $F = 3.55$, $p = 0.016$, $n = 25$). This work highlights correlational linkages between the phenology of endocrine responses and stage-dependent fattening to provide valuable and foundational information about the potential underlying mechanisms driving fat gain in seasonal birds.

Conditioning songbirds to human-dominated environments: Can we train for success?
Proppe, Darren - Calvin College

Songbirds live in a rapidly changing world. Unfortunately for many species, the outcomes are often problematic; reduced abundance, reproductive success, and physical condition. This situation frequently places wildlife managers in conflict with other interest groups, with one party often suggesting that the overarching effects of development are positive because they increase human wellbeing while others decry the effects of development on the natural world. While some avian conservation efforts have been highly successful, many aimed at preserving habitats have met with resistance. In these cases, ecologists and concerned citizens are often frustrated by the dismal projections for many songbird species and the inability to pursue ideal solutions. While we must continue our efforts to elevate the status of avian conservation issues, we must also find ways to sustain avian populations within less than ideal social and political conditions. Some bird species have already adapted to our presence and altered landscapes. But many species become less common. In this session, I will explore the potential for using learning principles to facilitate more rapid behavioral adaption to human environments in

songbirds. We will examine theoretical possibilities such as manipulating cue-response systems and actively applying classical and operant conditioning paradigms to modify aversive behavior and promote the social transmission of more successful avian behaviors. Ultimately, we must use a wide variety of tools to sustain avian populations, and actively promoting human-friendly behaviors may help tip the balance towards persistence in some species and populations.

Using thermal infrared cameras to detect avian chicks at various distances and vegetative coverages: A pre-field assessment

Prosser, Diann - US Geological Survey, Patuxent Wildlife Research Center; Thomas Collier - UASBio, LLC; **Katherine Dale** - United States Geological Survey, Patuxent Wildlife Research Center; Carl Callahan - US Fish and Wildlife Service, Chesapeake Bay Field Office; Peter McGowan - US Fish and Wildlife Service; Edward Gaylord - University of Maryland College Park; Julia Geshke - University of Maryland College Park; Brian Ho-Sung Lee - Montgomery College; Lucas Howell - University of Maryland College Park; Paul Marbán - University of Maryland College Park; Saba Raman - University of Maryland College Park

Population monitoring of waterbird colonies typically involves frequent entries into the nesting area. Thermal infrared (TIR) cameras mounted on small unmanned aircraft systems (sUAS) may provide a cost-effective way to remotely survey birds and their nests more effectively and with less disturbance than traditional methods. Here, we evaluate the ability of two TIR camera systems suitable for mounting on a small sUAS to detect an avian chick under varying vegetative cover and distances. Seven “bio-boxes” were created to simulate a range of natural vegetation types and densities for the common tern (*Sterna hirundo*), a species of interest in the Chesapeake Bay. A juvenile chicken (Gallus gallus, a surrogate for a tern) was placed in each box, and cameras were tested at five elevations ≤12 m. We hypothesized that the ability of the camera to detect the chick would decrease with increasing vegetative cover and distance from the substrate. Digital thresholding of the resulting images successfully distinguished the chick in 88% of 139 images. Our tests determined that elevation did not significantly affect the area of chick detected by the camera. Vegetative growth form reduced detection more than the overall plant volume. Notable differences were observed between cameras including visual resolution of detected temperature differentials and image processing speed. Results of this controlled study show promise for the use of sUAS-mounted TIR systems in detecting small cryptic species in vegetation. Next steps are to combine TIR and visual sensors with an sUAS in a field application.

Management of threats faced by avian fauna at Mangla Dam: A neglected wetland for migratory birds

Punjab, Bushra - University of the Punjab

The Mangla Dam of Azad Jammu and Kashmir is the 9th biggest dam of the world. This deep fresh water lake is located (33.12 N, 73.39 E) 30 Km North West of Punjab province in Pakistan. The site was visited 42 times from 2011-2014 to access the ornithological fauna with point count method. During three years of birds population assessment highest count were 57,892 birds belongs to 188 species during 2011-2012, 54,311 birds of 186 species in 2012-2013 and 52,682 birds of 187 species in 2013-2014 steady decrease in avian population was observed. Among these birds Sterna acuticauda was endangered, Prinia burnesii, Anhinga melanogaster, Aythya nyroca and Circus macrourus were near threatened, and Ficedula subrubra, Saxicola macrorhyncha and Haliaeetus

leucoryphus were vulnerable. Various threats like pollution, illegal hunting, agriculture runoff, poverty, illiteracy and poor law enforcement were observed at site. To address the issues a sustainable management plan has been proposed to conserve and protect the avian fauna with following recommendations:-

- Immediate need to conserve the threatened species
- Immediate ban on hunting.
- Strict law enforcement with implementation of wildlife act on equality basis.
- Awareness of community to value the biotic resources.
- To be declared as RAMSAR site to attract international organizations for involvement of conservation projects.

White-headed Woodpecker Habitat Selection in the Southern Sierra Nevada, CA

Purcell, Kathryn - US Forest Service Pacific Southwest Research Station

Throughout much of its range, the White-headed Woodpecker (*Picoides albolarvatus*) is closely with pines, especially ponderosa pine (Pinus ponderosa), but reaches its greatest abundance in areas with two or more pine species with large seeds. From 1995 through 2002 we collected data on abundance, nest site selection, and nest survival for White-headed Woodpeckers in four forest types along an elevational gradient in the southern Sierra Nevada, California. The forest types in order of increasing elevation were ponderosa pine (elevation 1024-1372 m), mixed conifer (1707-2012 m), true fir (2170-2347 m), and lodgepole pine (2469-2774 m). In contrast to previous work done on the species, White-headed Woodpeckers were most abundant true fir habitat. Cavity and substrate reuse was common. The same substrate was reused for nesting 33 times (21%), with 8 substrates reused three times over the 8 years of the study. Nest survival did not differ across forest types. Overall nesting success was 46.3%. Successful nests were in smaller diameter substrates, in areas with higher canopy cover and more large trees, and had lower basal area of snags compared to failed nests. In contrast, nest sites were in larger diameter substrates, in areas with lower canopy cover, with fewer large trees, higher basal area of snags, and were more decayed compared to available sites. White-headed woodpeckers may not be selecting optimal nesting sites. Our results suggest the importance of studying the abundance and productivity of White-headed Woodpeckers across a wide range of conditions.

Augmentation of nest site availability for four species of cavity nesting birds: Barred Owl (*Strix varia*), Eastern Screech-Owl (*Megascops asio*), Hooded Merganser (*Lophodytes cucullatus*), and Wood Duck (*Aix sponsa*)

Rahinsky, T.L. - University of North Georgia; J.M. Dorough - University of North Georgia; D.E. Lubeski - University of North Georgia

Tumbling Creek Woods is a 31-ha nature preserve owned by the University of North Georgia. This preserve is adjacent to the Oakwood, Georgia campus of UNG and is heavily used for outdoor course activities and undergraduate research. Tumbling Creek Woods is comprised of a mosaic of habitats including mature pine forest, Privet-invaded shrubland, mixed hardwood forest, and forested wetland, among others. Avian monitoring of this area was first initiated in January 2016 and revealed the presence of many bird species typical of this region and these habitat types. However, despite published range data and their presence in nearby areas, Barred Owls, Eastern Screech-Owls, Hooded Mergansers, and Wood Ducks have not been detected. Nest site availability is often a limiting factor for many populations of birds, especially secondary cavity nesting birds. From

February-April 2016, we selected sites for and installed a number of nesting boxes for these secondary cavity nesting species. We placed duck boxes on poles in small canopy openings of the forested wetland. We attached owl boxes directly to trees of a variety of species, heights, circumferences, and abundant canopy cover. All box placement allows ample flight paths for entering and exiting birds. By increasing the availability of nest sites we hope to augment these owl and duck populations in Tumbling Creek Woods.

Mercury and Molt: no strong Hg trend across songbird primary feathers

Ramsden, Danielle - Oregon State University, Department of Fisheries and Wildlife; Katie Low - Oregon State University, Department of Fisheries and Wildlife, Department of Zoology; Allyson Jackson - Oregon State University, Department of Fisheries and Wildlife

Mercury (Hg) is a bioaccumulative metal that can threaten the health of wild birds. Feathers are commonly used biomonitoring tools for non-lethally estimating Hg exposure in birds because they contain stable Hg concentrations upon completion of feather growth, when blood flow to the feather has stopped. Despite the common use of feathers as indicators of avian exposure, little is known about how feather concentrations relate to internal tissue exposures. Songbird feather physiology and how factors such as molt may impact Hg sequestration into songbird feathers are particularly lacking. To understand sequestration of Hg into primary feathers, we examined patterns of Hg concentrations among the 9 primary feathers of individual birds where molt order was known. Hg concentrations in the left primary feathers from 31 salvaged individual specimens from families Turdidae and Passeridae (*Catharus ustulatus*, *Ixoreus naevius*, *Turdus migratorius*, *Melospiza melodia*, *Zonotrichia atricapilla*, *Passerella iliaca*, *Pipilo maculatus*, *Junco hyemalis*) were measured. Preliminary results indicated that a conclusive trend in Hg concentration with increasing primary feather number was lacking, with only small variation in Hg concentration among primary feathers. Similar studies in seabird primaries have shown strong downward trends in Hg ppm with molt order. The lack of a trend in songbird primaries may be influenced by diet shifts during molt or changes in sequestration to other feather tracts and body tissues. Conclusions on Hg exposure in birds based on feathers must take time and location between feather growth and the feather sampling into consideration.

Scale-dependent responses to forest structure in two ground-nesting warblers

Ransom, Tami - Salisbury University; Ravyn Saunders - Salisbury University; Marshall Boyd - Salisbury University

Forest fragmentation and forestry management practices influence the habitat suitability of forests for migratory warblers. Here, we focused on habitat use of two species of ground-nesting warblers, Ovenbirds and Worm-eating Warblers. On the Eastern Shore of Maryland, these Forest Interior Dwelling Species (FIDS) inhabit small and fragmented lowland forest patches. We sought to determine vegetative patterns affecting 1) landscape-level occupancy and 2) habitat-patch nesting site preferences for these two warblers. We established 103 point count locations and examined Breeding Bird Atlas data to determine landscape occupancy. We then located and monitored Ovenbird and Worm-eating Warbler nests in two forested areas. Looking at landscape-level patterns, Ovenbird and Worm-eating Warbler populations are declining on the Lower Eastern Shore of Maryland compared to 35 years ago, concomitant with habitat loss. In addition, ground-nesting warblers, including Ovenbirds and Worm-eating Warblers, were more likely to be found in forests with fewer

pine trees. At the habitat-patch level, both Ovenbirds and Worm-eating Warblers tended to select nest locations with greater leaf litter depth compared to control locations. However, while Ovenbird nest sites did not differ from control sites in the proportion of pine needles in the leaf litter, Worm-eating Warblers selected nest sites that contained more pine needles in the leaf litter compared with control sites. Successful nests of both species tended to be composed of more pine needles by mass than depredated nests. These results highlight the complexity of understanding natural and management factors that influence both density and nest success of ground-nesting warblers.

Preliminary Analysis of Plasma Metabolites for Baltimore Orioles During Two Stages of The Annual Cycle
Reichart, Letita - University of Nebraska-Kearney

Avian species likely differ in resource use and physiological condition during different times of their annual cycle. Physiological coping mechanisms are ways birds deal with changes in environmental conditions or changes in behaviors associated with different parts of the avian annual cycle. Measures of plasma metabolites can provide information regarding the physiological response for birds during different parts of their annual cycle. For example, measurements of plasma lipid metabolites and creatine kinase may show resource use by birds. Plasma lipid metabolites show use of stored versus recently acquired lipids and creatine kinase shows catabolism of muscle tissue, mobilized during migration. Each species responds differently to stressful conditions during their annual cycle, such as migration or breeding. Here we present preliminary analysis of three types of plasma metabolites: 1) triglycerides and beta-hydroxybutyrate, 2) creatine kinase, and 3) corticosterone, for Baltimore Orioles, Icterus galbula, captured during Spring and Summer 2016. For this project we evaluated variation in plasma metabolites with respect to observed stage of the annual cycle. Results from this study will be used to identify testable hypotheses to better understand ways in which Baltimore Orioles mobilize resources during different stages of their annual cycle.

Ectoparasites in a Colonial Blackbird Species
Rice, Carrick - University of California, Davis

The Tricolored Blackbird (Agelaius tricolor) is an Icterid species endemic to the southwestern region of North America, with nearly all of the population historically breeding in large colonies in California.Ø As a densely colonial breeding species with a limited range, Tricolored Blackbirds are potentially more susceptible to transmission of diseases and ectoparasites within the population. Increased parasite loads and higher rates of horizontal transmission have been regularly noted in a variety of colonial and highly social avian species, and often result in a stress hormone response that can lead to reduced fitness and body condition. However, some densely nesting species have evolved traits that allow them to resist or repel ectoparasitic infestation. However, no prior study has examined ectoparasites in Tricolored Blackbirds. Tricolored Blackbirds give off a unique feather odor, containing volatile aldehyde components (octanal, nonanal, and decanal) that have been proven to repel ectoparasites in other colonial nesting avian species that produce similar odors - such as the Crested (Aethia cristatella) and Whiskered Auklets (A. pygmaea). In order to determine if this similar odor has the same repellent effect in Tricolored Blackbirds, wild birds were sampled using trap-release methods. Ectoparasite loads were visually assessed and quantified. Preliminary evidence suggests that Tricolored Blackbirds tend to have reduced

ectoparasite loads. Expression of volatile aldehydes could be an convergently evolved trait in some colonial birds for ectoparasite protection.

Habitat-specific Survival of Golden-winged Warblers (*Vermivora chrysoptera*) in the Nonbreeding Season.

Ritterson, Jeffrey - Massachusetts Audubon Society; David King - USDA Forest Service Northern Research Station / University of Massachusetts, Amherst; Richard Chandler - University of Georgia

Habitat quality during the nonbreeding season can affect populations of Neotropical migrants, and informed management during this time is important for full annual-cycle conservation. The Golden-winged Warbler is a neotropical migrant of elevated conservation concern. Nonbreeding abundance on our site is known, but may not reflect habitat quality. Vital demographic rates such as habitat-specific survival are great indicators of habitat quality, but are difficult to obtain for Golden-winged Warblers. This species is cryptic and occupies large (9 ha) home ranges, so standard mark-resight methods are not feasible, and radio transmitters affect survival. We developed a novel methodology for cryptic species with large home ranges, and used a Cormack-Jolly-Seber approach to estimate habitat-specific survival rates. Survival was highest at sites with intermediate canopy heights, which is also where abundance is greatest. The results of this study demonstrate the feasibility of using this novel mark-resight method, and also provide key information necessary for managing habitat that enhances survival of wintering Golden-winged Warblers.

Evaluating Space Use and Reproductive Success of the Threatened Marbled Murrelet in Western Oregon

Rivers, James - Oregon State University; Joseph Northrup - Oregon State University; Matthew Betts - Oregon State University; Kim Nelson - Oregon State University; Daniel Roby - US Geological Survey-Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Oregon State University

The Marbled Murrelet (*Brachyramphus marmoratus*) is a small diving seabird (family Alcidae) that occurs along the Pacific coast of North America. Murrelets require nearshore marine habitats for foraging, yet nest in late-successional/old-growth forests in the conterminous U.S. Murrelets were once common along the coasts of Washington, Oregon, and northern California, but are now listed as Threatened under the U.S. Endangered Species Act. Oregon has some of the highest at-sea densities of murrelets in the conterminous U.S., but additional nesting data are needed to provide effective guidelines for managing murrelet breeding habitat in light of forest management practices. To fill this gap, we launched a large-scale, long-term study of murrelet space use and reproductive success in western Oregon. This work includes (1) spatial modeling of murrelet distribution and nest sites using existing data, (2) at-sea marking of murrelets with satellite tags and ground-tracking to test whether this technology can be used to locate nests, (3) evaluating foraging ecology of a known nest predator, the Steller's Jay (*Cyanocitta stelleri*), and (4) conducting a landscape-scale conspecific attraction experiment to determine whether murrelets can be lured into suitable yet unoccupied forest stands. We outline our proposed work in more detail, present preliminary findings from our spatial modeling work, and provide a summary of field research results from 2016. Given its scope, this project will allow an enhanced understanding of murrelet

habitat needs in extensively forested landscapes, while seeking a balance between conservation of murrelet nesting habitat and forest management practices.

Use of Drones to Collect Nocturnal Illumination for Bird-Window Collision Studies

Roberts, Ashton - Oklahoma State University; Corey Riding - Oklahoma State University; Scott Loss - Oklahoma State University, Department of Natural Resource Ecology and Management

Recent research indicates that about 600 million birds in the U.S. alone are killed in window collisions every year. With the expansion of urbanization and construction of new buildings, including a rapidly increasing number of buildings with vast expanses of glass, the number of collision-related bird deaths will continue to increase. A major mechanism that appears to influence bird-window collision risk—and the risk of avian collision with manmade structures in general—is the emission of artificial light, which attracts and confuses birds and thus increases collision risk. Previous research into the influence of light on bird-building collisions has investigated down-welling light (i.e., light moving toward the ground). However, from the perspective of nocturnally migrating birds, up-welling light at heights where birds are migrating is likely to be more important. Unmanned aerial vehicles (UAVs or drones) are increasingly being used in ecology research, and we have developed a novel method of measuring up-welling light at night that comprises a light meter docked to a UAV that flies pre-programmed paths and takes light intensity readings at ground-level up to an altitude of 100 m. . This lighting data is being used to: (1) assess the degree to which artificial light intensity varies between altitudes, and (2) examine whether upwelling or down-welling light intensity better predicts bird collision risk. Our method is generalizable to other artificial light sources that pose a threat to nocturnally migrating birds (e.g., communication towers, wind turbines, spotlights, and flares).

Surveying the Seabirds of Ka`ula Island, Hawai`i, using High Resolution Digital Aerial Oblique Imagery

Robinson Willmott, Julia - Normandeau Associates, Inc; Franz Juola - NAVFAC Pacific, EV22; Simon Warford - APEM Limited

The first aerial digital surveys of the seabirds of Ka`ula Island have been carried out between 2012-2016, an island very difficult to survey using standard methods due to major safety issues. These surveys were sponsored by the U.S. Pacific Fleet. High resolution digital imagery gathered by nadir (vertical) survey complemented by oblique survey allowed the birds on top of the volcanic tuff cone as well as those present on the cliff faces to be recorded. The surveys recorded the following peak numbers of individuals: 11 black-footed albatross, 100 Laysan albatross, 314 red-tailed tropicbird, 1415 great frigatebird, 3696 red-footed booby, 526 masked booby, 867 brown booby, 7137 brown noddy, 22 black noddy and 14,635 sooty tern. The black-footed albatross is globally Endangered, and more than 95% of the global population breeds in Hawai`i. During the surveys a maximum of 11 Endangered Hawai`ian monk seals were recorded at any one time on the island (ca 1% of world population) as well as large numbers of humpback whales offshore.
As well as presenting the survey results and placing them in a wider Hawai?ian context, the strengths and weaknesses of this novel use of oblique imagery for seabird colony survey will be described. The method creates minimal disturbance and is of great value for seabird colonies that are difficult to access or located in areas with site hazards.

When molecules do not follow morphology: Phylogeography of the *Atlapetes albinucha* complex (Aves, Emberizidae).

Rocha-Mendez, Alberto - UNAM; Enrique Arbel ez-Cortes - Instituto de Investigacion de Recursos Biolegicos Alexander von Humboldt; Luis Senchez-Gonz lez - UNAM

The white-naped brush finch (*Atlapetes albinucha*) complex comprises eight subspecies identified based mainly in the color pattern (gray vs. yellow belly) and geographic distribution. Yellow and gray bellied forms were long considered two different species (*A. albinucha* and *A. gutturalis*). Previous studies in *Atlapetes* have shown that the phylogeny is usually not congruent with characters like coloration, ecology, and distributional patterns. Herein, we analyzed the phylogeography and phylogenetic relationships in A. albinucha using two mitochondrial and one nuclear markers from samples including 28 different localities along the whole distribution, from the mountains in eastern Mexico to Colombia, and were divided for the analyses into six populations according to their geographical distribution. Topologies recovered by means of Bayesian inference and Maximum Likelihood analyses revealed no geographic structure within populations in the complex, however both recovered a major Colombian clade. Molecular diversity indices in both mitochondrial markers were analyzed and showed low diversity between geographically distant populations. The results provided by the haplotype network structure suggest a recent process of expansion after a bottleneck event with a cryptic speciation scenario thanks to a differentiation owed to a glacial refugia event. This type of hard polytomies, maintained even with the use of alternative data sets, may reflect a simultaneous lineage diversification.

Social structure among resident Carolina Chickadees (*Poecile carolinensis*) and irruptive Black-capped Chickadees (*P. atricapillus*)

Roche, Christopher - Villanova University; Robert Curry- Villanova University

Intraspecific and interspecific social relationships among overwintering passerine birds during irruptions (facultative migration from high to low latitudes) are poorly understood. We studied relationships between resident Carolina Chickadees (*Poecile carolinensis*) and irruptive Black-capped Chickadees (*P. atricapillus*) in southeastern Pennsylvania during winter of 2012-2013. In allopatric populations, each species participates in mixed-species flocks in non-breeding seasons, but little is known of interactions when they co-occur in winter during Black-capped Chickadee irruptions. We used radio frequency identification (RFID) methods to quantify use of 16 feeders over 5 months by 46 resident Carolina Chickadees and 13 irruptive Black-capped Chickadees equipped with passive integrated transponder (PIT) tags (n = 152,806 visits). Individual Black-capped Chickadees persisted for up to 4 months; none remained after April. Feeder visitation was steady over most hours of the day in a pattern that was similar between species and across months. Collectively, the birds preferentially visited distinct subset of feeders in a pattern that varied little among months. Similar patterns persisted for each species alone, although each species exhibited preference for different subset of feeders. Social network analysis (SNA) divided the birds into three mixed-species “communities” (distinguishable sets of interacting birds) with closed group membership and one Carolina Chickadee discrete flock. Carolina Chickadees associated more with conspecifics than irruptive Black-capped Chickadees. Black-capped Chickadees associated more with resident Carolina Chickadees than conspecifics, an outcome determined

largely by asymmetric abundance. Our combined RFID and SNA methods were effective tools for understanding intraspecific and interspecific relationships during an irruption.

Relation of the characteristics of Urban Green Areas and Artificial Nest Predation in Mexico City

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Nest predation is an important ecological driver that can mold avian communities. In this study, we assessed artificial nest predation pressure in an urban gradient considering the characteristics of the nest, spatial and habitat traits of parks and urban green areas. The probability of nest survival was calculated with Mark Program and the most important variables that influence predation were identified. Our results show that artificial nest predation was driven by the interaction between vegetation coverage the area and structure of the trees where the nests were located. TheØhighest values of diameter at breast height (DBH) is related with nest predation because it allows access to larger predators and due to the detectability of the nest provided by arboreal coverage. Differences in the community of predators own each study site were found, records are divided between mammals and birds. Small mammals were important predators due to the abundance of their populations in some urban parks, followed by birds. The differences in vegetation cover of the landscape and green areas could determine the presence and dynamics of predators acting as attractors for the bird species they support. Therefore, this study describes potential predators in urban areas in Mexico City and reflects the relations between the characteristics of urban green areas and the probability of predation. Identifying requirements for nesting birds and the recognition of the factors that put pressure on their reproductive success, will allow us to take actions for the conservation of these species in urban areas.

Recovery of Bird Diversity and Activity in a Tropical Forest Restoration

Roels, Steven - Michigan State University; Catherine Lindell - Michigan State University

Human-directed reforestation with native tree species in the Neotropics offers opportunities to create new bird habitat. Birds can also facilitate ecological recovery by delivering ecosystem services such as seed dispersal, pollination, and herbivorous insect reduction. Furthermore, birds act as indicators of returning ecological complexity in restorations due to their wide variation in diet, specialized foraging strategies, and micro-niche preferences.

Interest in active forest restoration in Panama is increasing and the isthmus forms a crucial corridor for wildlife that range, as species and individuals, across two continents. Many reforestation projects in Panama create plantations of native trees; how avian communities respond to different planting designs may influence the value and trajectory of these restoration efforts. There is a long-standing ornithological interest in studying the relationship between vegetation characteristics and avian diversity; active reforestation projects provide chances to directly manipulate tree diversity and vegetation structure and observe bird responses.

We conducted annual bird surveys at an experimental reforestation site in central Panama for five consecutive years. In the final year, we also conducted a more intensive, repeated effort survey to evaluate hypotheses regarding the relationship between bird diversity and activity and restoration plot characteristics, including planted tree diversity and canopy cover. Our results show a progressive return of birds to

the restoration, but also a notable time lag in increases in total bird diversity and activity after tree planting. We also found that both diversity and activity were unevenly distributed throughout the site, likely due to the influence of adjacent land cover.

Field type influences distribution of wintering birds in the Northeast
Rosenblatt, Connor - Cornell University; David Bonter - Cornell Lab of Ornithology

Declining populations of open field birds has been well noted for decades. Conservation efforts tend to focus primarily on the breeding season-however, wintering distribution and habitat selection are under studied. This is especially important in the Northeast, where abandoned agriculture fields are becoming re-forested, reducing the amount of open field habitat. In this study, we examined how the abundance of Snow Buntings (*Plectrophenax nivalis*) and Horned Larks (*Eremophila alpestris*) varied between fields of different cover types and sizes. We conducted repeated transect surveys in nine fields and a rapid, one-time survey of 99 fields. For the transect survey, from November through February, we visited fields with corn, hay, and pasture stubble (all roughly the same size) and walked transects through the fields, recording all birds observed. The rapid survey was done in a single day in February, which consisted of driving pre-determined routes and stopping at pre-determined fields of a variety of cover types and counting birds for 3-minutes in a road-side survey. The transect surveys revealed that both Snow Buntings and Horned Larks were significantly more likely to be detected in corn stubble fields compared to pasture and hay fields. The rapid survey revealed no difference in detection probability of Snow Buntings related to cover types or field size, but for Horned Larks, detection probability was significantly greater in corn and soy fields compared to all types of grass fields, and detection probability was also greater in larger fields.

No evidence of critical slowing down in two endangered Hawaiian honeycreepers
Rozek, Jessica - Tufts University; Richard Camp - University of Hawai'i at Hilo; J. Michael Reed - Tufts University

The population trends of some endangered forest birds in Hakalau Forest National Wildlife Refuge, Hawaii, are currently in dispute. Using long-term population estimates, some studies report forest bird populations as stable or increasing. Other analyses, however, report signs of population decline or of impending extinction associated with Japanese white-eye (*Zosterops palpebrosus*) increase. Reliable indicators of population collapse have been reported in simulations and microcosm experiments. In these studies, statistical indicators of critical slowing down, a phenomenon characterized by longer recovery rates after perturbation, is reported to be an early warning signal of impending regime shift observable prior to the tipping point. While the conservation applications of recognizing critical slowing down are commonly discussed, early warning signal detection methods are rarely applied to ecological field data and their validity and utility in conservation management remain unclear. Here, we evaluate two time series to test for evidence of early warning signals in two species of the endangered Hawaiian forest birds under debate, the Hawaii Creeper (*Oreomystis mana*) and Hawaii `Akepa (*Loxops coccineus coccineus*). We looked for signals prior to 2000, when white-eye abundance began increasing. We analyzed abundance data from Hakalau using new state-space abundance estimates. We found no clear evidence in either species of changes in variance or autocorrelation in population size, two common early warning indicators of critical slowing down. Piecewise regression

showed a reduced rate of increase in population size in the Hawaii Creeper starting in 2000, but both species? populations appear to be stable or increasing.

Mining Metadata: Digital Media Collections as Sources of Biological Knowledge
Rumelt, Reid - Cornell University; Cynthia Parr - USDA; Mike Webster - Cornell University

In the digital era, biological sounds and visual displays are most faithfully preserved in the scientific literature as image, audio, or video files. A number of media libraries have assumed the role of managing these digital specimens, making them available to researchers and the public. Although the specimens themselves are critical in documenting intrinsic behavioral qualities, the associated metadata also represent a valuable source of biological knowledge. Here, we demonstrate ways in which metadata from digital media collections may be mined for information about organismal biology and behavior. We also discuss common features of metadata which may impede such analyses, including structural heterogeneity, database storage artifacts, and (for digitized versions of older analog media) variability due to the age of the specimen, Finally, we suggest methods for dealing with and, occasionally, embracing these idiosyncrasies.

“Man’s Best Friend”: A Threat To Shorebirds?
Rutter, Jordan - University of Minnesota; Francie Cuthbert - University of Minnesota

Dog disturbance on beaches is a well-documented threat to breeding and non-breeding shorebirds but little guidance exists to address this problem. This review synthesized previous research on the impact of dogs on shorebirds to identify effective strategies to reduce dog-related threats to this group of birds. Research demonstrates that dog disturbance is a global issue that is not biased toward specific bird-taxa, bird-age, season, or other aspects of the full annual life cycle. Studies have also investigated a diversity of disturbance categories (e.g. humans, dogs, and humans with dogs) and determined that most human activities affect shorebirds; however, any activity that additionally involves a dog is almost always a greater threat to birds. For example, research reported that dogs increase bird stress levels, lower foraging time and decrease breeding success. Strategies to reduce dog impacts to shorebirds include partial or full closure of beaches to humans, strict leash laws, and creation of “dog parks” on or adjacent to beaches. To date, no study has developed and tested effective outreach and education programs to target dog owners on beaches and such an effort is needed to complement existing management and conservation programs. Because many shorebird species are declining at alarming rates globally, reducing threats from dogs should be a priority for most shorebird conservation efforts.

Home range analysis of Ammodramus sparrows wintering on the Chihuahuan Desert of Mexico
Ruvalcaba-Ortega, Irene - Laboratorio de Biologia de la Conservacion y Desarrollo Sustentable, Facultad de Ciencias Biologicas, Universidad Autonoma de Nuevo Leon; Erin Strasser - Bird Conservation of the Rockies; Ricardo Canales de Castillo - Facultad de Ciencias Biologicas, Universidad Autonoma de Nuevo Leon

Only two Ammodramus species distribute in Mexico, both are grassland specialist and have shown steep population declines over the last 50 years. However, basic ecological parameters of their wintering ecology are unknown. To characterize their wintering

home range in three GPCA of the Chihuahuan Desert, we used radio-telemetry on 255 individuals, 127 in Cuchillas de la Zarca, Durango, 91 in Janos, Chihuahua, and 39 in Valle Colombia, Coahuila. Radio-tagged birds were monitored from early December 2014 to Mid- March 2015. When captured, a single tail feather was taken to sex individuals through molecular methods. Overall mean home range for male Baird's sparrows was 21.2 ha, and 8.3 ha for females; however, each site showed important differences in range extension among sexes. Males' mean home range was larger in Durango ($p=0.30$) and Chihuahua ($p=0.10$) site, but not in Coahuila ($p=0.20$), but none of the differences was significant. On the other hand, home range variation, measured as standard deviation, was significantly higher for males in Durango site, and females of the Coahuila site ($p < 0.05$). When compared, individuals that survived showed less variation in home range extension ($p=0.09$) than those that did not. Overall mean home range for male grasshopper sparrows was 12.4 ha, and 49.6 ha for females. Only for the Durango site, females' mean and variation of home range size was significantly larger in females than in males ($p < 0.05$). Differences between species, sexes and sites may be associated to initial body condition and food availability.

Building Design for Energy Efficiency and the Potential Benefit to Birds
Ryon, Thomas - National Renewable Energy Laboratory

Hundreds of millions of birds are killed every year in North America by colliding with buildings. Compared to other causes of bird mortalities, this risk is substantial, perhaps biologically significant to bird populations, and is likely only surpassed by the effects of habitat alteration. Birds lack the ability to perceive glass as a barrier due to its transparency and reflectivity. Additionally, night-time lighting can attract birds to buildings, particularly in foggy conditions, where they either collide with the structures or become exhausted trying to find a way out. Design methods and material alterations can reduce the reflectivity and transparency of glass used in structures, as well as reduce the impacts of night-time lighting, resulting in the reduced risk of collisions. Because glass reflectivity and transparency, and lighting efficiency are critical in energy efficient building design, bird-friendly design features can complement design for energy efficiency. This presentation compares bird mortalities associated with several types of structures and compares bird collisions resulting from contemporary building design with those resulting from a net-zero energy office building at the National Renewable Energy Laboratory in Golden, Colorado.

Breeding biology of a year-round resident population of the Loggerhead Shrike (*Lanius ludovicianus*) from central Mexico
Salgado-Ortiz, Javier - Universidad Michoacana, Facultad de Biologea; Octavio Soto-Rojas - Universidad Michoacana, Facultad de Biologea; Stephen Lougheed - Queen’s University

The Loggerhead Shrike (*Lanius ludovicianus*) has a broad distribution in North America with southernmost population found in Central Mexico. While the species has been relatively well studied in U.S. and Canada, life history data are scarce for Mexico where both resident and migratory populations are found. We provide for the first time, data on the breeding biology of a resident population from Central Mexico. Based on 70 nests found along three breeding seasons, we determined that average clutch initiation date was March 28th, with variation among years. The breeding period lasted 3.5 months, starting at the end of February and ending on early June. The laying period

averaged 4.6 days, incubation 18 days and the brooding period 16.6 days, for a total of 39.2 days since the beginning of laying to the end of brooding. Clutch size averaged 4.1 eggs (range 2-5 eggs) with a mode of 4 eggs. Nesting success for the three years combined was 64.3% with no significance variation among years. Average number of fledglings at successful nests was 1.5. Depredation was the main cause of nest failure (35.7%) of unsuccessful nests. Life history traits of this Mexican Loggerhead Shrike population are in general similar to those reported for northern breeding populations. We report however, smaller clutch size and longest average of incubation period registered of 18 days, probably as a result of the latitude and possible related to environmental factors, intrinsic characteristics of the species and/or food availability, all factors that deserve further investigation.

The restoration of small coastal islands for waterbirds: Audubon California's Aramburu Island Enhancement Project
Sanghera, Nuvraj - University of Bristol; Andrea Jones - Audubon California

Changes in large-scale land use have reduced habitat along the Californian coastline, most of which provided important areas for many bird species throughout their annual cycle. In the San Francisco Bay area over 90% of important native tidal mud flats and marsh habitat have been destroyed over the last 200 years. The US government and NGOs are working to restore and create replacements for these lost habitats, to provide safe areas for birds, reducing the losses and also preserving their natural behavior. The Aramburu Island Enhancement Project was initiated after the Cosco Busan 2007 oil spill in San Francisco Bay highlighted the importance of the 17-acre island. The project went through several stages to restore the shoreline and reduce erosion and remove invasive plant species and to plant vegetation native to the Bay area. Preliminary results show a species-dependent effect of the reconstruction efforts, with increasing numbers of dunlin, eared grebes, several waterfowl and tern species, and decreasing numbers of certain shorebirds. The statistical analysis and research into habitat restoration is extremely important in a world where space for avian species is at a premium, especially in areas which were known to have a historic significance. This research will help provide a detailed look at the management of these types of projects and help to direct future projects to ensure even greater success.

Multilocus phylogeographical analysis of the species complex Amazona aestiva/A. ochrocephala (Aves, Psittacidae)
Sato, Fernanda - Institute of Biosciences, University of Sao Paulo; **Cristina Miyaki** - Institute of Biosciences, University of Sao Paulo

Phylogenetic and phylogeographic studies of South American Amazona aestiva and Amazona ochrocephala have shown that these taxa are not reciprocally monophyletic. As these analyses were based only on mitochondrial DNA, we performed a multilocus phylogeographic study of this species complex and added more samples. We analyzed mitochondrial DNA sequences of COI (512 bp, N=189) and ND2 (524 bp, N=146); and sequenced three autosomal nuclear regions (AMZ-02: 525 bp, N=127; AMZ-10: 524 bp, N=128; and AMZ-12: 524 bp, N=130); and one intron of a Z chromosome-linked gene (PLAA: 473 bp, N=131). Mitochondrial data recovered four lineages: one with A. ochrocephala from northern South America and three that contained individuals from both species. However, the majority of individuals from each lineage belonged to either one of the species. Thus, our data showed a higher tendency to separate individuals from each species than previous studies, but still did not fully agree with current taxonomy. The geographic distribution of lineages matched

that of different biomes, suggesting possible influence of selective environmental pressures. Additionally, climatic oscillations during the Pleistocene seem to have resulted on demographic changes. The overlap of distinct lineages mostly occurred where the two taxa were geographically closer, suggesting that haplotype sharing could be caused by introgression. Nuclear sequences did not show any differentiation. The genetic structure based on the Z-linked locus moderately agreed with species taxonomy. Our study highlights the importance of using more samples and markers in evolutionary studies. Funds: FAPESP, CAPES, CNPq, BioComp.

Monitoring Spatial Gradients and Temporal Trends of Mercury in Songbirds of New York State

Sauer, Amy - Biodiversity Research Institute; Evan Adams - Biodiversity Research Institute; David Evers - Biodiversity Research Institute

Mercury (Hg) contamination in aquatic and terrestrial ecosystems is a widespread issue that poses considerable reproductive, behavioral and physiological risks to wildlife populations. Songbirds are now recognized as indicators of mercury in terrestrial ecosystems, where invertivore foodwebs biomagnify methylmercury (MeHg) to levels that can adversely affect reproductive success. With upcoming changes to Hg emissions regulations, understanding how MeHg bioavailability currently varies across the landscape is important for quantifying the effects of these changes. Building upon 13 years of mercury research in New York State, a five-year project was initiated in 2013, to identify at-risk songbird species, classify sensitive habitat types, and to assess spatial and temporal trends of mercury across a variety of ecosystems. To date, a total of 1,347 blood and feather samples have been collected and analyzed from songbirds across the state. This project focuses on: (1) annual sampling and monitoring at established study sites (Adirondack Mountains, Catskill Mountains, and Long Island) to evaluate temporal patterns in songbird mercury exposure; (2) analysis of museum specimens to quantify trends in Hg exposure over the 20th Century; (3) sampling new sites statewide to identify additional mercury hotspots and inclusion into a predictive map documenting spatial gradients of methylmercury availability; and (4) linking mercury exposure with trophic position and diet using stable isotopes of carbon and nitrogen.

An investigation into the genetic basis of partial migration in Western Bluebirds (*Sialia mexicana*) using candidate genes

Sauve, Drew - Queen's University; Catherine Dale - Queen's University; Anna Tiango - Queen's University

Avian migration is a widespread, complex behaviour which public has long fascinated scientists and the general public. However, factors controlling migration are poorly understood. Theory and empirical evidence indicate that migratory behaviour is influenced by a combination of environmental and genetic factors. However, the relative importance and identity of these controls have yet to be determined. Studies across avian taxa suggest that genetic and non-migratory behavioural variation are associated with differences in migratory strategy. Recently, scientists have identified candidate genes for non-migratory behavioural traits associated with migratory behaviour. Western Bluebirds (*Sialia mexicana*) in Okanagan, British Columbia, provide a good study system to test some of these associations because the population is partially migratory: each winter some, but not all, individuals in the region migrate. In a partially migratory population, we can test for differences in migratory behaviour while controlling for species and/or population differences. We tested whether variation at

candidate gene loci reflects neutral processes, or if it is associated with behavioural variation observed in Western Bluebirds. We tested variation at three candidate genes: adenylate cyclase activating polypeptide 1 (ADCYAP1), dopamine receptor d4 (DRD4), and serotonin transporter (SERT) for associations with migratory strategy and non-migratory behavioural variation. We found that variation at the DRD4 locus was associated with migratory strategy. An association with DRD4 variation and migratory behaviour could suggest the functional significance of a DRD4 SNP or linkage with variation at another functional locus. Our research suggests a potential genetic control of migratory behaviour.

American Kestrel nesting habitat and nestling provisioning in the West Gulf Coastal Plain

Schaefer, Richard - USDA, Forest Service, Southern Research Station; Craig Rudolph - USDA, Forest Service, Southern Research Station

Both migrant and resident populations of the American Kestrel (*Falco sparverius*) occur in the West Gulf Coastal Plain (WGCP). Migrants/winter residents belong to the nominate subspecies sparverius. They arrive in the WGCP in late August to early October and are mostly gone by late April. The resident population belongs to the subspecies paulus of the southeastern United States, and reaches the western limit of its range in the WGCP. This subspecies, known as the Southeastern American Kestrel, has declined in many areas, and there has been little research in the western portion of its range. A majority of kestrel nests (83%) were located in forest stands managed for the endangered Red-cockaded Woodpecker (*Picoides borealis*). We compared nest site (n = 42) and random site (n = 42) habitat variables. Kestrel nesting habitat contained fewer canopy trees and midstory hardwoods, less canopy and midstory closure, greater herbaceous and woody ground cover, and less bare soil and leaf litter. Shrub height was similar between nest sites and random sites, but shrub density was greater around nest sites. These habitat characteristics are typical at sites where forest thinning and prescribed fire are used to manage Red-cockaded Woodpecker habitat. We recorded 412 prey deliveries (males = 225, females = 187) to nest sites by breeding kestrels. Most vertebrate prey was delivered by males (85%), with green anoles (*Anolis carolinensis*) being the most common prey item (n = 121). Females delivered mostly invertebrates (88%), and grasshoppers were the most common prey item (n = 55).

Describing Migratory Behaviors During Stopover Using Automated Radio Telemetry

Schofield, Lynn - Yosemite National Park; Jill Deppe - Eastern Illinois University; Michael Ward - University of Illinois at Urbana-Champaign

During migration, birds require stopover habitat to rest, refuel and prepare to continue migration. For songbirds, many short movements made while exploring or foraging within a stopover site can be costlier than a single long migratory flight, because it requires more energy to initiate than to sustain flight. We expect migrating birds to balance energy expended on movement with potential energy gains during stopover. At a fall stopover site in coastal Alabama, we used automated radio telemetry to measure activity levels throughout the day of three species: Red-eyed Vireo (*Vireo olivaceus*), Swainson's Thrush (*Catharus ustulatus*), and Wood Thrush (*Hylocichla mustelina*). In addition to contrasting the activity of species, we tested how age, fat stores, local wind speed, and wind direction affected movement patterns of individuals within a species. Our activity data show that the best predictors of movement differed for each species, although the influence of any covariate examined was minimal. We posit that this is an indication

that the habitat at this site is relatively poor and the potential for energy gain is too low to make altering movement patterns a viable strategy for optimizing energy use and fat gain. With these data, we also characterized a behavior known as quiescence, a period of stillness prior to the onset of peak nocturnal activity observed in cage studies, but not clearly documented in free-living birds. Vireos showed a pronounced quiescent period, but the other species did not, demonstrating further differences in migratory behaviors.

The role of microhabitat in the evolution of sound propagation of rail calls
Schroeder, Katie - East Carolina University;
Susan McRae - East Carolina University

The acoustic adaptation hypothesis, states that auditory signals evolve to transmit most efficiently through an animal's environment. Long-billed rails live in wetland habitats with relatively dense vegetation. Their calls should therefore be under strong selective pressure to transmit though visually obstructed environments. The goal of this study was to test the prediction that King Rail, *Rallus elegans*, calls transmit most effectively over distance in their optimal breeding microhabitat, as predicted by the acoustic adaptation hypothesis. We compared the effectiveness of acoustic propagation of King Rail calls within different microhabitats in their breeding area. King rail mating calls were played in different vegetation types of varying densities, and recorded at standardized distance intervals along a transect. Degradation of calls was measured based on changes in sound pressure level, frequency, and pulse rate. Sound propagation of king rail calls was also compared to calls of the confamilial American coot, *Fulica americana*, that prefers more aquatic, open habitat. This experiment allowed us to ascertain whether the calls of these rails have been shaped to propagate best in the microhabitat where they are most often found, therefore testing the acoustic adaptation theory at the microhabitat level.

Western Scrub Jay scatter hoarding and post-dispersal acorn fate: when habitat matters.
Schubert, Spencer - Old Dominion University;
Mario Pesendorfer - Cornell University;
Walter Koenig - Cornell University

Scatter-hoarding by corvids is an important seed dispersal mechanism for nut-bearing trees. Corvids often show habitat preferences when caching. We investigated how different habitats affect survival and recruitment of cached acorns. During the fall seasons of 2014 and 2015, we planted cohorts of 400 acorns (mixed *Quercus lobata* and *Quercus agrifolia*) in five different habitats at Hastings Natural History Reservation (CA) simulating caches by Western Scrub Jays (Aphelocoma californica) to monitor seed fate. We randomly distributed acorns to 25 replicate planting quadrats, representing each habitat evenly. Acorn presence/absence was recorded from weekly monitoring during November and December, and follow up checks were made six and twelve months after planting to census seedlings. The most active acorn pilferers in the landscape were wild pigs (*Sus scrofa*), corvids, woodrats (*Neotoma spp.*), and other small mammals. In 2014, there was a significant effect of habitat on acorn removal from the plots ($x^2=107.7$, $df=4$, $p=0.01244$). Predation was highest in chaparral sites and lowest in woodland sites. Predation was not significantly affected by habitat in 2015 ($x^2=1.83$, $df=4$, $p=0.7671$). The interannual change in predation risk among habitats reflected the changes in acorn availability from the three masting oak species at the site (*Quercus lobata*, *Quercus agrifolia*, *Quercus douglasii*). Our results suggest that masting conditions influenced habitat associations of the major acorn predators. Such conditions likely dictate the effectiveness of acorn dispersal by scrub jays.

Mobilization of mercury from lean tissues during simulated migratory fasting in a model songbird

Seewagen, Chad - Great Hollow Nature Preserve & Ecological Research Center; Daniel Cristol - The College of William and Mary; Alexander Gerson - University of Massachusetts, Amherst

Methylmercury accumulates within the lean tissues of birds and other animals. Migrating birds catabolize substantial amounts of lean tissue during flight, which may mobilize methylmercury and increase circulating levels of this neurotoxin. As a model for a migrating songbird, we fasted zebra finches (*Taeniopygia guttata*) that had been dosed with 0.1 or 0.6 ppm dietary methylmercury, and measured changes in blood total mercury concentrations (THg) in relation to reductions in lean mass. A group that was given no methylmercury served as a control, and the dosing levels of 0.1 and 0.6 ppm were intended to reflect a low and high range of mercury concentrations found in invertebrate prey of wild songbirds in the eastern U.S. Birds lost 6-16% of their lean mass during the fast, and THg increased an average of 12% and 11% in the 0.1 and 0.6 ppm treatments, respectively. Trace amounts of THg in the control group also increased, but remained extremely low. THg increased 0.4 ppm for each gram of lean mass catabolized in the higher dose group. Our findings indicate that methylmercury is mobilized from lean tissues during protein catabolism and results in acute increases in circulating concentrations. Circulating mercury is readily available to cross the blood-brain barrier, raising questions about how these surges might affect neurological processes involved in migration. This is a previously undocumented potential threat to migratory birds, which may experience greater surges in circulating methylmercury than demonstrated here as a result of their greater reductions in lean mass.

Influence of landscape-change on genetic structure in Bachman's Sparrow, an ephemeral habitat specialist

Settlecowski, Amie - Louisiana State University, School of Renewable Natural Resources; Jermey Brown - Lousiana State University, Biological Sciences; James Cox - Tall Timbers Research Station and Land Conservancy

Previous studies of genetic structure in specialists of early successional, fire-mediated habitats suggest these ephemeral species have evolved high vagility as an adaptation to disturbance prone habitats, maintaining population connectivity at large scales and limiting population structure. It is unclear whether ephemeral specialists with decreasing population trends will be able to overcome large-scale landscape changes such as the loss and fragmentation of suitable habitat. We empirically investigate this question using historical and contemporary DNA samples of the near-threatened Bachman's Sparrow (*Peucaea aestivalis*), a close associate of fire-mediated longleaf pine habitats of the Southeastern US with a well-documented and dynamic history of population declines and anthropogenic driven range expansion/contraction. Specifically, we investigate genetic differentiation and population structure before and after anthropogenic landscape modification. Our dataset includes 10 microsatellite loci amplified in historical museum and contemporary blood samples from across the distribution of Bachman's Sparrow. The results will indicate the influence of recent anthropogenic driven, large-scale landscape change on population structure, with potential conservation management implications for Bachman's Sparrow. More broadly, including time-stratified data from before and after anthropogenic disturbance has the potential to extend our understanding of how the distribution and diversity of genetic variation is maintained in ephemeral habitat specialists.

Tapping the Tree to Gain Insight into Woodpecker Evolution
Shakya, Subir - Louisiana State University; Jereme Fuches - Museum National d'Histoire Naturelle; Jean-Marc Pons - Museum National d'Histoire Naturelle

The woodpeckers (family Picidae) are a distinct and speciose assemblage of birds, comprising 217 species (Dickinson and Remsen 2013) and occurring in every major biogeographic region except Antarctica, Australasia, and Madagascar. Although many studies have examined phylogenetic relationships within the family, a comprehensive and well-sampled phylogenetic reconstruction of the entire group is still lacking. We reconstructed the phylogeny of the Picidae by comparing DNA sequences representing a nearly-complete matrix of six loci from 203 species. We then used the phylogeny to explore the biogeographic history of the family, examine diversification rates across clades, and compare speciation rates between tropical and temperate clades. Our phylogenetic tree suggests that several species, where we sampled multiple individuals, are not monophyletic, and the subfamily Picumninae is not monophyletic. Our phylogenetic tree also suggests that extensive hybridization occurred among species, especially among piculets. Examination of diversification patterns indicated rapid radiation within the Picidae at least twice, and potentially greater diversification rates in species inhabiting temperate regions than those in tropical regions.

The Structure and Function of Female Song in Eastern Bluebirds (*Sialia sialis*)
Shank, Evangeline - UMBC Department of Biology; Kevin Omland - Unveristy of Maryland, Baltimore County

In tropical songbird species it has long been acknowledged that females sing. Odom et al. (2014) recently determined that female song is ancestral in all songbirds. However, studies of female song in temperate regions remain scarce. Female Eastern Bluebirds (*Sialia sialis*) are known to sing in the presence of predators. I propose a study looking at the structure and function of Eastern Bluebird songs in the presence of various predators. Additionally, I will test for the occurrence of female song in other contexts, (e.g. territory defense and mate guarding) by presenting male and female bluebird models. Preliminary results suggest that both male and female bluebirds sing at increased rates in the presence of avian predators of adult bluebirds and at decreased rates in the presence of nestling predators. Preliminary results of acoustic structural elements suggest that males and females sing songs similar in length duration and syllable type in a predator alarm context. I will continue to compare structural differences between the songs of males and females and begin to compare structural differences between song functions.

Post-fledging population numbers and habitat use in the Chough (*Pyrrhocorax pyrrhocorax*) on Valentia Island, County Kerry, Ireland
Shedd, Douglas - Randolph College/Department of Biology

The Chough (*Pyrrhocorax pyrrhocorax*) is declining in Western Europe and listed in Annex 1 of the European Community's Birds Directive. Species in Annex 1 are: "In danger of extinction; vulnerable to specific changes in their habitat; considered rare because of small populations or restricted local distribution; or requiring particular attention for reasons of the specific nature of habitat." Western Ireland is one of the few remaining strongholds of the Chough in Western Europe and the population on Valentia Island in County Kerry historically has been one of the densest in Ireland. I conducted post-fledging censuses of choughs on Valentia in June 2003 and every June from 2005-2015 to determine the state of the island's Chough population, and to find out which areas of the

island are crucial to the species' breeding success. Choughs during this time were only found in areas of grazing land on Bray Head, the coastal downland, and Geokaun. The post-fledging population was stable through 2010, but has shown signs of decline since then. The survival of the chough as a breeding species on Valentia is dependent on grazing land, so the species is vulnerable to changes in agricultural practices and loss of agricultural land to development, both of which have occurred on Valentia. The sensitivity of the Chough to habitat change makes it an important indicator species for the health of coastal ecosystems that typify much of Western Ireland, so any decline is cause for concern.

King Rail Trapping and Detection in northwest Ohio, USA
Shirkey, Brendan - Winous Point Marsh Conservancy

The more northerly, migratory population of king rails that breed in the Upper Midwest (U.S.A) are poorly studied due to their secretive nature. The little evidence that has been gathered suggests these birds have experienced significant population decline in the past several decades likely as a result of habitat loss. To evaluate whether a recorded near absence of king rails since 2011 on a 5,000 acre privately owned wetland complex in northern Ohio was a result of actual absence or just lack of detectability a pilot project was developed in spring of 2014 and 2015 to further test for king rail presence on the property. The objectives of this project were twofold: (1) to evaluate the trapping efficiency of two different trapping techniques (walk-in traps vs whoosh net) for king rails and (2) to compare number of detections of a camera trap array in 2014 and 2015 to secretive marshbird surveys conducted on site from 2011 to 2015. Six king rails were captured using walk-in traps and two were captured using a whoosh net. Furthermore, 13 king rails were detected in two years using a camera trap array as compared to a single king rail detection that has been recorded during five years of secretive marshbird surveys. We hypothesize current secretive marshbird survey protocol is handicapped for extremely rare species with low rates of detectability because surveys are limited temporally (10 mins/point) and camera trap arrays could be viable option for further informing secretive marshbird survey data.

Optimizing tidal marsh bird monitoring in the Northeastern, USA.
Shriver, Greg - The University of Delaware; Chris Elphik - The University of Connecticut; Brian Olsen - The University of Maine

Developing long-term monitoring programs is fundamental to managing wildlife populations but can be fraught with challenges related to sampling effort, detectable effect sizes, time-frames, and costs. Breeding tidal marsh birds, specifically, Clapper Rail, Willet, Saltmarsh Sparrow, and Seaside Sparrow, are not adequately sampled by the Breeding Bird Survey and, therefore, require the design and implementation of coordinated and customized monitoring programs. Here, we used five-years of tidal marsh bird surveys at approximately 1,500 locations distributed in a probabilistic design throughout the Northeastern USA to compare the power to detect population declines of 10%, 25%, and 50% over five and ten-year time-frames. We used simulations based on our five-years of survey data to compare three different methods for estimating power (frequentist, Bayesian, and Bayesian including spatial correlation) for the four tidal marsh bird species and for a community abundance metric of all tidal marsh obligate birds. We first estimated the power to detect population declines at the site scale (within USFWS Refuge salt marsh management units) and then used the optimal design within refuges to compare the regional designs; 1) always revisit, 2) rotating panel, 3) split panel, and 4) augmented serially alternating design. We evaluated designs using power curves and variance components estimated with total.est

in R Package Spsurvey. Our within site power analyses indicated that the Bayesian simulation including spatial correlation had four times greater power estimates than Bayesian without spatial correlation, and six times greater power estimates compared to our frequentist approach.

The Parental Choreography Hypothesis
Shutler, Dave - Acadia University; Jennifer Schellinck - Carleton University

Bird eggs and nestlings are more often victims of predation than any other form of mortality. Accordingly, parents are predicted to invest significantly in strategies to keep nests concealed in all sensory modalities, including visual crypsis related to parental behaviour. The Parental Choreography Hypothesis (PCH) predicts that parents will coordinate arrivals and departures so that predators see fewer intervals of activity around nests. The PCH also predicts that approach vectors of one parent will more often be 180 degrees from departure vectors of the second parent so that visual predators will assume that a single bird has flown along a single vector, perhaps paused out of sight, but did not stop at a nest site. We used models to evaluate how these predictions are affected by predator search and foraging strategies. Ongoing work is testing whether parent birds avail themselves of strategies suggested by the PCH.

Nest tree preference as a mechanism of expansion for Great-tailed Grackle
Simons, Brittany - Oklahoma State University; Timothy O'Connell - Oklahoma State University

Invasive and encroaching species sometimes owe their expansion to an ability to make use of some new feature in a landscape that native species do not. The Great-tailed Grackle is a large blackbird, native to the Gulf Coast and southern Texas in the United States, which in recent decades has expanded its breeding range into the Midwest, Great Plains, and west to the Pacific Coast. Grackles nest and roost in colonies, and are seen as a nuisance when they encroach upon urban areas. They are noisy, their accumulated droppings foul automobiles and walkways, and they can become pests of grain crops and orchards. In some communities, trees have been removed from parking lots and parks to discourage nesting grackles. We are working to determine nest tree preference for Great-tailed Grackles in their zone of expansion in central Oklahoma. We hypothesize that grackles prefer to nest in the dense foliage and stout branches of the widely planted Bradford Pear, which is abundant in urban areas and naturalized in the study region. We are surveying for nesting grackles at 40 random locations to conduct analysis of nest survival and colony size according to nest tree species. Preliminary results suggest both strong selection for and high nest survival in Bradford Pear. If those results remain consistent through the study, we can use them to advise communities on pruning options and/or replacement urban trees that could be less desirable to nesting grackles.

Sedentary dark eyed-juncos (*Junco hyemalis*) maintain a higher prevalence of Plasmodium infections throughout the winter and early spring than migratory juncos in a seasonally sympatric population
Slowinski, Samuel - Indiana University; Jonathan Atwell - Indiana University; Adam Fudickar - Indiana University

In temperate climates, some avian *Plasmodium* (malarial) parasites alternate between an active stage in the host blood stream in the spring and summer, and a dormant stage in the host organs in the winter. We predicted that *Plasmodium* parasites should re-emerge into the host blood stream earlier in the spring in host populations that breed at lower (warmer) latitudes where vectors likely emerge earlier.

We compared *Plasmodium* infection densities in the bloodstream in 2 closely related populations of dark-eyed juncos (*Junco hyemalis*): one population (sedentary) winters and breeds in Virginia while the other population (migrant) winters in Virginia and migrates North to Canada to breed. We captured male sedentary and migrant juncos in December in Virginia, and brought them into a common garden indoor aviary (vector-free) environment where they were maintained under a natural (Virginia) photoperiod. We extracted DNA from blood samples collected in December, early March, and late March, and measured the relative densities of *Plasmodium* parasites using a quantitative Polymerase Chain Reaction. We found no evidence for spring emergence of *Plasmodium* parasites into the host blood stream; parasite prevalence did not increase over the course of the study. However, we found that our sedentary population of juncos sustained a higher prevalence of *Plasmodium* parasites throughout the study. Thus, our results are consistent with the migratory culling hypothesis, which posits that long distance migration weeds out infected animals, and which predicts that parasite infection prevalence should be higher in sedentary host populations than in closely related migratory host populations.

Factors influencing spring migratory phenology in Common Yellowthroats (*Geothlypis trichas*) at a northerly stopover/breeding location

Smith, Robert - University of Scranton; Margret Hatch - Penn State Worthington Scranton

Timing of spring migration, and consequently arrival at the breeding grounds has reproductive consequences and is influenced by intrinsic (e.g., sex) and extrinsic (e.g., weather) factors operating both during passage as well as prior to the migratory event. Our work on the migration ecology of landbirds in northeastern Pennsylvania provided opportunity to examine passage and arrival patterns of Common Yellowthroats at a northerly stopover and breeding site, adding to our understanding of factors influencing this species' migration phenology. We captured birds during spring migration, 2004 - 2013, investigating the influence of en route temperature on Common Yellowthroat timing and condition using data collected from weather stations south of our study area (USA Historical Climatology Network). We also looked for relationships between timing/condition and wintering ground climate using monthly values of standardized El Niño/ Southern Oscillation (ENSO) conditions (December-March) for each year preceding migration. We used a generalized least squares approach to assess the influence of age, sex, breeding status, April and May temperatures and ENSO on timing/condition. We found that older birds preceded and were in better condition than younger birds, males preceded females and were in better condition, and birds migrating in warmer years arrived earlier and in better condition. We also found that while ENSO influenced arrival timing it did not influence arrival condition. Our results support the hypothesis that landbirds adjust migratory timing in response to situations encountered en route and that circumstances experienced on the wintering grounds may influence arrival timing at northerly stopover/breeding locations.

Occurrence of Northern Saw-whet Owls in northwestern Arkansas during fall migration

Smith, Kimberly - University of Arkansas; Mitchell Pruitt - University of Arkansas

The secretive Northern Saw-whet Owl (*Aegolius acadicus*) is believed to be more widespread during fall and winter than previously thought. Of the few places in the southern United States conducting research on this species, all have been successful at capturing birds. A total of 12 historic records existed for Arkansas since 1959 until our work began in fall of 2014. Over two field seasons, we captured and banded 24 saw-

whet owls in rural northwestern Arkansas. All birds were mist-netted along a trail, in woodland composed of pine and cedar with fairly dense undergrowth, using an audio lure. Two were captured during 2014 after a late start (mid-November) and 22 were captured in 2015, likely the result of an earlier start (mid-October). It would appear that the peak of migration in Arkansas is late October through early November, with capture rates dropping off to zero by early December. Of the birds captured, all but one was female, the most common sex this far south. A variety of age classes were identified, with a fairly even distribution of hatch-year, second-year, and after-second-year birds. Exactly from where the saw-whets are migrating is unknown, but three foreign recoveries in Missouri and four recoveries in Arkansas suggest they are coming from the western Great Lakes region. Once considered a rare vagrant, based on our research, the saw-whet appears to be an uncommon fall migrant in the Ozarks of northwestern Arkansas.

Minimum temperature influences initiation of long distance fall migration in individual-based simulated tracks
Snell, Katherine - Centre for Macroecology, Evolution and Climate; Kasper Thorup - Center for Macroecology, Evolution and Climate, Natural History Museum of Denmark, University of Copenhagen

Every fall billions of northern hemisphere birds embark on intercontinental journeys of several thousand kilometres to their non-breeding grounds. Around 40% of all North American and 23% of European species undertake these annual long distance movements. This phenomenon is driven by endogenous and exogenous factors that shape their patterns, routings and timings. Here we used simulated random tracks within the Afro-Palaearctic flyway to identify contributing environmental parameters that govern sub-Saharan migrants: birds undertaking the crossing of the ecological barriers of the Mediterranean Sea and the Sahara Desert to south of the Sahel. In this study, preliminary analysis of 25 years of satellite derived temperature data, indicates a minimum temperature of 8°C may drive long distance migrants out of Europe to sub-Saharan Africa and play a role in shaping the migration strategies observed in so many species. Further work will investigate environmental stability and climate variation in the context or migration. In addition, from tracking technologies deployed on free flying individuals we will verify modelled tracks with empirical data to identify external variables influence obligate migrants.

Altered mountain chickadee (*Poecile gambeli*) song in regions of sympatry does not reduce aggression from black-capped chickadees (*Poecile atricapillus*)
Snell, Cara - Thompson Rivers University

Closely related mountain chickadees (*Poecile gambeli*) and black-capped chickadees (*Poecile atricapillus*) have partially overlapping ranges and habitat requirements, resulting in a mix of sympatric and allopatric populations. In regions where both species co-occur, subdominant mountain chickadees alter their song, undergoing a character shift, whereas in isolated regions the songs of both species are quite similar. I investigated why subdominant mountain chickadees altered their song only in regions of co-occurrence with the dominant black-capped chickadee. Specifically I asked whether the character shift acts to decrease the intensity of aggressive interactions, as previously documented in tit species in Europe and Asia. I conducted a playback study in Prince George, BC, Canada in April 2015. I created a series of playbacks of sympatric and allopatric mountain chickadee songs to present to focal black-capped chickadee males. I recorded the focal male's distance from the speaker, time spent at each distance, how many vocalizations were made and the level of aggressiveness for each stimulus, as well as latency to respond and time spent within 10 metres of the speaker

after the playback ended. I found that black-capped chickadees did not differentiate between the two mountain chickadee songs, and reacted equally to both allopatric and sympatric song types. Therefore, the mountain chickadee character shift may not reduce aggression from black-capped chickadees, as observed in European and Asian tits, but could potentially be a result of sexual selection.

Six years after Deepwater Horizon: Diet analysis of the Seaside Sparrow (*Ammodramus maritiums*) using DNA barcoding

Snider, Allison - Louisiana State University; Sabrina Taylor - Louisiana State University; Philip Stouffer - Louisiana State University

Seaside Sparrows (*Ammodramus maritimus*) live year round in the coastal marshes along the Gulf of Mexico from Florida to Texas. As habitat specialists, they are dependent on the coastal salt marsh, and thus are at risk of habitat loss from sea level rise, human development, and damage from disasters such as oil spills. The subspecies A. m. fisheri inhabits coastal marshes from Texas to Florida, and includes populations that were exposed to the 2010 Deepwater Horizon oil spill. Though Seaside Sparrows are common and easy to access, relatively little is known about their diet, and less is known about the lasting impact of the oil spill on the terrestrial food web. In addition to causing vegetation die off and habitat change, initial and residual oil in the marsh impacts the insects and invertebrates the sparrows prey upon, and will likely affect the diet and health of these birds. By using DNA barcoding of the COI mitochondrial and 16s ribosomal RNA subunit genes on fecal, gut, and ligature contents, this study aims to assess the general diet of A. m. fisheri and compare the diet of birds that inhabit historically oiled and unoiled plots in southern Louisiana. Through identifying the organisms that make up the diet of this subspecies, we hope to gain an understanding of the trophic level occupied by the Seaside Sparrow in the marsh ecosystem, and evaluate any lasting impacts of the Deepwater Horizon oil spill on the diet of these birds.

Full-service hotels, convenience stores, or fire-escapes: evaluating fall stopover sites for Neotropical migratory songbirds in the northern Yucatan Peninsula

Solomon, Lauren - Eastern Illinois University; Jill Deppe - Eastern Illinois University; Antonio Celis Murillo - Illinois Natural History Survey

Neotropical migratory songbirds have recently exhibited widespread population declines. The functional value of a stopover site is essential when prioritizing sites for the conservation and management of Neotropical migrants. We evaluated the function and quality of two sites along the southern Gulf of Mexico in the fall: Contoy Island National Park (14 km east of mainland) and El Eden Ecological Reserve (mainland) in Quintana Roo, Mexico. We considered capture rates and physical condition of common migratory species and estimates of stopover behavior based on automated radio-telemetry for two focal species: Swainson's Thrush (*Catharus ustulatus*) and Red-eyed Vireo (*Vireo olivaceus*). We captured 2,694 migrants in 2014 and 2015. Capture rates varied by site (0.49 birds/net hour at Contoy, 0.26 birds/net hour at Eden). The distribution of fat (˜ score 2) and lean (— score 1) birds was not different between sites ($x^2 = 0.92$, $df = 2$, $p = 0.6$). We estimated minimum stopover duration for 71 individuals. Mean stopover duration did not differ by site ($F_{1, 68} = 1.48$, $p = 0.22$, $R^2 = 0.02$) but departure direction did ($F_{1, 61} = 9.18$, $p = 0.003$, $R^2 = 0.13$). Migrants departed Contoy heading west towards mainland Mexico whereas birds at Eden departed south. Based on our data Contoy appears to function as a lower quality site, demonstrated by the higher proportion of birds departing in a seasonally inappropriate direction. Our results will inform conservation and management activities in the Yucatan

Peninsula and contribute to the development of full-life-cycle conservation plans for Neotropical migratory songbirds.

Understanding the Global Prevalence of Plumage Microbes

Sotnychuk, Nadia - Ohio Wesleyan University; Larynn Cutshaw- Ohio Wesleyan University; Christa Beckmann - Deakin University

Bird plumage is an ecosystem of microbes that live on an avian host. The types of microbes in plumage, including bacteria that degrade the keratin in feathers, varies based on geography within the US but little is known about bacteria in the plumage of Australian birds. To investigate this, feathers were sampled from 298 birds of 26 species in 10 different locations within a 170 km radius of Deakin University Waurn Ponds Campus, Victoria, Australia. Birds were sampled using contact plates of Tryptic Soy Agar, Mannitol Salt Agar, Eosin Methylene Blue Agar, and Yeast Mold Agar. We counted various kinds of bacteria and fungi including but not limited to Bacillus lichenformis, Bacillus cereus, Bacillus subtilis, Staphylococcus, and white cottony fungi. Venter feathers were also collected from the sampled birds for extraction of Bacillus in the US to test for feather degradation. We isolated Bacillus spp. from 25 of 26 species and 86% individuals sampled. Bacillus was not present on the grey fantail (*Rhipidura albiscapa*) for two reasons: the first is due to a low sample size and the second is due to the foraging style of the this bird. The grey fantail is an aerial insectivore while Bacillus spp. are soil microbes. In contrast Bacillus was found on all of the white browed-scrubwrens (*Sericornis frontalis*), a forest floor dweller, sampled. This is the first report of Bacillus on Australian bird plumage in vivo. Bacillus spp. were isolated from the collected feathers and are currently being evaluated for feather-degrading capabilities.

The Incredibly Adaptable Urban Junco: Dark-Eyed Junco Nesting Activity Within Active Construction Projects in Silicon Valley

Sousa, Bridget - H. T. Harvey & Associates

Nest placement may vary widely among habitats, both within and among species. For birds colonizing new habitats, plasticity in nest placement and materials may be important in their success. This may be particularly true in species colonizing urban landscapes. Dark-eyed juncos were first recorded breeding in an urban environment in the 1980s, in landscaped, moderately disturbed areas of U.C. San Diego. Over time, this population increasingly utilized off-ground nest placement, instead of ground nests more typical of the species. Juncos similarly began invading urban areas of the South San Francisco Bay area in the 1990s. Here, we document a continuation of the junco?s adaptation to the urban environment, with observations of nesting within one of the most extreme urban environments: active construction sites. Over two years, we monitored nesting at three Silicon Valley construction sites. Juncos nested on multiple levels of the buildings, including the basement. All nests built within buildings were placed near the ceiling, atop I-beams and framing. Most nests were constructed of natural materials, but some pairs utilized large percentages of construction materials. While most pairs were observed foraging and collecting material outside the construction site, a few pairs were observed singing, foraging and gathering material almost exclusively within the buildings. Juncos often initiated nests near high levels of human activity, and contractors adapted their work to avoid impacting nests. Of 10 nests initiated within active construction, nine fledged young and one was depredated. These observations demonstrate the continued incredible adaptation of juncos to the urban environment.

The Atlantic Marine Bird Cooperative: Facilitating over 10 years of collaboration to understand and conserve marine birds in the northwest Atlantic

Spiegel, Caleb - U.S. Fish and Wildlife Service, Division of Migratory Birds

Seabirds are key indicators of functional marine ecosystems. Worldwide, seabirds face greater threats from human-related activities than most other bird taxa, with many species experiencing substantial declines during recent decades. In the northwest Atlantic ocean (defined here as Canada to the Caribbean), primary threats include competition for food resources with fisheries, bycatch in fishing gear, displacement and mortality associated with offshore energy development, pollution, and degradation of nesting habitat. The magnitude of these issues requires collaboration among many stakeholders. Since its formation in 2005, the Atlantic Marine Bird Cooperative (AMBC) has brought together a diverse international partnership of agencies, NGOs, and academic institutions to identify, prioritize, and better understand the most pressing conservation needs for marine birds in the Northwest Atlantic, and develop actions to address them. The AMBC is a World Seabird Union Member Organization, contributing regional knowledge to seabird work worldwide. Group accomplishments include the NW Atlantic Seabird Catalog, a comprehensive data repository of northwest Atlantic marine bird surveys since 1938; the Business Plan for Addressing and Reducing Bycatch in Atlantic Fisheries, leading to alternative gear trials (with industry participation) aimed at reducing bycatch mortality; and tracking, surveying and distribution modelling research that directly informs offshore energy development. We review the achievements of the AMBC, and highlight innovative ways the group has developed productive partnerships, shared ideas and information, and utilized working groups to develop action-oriented projects and associated funding. We also discuss future group direction and encourage participation by those with a stake in Atlantic marine birds.

Endangered Williamson's Sapsuckers prefer large live Douglas-firs for foraging in montane forests in Canada

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The quality and quantity of available habitat for Williamson's Sapsuckers might be reduced by forestry practices after local declines were observed. The habitat features for nesting have been determined for the critical habitat, but information on the foraging habitat is still required to guide forest management. We describe the foraging ecology of the Williamson's Sapsucker, including 1) specific foraging behaviours, 2) selection of foraging tree characteristics such as species, size and decay class, and 3) variability in the selection of tree characteristics according to the sex and nesting status of the birds. We used radio-telemetry to obtain foraging observations of Williamson's Sapsuckers in managed forests of south-central British Columbia in 2014-2015. We caught 29 birds and collected 1134 foraging observations; 99% of observations were on standing trees, including 89% on live trees. Douglas-fir was the preferred live tree species, while lodgepole pine and deciduous tree species were avoided. The diameter at breast height (dbh) of foraging trees ranged between 3.5-141.8 cm, and live Douglas-fir >22.5 cm dbh were selected more frequently compared to their availability, while smaller trees were avoided. The decay class was only significant on one site, where trees with blistering and resin on the trunk were preferred for foraging. Our results suggest that large to very large (22.5-142 cm dbh) Douglas-fir should be considered as critical foraging habitat for Williamson's

Sapsuckers. Overall, large coniferous trees, alive and dead, comprise critical habitat attributes required to support these endangered montane forest breeding sapsuckers in Canada.

Understanding Spatial and Temporal Distribution of Red Foxes (*Vulpes vulpes*) in Piping Plover Nesting Habitat in Southern New Jersey

Stantial, Michelle - SUNY-ESF; Jonathan Cohen - SUNY College of Environmental Science and Forestry

Many bird species commonly found throughout the United States have suffered population declines largely due to habitat loss and the effects of predation. Efforts to protect and increase breeding piping plovers (*Charadrius melodus*) on the Atlantic Coast have continued since the species' Endangered Species Act listing in 1986. Yet, despite intensive management that aligns with recovery plan guidelines, the population of piping plovers nesting in New Jersey has seen no increase in abundance since listing. Predators have played a major role in preventing the species recovery. We studied red fox (*Vulpes vulpes*) occupancy in the nesting habitat of a threatened shorebird, the piping plover, at eight study sites throughout southern New Jersey. We used dynamic occupancy models analyzed in a Bayesian framework to estimate the probability of habitat use by red foxes and track how fox habitat use changed throughout the course of the nesting season. We had a total of 77 fox detections from 61 survey plots. Distance to dune was the only significant covariate. As the distance to the dune increased, the probability of habitat use by red foxes decreased. Our results suggest that red foxes tend to use areas closer to dunes and vegetation, and management that maintains the heterogeneity created by coastal storms may be important for successful nesting of piping plovers because birds are not forced into nesting in areas which are typically used for hunting by red foxes.

Adding uncertainty to North American landbird population size estimates

Stanton, Jessica - U.S. Geological Survey; Peter Blancher - Environment and Climate Change Canada; Kenneth Rosenberg - Cornell Lab of Ornithology; Arvind Panjabi - Bird Conservancy of the Rockies; Wayne Thogmartin - United States Geological Survey

An important component of Partners in Flight's (PIF) standardized species conservation assessment scores are the estimates of continental and regional population sizes for North American landbirds. These population size estimates are calculated from a formula designed to extrapolate from bird counts recorded by the North American Breeding Bird Survey (NABBS) and other avian surveys. The extrapolation formula includes multiple assumptions and sources of uncertainty, but there were previously no attempts to quantify this uncertainty in the final population size estimates. Using a Monte Carlo approach we propagated some of the main sources of uncertainty arising from individual components of the model through to the final estimation of landbird population sizes. This approach results in distributions of population size estimates rather than the previous single point estimates. The population size distributions are derived by randomly sampling from distributions representing each variable or 'non-fixed' model component. The components of the model that were variable were either species-specific (pair adjustment, detection distance adjustment, time of day adjustment) or species-by-region specific (route-level NABBS count). We calculated the range of uncertainty by estimating calculation limits that capture 95% of the population size distribution estimates. We found the relative width of the uncertainty bounds were heavily influenced by the

number of NABBS sample routes on which a species was observed with fewer routes resulting in greater relative uncertainty.

Bird communities in anthropogenic hill forest habitats in Sri Lanka: A comparison of conservation potential of analog forests, plantations and preserves

Starkloff, Naima - University at Albany, SUNY; Roi Ankori-Karlinsky - Bennington College

With rapid global land use change and population growth, scientists are urged to find more effective strategies for biodiversity conservation. We require methodology that not only involves the protection of our ecological diversity but also provides the natural resources, ecosystem services, which the human species needs. Our study used point counts to identify species of birds, and quantify their abundances, in 81m2 plots. This served as a proxy for the conservation potential of three different hill forest types in Sri Lanka. We found that analog forests (forests managed for both food production and functional similarity to natural forests), even under fifteen years of age, provide similar ecological conservation potential to forest preserves as measured and defined by bird species, family, and guild richness, as well as abundance. The two habitat types do vary significantly in their avian community composition and guild structure. This, thus, raises the question of whether certain species of birds are more important to target in conservation efforts than others. Older analog forest plots do, however, seem to support the same proportion of endemic bird species as forest preserve plots, which younger analog forest plots do not. Timber plantations had significantly lower numbers than the other two forest types for most diversity variables. This study argues that analog forests do indeed possess conservation potential, especially when considering the additional benefits of ecosystem services valuable to human beings. Future studies should assess the additional economical conservation potential of this forestry strategy.

Growth and survival of nestlings in two island populations of Black-crowned Night-Herons in southwestern Lake Erie

Stein, Kristie - The Ohio State University; Christopher Tonra - The Ohio State University

Located 9 miles due north of the Ohio mainland, West Sister Island is home to 40% of the nesting herons and egrets in the U.S. Great Lakes. One such species of heron, Black-crowned Night-Heron, has experienced a decline in breeding pairs from 3,000 in 1977 to 387 pairs in 1999 and is currently listed as threatened in Ohio (Hothem et al. 2000). Understanding factors influencing movements of individuals across spatial and temporal scales is critical to the preservation of populations threatened by environmental change. Using this information, in accordance with survivorship estimates, is important in understanding population dynamics and the conservation needs of species. To estimate post-fledging survival and examine dispersal patterns, Black-crowned Night-Herons (n=15 fledglings) were marked with coded nanotags in Lake Erie, Ohio, in 2015. Adult night-herons (n=5) were captured at local marinas near public-use fish-cleaning stations using a baited woosh net technique. In combination with active hand tracking, automated telemetry towers were used to passively monitor movement activity of marked birds. During the 2016 nesting season, we will use the same techniques to deploy coded nanotags (n=60) and ARGOS satellite transmitters (n=15 adults). I will present preliminary results on fledging rates, survival, recruitment, and movements of juvenile and adult Black-crowned Night-Herons. Incorporating knowledge of night-heron movement and population demographics may help guide future

management decisions to maintain a viable population.

Breeding Home Range Size of Scissor-tailed Flycatchers (*Tyrannus forficatus*)
Stokes, Jared - Cameron University; Diane Roeder - University of Oklahoma; Mike Husak - Cameron University

The Scissor-tailed Flycatcher (*Tyrannus forficatus*), has been extensively studied in areas such as breeding biology and migration patterns. However, no previous studies have looked at the home range size during the breeding season and the variables that could influence size. We calculated home range sizes of nesting Scissor-tailed Flycatchers in native oak/elm (Quercus/Ulmus) savannahs and invasive mesquite (*Prospois glandulosa*) savannahs in southwestern Oklahoma. Color-banded adults were followed during two breeding seasons and their perch locations recorded on a Garmin 62Csx handheld gps unit. Taking advantage of unique weather patterns, we were able to record data for the first season during a record drought and the second season's data were recorded post drought and after record rainfall. Aerial photographs were used to verify accuracy of gps points, and ArcGIS was used to determine home range size using minimum convex polygons. There was considerable variation in home range sizes (1.53 – 18.21 ha), but no significant differences were found between savannah types or between years. Mean home range size (5.90 ha) was larger than has been implied in previous literature. We also looked for differences between nesting phases and determined there was no significant difference between egg and nestling phases. Additionally, a multiple linear regression model examined potential effects of one-ha scale habitat variables on home range size between nesting sites and years. This model did not show vegetation effects driving home range size variation.

Winter survival of Baird's and grasshopper sparrows in the Chihuahuan Desert: Is this where populations are limited?
Strasser, Erin - Bird Conservancy of the Rockies; Arvind Panjabi - Bird Conservancy of the Rockies; Irene Ruvalcaba-Ortega - Laboratorio de Biología de la Conservación y Desarrollo Sustentable, Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León; José Hugo Martinez - Universidad Juárez del Estado de Durango; Viviana Ruiz Gutierrez - Cornell Lab of Ornithology

Winter survival is a key component of full annual cycle conservation, however we lack information both on survival rates as well as drivers of these patterns on the wintering grounds. Grassland birds have declined significantly and most winter in the highly threatened and limited Chihuahuan Desert grasslands. Between December 2012 and March 2016 we radio-tracked 765 sparrows (366 Baird's, 399 Grasshopper Sparrows) at three study sites across the Chihuahuan Desert of northern Mexico. We monitored birds daily to identify causes of mortality, calculate survival probabilities, and characterize home ranges. We measured grassland composition and structure, bird densities, and winter climate across our study areas to assess relationships between survival and these habitat covariates. We also documented 300 mortalities, of which depredation by avian predators was the leading cause. Daily survival probabilities extrapolated over the four-month monitoring period suggest widely varying survival depending on study area, year, and species. Grasshopper sparrows exhibited lower mean survival across sites and years compared with Baird's, and survival was lower following bouts of cold wet weather. Grasshopper sparrows also used smaller territories when compared to Baird's, and were characterized by sparser grass cover and more shrubs. Our results show low winter survival in both species, and suggest

this seasonal limitation may be driving the observed annual population declines. Further, ideal habitat conditions for these species may be manageable through adaptive grazing strategies. This information can be incorporated into models that can guide conservation efforts at both the continental and local scales.

Acoustic adaptation as a driver of song divergence in Galapagos finches
Strauss, Amy - University of Massachusetts - Amherst; Jeffrey Podos - University of Massachusetts - Amherst

Vocal mating signals (songs) in the Galapagos finch radiation have diverged markedly over the course of the clade's brief history. Song today plays a key role in mate recognition and selection within this group, reinforcing or even driving speciation by maintaining reproductive isolation among closely related species. Thus, to effectively explain speciation within the Galapagos finches, it is critical to characterize factors that drive song divergence. Here we explore one such factor, initially addressed by Robert Bowman over a half-century ago but since largely overlooked – acoustic adaptation. The premise of the "acoustic adaptation hypothesis" is that songs in different habitats should diverge to optimize local transmission efficiency, i.e., to minimize negative effects of acoustic degradation caused by attenuation, masking, and reverberation. To test the acoustic adaptation hypothesis in Galapagos finches, we recorded songs at close distance from nine finch species occupying two habitats – an upland/forested habitat and an lowland/open habitat – and then played and re-recorded those songs at increasing distances along three transects in each habitat. The acoustic adaptation hypothesis predicts that songs would transmit more successfully (with less degradation) through their "home" habitats. We used two main methods to quantify song degradation by distance: analysis of individual frequency parameters, and spectrogram cross-correlation analyses. Results from our analyses will be compared to results from Bowman's classic work, and will also be framed relative to other factors, such as morphology and drift, that drive song divergence in this clade.

Why are there so many women graduate students and so few women professionals in ornithology?
Sullivan, Kimberly - Utah State University

Starting in the 1960's, an increasing number of women entered graduate programs with the intention of establishing a career in the scientific study of birds. As career opportunities expanded for women the transition rate from graduate student to professional member increased until men and women were equally likely to remain as society members by the late 1980's. Starting in the 1990's the job market changed with greater competition for academic and federal jobs. As the jobs became more competitive, individuals spent more years in graduate school and as post-docs and temporary employees. The length of the training period decreased transition rates for women to one half of their male counterparts by the early 2000's. Partnered women in their mid-thirties followed partners to jobs and applied for fewer jobs than younger and single women. Results obtained from a longitudinal study of AOU, COS and WOS membership records will be compared to current membership records to see if these patterns have continued. The data will be interpreted in light of extensive interviews of early career scientists in ornithology and ecology.

Family morph matters: factors determining survival and recruitment in a long-lived polymorphic raptor

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From an evolutionary perspective, recruitment into the breeding population represents one of the most important life-history stages and ultimately determines the effective population size. In this study, we explore factors influencing both offspring survival and their subsequent recruitment in a long-lived urban raptor, the black sparrowhawk (*Accipiter melanoleucus*). Adult black sparrowhawks show discrete colour polymorphism (dark/light), and in South Africa morphs are distributed clinally with the highest proportion of dark morphs present on the Cape Peninsula (75%). For offspring survival, parental morph combination was important – with young produced by pairs of contrasting morphs having higher survival rates than young fledged from like-pairs. The association between recruitment and morph was more complex; with an interaction between male morph and breeding time, whereby recruitment of offspring from dark morph fathers was more likely when fledging earlier in the season. The opposite relationship was found for light morph fathers, with their offspring more likely to be recruited if fledged later in the season. This interaction may be due to differential morph-specific hunting success of fathers, linked to background matching and crypsis in different weather conditions. Dark morph males may hunt more successfully in rainier and cloudier conditions, which occur more frequently earlier in the breeding season, and light morph males may be more successful later on, when weather conditions become increasingly brighter and drier. Our results reveal a complex situation whereby the family morph combination influences survival, and the father morphs specifically recruitment, revealing morph-specific benefits dependent on the timing of breeding.

Patterns of evolution between a group of New World doves and their parasitic feather lice

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Hosts-parasite interactions are plentiful and diverse, and understanding the patterns of these interactions can provide novel insight into the evolution of the organisms involved. Comparing the evolutionary patterns (i.e. phylogenies) of a group of hosts and their associated parasites is a way to test for biologically relevant relationships. In this study we focus on a clade of parasitic chewing lice (Insecta: Phthiraptera) associated with a group of birds, the small New World ground-doves (Aves: Columbidae). We used lice sampled from most ground-dove species, and included samples from multiple geographic locations. From these samples we sequenced mitochondrial and nuclear loci for the lice, and used this data to estimate phylogenetic relationships. We then used cophylogenetic analyses to compare the louse phylogeny to an existing host phylogeny. The cophylogenetic analyses indicated an overall congruence between the host and parasite phylogenies, but only recovered a single cospeciation event. This indicates the patterns are not consistent across this host-parasite system. Lice with the highest levels of congruence are associated with a genus of high Andean ground-dove that are well separated from other related taxa (Metriopelia). The other associations are not as congruent. However, testing for structure according to host biogeography in the louse

phylogeny yielded highly significant results, suggesting phylogenetic relationships among the lice are perhaps best predicted by host biogeography. The results from this research highlight the importance of studying host-parasite interactions to further understand the evolutionary history of a group of birds.

The role of vegetation structure and canopy composition on Red-naped Sapsucker occupancy across an aspen-conifer gradient

Swift, Charles - University of Idaho; **Kerri Vierling** - University of Idaho; Andrew Hudak - US Forest Service; Lee Vierling - University of Idaho

Red-naped Sapsuckers (*Sphyrapicus nuchalis*) are considered ecosystem engineers through their creation of tree cavities. Red-naped Sapsuckers use conifer and deciduous habitats for breeding, and previous research has largely occurred in quaking aspen (*Populus tremuloides*) forests. Aspen declines across western North America are due to a variety of factors including changes in fire regimes, climate, grazing, insect outbreaks, and synergies amongst these processes. The encroachment of conifers into aspen as a result of changes to fire regimes is one such change in aspen stands that may influence Red-naped Sapsucker occupancy. We used four LiDAR-derived vegetation structure metrics and canopy composition (aspen-dominated, mixed aspen-conifer, or conifer-dominated) to examine Red-naped Sapsucker occupancy across an aspen-conifer forest gradient. We surveyed for sapsuckers between 2013 and 2014 in west-central Idaho, and used occupancy models and an information-theoretic approach to model sapsucker occupancy. Sapsuckers were positively associated with aspen canopy composition and foliage height diversity, and negatively associated with understory density and mid/upper canopy density. These results concur with previous studies, and further emphasize the importance of aspen for this species.

Color Association in Mercury-dosed Zebra Finches

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Methylmercury (Hg) is an anthropogenic neurotoxin that affects numerous biological systems across avian taxa, leading to altered reproduction and behavior. Birds used in our study were exposed to one of two dietary, lifetime Hg treatments: 0.0 or 1.2 parts per million. We used a progressive shaping procedure to teach birds how to remove lids from eight 2.5cm circular food wells in a 20x20cm foraging grid. After demonstrating they had learned the skill, birds were given the same foraging grid with four green and four orange lids covering the food wells. One randomly selected color of lid concealed a food reward. Performance at finding food throughout ten trials with randomized rearrangement of lids was measured to assay a bird's color association abilities. During the progressive shaping procedure, similar numbers of birds from each treatment group failed to demonstrate the skill: six birds from the 0.0ppm Hg group and seven from the 1.2ppm Hg group. Performance during the ten color association trials also did not statistically differ between treatment groups: control birds made 20.0 mistakes, on average, whereas Hg birds made an average of 17.5 mistakes ($t = 1.29$, $df = 27.93$, p-value = 0.21). We have recently showed that dietary Hg reduced performance on a similar task involving spatial memory. Our negative results here suggest that Hg does not have detectable effects on the color association abilities of zebra finches, suggesting that the cognitive

impairment by mercury is specific to certain brain regions and functions.

Maternal care in different contexts: Incubation constancy and nestling provisioning by female Carolina Chickadees

Tipton, Joseph - Northern Kentucky University; Lindsey Walters - Northern Kentucky University

Both incubation and nestling provisioning are integral to avian reproductive success and both are skills that could be learned and refined over time as an individual bird practices them. We hypothesized that mothers who have learned how to effectively incubate their eggs will also show more success in their skill at provisioning their nestlings. We tested this hypothesis in Carolina Chickadees (*Poecile carolinensis*), a socially monogamous songbird which exhibits female-only incubation and biparental provisioning of nestlings. We predicted that the mean length of incubation recesses per female should be inversely related to the mean number of provisioning visits per female. To test this, we measured incubation recesses by placing remote data loggers in the nests of incubating females. These devices recorded nest temperature, which decreased when the mother left the nest, allowing us to measure the length of female absences. We measured provisioning visits by observing the nest boxes for one hour intervals and recording the number of visits by the banded parents. Contrary to our prediction, we found no relationship between provisioning visit rate and incubation recess duration. This could be due to a number of factors. Provisioning was only measured for a few hours total per bird, and variation in provisioning rate due to weather, nestling age, etc. could hide any potential relationship with incubation constancy. Alternatively, it could be that parental skill influences one of these behaviors more than the other, so there really is no relationship between these types of maternal care.

Body condition as a metric to compare and evaluate cloud forest and shade coffee as suitable habitat for migratory and resident birds in northern and west-central Nicaragua

Torrez, Marvin - Centra American University (UCA); Mariamar Gutierrez - University of Massachusetts, Amherst; **Wayne Arendt** - USDA Forest Service, International Institute of Tropical Forestry

Birds are prime bioindicators of habitat quality and ecosystem health. Avian body condition is a convenient, indirect measure of habitat quality. To evaluate cloud forest and shade coffee as suitable habitat for migratory and resident birds in Nicaragua, we used the first principle component (PC1) from a PCA as a covariate in an ANCOVA on eight longitudinal measurements (standardized structural differences), deriving masses adjusted for body size to obtain a body condition index. Birds relatively heavy for their size were considered to be in good condition and vice versa. The data set constitutes 1,403 captures (3 migratory and 7 resident species) inhabiting cloud forest (n = 595) and coffee (808). We assessed body condition of 845 captures (min. = 35; max.133, avg. 85 per species). Nine age class (adult, juvenile) and gender comparisons resulted in differential capture rates ($\alpha = 0.05$) within and between habitats. Some 65% adult and 52% juvenile females were captured in forest. About 73% of juvenile males and 60% juvenile females were captured in coffee. All three migrants (*Catharus ustulatus*, *Hylocichla mustelina*, *Seiurus aurocapilla*) and two residents (*Lampornis sybillae*, *Mionectes oleaginous*) were fitter in forest, three in coffee (*Campylopterus hemileucurus*, *Chlorospingus ophthalmicus*, *Chiroxiphia linearis*), and two comparable (*Eupherusa eximia*, *Phaethornis longirostris*). Forest and

shade coffee are suitable habitat for resident and migratory birds. Demographics must be emphasized when using habitat-specific measures of abundance, performance or condition of birds to measure and evaluate habitat quality. Land stewards are encouraged to maintain comparable preserved and production acreage.

Lightweight GPS tags show migratory use of desert wash and other habitat types by western yellow-billed cuckoos
Tracy, Diane - Southern Sierra Research Station; Shannon McNeil - Southern Sierra Research Station

Limited knowledge of habitat types used during migration – the most dangerous period for most long-distance migrants – impedes full life-cycle conservation of threatened taxa, such as the western distinct population segment of yellow-billed cuckoo (*Coccyzus americanus*). Migration data collected by light-level geolocation is highly error-prone, especially in forest-dwelling species such as cuckoos. More accurate stopover locations may reveal specific habitat types and areas used. In 2014 and 2015 we mist-netted and placed lightweight GPS tags on 7 western yellow-billed cuckoos breeding at Palo Verde Ecological Reserve, California, and tried to recapture them the following year to retrieve the data. Each GPS tag recorded up to 10 locations per bird. We recaptured 3 females in 2015 at their original capture sites. Two points were recorded in Sonoran Desert washes within public lands in southern Arizona pre- and post-breeding. Fall migration points were recorded along the Pacific coast of Mexico and Nicaragua, including clusters of points in Michoacán Mexico and Nicaragua. During spring migration, point clusters occurred in Campeche Mexico, within the Calakmul Biosphere Reserve. So far our data suggest that desert washes may be important to birds migrating through the southwestern US, including riparian breeding obligates such as western cuckoos, and the point clusters recorded may indicate these areas are also important to this population. We hope to add more locations during the 2016 breeding season.

Dying for Love: Illegal International Trade in Hummingbird 'Chuparosa' Love Charms
Trail, Pepper - U.S. Fish and Wildlife Service

Objects incorporating the bodies of hummingbirds have long been used as love charms in Mexico. These charms are known as chuparosas, after the colloquial Mexican word for hummingbird, literally "rose-sucker." Recent investigations by the U.S. Fish and Wildlife Service have resulted in the seizure of approximately 200 chuparosa charms in Texas and California. The chuparosas are commercially packaged with printed "prayers" (oraciones) and are sold in shops specializing in traditional Mexican herbal remedies. Chuparosas for sale in the United States appear to originate in Mexico. Examinations of 160 chuparosas at the National Fish and Wildlife Forensics Laboratory identified ten hummingbird species of nine genera. Archilochus and Selasphorus accounted for 58% of identified remains, including Ruby-throated, Black-chinned, Allen's, and Broad-tailed Hummingbirds, all widespread in the U.S. Species whose U.S. range covers only the southwestern border region accounted for 19% of identifications, including White-eared, Violet-crowned, Magnificent, and Blue-throated Hummingbirds. Three chuparosas (2%) contained Green Violetear, a tropical species only vagrant in the U.S. The remaining 21% were identified to the genera Cynanthus and Calothorax only; these genera include Mexican endemics as well as species found along the southwestern U.S. border. This talk will summarize available information on chuparosa love charms in Mexico and the

United States, and discuss the conservation implications of this little-known international hummingbird trade.

Molecular Analysis of Nestling Diet in a Long-Distance Neotropical Migrant, the Louisiana Waterthrush (*Parkesia motacilla*)
Trevelline, Brian - Duquesne University; Steven Latta - National Aviary; Leesia Marshall - Louisiana State University – Alexandria

Elucidating the diet of Neotropical migratory birds is essential to our understanding of their ecology and to their long-term conservation. Reductions in prey availability negatively impact Neotropical migrants by affecting their survival as both nestlings and adults. Beyond broad taxonomic or morphological categories, however, the diet of Neotropical migrants is poorly documented. Using the molecular techniques of DNA barcoding and next-generation sequencing, we elucidated the diet of Louisiana Waterthrush (*Parkesia motacilla*) nestlings in Arkansas and Pennsylvania, USA.
Waterthrush have been shown to respond negatively to the reduced availability of aquatic insects in the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT taxa). We hypothesized that Louisiana Waterthrush nestling diet would be primarily composed of these pollution-sensitive aquatic taxa, and that changes in the riparian insect community would be reflected in their diet.
Unexpectedly, the orders Lepidoptera (92%) and Diptera (70%) occurred frequently in the diet of Louisiana Waterthrush nestlings. Among EPT taxa, only the order Ephemeroptera (61%) was frequently detected whereas Plecoptera (7%) and Trichoptera (1%) were poorly represented. The frequency at which aquatic Ephemeroptera and terrestrial Lepidoptera were detected in waterthrush nestling diet differed significantly over the nesting period in Pennsylvania but not in Arkansas, suggesting that phenological shifts in the availability of non-EPT prey taxa may be an important yet undescribed factor influencing the foraging ecology of waterthrush on the breeding grounds. Furthermore, these findings suggest that terrestrial insects may be more important to waterthrush nestlings than previously thought, which enhances our understanding of this biological indicator and Neotropical migrant.

Seasonal Survival in a Black-capped Chickadee (*Poecile atricapillus*) Population in Central Minnesota 1969-2012.
Tuma, Molly - University of Minnesota, Twin Cities

Annual survival rates are a source of important information on the ecology, and conservation needs of birds; however, little has been done to investigate seasonal survival rates. There are two reasons for this: 1) It requires following migratory birds throughout their full migrational cycle, 2) it requires collecting either continuous time data (satellite telemetry) or have multiple band/encounter events per year. Using an extensive mark/recapture dataset of black-capped chickadees (*Poecile atricapillus*) from Lowry Nature Center in Victoria, Minnesota, we addressed these issues using a non-migratory passerine with multiple band/encounter events per year. Using data from 2,346 chickadees collected monthly from 1969-2012, we estimated survival based on six two-month periods using Cormack-Jolly-Seber (CJS) models in Program Mark. Apparent survival (ϕ) and capture probability (p) varied by age and season in the best-supported model. Adult survival was higher than juvenile survival, and decreased from summer to winter. Juvenile survival was lower summer through early fall, but increased from late fall through winter. Because CJS models measure apparent survival it is difficult to make inferences about true survival during

fall and winter because this is when juvenile dispersal is highest. An initial test showed no transient effects on survival. Our study showed lower survival for adult birds during colder periods, and an increasing trend of survival for juveniles after their post-fledging dispersal. This information gives us insight into the risks that a chickadee faces in their annual cycle, and opens up the possibility of conducting similar analysis for other year-round residents.

DOES THE MICROBIAL COMMUNITY OF NESTLINGS' FECAL SACS INFLUENCE PARENTAL NEST SANITATION BEHAVIOR OF A SONGBIRD?

Tutterow, Jessica - Guilford College; Alexandra Babour - Guilford College; Melanie Lee-Brown - Guilford College; Christine Stracey - Guilford College

The feces of nestling songbirds are encapsulated in a mucous covering, allowing parents to transport waste from the nest and/or prevent nest contamination. Several songbird species ingest fecal sacs when nestlings are young and then switch to removing fecal sacs of older nestlings. There are four hypotheses to explain this switch in nest sanitation behavior; however, none of them explicitly take into account microbial content of fecal sacs. We address the following research questions: 1) Do Eastern Bluebirds (*Sialia sialis*) consume nestling fecal sacs; 2) If so, at what point do parent Eastern Bluebirds (EABL) stop consuming fecal sacs and begin to transport them from the nest; and 3) Could changes in the microbial load and diversity of nestlings' feces explain why parent songbirds stop consuming fecal sacs. We hypothesize that EABLs exhibit a switch in nest sanitation behavior from consumption to transport as nestlings age and this switch is correlated with an increase in microbial load and/or a change in microbial diversity in the fecal sacs. We collected fecal sac samples in sterile centrifuge tubes and used GoPro cameras to monitor nest sanitation behavior. EABL parents consumed all observed nestlings' fecal sacs on days 0-1, exhibited both behaviors on days 3-8, and solely transported fecal sacs on days 9-12. Future work will identify microbial diversity and microbial community composition changes of fecal sac samples as the nestlings age. We expect to see a correlation between increased microbial load and microbial diversity and changes in nest sanitation behavior.

Measurement of Creatine Kinase Levels for Baltimore Orioles During Spring Migration and Breeding in South Central Nebraska

Van Brocklin, Marika - University of Nebraska-Kearney; Letitia Reichart - University of Nebraska-Kearney

Migratory birds travel long distances each year and use of energy stores likely differs between parts of the avian annual cycle. Our research aims to gain a better understanding of energy use for migratory and breeding Balitmore Orioles, *Icterus galbula*. We measured the amount of muscle damage and muscle repair for both migratory and breeding Baltimore Orioles (BAOR) in south Central Nebraska. To measure muscle damage and repair, we collected blood samples from individuals BAOR to determine the amount of creatine kinase in the blood. Creatine kinase is a plasma metabolite and variation in the amount of creatine kinase is linked to differences in resource use and innate genetic variation. Muscle damage is common in migratory birds that participate in long-distance flights and the rate at which muscle repair occurs differs among individuals. For this project, we analyzed samples collected during spring and 2016, from BAOR. We collected blood samples within five minutes of capture from the brachial vein and then samples were stored on ice. Plasma was removed from the remaining blood components and stored at -80°C until analysis. We analyzed blood

plasma samples for creatine kinase using kinetic assays. Here we report preliminary results for plasma metabolite assays for samples collected during spring and summer 2016. Results from this study will be used to formulate new testable hypotheses regarding muscle damage and repair for BAOR during their annual cycle.

Human perturbation promotes ruderal strategies in resident bird communities of Neotropical seasonal forests

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Dry forests have one of the highest deforestation rates among the Neotropical ecosystems. Habitat loss owing to agriculture, cattle, and human settlements results in species extinction; indeed, dry forest biodiversity is critically endangered. Studies using bird communities as model to understand the effects of perturbation on dry forests biodiversity have shown patterns of species richness loss and changes in community dominance, but do not provide solid information about the ecological mechanisms behind this biodiversity loss. In this study, we used a trait-based approach to evaluate ecological changes in bird communities of three progressive levels of anthropic perturbation within the tropical deciduous forest and oak forest in the upper Balsas River basin, Mexico. We performed point-count surveys to characterize the avian community, and we constructed an effect-response trait matrix for all recorded species. A multivariate analysis shows significant patterns of trait covariation in function of human disturbance intensification. We found evidence of differential ecological success of organisms with rapid life cycles and high reproductive investments within more intensely perturbed habitat in both forests types. Our findings show that human activities promote a bird biodiversity loss process drived by ecological filtering that favor traits related with the ruderal adaptive strategy, similar to those that occur in plant ecology studies.

Eroding the differences: Human perturbation promotes biotic homogenization in resident bird communities of Neotropical Dry Forest

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Human activities promote changes in ecosystems that generate homogenous ecological conditions according to human requirements, and facilitate biological invasions mediated by man-made transportation at global scale. On that set of conditions, biotic homogenization can occur. This phenomenon consists in erosion of biological differences between contrasting ecosystems and geographical regions, due to extinction of local specialist species, and invasion of exotic generalists. However, scenarios where differences increase (biotic differentiation) can also occur. In this study, we assess the biotic homogenization hypothesis in resident bird communities of tropical dry forest in central Mexico, a globally relevant ecosystem due to its endemism richness, but also critically endangered due to human activities. We conducted point-count surveys to assess biotic dissimilarity between resident bird communities in both tropical deciduous and oak forests in the upper Balsas River basin, considering three progressive levels of

anthropic perturbation. Our findings show a significant decrement of species richness and also in taxonomic dissimilarity due to reduction of species turnover in function of anthropic perturbation. This results in homogenization of bird communities in human settlements at both vegetation types, thus breaking the natural pattern of distance-decay of similarity. Our findings show that human perturbation promotes biodiversity loss mediated for the taxonomic homogenization of bird communities in the Neotropical dry forests, indicating the need for developing production strategies with lesser impacts in natural vegetation cover, in order to reduce the biodiversity erosion that human activities has driven over natural systems, especially within areas with high-level of endemism

Individual Variation in Testosterone and Cooperative Behavior in a Neotropical Lekking Bird, the Wire-Tailed Manakin
Vernasco, Ben - Virginia Tech University; Ignacio Moore - Virginia Tech University; Brent Horton - Department of Biology, Millersville University; T Ryder - Smithsonian Migratory Bird Center

Manakins of the family Pipridae are known for performing complex courtship displays at leks. These complex displays have evolved in association with strong reproductive skew, suggesting individual differences in courtship behavior exist. By measuring components of hormone regulatory networks, one may be able to elucidate the proximate mediators of individual variation in courtship behavior. To date, however, work documenting the relationship between individual variation in reproductive behavior and circulating steroids in manakins has been inconclusive. Here, using video recordings of male territories and subsequently collecting a blood sample, we quantified the relationship between individual variation in reproductive behavior and circulating testosterone in male wire-tailed manakins (*Pipra filicauda*). In this system, previous research has shown that territory-holding males have higher testosterone than floaters (i.e., non-territory-holding males), implying that testosterone plays a role in territory acquisition and maintenance. Our results show that that males with a higher proportion of cooperative displays (an important predictor of male wire-tailed manakin reproductive success) perform longer displays. However, males with high circulating testosterone engage in fewer cooperative display bouts suggesting that high levels of testosterone may interfere with effective cooperative behavior and result in shorter display bouts. These results suggest that individual differences in circulating testosterone levels play an important role in mediating individual variation in male reproductive behavior and potentially success. This research ultimately adds to our knowledge about the proximate mechanisms that mediate individual variation in both reproductive and cooperative behavior.

A Strategy for Grassland Bird Conservation in Massachusetts
Vitz, Andrew - Massachusetts Division of Fisheries and Wildlife

Grassland birds are among the most imperiled cohort of birds in the Northeast. The Grasshopper Sparrow is listed as threatened and the Upland Sandpiper as endangered under the Massachusetts Endangered Species Act. As a result, the Massachusetts Division of Fisheries and Wildlife has developed a conservation strategy for these species. The first step was to create a publicly accessible document highlighting the need for grassland bird conservation and ranking all known breeding sites of Grasshopper Sparrows and/or Upland Sandpipers. Site rankings were based on the number of birds documented and its grassland restoration potential. To update information on the state-wide distribution of these species, distance based point-counts were

conducted at 33 sites for 10 species of grassland birds in June of 2014 and 2015. When possible, species specific densities were generated for individual sites or site types (e.g., airport, landfill). Our results indicate that the highest densities of both Upland Sandpiper and Grasshopper Sparrow occurred in large grasslands, which is consistent with their area-sensitive status. For example, the 1,300 acres of grassland at Westover Air Reserve Base (a regionally important site) had over 200 singing Grasshopper Sparrows and 80 Upland Sandpipers. We will replicate this state-wide survey every 5 years to update our grassland bird database and inform management actions. This information will be used to best direct the use of mitigation funds to benefit breeding populations of Grasshopper Sparrow and Upland Sandpiper in Massachusetts (e.g., land acquisition, grassland restoration).

International Waterbird Census on Skadar Lake, Montenegro

Vizi, Andrej - Natural History Museum of Montenegro

The International Waterbird census is the longest running bird monitoring scheme in Montenegro. Started in 1991, it represents a most complete and reliable data source for analysis of water bird trends n the national and international level. Moreover, it is a common platform
for collaboration of professional ornithologist s and volunteers and the conservation policy makers. The IWC at Skadar Lake in certain years showed sharp decline trend in total number of birds, which can't be attributed only to human pressure.

First steps towards reintroducing the Green and Red Macaw (*Ara chloropterus*) to Argentina

Volpe, Noelia - Centro de Ecología Aplicada del Litoral; Adrian Di Giacomo - Centro de Ecología Aplicada del Litoral (CECOAL)-CONICET; Igor Berkunsky - UNCPBA-CONICET

The Green and Red Macaw, Ara chloropterus, became extinct from Argentina in the 19th century. In order to restore its ecological role as consumer and disperser of large fruits and seeds we developed a project to reintroduce this species in the Ibera Wetlands, northeast Argentina. In September 2015 we started training a group of seven macaws, promoting fruit search behavior, consumption of native fruits and flight. After one-month stay in a pre-release cage, the group was set free in late October 2015. In our first release attempt, we flushed the group and six of the macaws flew out of the cage. A week later, and after re-capturing the six previously released macaws, we tried a different approach, letting them exit at their own pace. Of the seven released birds, 2 were predated by a wildcat on days 4 and 5 after the second release, one macaw was found dead and we were not able to determine the cause, three macaws flew outside of our telemetry equipment's detection range and one macaw was recaptured. We show details of this first release experience, discuss the causes that lead to a high number of losses and present the new pre-release protocol being currently used, which addresses these issues.

Red-crowned Parrot (*Amazona viridigenalis*) ecological niche model in the Lower Rio Grande Valley, Texas using aerial imagery for conservation planning in an urban landscape.
Voltura, Elise - Texas A&M University / College of Veterinary Medicine / Department of Veterinary Pathobiology; James Tracy - Texas A&M University / Department of Entomology / Knowledge Engineering Laboratory; Robert Coulson - Texas A&M University / Department of Entomology / Knowledge Engineering Laboratory; Donald Brightsmith - Texas A&M University

The Red-crowned Parrot (RCP), *Amazona viridigenalis*, is an endangered amazon parrot native to northeastern Mexico. It is being considered for listing under the Endangered Species Act in the USA by USFWS. The long-term viability of the RCP in its native range is uncertain due to insufficient conservation regulatory mechanisms. Historically, the RCP was an occasional migrant to the Lower Rio Grande Valley (LRGV) of Texas, however, a resident population become established in certain urban areas in the region in recent decades. Conservation of this population is paramount since it currently represents 15-33% of the total global numbers. This study aimed to identify suitable RCP habitat in the LRGV and to make recommendations regarding habitat protection and enhancement actions for the region. We used Maxent modeling software to develop a high-resolution ecological niche model using variables primarily derived from USDA NAIP aerial imagery, including raw vegetation, landscape composition, and texture indices. The model clearly projects highly suitable habitat within the regions urban boundaries, particularly where certain ornamentals are frequently cultivated. Our model suggests heterogeneity and spatial arrangement of the urban landscape may be key factors in explaining RCP presence patterns in the LRGV. Suitable habitat beyond what is currently being occupied appears limited; however, encouraging people living in the LRGV to plant the ornamentals the parrots rely on might allow the existing RCP population to grow in number and expand beyond its current range and thereby improve the species' conservation status.

Rodenticide hazards to non-raptor species
Vyas, Nimish - US Geological Survey

Little information is available on rodenticide hazards to non-raptor species. These birds can be poisoned via feeding on the rodenticide bait. Rodenticide incidents for non-raptor taxa are presented to illustrate how species biology, the rodenticide class, mode of action, toxicity, formulation, and application method, and environmental conditions result in mortality of free-flying birds. Mortalities have been reported for species in the orders Anseriformes, Galliformes, Gruiformes, Charadriiformes, Columbiformes, Psittaciformes, and Passeriformes. Additionally, a western meadowlark, *Sturnella neglecta*, mortality is provided as a detailed case study. Rodenticide poisoning was identified as the cause of the meadowlark's death based on residue analysis and the presence of macroscopic and microscopic hemorrhaging in the brain and pectoral muscles.

Female hooded warbler (*Setophaga citrina*) behavior in response to a foreign object in the nest
Ward, Michelle - Ohio University; Brandan Gray - Ohio University; Kelly Williams - Ohio University

In order to avoid parasitism, maintain nest cleanliness, and defend their broods, many birds have developed behavioral responses to foreign objects in their nests. Female hooded warblers (*Setophaga citrina*) express individual variation in their nesting behaviors. I examined how female hooded

warblers react to a foreign object in their nest. A temperature logger (iButton ®) was placed in the bottom of nests during the 2015 breeding season, and I video recorded each females' behavior after the iButton insertion. I scored the females initial response to the iButton, and quantified the female's behavior 20 minutes following the female's return to the nest. I then calculated the proportion of time spent inspecting the iButton and the proportion of time spent exhibiting vigilant behaviors. I found that females with higher initial behavioral response exhibit a higher proportion of nest inspection behaviors at the nest, and that females who engaged in more nest inspection behaviors had higher nest temperatures. Nest behaviors were not related to survival, but similar studies suggest that females who have higher nest temperatures have higher fledgling success. Variation in female response to iButtons may predict the variation in nestling survival, nest temperature, and amount of vigilant and nest inspection behavior displayed at the nest. Response to the iButton may also provide insight into how a female responds to a foreign egg in her nest, such as a parasitic egg from a Brown-headed Cowbird (*Molothrus ater*).

Using Inscriptions to Bridge Birders and Scientists: A Detailed Analysis of Two Competing Methodologies to Delineate Raptor Populations In the Eastern Flyway

Wargo, Brian M. - Hawk Migration Association of North America

Hawkwatching is a citizen science activity that bridges professional scientists with birders who specialize in counting raptors as they pass through known migratory routes. This odd coupling leaves a discernable gap in the ways in which the results are conveyed. For scientists, esoteric language in specialized journals precludes the hawkwatchers from the dissemination of the results. For the hawkwatchers, experience and daily conversations concerning the vitality of each species is omnipresent, yet is often not conveyed to the scientists. The purpose of this project is to unite the groups by representing raptor data using inscriptions that illustrate not only the trends in the populations, but also in the difficulty of analyzing such data sets. In this particular instantiation, spring data from twenty hawk sites has been analyzed and represented using graphs, charts, and figures. Each elucidates a differing view of the data, but offers complementary methods for demonstrating trends. The thesis of this work is that clear and simple representations are sufficient for demonstrating trends while exposing the fundamental impediments to any population work, both for the layman and the scientist.

Gene flow through the mountains: effect of barriers on genetic variation in white-crowned sparrows (*Zonotrichia leucophrys*)

Welke, Catherine - University of Lethbridge; Theresa Burg - University of Lethbridge

Gene flow in populations can be restricted by climatic, geographic, and behavioural barriers, leading to genetic differentiation and speciation. Mountains are important zones for biodiversity, restricting gene flow within populations across small distances due to environmental pressures along elevational gradients. The extent of gene flow may be diminished in species with lower dispersal propensity (i.e. resident versus migratory breeders), but the nature of this relationship can be complex. Here we test for the effect of climatic and geographic barriers on gene flow in two montane, migratory and highly philopatric subspecies of white-crowned sparrows (*Zonotrichia leucophrys*). It will be beneficial to use this widespread North American passerine to increase our understanding of the effect of barriers on gene flow in montane environments, especially since these two

subspecies also exhibit both long-distance migration and resident breeder behaviour. DNA samples were collected from *Z. l. oriantha* and *Z. l. gambelii* distributed along elevational gradients and on both sides of the Rocky Mountains of southern Alberta and British Columbia. We hypothesize that: (1) mountains restrict dispersal within populations *of Z. l. oriantha* and *Z. l. gambelii*, and (2) gene flow is reduced along elevational gradients. Analysis of population genetic variation at nuclear and mitochondrial loci shows greater haplotype diversity at high elevations and on the east side of the Rocky Mountains. These results suggest gene flow is constrained across the mountain range and by high elevation.

Airspace use by night migrating landbirds in relation to the southwestern shore of Lake Erie, OH.

Wellik, Michael - US Geological Survey; Eileen Kirsch - US Geological Survey

The Great Lakes are prime targets for on and offshore wind energy development. Migrating landbirds require critical stopover habitats along Great Lakes shorelines and may perceive these large water bodies as obstacles to direct movement. The east-west orientation of Lake Erie especially causes bird numbers to concentrate in woody habitats along the shoreline during migration. Man-made obstacles along these important shorelines may inhibit direct movement of migrating land birds and pose mortality risks under certain weather conditions. We studied airspace use of night migrating landbirds in spring and fall, 2012-2014, along the southwestern shore of Lake Erie in Ohio, USA using two 25kw X-band marine radars in paired shoreline and 3 mile inland locations. We documented direction and altitude of flight and characteristics of ascent/descent using 1.2m diameter high gain parabolic antenna and vertically oriented 2.0m open array antenna. In spring most targets detected in shoreline and inland samples were flying over the lake, whereas in fall shoreline flights were oriented along the shoreline and inland flights were heading south. Flight altitudes in fall were slightly higher and more variable than in spring but the majority of targets flew below 500m regardless of location or season. Ascent and descent rates both seasons were symmetrically distributed along a 0 slope axis, with greater variation during evening and early morning (because of diurnal bird activity, e.g. gulls). Targets during the middle of the night were primarily in level flight.

Sex allocation in a conspecific brood parasite

Wells, Caitlin - University of California, Davis; Cara Thow - University of California, Santa Cruz; Bruce Lyon - University of California, Santa Cruz; **John Eadie** - University of California, Davis

Sex allocation theory predicts that parents should bias investment in offspring toward the sex that will yield the higher fitness returns, and one outcome may be biased offspring sex ratios. Much attention has been paid to sex allocation in birds with cooperative breeding systems, but very little has been paid to theory or empirical work in birds with parasitic breeding systems, such as waterfowl. Wood ducks (*Aix sponsa*) are a conspecific brood parasite, and rates of parasitism appear to increase with density. Because female wood ducks are philopatric, local resource competition theory predicts that females should overproduce male offspring (the dispersing sex) when competition (density) is high. However, the strength of competition may also vary with female breeding strategy, according to whether a female is a host, parasite, or host+parasite. We studied sex allocation in 4 populations of wood ducks – 2 low density and 2 high density – from 2012-2015. In contrast to predictions from local resource competition theory, we found that high-density populations overproduced female offspring, while low-density populations

produced unbiased- or male-biased offspring sex ratios. Additionally, female-bias was amplified in parasitically-laid offspring. We discuss several possibilities for why parasitic females, which presumably face the most intense competition, appear to overproduce the competitive sex.

Habitat Network: Re-imagining and Transforming America's Yards
Whatton, Megan - The Nature Conservancy

Habitat Network is a collaboration between The Nature Conservancy and the Cornell Lab of Ornithology geared to support stewards of private lands, public lands, schools, campuses and organizations interested in exploring residential ecosystems with citizen science. Duke University's Nicholas School of the Environment estimates that the United States has more than 40.5 million acres of lawn, in which approximately 30 billion dollars, 7 billion gallons of water and 3 million tons of pesticides are invested annually to care for and maintain spaces that provide little to no resources for wildlife. Previous research suggests that small changes in the way properties are managed can enhance wildlife habitat, reduce the strain on streams and rivers, support migratory species and turn barriers into bridges for wildlife. Our mapping tool captures and shares the state of private and public lands mapped by participants, highlighting ecologically relevant practices to build a social movement to affect ecological change on a large, and ecologically-relevant scale. The Habitat Network tackles a widely acknowledged conservation issue—the importance of human-occupied landscapes—by bringing people together to meaningfully restore ecological function to residential landscapes.

Local resources may limit parental flexibility in provisioning behavior
White, Aija - University of Northern British Columbia; Russell D. Dawson - University of Northern British Columbia

Behavioral flexibility and resource supply during the brood-rearing period may affect how well parents manage the costs of raising offspring. In a population of Mountain Bluebirds (*Sialia currucoides*) breeding in nest-boxes in central British Columbia, Canada, we conducted a short-term (within-day) manipulation of nestling age to determine how parents respond when offspring demand changes but local conditions do not. We exchanged younger (day 7 post-hatch) with older broods (day 11) for a portion of the day, producing increased-age and decreased-age treatment groups. We video-recorded parents feeding both their own and age-manipulated broods, as well as control pairs feeding comparably-aged broods. We quantified rates of food delivery, scoring the size of prey items delivered by each parent, and for a subset of broods, counting the number of prey items fed to individual nestlings. Unlike control pairs, parents feeding age-manipulated broods did not feed larger prey to older nestlings, but did significantly alter their per-capita feeding rates when their broods were exchanged. Both control and age-manipulated pairs showed no favoritism in older broods, but fed heavier nestlings more in young broods. While parents may be sensitive to offspring demand, local resources may limit their ability to adjust: parents in both age-manipulation treatment groups fed older broods more often, but parents in the increased-age treatment continued to feed smaller prey when provisioning older nestlings, and parents in the decreased-age treatment fed larger prey when raising younger nestlings.

Experimental Evidence that Colorful Males Sire More Extra-pair Young in Swallows
Whittingham, Linda - University of Wisconsin-Milwaukee

Few studies have found correlations between male traits and extra-pair mating success in birds, and even fewer studies have experimentally manipulated male traits to determine if they are directly related to paternity. As a consequence, there is little evidence to support the widespread hypothesis that female birds choose attractive males as extra-pair mates. Here, we conducted an experimental study of the relationship between male plumage color and fertilization success in tree swallows (*Tachycineta bicolor*). The sexes are monochromatic, but frequent extra-pair mating suggests that sexual selection could be strong. Previous work suggested that male plumage brightness was positively related to male extra-pair fertilization success. In this study we experimentally dulled male plumage (with non-toxic ink markers) early in the breeding season prior to egg laying. As predicted, dulled males sired significantly fewer young (both within-pair and extra-pair) than control males. Thus, male plumage brightness is an important signal to female tree swallows choosing both within-pair and extra-pair mates.

Spatial and temporal variation in movement patterns within the seed dispersal community on Oahu, Hawaii
Wilcox, Rebecca - University of Wyoming; Corey Tarwater - University of Wyoming

Seed dispersal is a critical ecosystem process for maintaining the integrity, diversity and structure of ecosystems. Understanding disperser movement is a key part of the seed dispersal process, however we often take a static view of movement and ignore how temporal variation in movement might alter seed dispersal. This is particularly important in novel ecosystems where plants and their dispersers have not evolved together and a decoupling between plant phenology and long distance dispersal events may occur. Here we examine spatial and temporal variation in movement of the three key vertebrate dispersers on the island of Oahu, Hawaii; a location where all native frugivores have gone extinct. Our species range in body size, gape size, diet preference, and density. Interspecific and intraspecific variation in their home ranges, distances traveled, and foraging behaviors may impact what seeds are dispersed and how far they are dispersed. We examined variation in disperser movement using radio-telemetry and found that while home range size didn't differ between the species, home range size and location vary through time. Space use differs between species, with species using different parts of the forest, and therefore, potentially encountering different fruits. Studies often ignore variation in disperser movement across time and space, and yet these movements are critical for understanding seed dispersal and its impacts on plant communities. Our work here indicates that understanding temporal and spatial variation in disperser movement and fine-scale space use is critical for managing native and non-native plants.

Persistent foraging segregation between closely-spaced seabird populations: A stable isotope perspective from the last millennium
Wiley, Anne - University of Akron; Peggy Ostrom - Michigan State University; Andreanna Welch - Durham University; Sam Rossman - Michigan State University; Craig Stricker - USGS Fort Collins Science Center; Helen F James - Division of Birds, Smithsonian Institution

Foraging segregation among seabird colonies may facilitate their coexistence and promote genetic divergence in the absence of physical barriers to dispersal. While inter-

population differences that persist for many generations are presumably the most influential, foraging studies are typically limited to much shorter time frames. Here, we investigate the nature and persistence of foraging segregation among geographically proximate, but genetically distinct populations of the Hawaiian Petrel (*Pterodroma sandwichensis*). Petrel colonies from Lanai and Maui are differentiated in their foraging throughout the entire period of primary molt, as seen by distinct δ15N values (non-overlapping CIs for mean δ15N in P1-P10), apparently a reflection of spatial habitat segregation. Additionally, the Maui population likely uses a wider range of foraging locations during primary molt: a pattern that has existed for at least 40 years (0.9992 probability that total N isotopic niche width is larger in Maui). Using stable isotope data from modern and ancient bone collagen (reflective of the entire annual cycle), we found that foraging segregation among petrel colonies was present well before human colonization of the Hawaiian Islands, over 1,000 years ago. Intriguingly, some petrel populations also differ in δD (ca. 80 ‰ difference, hatch-year feathers); we suggest this may reflect a large divergence in dietary salt load. Overall, we find that inter-colony foraging differences are a) strong during the non-breeding season, b) at least partially spatial, and c) persistent through many generations: all observations consistent with the hypothesis of genetic divergence mediated by foraging segregation.

Using field environmental philosophy to bring ornithology, ethics, and conservation together

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At the Long-term Ornithological Research (LTOR) site of the Omora Ethnobotanical Park (OEP) we developed the Field Environmental Philosphy (FEP) methodological approach to address the need for broader integration of scientific, cultural, and social components of conservation. FEP integrates ecological research and environmental ethics into biocultural education and conservation through an interrelated four-step cycle. With the aim to integrate biological and cultural dimensions that provide insights about the values and assumptions ornithologists and other people carry into the field, we focus on FEP's first two steps. The first integrates scientific and philosophical research on birds and on how we look at birds from different cultural and disciplinary traditions. The second step of FEP, "poetic communication," was adapted to consider how the Tree of Life and the Web of Life metaphors can serve as a bridge between science, traditional ornithological knowledge, and conservation. We conducted our study at OEP LTOR in the southermost forests of the Americas, protected by the Cape Horn Biosphere Reserve, Chile. We conducted compartive analyses of scientific ornithological and ethno-ornithological research of indigenous Yaghan ornithological knowledge. We found 93% of the forest bird species scientifically identified are also identified by Yaghan ornithological knowledge. We also found

both scientific and indegenous ornithological knowledge support the notion of kinship among birds and humans. Thus, they represent complementary understandings of inter-species co-inhabitation, combined, they can contribute to biocultural conservation and the well-being of birds, humans, and the diverse forms of life.

Distribution of migrating marsh birds within and among moist-soil managed wetlands in Kansas

Wilson, Eric - Emporia State University; **William Jensen** - Emporia State University; Richard Schultheis - Kansas Department of Wildlife, Parks and Tourism

Moist-soil wetland management involves hydrological drawn-downs during early spring to enhance vegetative production, and flooding in the fall, to accommodate migrating waterfowl. Habitat use by other wetland-dependent birds within and among such wetlands has received little study. We examined use of variable habitat structure by migrating (spring and fall) bitterns and rails within and among moist-soil wetlands. We used call-playback surveys during spring and flush counts during fall. Abundances of marsh birds and water coverage and depth were correlated and varied markedly among the two years of study (2014-2015). In spring Sora were found in marshes with relatively tall Polygonum, a plant we found to have greater cover and height in wetland units with mid- and late-spring drawdowns. No other patterns of marsh bird abundance and habitat structure among wetland units were detected during spring or fall. During fall, American Bitterns were detected in areas within wetland units with higher cattail (Typha) coverage than Sora locations or systematic sampling points. Sora were detected in areas within wetland units with taller grass and Polygonum, higher Polygonum cover, and deeper water than American Bittern locations or systematic sampling points. Moist-soil management of wetlands could provide habitat for marsh birds through the use of mid to late season drawdowns in the spring and early pumping of water—or the closing of water control structures—in the fall to allow natural precipitation to fill wetlands.

Population biology, life history, ecology, and conservation of the endangered Bahama Swallow (*Tachycineta cyaneoviridis*)

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The Bahama Swallow (*Tachycineta cyaneoviridis*; BAHS) is an endangered species that is endemic to the northern Bahamas. Very little is known regarding the abundance, distribution or dispersal among islands of BAHS, or the factors responsible for the species' decline. We are assessing the current population biology of BAHS using population surveys, capture-recapture and genetic-based methods, and expanding the limited life history data available by locating and monitoring BAHS nests. Preliminary results show that BAHS breed between April and July, laying an average of three eggs in pre-existing cavities, primarily abandoned woodpecker cavities in snags of Caribbean Pine (*Pinus caribaea*) and utility poles, and holes in cell phone towers and buildings. Bahamian pine forests were heavily logged through the early 1970s. Work to date suggests availability of nest sites limits populations, and reductions in this resource may be responsible for the species' decline. We are conducting surveys of the pine forest and other habitats to assess the availability of cavity-nesting resources across the landscape and constructing a cavity-nest web illustrating species interactions. BAHS appear to rely on West Indian Woodpeckers (*Melanerpes superciliaris*) and especially Hairy Woodpeckers (*Picoides villosus*) to excavate cavities, and compete with secondary cavity-nesters including

American Kestrels (*Falco sparverius*), La Sagra's Flycatchers (*Myiarchus sagrae*) and House Sparrows (*Passer domesticus*).By working with local organizations to facilitate and promote this work, our ultimate goal is to provide information that can be used develop conservation strategies for BAHS and their breeding habitat.

Songbird response to vegetation recovery on reclaimed well sites in the boreal forest of Alberta.
Wilson, Scott - University of Alberta; Erin Bayne - University of Alberta / Department of Biological Sciences

Industry is required to reclaim oil and gas well sites in Alberta, Canada with the intention of recovery to an equivalent ecological function as prior to disturbance. Songbird community response to forest regeneration following various types of disturbance is well studied. However, limited information exists on how communities change with vegetation recovery on reclaimed oil and gas infrastructure. The objectives of this study are to use bioacoustic methods to determine how vegetation regeneration influences songbird use of reclaimed well site footprints. Songbird communities were surveyed on reclaimed well sites at different stages of regeneration in the boreal forest natural region of Alberta in 2015 and 2016. Grids of GPS time-synced autonomous recording units were placed over the well site footprint. Acoustic localization was used to triangulate the singing locations of birds within the well site footprint by using the time of arrival difference of a vocalization to subsequent recording units. Species associated with early stages of forest regeneration sang from reclaimed well sites, including Alder flycatcher and Clay-coloured sparrow. Species sensitive to disturbance such as Ovenbirds only sang from reclaimed well sites when shrub and ground cover were similar to the adjacent forest, and trees approached heights half of those in the adjacent forest. Results from this study will provide insight into the thresholds of vegetation regeneration which promote use of reclaimed well sites for different songbird species.

Evidence of Predation and Disturbance in Nesting Waterbird Colonies on a Louisiana Barrier Island System using Video Monitoring
Windhoffer, Eva - Nicholls State University; Aaron Pierce - Nicholls State University

Isles Dernieres Barrier Islands Refuge (IDBIR) in coastal Louisiana provides critical breeding habitat for numerous species of colonial nesting waterbirds. These islands are also inhabited by mammalian and avian species that have the p--otential to reduce overall waterbird breeding success, primarily through nest predation and disturbance. Nutria (*Myocastor coypus*) and Laughing Gull (*Leucophaeus atricilla*) are two primary species that are believed to affect the breeding success of waterbirds on IDBIR. In conjunction with in-situ nest monitoring, three video systems were deployed for the first time on East R-accoon Island to determine disturbances to nesting colonies and specific nest predators of Royal Tern (*Thalasseus maximus*) and Sandwich Tern (*Thalasseus sandvicensis*) during the 2015 breeding season. In addition, we also identify egg scavengers. Our video recordings indicated recurrent and oftentimes aggressive predation of tern eggs by nutria. Video footage (1,834 hours) revealed that nutria predation accounted for 42.3% of all recorded predation events and that nutria were the most common cause of disturbance. Laughing Gulls contributed the most to predation of tern eggs, accounting for 52.6% of all predation events. Ruddy Turnstones (*Arenaria interpres*) were the most common scavenger. To our knowledge, this is the first non-anecdotal evidence of nutria predation of bird eggs. Our video data from the 2015 breeding season illustrates the important effects that

nutria have on waterbird nesting success. Video monitoring for predation in Royal and Sandwich tern colonies will continue during the 2016 breeding season.

Hunting Behaviors and Foraging Success of Winter Irruptive Snowy Owls in New York

Winter, Russell - SUNY College of Environmental Science and Forestry

The snowy owl (*Bubo scandiacus*) is a charismatic raptor that exhibits irruptive movements to exploit unpredictable resources in the Arctic tundra. During irruption years, many owls migrate past the southernmost extent of their traditional wintering grounds and must adjust to entirely unfamiliar habitats. The conditions associated with these new habitats may impact aspects of snowy owl behavior, and may influence snowy owls' abilities to adapt to their wintering grounds during irruption years. I analyzed the hunting success, hunting behaviors, and diurnal activities of winter irruptive snowy owls in New York, USA, from January-March, 2015, and assessed how environmental factors (temperature, time period, cloud cover, snow depth, habitat type, etc.) influence snowy owl hunting success and behavior. I used an online citizen science resource, eBird, to locate snowy owls and I observed them from an automobile. Snowy owls were successful in 45.10% of 51 prey capture attempts. Adult owls were 30% more successful in capturing prey than were juveniles. Snowy owls used variants of the sit-and-wait technique to capture mammalian prey. Owls executed hunting attempts more frequently at low temperatures than at high temperatures. Snowy owl hunting activity peaked during the morning and late afternoon. Snowy owls were more successful in capturing prey at 50-100% cloud cover than at 0-50% cloud cover. All other environmental factors had no influence on snowy owl hunting success. When compared to previous studies, winter irruptive snowy owls were equally as adapted to their wintering grounds as were wintering snowy owls during non-irruption years.

Verdins recognize divergent songs: relating the window of recognition to life history in the only New World member of the Remizidae

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Understanding how animals recognize one another is fundamental to understanding processes such as speciation, social behavior, and interspecific interactions. In birds, song is often an important signal for recognition, and accordingly many species show a pattern of strong recognition of acoustically similar phenotypes and reduced recognition of dissimilar phenotypes. The range of song phenotypes that a bird recognizes as relevant to itself can be conceptualized as its "window of recognition." These windows are important evolutionarily, because animals should neither respond to every sound they hear (doing so would be costly), nor should they ignore sounds important for interactions with conspecifics. The verdin (*Auriparus flaviceps*) is a species that has 1) no nearby confusable heterospecifics—it is the only representative of its family in the New World, and 2) within-species variation in song and potentially high dispersal, such that individuals may encounter variable conspecific phenotypes that they would benefit from recognizing. Given these qualities, we expected verdin to have large windows of song recognition. We tested this hypothesis with a playback experiment in which we presented focal pairs with 1) acoustically similar conspecific songs, 2) acoustically divergent conspecific songs and 3) acoustically divergent heterospecific songs. We found that verdin did have a relatively wide window of recognition because they responded to acoustically

divergent conspecific songs, though not songs from Old World relatives. Overall, this work illustrates how both ecology and phylogenetic history influence how species recognize and respond to conspecifics.

Wild Horse and Burros on National Forest System Lands: Impacts and Opportunities for Management and Research

Woodward, Hope - USDA Forest Service

Free-roaming horse and burro populations and their progeny using National Forest System (NFS) lands on or after December 15, 1971 are protected under the Wild Horse and Burro Act. The USDA Forest Service (FS) manages approximately 5,800 wild horses and 700 burros on 35 active wild horse and burro (WHB) territories across the western United States (Arizona, California, Montana, Nevada, New Mexico, Oregon, and Utah) at an average annual cost of approximately $2 million. The Act requires that wild free-roaming horses and burros (WHB) be managed in a manner that is designed to achieve and maintain a thriving natural ecological balance on public lands. WHB herds grow by nearly 20 percent every year; territories with populations that exceed appropriate management level (AML) and/or are impacted by drought frequently experience degradation resulting in negative impacts to soil, plants, and wildlife habitat, as well as to the wild equids themselves. Recent policy decisions on greater and bi-state populations of sage-grouse underscore the need to protect sage-grouse and sensitive bird habitat from negative influences of grazing by free-roaming equids. Current management tools include removing excess animals for adoption and/or sale, fertility control, adjusting AMLs, and updating WHB management plans. Site-specific monitoring and research has been conducted on wild horse vegetation use and wildlife-wild horse interactions, and a comprehensive review of the science of wild horse management has been completed. This presentation explores use of new management tools and research opportunities that potentially could lead to improvements in wildlife conservation.

Differential Habitat Selection Behavior at the Periphery of an Expanding Songbird Population

Worm, Alexander - Arkansas State University; Diane Roeder - University of Oklahoma; Mike Husak - Cameron University; Than Boves - Arkansas State University

Avian distributions are dynamic with many factors influencing expansion or contraction of ranges. In light of global climate change, predicting future distributions is vital for the management and conservation of many species. To more accurately predict future ranges, we need to understand the variability of habitat selection processes among birds living within and outside of historical distributional ranges. Scissor-tailed Flycatchers have been expanding their breeding range over the past half-century, and it's unclear if individuals at the periphery are selecting for habitat similarly to those in the historic core, or how their respective decisions affect fitness. We tested the hypothesis that variation in habitat behavior may allow for successful range expansion. We compared multi-scale habitat selection and associated reproductive performance in both regions and found differing variables and directionality of similar variables in habitat selection and nest survival. Individuals breeding in the core selected for greater tree, scrub, and shrub cover, and lesser road cover and lower nest height. Individuals at the periphery selected for greater urban and grass cover and lower tree and woody-plant cover. Nest survival was equivalent in both regions, but shrub and forest cover was negatively related to daily nest survival in the core, while no habitat variable strongly influenced survival at the periphery. Our results support our

hypothesis; those individuals that are dispersing from the core are choosing different habitat features, resulting in similar reproductive fitness. These behaviors may explain the species current expansion into dissimilar habitats and may continue to facilitate future range expansion.

Anthropogenic predation risk and habitat structure interact to shape avian spatial decisions

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Prey individuals may display striking anti-predator responses to perceived risks, independent of the actual probability of prey mortality. These responses can vary remarkably between individuals exposed to an ostensibly similar magnitude of risk, begging the question of what drives individual variation in anti-predator responses. We use pheasant hunting to model the effects of variable predator behavior and habitat complexity on avian anti-predator responses, independent of the confounding effects of selection. Only male pheasants may be harvested, but female pheasants still experience predator cues from hunting, creating a model prey population whose behavioral responses to hunting must be due to variation in the risk environment, not to mortality from predators. We quantify prey anti-predator responses by recording female pheasant spatial decisions before and during the hunting season via radio and GPS telemetry. We map the fine-scale distribution of predator activity using time-lapse photography and GPS wristbands on hunting volunteers. We assess habitat complexity by measuring vegetation height, density, and functional group composition. We found that female pheasants responded to hunters by moving from spaces of high hunting activity to spaces of lower hunting activity. Female pheasants were less likely to leave spaces with tall vegetation, which also received less hunting pressure. These results indicate that habitat structure affects prey anti-predator responses by changing predator behavior and prey perceptions.

The Under-appreciated Undertail Covert: Swallow Identification by Contour Feathers

Wuenschel, Andrea - H. T. Harvey and Associates

Due to changing climate, technological advances, and recent government mandates, many more alternative energy facilities are being constructed. Because bird species are protected by the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and Endangered Species Act, companies that build and operate alternative energy facilities are required to monitor and document avian mortality. This is accomplished through avian fatality searches performed at regular search intervals. However, due to scavenging and decomposition, many carcasses are reduced to partial remains or scattered feathers by the time searchers find them, making them difficult to identify to species. Identification to species is crucial to determine if endangered, threatened, or special-status species are being impacted by these facilities, or if a specific species is more vulnerable at a particular facility. Few books and online identification guides to avian remains are available. Those that do typically focus on flight feathers, leaving out a wealth of information about species identification found from contour feathers. Underwing and undertail coverts have particular coloration and markings that are useful in the identification of many bird species, especially when combined with several remiges. To facilitate the identification of swallows (Family: Hirudinidae) from partial remains, characteristics of the contour feathers of six

swallow species commonly encountered in the United States are presented, complemented by a photographic guide created from museum specimens illustrating defining characteristics.

Diet Composition Shifts With Rainfall In Kirtland's Warbler Suggest that Predaceous Arthropods Are A Default Food Item During Winter Droughts

Wunderle, Joseph - International Institute of Tropical Forestry, USDA Forest Service; Patricia Lebow - Forest Products Laboratory, USDA Forest Service; Adele Powell - Oxford University; Stuart Bearhop - Exeter University; Sarah Rockwell - Klamath Bird Observatory; Jennifer White - International Institute of Tropical Forestry, USDA Forest Service; Dave Currie - International Institute of Tropical Forestry, USDA Forest Service; Dave Ewert - The Nature Conservancy, Michigan Chapter

Wintering Kirtland's Warblers (KW, *Setophaga kirtlandii*) feed on insects, spiders, and fruit in The Bahamas. To determine how the proportional contribution of different food items in KW diet varied with rainfall over four winters, we used a mixing model (SIAR) to estimate the proportional contribution of each diet item to blood carbon and nitrogen. Mean δ13C and δ15N values for each of five diet items including predaceous arthropods, herbivorous/omnivorous arthropods, and fruits of *Chiococca alba*, *Erithalis fruticosa*, and *Lantana involucrata* were used in the SIAR model to account for variation in C and N in the different sources. Using the proportion of a specified food item in each bird's diet as the response variable, we used a generalized linear mixed model (GLMM) to determine the effects of fixed factors of sex, age, and covariables days after 1 October and prior rainfall and a random factor (winter x site). The proportion of predaceous arthropods in KW diets decreased as rainfall increased during 60 to 120 days prior to sampling in contrast to the proportion of herbivorous arthropods, which never varied with rainfall. Rainfall always had a positive effect on proportion of Lantana fruits in the diet, but only in the prior 120 days for Erithalis fruits. As the winters proceeded, the proportion of fruit in the diet usually decreased, in contrast to the proportion of herbivorous arthropods, which always increased. Predaceous arthropods are the default food item in dry periods, but are likely insufficient for timely pre-migratory increase in body condition.

Tight and diffuse coevolution: Exploration of hummingbird beak and floral morphology.

Zvornicanin, Jasmin - Utica College; Chelsea Berns - Utica College

Here, I review the dogma that hummingbird bill and floral morphology represent tight coevolution. For years, observations of a close association between the two have been used as prime examples of coevolution. In fact, some flowers seem to have adapted an ability to reward specific pollinators by providing more nectar and pollen to those hummingbird species whose bill fits the form of its flower. Recently, now that we are capable of creating time-dated phylogenies, we can examine if hummingbirds arose at the same time as their coevolved flowers. Interestingly, research is finding that dates of origination for hummingbirds and their morphologically coevolved flowers are different. This is being presented as evidence that the two are not tightly coevolved and instead are an example of diffuse coevolution. Even if the morphology of a species of flower is closely coevolved with one species of hummingbird, the flower is still often pollinated by multiple sources, also suggesting a lack of sole reliance on just one specific pollinator. This begs the question of whether hummingbirds and their flowers fit the dogma of being tightly coevolved, and the answer likely lies in a complex interaction between numerous factors. My poster reviews a century of

research and presents future directions to explore the dogma of tight coevolution between hummingbird bill and floral morphology.