



# ABSTRACT BOOK

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# ORAL PRESENTATIONS

## **Coevolution in action: Defenses against brood parasitism in new and old hosts of the Eastern Koel**

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Avian brood parasitism is a model example of coevolution, yet measuring the rate at which coevolution takes place between a brood parasite and its host is difficult, as parasites rarely switch to completely naïve hosts. In Australia, the brood parasitic Eastern Koel (*Eudynamis orientalis*) recently switched to a new host, the Red Wattlebird (*Anthochaera carunculata*), providing a rare opportunity to observe coevolution in action. We compare the evolution of defenses in the new host with those of traditional hosts at two sites with different durations of parasitism by the koel: Sydney (~37 years) and Canberra (~7 years). Specifically, we test 1) which hosts have evolved the ability to reject foreign eggs, and 2) whether koels have evolved mimicry of host eggs. Model egg rejection experiments show that the traditional hosts are expert egg rejecters, whereas the new host has not evolved egg rejection at either site, indicating that 37 years of parasitism is insufficient time for egg rejection to evolve. However, wattlebirds in Sydney were significantly more likely to abandon their nests in response to disturbance than those in Canberra, which may be an early stage in the evolution of defenses. We used objective measures of color to determine if egg rejection by hosts has selected for egg mimicry in koels. Koel eggs from wattlebird nests in Sydney appeared more similar to Sydney wattlebird eggs than to the eggs of their traditional hosts or Canberra wattlebirds. This result is puzzling considering the lack of rejection response shown by wattlebirds, but could be a counteradaptation to nest abandonment by wattlebirds. This study provides important information on how quickly hosts and parasites can adapt, which can be used in fields such as conservation and speciation.

## **Effectiveness of predator guards on nest boxes for House Wrens**

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Predation limits reproduction and survival in many animals. Some bird species protect their eggs by laying them in cavities that prevent predators from accessing the nest. Nesting boxes are often used to increase the nesting opportunities for cavity-nesting birds, but they are susceptible to predators. I tested the effectiveness of three types of predator guards relative to a control (no predator guard): an extension of the entrance to prevent predators from reaching into the nest box, a tube which prevents predators from getting a grip on the pole, and a funnel which predators cannot proceed past. Thirty nest boxes of each type (control, extension, tube, and funnel) were distributed equally among a wooded area, a golf course, and a park (120 nest boxes total). Nest boxes had a 3-cm diameter entrance hole which allowed House Wrens (*Troglodytes aedon*) to enter, but excluded most other cavity-nesting species. House wrens attempted nests in all predator guard types equally. The tube predator guard had the greatest proportion of nests that successfully fledged at least one offspring; whereas, wrens nesting in control boxes were the least successful. An

unexpected finding was that some predators accessed nest contents by removing the lids and that this occurred most often in the boxes with the entrance extension. Future research should determine whether greasing the tube decreases predation further. This study demonstrates that predator guards are effective in reducing predation of nests in artificial cavities.

## **Monitoring the over-winter survival of Neotropical migrants in Mexico: History of the MoSI Program, and a plan for the future**

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The Monitoreo de Sobrevivencia Invernal (MoSI) / Monitoring Over-winter Survival Program is an international network of collaborators, whose members coordinate bird banding efforts in the northern Neotropics. Since 2002, the program has facilitated the participation of more than 200 stations in 15 countries. Mexico has had, by far, the longest participation and greatest number of stations. The MoSI network provides information on the population status of many migrant and Mexican resident species that are used to develop conservation strategies, and helps answer important questions such as: What factors influence the persistence of individuals during the winter? Where do we see the worst effects during the winter nesting? What factors intuit more about the population decline of certain species? What is the relationship between population changes related to climatic conditions and habitat loss? What can we do to reverse these declines? The MoSI program also helps train biologists from both the U.S. and Mexico, and has been a source of scientific and cross-cultural exchange. While vigorous and successful for over a decade, in recent years, the program has lost much participation, largely due to federal or NGO budget constraints on both sides of the border. However, scientists from the U.S. and Mexico are determined to revitalize MoSI. We will provide a brief history of the program, and a vision for moving MoSI successfully forward in the 21st Century.

## **Mapping and modeling lethal dehydration in desert passerines: Conservation and climate change implications**

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High temperature extremes have a variety of direct and indirect effects on birds, including large scale mortality. Dehydration is a major mechanism of heat-related mortality. With the frequency and severity of high temperature extremes increasing, it is important to understand where and when die-offs can be expected to occur. Here, we explore the dynamics and spatial patterns of current and future dehydration risk to desert passerines in the US Southwest. For a suite of seven passerines, we asked: What are rates of evaporative water loss (EWL) across range of temperatures? How frequently, over what areas, and at what intensity does dangerous dehydration occur? How does body size influence dehydration risk? And how will a warmer climate affect frequency and intensity of dangerous dehydration? We developed models of EWL and lethal dehydration risk from measured rates of EWL in heat-acclimated birds captured in the field. We then mapped and modeled the distribution and frequency of dehydration risk using the North American Land Data Assimilation System dataset for the period 1980-2013 at a 14-km spatial grain. We also explored the implications of a 4°C warming scenario, consistent with projections for 2070-2100. We found that

smaller-bodied birds, with higher mass-specific rates of water loss, are more susceptible to lethal dehydration. While milder dehydration conditions are frequently encountered in the US Southwest today, more intense conditions are extremely rare for larger bodied passerines and limited in spatial extent for smaller birds. The warming scenario produced dramatic increases in the frequency, extent, and intensity of dehydration. These results suggest a need for conservation professionals to consider the effects of hot extremes on desert birds and promote adaptive measures, including conservation of thermal refugia and the provision of water sources.

#### **A Mexican avian thematic network (MATNet) for conservation**

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Mexico with about 1,100 bird species is ranked worldwide 8th among top biodiversity countries, 14th due to its territory size, and 11th because of its population size. Currently, 296 avian species, and 96 subspecies are considered nationally at risk (10 species probably extinct), whereas 58 are considered endangered at international level; beside, 105 species are endemic and 300 are migratory. In order to preserve such biodiversity, the Mexican State has established a natural protected area (NPA) system that is encompassing about 15% of its surface; however, most of it is not federal or public land but common properties (ejidos and indigenous communities); their owners are among the poorest in the country. Under this scenario, challenges for bird conservation in Mexico are enormous. Science is considered one of the key elements for a successful conservation; nevertheless, nowadays it is not clear who, how many and where participants are active in avian conservation in the country; moreover, several conservation initiatives are disconnected. The Mexican Avian Thematic Network (MATNet) is a project that proposes to join the efforts of different actors (researchers, students, birdwatchers, academic institutions, NGO's, etc.) interested in avian conservation in Mexico; the main goal is to produce scientific information addressing the needs of bird (without disregarding the socioeconomic problems also involved); that is, to foster science-based conservation in Mexico. Consequently, MatNet encourages collaboration as well as exchange of knowledge and ideas among its members. MATNet is actually embracing actions on two main approaches: conservation based on areas, and conservation based on species. As one of its first international actions, MATNet has organized the symposium entitled "Bird conservation experiences in Mexico" to be hold in the 2015 AOU-COS Conference, in order to expose a sample of bird conservation efforts currently performed by individuals and institutions in that country.

#### **Recommendations to the proposed mitigation and compensation of the impact of the construction of the new international airport of Mexico City in the Important Bird Area Lake Texcoco**

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In 2014, the Mexican government announced the construction of the new international airport of Mexico City (NAICM) in Lake Texcoco, which is located northeast of the Valley of Mexico and represents the largest remnant of a lake (about 7% of the original surface) that once covered the region. Given the claim that the NAICM will not affect the biodiversity value of the zone and that wetland area will be duplicated as compensation, we assessed the ecological and conservation status, threats and management effectiveness of the zone using the Western Hemisphere Shorebird Reserve Network (WHSRN) evaluation guide as well as bird counts conducted from 1996 to present. Our evaluation indicates that the project is incompatible with bird conservation. However, if the plan continues, the following considerations should be acknowledged: the loss of a unique wetland (epicontinental soda lake) of international importance (recognized as IBA and WHSRN site); the project's incompatibility with land suitability and its conflict with the Federal Government's commitment to bioconservation; the need for a strict implementation of the Business and Biodiversity Offsets Program compensation/mitigation guidelines, provided that hardly any measurement would replicate/replace habitat loss of endemic species such as the Mexican Rail and Black Polled Yellowthroat, and other important populations of resident and migratory shorebirds and waterfowl; the need to maintain constant monitoring of wildlife and to make the information openly accessible; the need to review the environmental impact assessment, because it does not fully incorporate bird-aircraft strike hazards; and the need to enforce risk management for wildlife in the NAICM. In short, the NAICM project is discordant either with aquatic bird conservation and their habitat or with aviation safety; consequently, we recommend rethinking the conservation strategies and implement them in a way that bird-aircraft risk would be reduced, and truly compensate the 10,000 ha of bird habitat that will be lost.

#### **Development and application of an avian index of biotic integrity habitat model**

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The degradation of water resources and the associated riparian habitats continues to be a national concern for resource agencies. As a result, the restoration of aquatic ecosystems is one of the key missions of the U.S. Army Corps of Engineers (USACE). For USACE studies, the formulation of restoration measures and alternatives requires an assessment of existing and future conditions to quantify the changes in the ecosystem with and without the proposed ecosystem improvements. Because the quality and diversity of aquatic and riparian habitats have a direct influence on the population size and diversity of fish and wildlife communities, an Index of Biotic Integrity (IBI) model is often selected to quantify existing and future biotic conditions. Most existing IBI models were developed using aquatic invertebrate and fish species as indicator communities. For the Westside Creeks Ecosystem Restoration feasibility study, the Regional Planning and Environmental Center of USACE developed an IBI model specific to the avian communities of the Texas Hill Country. The resulting Avian IBI model was then used to quantify avian diversity with and without project conditions for study in the formulation of ecosystem restoration alternatives for the Westside Creeks project.

## **A review of the impacts of corvids on bird productivity and abundance**

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Corvids are often viewed as efficient predators capable of limiting prey populations. Despite this widely held belief, a comprehensive review quantifying the effect of corvids is lacking. We examine the impacts of crows, ravens and magpies on other bird species. We summarise results from 42 studies (arising from a systematic search in Web of Science), which included 321 explicit evaluations. We examined “abundance” and “productivity” parameters from both experimental and correlative studies. Negative impacts were more likely for productivity than for abundance (49% vs 8%). Experimental studies removing only corvids were less likely to show a negative impact on productivity than those removing corvids alongside other predators (14% vs 63%). This suggests that the impact of corvids is smaller than that of other predators, or that compensatory predation occurs. The impact of corvids was similar between different avian groups (such as waders, passerines and game birds; or ground-nesting and non-ground nesting species). Crows were more likely to have a negative impact on target species productivity than Magpies (58% vs 20%). We conclude that whilst corvids can have a negative impact on bird species, their impact was nearly 6 times more frequent for productivity than for abundance. These results suggest that in the vast majority of cases bird species are unlikely to be limited by corvid predation pressure and therefore that conservation measures may generally be better targeted at other limiting factors.

## **Behavioral and reproductive correlates of within-individual variation in testosterone levels in Eastern Bluebirds (*Sialia sialis*)**

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Within-individual variation in hormone levels can play an important role in how animals respond in social situations. In birds, hormones, such as testosterone, can mediate behaviors that can impact fitness (e.g., parental care and aggression). Many previous studies have examined the relationships between testosterone and behavior at the population level. Relatively fewer studies have examined endocrine traits at the individual level. In 2012 and 2013, we studied within-individual variation in testosterone in adult Eastern Bluebirds (*Sialia sialis*) within different behavioral contexts. As a parental context, we observed feeding behavior of adult bluebirds when nestlings were 5-7 days old. As an aggressive context, we conducted simulated territorial intrusions using a live House Sparrow (*Passer domesticus*) to elicit aggressive behavior in adult bluebirds when nestlings were 7-9 days old. Following parental care observations and territorial intrusions, we conducted gonadotropin releasing hormone (GnRH) challenges to quantify each individual's ability to produce testosterone. We first took an initial blood sample to determine circulating testosterone levels. We then administered GnRH, and took a second blood sample 30 minutes later to determine the change in testosterone in response to GnRH. Finally, we examined individual variation in circulating and GnRH-induced testosterone levels within parental care and aggressive

contexts. We discuss potential sources of within-individual variation in testosterone levels in bluebirds. By relating individual variation in responsiveness of endocrine traits to potential fitness-related traits, we may be able to gain insight into how endocrine traits respond to natural selection.

## **Migrating birds reorient towards land at dawn over the Great Lakes**

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Landbirds migrate at night and typically make landfall before dawn. Birds aloft over large water bodies at dawn must decide between continuing across water or returning to the nearest shore. We used three weather surveillance radars to observe migrating landbirds flying over the Great Lakes at dawn and measure their broad-scale distributions at the ground during stopover. We studied birds during four spring migration seasons from 2010-2013. The daily mean flight height of migrating birds over water at dawn was 240 m ( $p < 0.001$ ) above the concurrent flight height of birds over land. The flight direction of migrants at dawn was more directed towards the nearest shoreline than their flight direction at the peak of migration earlier in the night. Furthermore, birds over water at dawn shifted their flight direction a mean of an additional 11 degrees ( $p = 0.002$ ) more towards the shore when compared to birds concurrently flying over land. There was a 48% higher stopover density of birds within three km of near shores of lakes compared to far shores. There was a moderate positive correlation ( $r = 0.584$ ,  $n = 358$ ,  $p < 0.001$ ) between the seasonal mean density of birds aloft over water at dawn and the stopover density in adjacent shorelines. We conclude that birds over the water at dawn tend to return to stopover in nearside shorelines of the Great Lakes rather than continuing across water to farside shores. WWW

## **Songbirds conserved sites of MHC class I molecules reveal a unique evolution in vertebrates**

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Birds are considered dinosaurs that passed the 65 mya ago bottleneck. Songbirds (Passeriformes) include about half extant bird species (about 5000) and are generally the most air-thriving bird species, concordantly with their small size. MHC molecules present microbial peptides to start immune responses; they have seven conserved residues in all vertebrates from jawed-fishes, 300 million years ago, to humans, including chickens. All wild songbird species tested by us ( $n = 18$ ) and others ( $n = 2$ ) differ in a1 domain residue 10 and a2 residue 96 from all other vertebrates. Amplification, cloning and sequencing were performed by standard methods. Sequences alignment were done by using PAUP and MEGA programs software. Crystallographic studies were performed by using mammal and bird MHC molecules from MPID database and other sources and showed that these changes did not significantly vary the MHC class I molecule stability in songbirds. Further a1 and a2 domain comparisons by simple

Composition Distances and Bayesian Inference showed that songbirds overall MHC class I molecules are phylogenetically more separated from mammal than other birds molecules. These small birds have undergone a different evolutive pathway, than all other tested vertebrates and more terrestrial birds. Specific changes observed in songbirds have an entropic, stable solution similar to that reached by other vertebrates. Massive genome sequencing is not uncovering bird evolutionary and population genetics important questions; these must be specifically addressed by micro-DNA analyses.

#### **Understanding ecological drivers and natural disturbances: The key to effective grassland bird conservation, except when it isn't**

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In order to develop conservation strategies for grassland birds in different regions of North America, it is critically important to understand the ecological processes that originally sustained the species composition and structure of each type of grassland ecosystem. Unmanaged grasslands were sustained either by occasional disturbances or more continuous ecological drivers. The term "natural disturbance" accurately describes the pattern for grasslands in many forested areas of the continent where forest openings are ephemeral, while "ecological driver" is more appropriate for describing the ecology of persistent grasslands such as shortgrass prairies. Different types of disturbances or drivers, such as fire, grazing, seasonal flooding, and beaver activity, dominated in different grassland ecosystems. Misinterpreting the historical frequency, intensity, seasonality, and extent of these processes in particular grassland ecosystems can lead to inappropriate efforts at ecological restoration. Understanding these processes is less important when the goal is to sustain or restore cultural landscapes that support populations of grassland birds. In this case it may be more important to understand how agricultural intensification has led to population declines. In many parts of Europe grassland bird conservation focuses on managing populations in agricultural landscapes, often by providing financial incentives for farmers to use methods that enhance biological diversity at the cost of agricultural productivity. While restoring prairies, desert grasslands and coastal grasslands is a high priority for North American conservationists, a complementary effort to work with farmers and ranchers to preserve traditional cultural landscapes will also be important. Partnerships to preserve the life style, beauty and biological diversity of rural cultural landscapes are likely to find broad public support, including support from people who have little interest in preserving natural areas.

#### **Does blood hematology correlate with ectoparasite load and reproductive success in House Wrens?**

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Parasites have the potential to limit population growth. Infected hosts may have poor body condition, lower survival, or difficulty in successfully raising offspring. One of the first signs of infection may be altered white blood cell (WBC) expression as the immune system of infected hosts fights the pathogen. In this study, we looked for links among ectoparasites, WBC expression, and reproductive success in House Wrens (*Troglodytes aedon*), a species where blood-feeding mites are

common. In 2014, 120 House Wren nest boxes were monitored near Lima, OH. Blood was drawn from 96 adult House Wrens when nestlings were 4-10 days old, and analyzed for WBC count and type. After nestlings were fledged, the nest was removed and placed on a burlese funnel trap for mite extraction. A principal components analysis was used to summarize the four differentiated types of WBCs with two principal component scores. A high PC1 score indicated more heterophils but fewer lymphocytes, but was not related to any measures of reproductive success. A high female PC2 score, indicating more eosinophils and basophils, correlated with a smaller nestling tarsus. Eosinophilia and basophilia often result from parasitism, but mite load in the nest was not related to WBC counts or differentials (PC1 or PC2). For females, clutch size increased with a higher WBC count, regardless of type. Male hematology did not vary with ectoparasite load, clutch size or nestling size. These findings suggest that immune function of female House Wrens positively impacts clutch size and the size of offspring, but does not vary with ectoparasite load. Although WBC counts and differentials are commonly used in veterinary studies, this is one of the first studies to examine this aspect of physiology in wild birds in general, and House Wrens specifically.

#### **Breeding Biology of House Crow (*Corvus splendens*) at Hazara University, Garden Campus, Mansehra, Pakistan**

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Study on the nesting biology of the House Crow *Corvus splendens* was conducted at Hazara University, Garden Campus (125 acre), Mansehra during the 2013 breeding season (June to September). Details about nest locations, tree characteristics, nest and egg characteristics were recorded. Mean nest density of House Crow was 2.4 nests/ acre. Mean tree and nest height was 14.8±6.30 and 11.8±5.42m. Mean tree canopy spread was 9.5±2.48m. 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 was 15.6±1.52 and 13.3±1.15cm respectively. Nest depth and nest cup depth were measured 19.3±2.08 and 8.3±1.15cm respectively. Mean nest weight was 1.4±0.24 kg. Mean clutch size was 4.0 (ranged 1-6). Mean egg length was 38.6±0.69mm, breadth 26.0±0.69mm, egg volume 13.3±0.83cm<sup>3</sup> and egg shape index 1.42±0.83. Mean egg weight was 12.3±0.70g. Egg and nest success was calculated 55.1% and 69.0%. Hatchlings and fledglings produced per nest was 2.20 and 1.44 respectively. Main reasons for reproductive failures were unhatched eggs, poor nest construction, bad weather conditions and observer's disturbance.

#### **Occurrence and prediction of avian disease outbreaks in Kansas**

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There are a wide variety of diseases that affect migratory birds, including bacterial, viral, fungal, parasitic, and toxic (i.e. environmental contaminant). Of the diseases that affect migratory, wild birds, those of primary concern are avian cholera, avian botulism, duck plague, aspergillosis, West Nile, Newcastle disease, and avian influenza. Cause of outbreaks and

impacts of disease in wild bird populations are rarely studied beyond documentation of occurrence in terms of date, duration, species affected, and estimated number of individuals affected. There are few compiled databases of historical disease outbreaks at the state scale. In addition, for most states, a central disease reporting protocol does not exist, which leads to a lack of available historical knowledge of disease occurrence that could be used to predict and manage future outbreaks. For many avian diseases, certain environmental conditions are hypothesized to be necessary prior to the occurrence of epizootic events. Due to its location in the middle of the Central Flyway, Kansas provides critical habitat for breeding, migrating, and wintering migratory birds. Evidence from surveys and other accounts indicate that migratory birds are staging for longer periods in Kansas compared to historical duration, increasing the likelihood of increased impacts of disease outbreaks in the state. Preliminary analyses indicate that historical disease outbreaks in Kansas exhibit no discernable pattern relative to environmental conditions. However, given the increasing number and duration of migratory waterfowl staging in Kansas during migration, the likelihood of increasing number and severity of disease outbreaks will continue to elevate.

#### **Parental investment strategies in a polymorphic species with alternative reproductive strategies**

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The level of parental investment is a result of negotiations between pair members, where each balances the costs and benefits of current and future reproductive opportunities. These costs and benefits differ according to genotype and condition, as well as offspring "value." All of these factors contribute to familial conflicts between parents, as well as between parent and offspring. Here we examine parental investment in the polymorphic white-throated sparrow (*Zonotrichia albicollis*), a NA songbird that occurs in two genetic morphs that differ in plumage and behavior. White (W) and tan (T) morphs occur in both sexes and differentially invest in parental care. The morphs mate disassortatively creating two pair types (WxT and TxW) that differ in the amount and type of biparental care they provide. We investigated provisioning dynamics using detailed field observation, molecular assays of sex, morph, and parentage, as well as behavioral videos taken at the nest between days 1-6 post hatch. We hypothesized that, 1) overall competition (between pair members, between offspring and parents, and between siblings) would be lower in pairs with more biparental care, and 2) in more competitive environments, parents would differentiate amongst offspring based on sex and/or morph (i.e. genotype). Contrary to expected, our analysis shows that males made more feeding trips per hour than females. However, as expected, tan morphs provisioned slightly more than white morphs. The evolutionary implications of these and other investment strategies will be discussed. By focusing on a unique species, which not only varies in the extent of biparental care, but also exhibits a clear phenotypic and genotypic marker (i.e. morph) that is absolutely associated with variations in key breeding behaviors, we are able to tease apart the factors that likely contributed to the development and maintenance of biparental care.

#### **Genetic structure of a sapsucker hybrid zone**

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Hybrid zones, where two divergent taxa meet and interbreed, offer unique opportunities to investigate the evolutionary processes that contribute to reproductive isolation between closely related taxa. Red-naped (*Sphyrapicus nuchalis*) and Red-breasted Sapsuckers (*S. ruber*) hybridize along a narrow contact zone that stretches from northern California to British Columbia and are excellent models for investigating the evolution of reproductive isolation. Despite strong evidence of movement in the sapsucker hybrid zone, we still do not understand how movement has impacted the genetic structure of sapsuckers. To address how hybridization in sapsuckers has changed over the last 40 years, we used genetic data generated using genotyping-by-sequencing (GBS) data from specimens collected between 1970 and 2012. We sequenced a total of 193 contemporary specimens collected across the hybrid zone and 81 specimens from the historical hybrid zone, and generated 13,832 SNP loci. We used the program STRUCTURE to assess the genetic ancestry of each individual and the genetic structure of the hybrid zone through time. We were able to recover distinct genetic clusters that corresponded to the parental species. Within the hybrid zone, there were very few cases of F1 hybrids despite extensive genetic introgression. In areas where hybridization has been documented for many years, *S. ruber* ancestry was dominant, while in areas where hybridization is recent, *S. nuchalis* genetic ancestry dominated individuals. Comparisons of genotypes from individual collected in the 1970s to individuals collected in 2012 confirmed observations based on phenotypes of extensive hybrid zone movement, with a switch from both Red-naped and Red-breasted Sapsuckers to primarily Red-breasted Sapsuckers with backcross hybrids. Taken together with climate and behavioral data already analyzed, the genetic data provide new insight into the hybridization dynamics of this system.

#### **Breeding Bird Survey derived species distribution models drive habitat delivery in Nebraska's Rainwater Basin Joint Venture**

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The Rainwater Basin Joint Venture contains a variety of wetland, grassland, and riparian habitats. These habitats are estimated to support several million breeding landbirds. To help focus conservation delivery efforts for landbirds, the Rainwater Basin Joint Venture developed spatially explicit, Species Distribution Models for 15 priority species. These models were developed using stop level Breeding Bird Survey data and landcover data in a Geographical Information System. Once the Species Distribution Models were developed thresholds were established based on model statistics. These thresholds were used to identify those geographies that captured 95% of the observed occurrences. From these binary layers a set of Decision Support Tools were developed. These Decision Support Tools have been used to identify those tracts that if protected, restored, and/or enhanced have the greatest potential to maximize habitat for multiple priority species. These Decision Support Tools have been integrated with the Farm Service Agency's Common Land Unit field boundaries to complete a directed marketing campaign. The materials sent to

the eligible producers, with high priority tracts, highlighted the United States Department of Agriculture Programs and incentives that would be available to promote desired habitat conditions on working lands.

### **Sons do not take advantage of a head start: Parity in offspring sex ratios despite greater initial investment in male eggs in herring gulls**

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Skewed adult sex ratios sometimes occur in populations of free-living animals yet the proximate mechanisms, timing of sex-biases, and the selective agents contributing to skew remain a source of debate with contradictory evidence from different systems. We investigated potential mechanisms contributing to sex biases in a population of herring gulls with an apparent female skew in the adult population. Theory predicts that skewed adult sex ratios will adaptively lead to skewed primary sex ratios either to balance out the skew in the effective breeding population (Fisher 1958) or in response to environmental factors thereby increasing the fitness of the parents (Trivers and Willard 1973). Therefore, we expected to detect skewed sex ratios either at hatching or at fledging as parents invest differentially in offspring of different sexes. We sampled complete clutches (N = 336 chicks) at hatching to quantify potential skews in sex ratios by position in the hatch order, time of season, year, and nesting context (nest density), finding no departure from equal sex ratios at hatching related to any of these factors. Further, we sampled 258 chicks at near-fledging to investigate potential sex biases in survival at the chick stage. Again, no biases in sex ratios were recorded. Male offspring were favored in this population via greater maternal investment in eggs carrying male embryos and greater parental provisioning of male offspring which reached greater sizes by fledging. Despite these advantages, female offspring were equally as likely to fledge as male offspring. Thus, biased adult sex ratios apparently arise in the post-fledging and pre-recruitment stage in our population.

### **Assessing the effects of Hurricane Sandy on migratory bird stopover using weather surveillance radar**

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Hurricane Sandy was a Category 1 hurricane that made landfall in Brigantine, New Jersey on October 29th, 2012 when waterfowl migration typically begins in throughout the Mid-Atlantic region. We assessed the impact of Hurricane Sandy on migratory bird stopover distributions using weather surveillance radar data at six radars across the northeast US. We geo-referenced radar reflectivity collected at dusk to measure stopover densities on the ground. We then compared stopover density of birds between years before Sandy (2008 - 2011), immediately after the Sandy (2012), and two years following the storm (2013 and 2014) for the dates of October 29th - November 15th. Stopover density at areas closest to the storm path (< 150km) decreased by an average of 80% compared to areas farther from the storm track(>150km and <300 km), which doubled in stopover density by an average of 114%. To characterize stopover habitat use changes, we compared the proportional land cover composition at high

density use sites (i.e., where radar reflectivity was >1 SD above the mean) immediately after Sandy to baseline years. Land cover of high use sites after Sandy comprised of more developed (+10 %) and forested wetland (+3%) cover types, and less forest (-9%) and emergent wetland (-22%) cover types. Thus, birds (i.e., primarily geese) shifted to using more upland sites and areas farther from the coast in the weeks after the storm. Migrant distributions returned to baseline levels within two years.

### **Site-specific habitat and landscape associations of Rusty Blackbirds wintering in Louisiana**

Sinéad Borchert - Louisiana State University, Baton Rouge, LA, United States; Stouffer, Philip - Louisiana State University, Baton Rouge, LA, United States

The Rusty Blackbird (*Euphagus carolinus*) has earned fame in recent years as one of the fastest declining North American bird species, with a global population loss of as much as 95%. Causes of the decline are not completely understood, but high land cover change in the southeastern United States suggests that wintering habitat degradation may be a primary driver. To better inform management on critical wintering grounds, we surveyed 36 sites in Louisiana where Rusty Blackbirds had been known to occur to address occupancy, transience, ground cover habitat, and invertebrate biomass over four seasons. Rusty Blackbirds use a large area (~ 5 km<sup>2</sup>) while foraging on the wintering grounds, therefore management may also need to be targeted to larger spatial scales. We developed multi-season occupancy models that incorporated fixed landscape (600 m) covariates (land cover, cropland cover, soil hydrologic group) and dynamic site-specific (100 m) habitat covariates. Occupancy models containing floodplain forest, woody wetland, and wet leaf litter covariates were the best supported. Wet leaf litter was positively associated with site colonization and negatively associated with extinction. Unexpectedly for a supposed forested wetland specialist, occupancy probability was negatively associated with floodplain forest and woody wetland cover. However, percent covers of these habitat types had a significantly positive relationship with deep (> 5 cm) water cover in three of the four survey seasons, which likely made them too deep for Rusty Blackbirds to use. Rusty Blackbirds may benefit from management for shallowly flooded (≤ 5 cm) floodplain forest and woody wetland that can support high amounts of wet leaf litter on the ground's surface.

### **Body condition and survival throughout the annual cycle in tidal marsh sparrows**

Alyssa Borowske - , Colchester, Connecticut; Chris Elphick - University of Connecticut, Storrs, CT, United States

We evaluated body condition and within-season survival of male and female Saltmarsh (*Ammodramus caudacutus*) and Seaside (*A. maritimus*) Sparrows to test predictions related to reproductive investment theory. Saltmarsh Sparrows are non-territorial, both sexes engage in extensive multiple-mating, with no pair-bonds, and only females provide parental care. In contrast, Seaside Sparrows are territorial, socially monogamous, and exhibit bi-parental care. These differences in breeding strategies correspond to intra- and inter-species differences in types and degrees of reproductive investment. We tested the prediction that differences in parental care in male and female Saltmarsh and Seaside Sparrows lead to variation in adult survival and body condition during breeding and, potentially, during the winter. As predicted, females of both species had poorer body condition than conspecific males

during the breeding season. In each species, females also had poorer condition than males in the winter, suggesting non-lethal carry-over effects of reproduction. There was no difference in fat levels among male and female Saltmarsh and Seaside Sparrows during the winter. Yet, while males had significantly more fat during the winter than during breeding, females had similar levels of fat in both seasons. Despite the observed differences in body condition between males and females, we found no effect of sex, species, or body condition on the probability of apparent survival during the breeding season. Tarsus length was the best predictor of breeding survival, with, unexpectedly, the lowest probability of survival associated with the largest tarsus lengths. On the wintering grounds, we found no effect of sex, body size, or condition on survival, but found that Seaside Sparrows had lower apparent survival than Saltmarsh Sparrows. Comparisons of within-season apparent survival to published estimates of annual survival suggests that migration mortality is high, even in these short-distance migratory species.

### **The influence of plumage coloration on nesting behavior in Reddish Egrets**

Rebecca Bracken - Texas State University, San Marcos, TX, United States; M. Clay Green - Texas State University, San Marcos, TX, United States

Differences in avian plumage colorations can provide a unique opportunity to study behavioral variances in a single species. Foraging behaviors have previously been studied in the plumage dimorphic reddish egret (*Egretta rufescens*), but less is known about nesting behaviors and time budgets during nesting, and what differences exist between the two plumage morphs. Activity engaging in specific behaviors may vary temporally in response to fluctuations in daily temperature changes and nest predation by other avian species. It was predicted that there are distinct behavioral differences between the two plumage morphologies during the nesting season. We tested this hypothesis by developing an ethogram of nesting reddish egret behavior on Green Island, TX based on video recordings of active nests. Eight cameras were placed during the nesting season in 2008, four to observe white morph pairs and four to observe dark morph pairs. The videos were used to determine the hatching time intervals between the eggs at each nest, keeping in consideration the known time intervals for other Ardeidae species. Additionally, we compared the amount of time individuals engaged in each distinct behavior between daytime and nighttime, and between the two plumage morphs. Results from over 6,600 minutes of observation suggest that dark morphs leave nests unguarded for considerably longer lengths of time (mean = 14.03 minutes,  $s^2 = 9.15$  minutes) than white morphs (mean = 1.31 minutes,  $s^2 = 0.69$  minutes) while white morphs switch off parental care more frequently. Egg hatching times were determined to be shorter on average, and closer together, than other Ardeidae species. We are currently analyzing additional time from the nesting periods to more fully explore the relationship between daily changes in temperature and predation, and changes in nesting behaviors, for each plumage morph.

### **Determining relative stopover duration for migrating forest birds by integrating ground surveys and weather radar observations**

Jeffrey Buler - University of Delaware, Newark, DE, United States; Deanna Dawson - USGS, Laurel, MD, United States; Jaclyn Smolinsky - University of Delaware, Newark, DE, United States; Timothy Schreckengost - University of Delaware,

Newark, DE, United States; Matthew Boone - University of Delaware, Newark, DE, United States; J. Andrew Arnold - Old Dominion University, Norfolk, VA, United States; Eric Walters - Old Dominion University, Norfolk, VA, United States

Identifying important stopover sites is a critical step in development of comprehensive conservation plans for migratory landbirds. Assessments from radar-based measures of the relative use of sites by migrants would be enhanced if sites could also be classified by their ecological function. Measuring the mean stopover duration of individual migrants over the course of a season can help determine a site's general functional type. However, traditional approaches using mark-recapture methods via mist-netting require intense sampling effort and thus can only be applied at few sites. We present an alternative approach to estimate relative stopover duration across many sites, integrating mean daily migrant densities from ground surveys and radar measures of mean daily emigrant exodus densities. We apply this approach using data collected during the autumns of 2013 and 2014 along bird survey transects in 26 forest sites and by two NEXRAD radars within Delaware and Virginia. Generalized Additive Model analysis revealed that stopover duration decreased near the coastline, with greater amount of forest cover at local and landscape scales, and with greater abundance of insects in the understory. Thus, coastal areas appear to function as quick rest stops for autumn migrants. Migrants appear to quickly refuel within forested areas where food is abundant and stay the longest at sites away from coasts with little food or forest cover. This approach could be used to retrospectively derive relative stopover duration estimates from past migration monitoring efforts and potentially be validated with long-term banding station data.

### **Vigilance copying in European Starlings**

Shannon Butler - Purdue University, West Lafayette, IN, United States; Claire Hosinski - Purdue University, West Lafayette, IN, United States; Esteban Fernandez-Juricic - Purdue University, West Lafayette, IN, United States

A long standing question in behavioral ecology has been how birds modify their vigilance and foraging patterns relative to group members. Many have examined how birds modify their head-up vigilance and head-down foraging bouts in relation to other group members. However, no one has examined the patterns of lateral scans (i.e. scanning side to side while head-up vigilant). Though birds tend to have a wide visual field, they cannot see 360° around their head, which imposes a constraint on the amount of information that can be gathered from conspecifics and the environment. On one extreme, birds could direct their lateral scans either towards each other, in similar directions (i.e. synchronizing lateral scans), maximizing the amount of social information, but sacrificing the total visual coverage of the group due to an overlap in the locations of their visual fields. On the other hand, birds could direct their lateral scans in opposite directions, away from each other (i.e. coordinating lateral scans), maximizing the personal information gained from the environment, but inhibiting the ability to monitor each other. We hypothesized that since synchronizing lateral scans facilitates conspecific monitoring, animals that value social information highly will synchronize their lateral scans rather than coordinate. We examined this trade-off in European starlings (*Sturnus vulgaris*), a highly social passerine. We predicted that starlings would tend to synchronize their lateral scans to facilitate conspecific monitoring. Contrary to our predictions, we found that



starlings neither synchronized nor coordinated their lateral scans. However, patterns of scanning were not independent of their neighbor either: starlings tended to engage in a lateral scan sooner after their neighbor initiated a scan than predicted by chance, suggesting that starlings mimic the timing of lateral scans of their neighbor, which could serve as a mechanism to transmit information about perceived risk throughout a flock.

#### **Group composition and dynamics in American Crows**

Carolee Caffrey - University of California, Los Angeles, CA, United States; Charles C. Peterson - Joshua Tree, CA, United States

Breeding pairs of American Crows (*Corvus brachyrhynchos*) in Stillwater, OK, lived with 0-10 auxiliaries in territories distributed throughout public, campus, commercial, and residential areas. Unpaired crows moved easily among groups throughout the year, but commonly did so during the two months or so preceding the onset of nesting across the population, and the week or so preceding hatching within groups. In 2001 and 2002, pre-hatch group size ranged from 2-10 (mean = 4.5 in both years), and auxiliaries included a male sibling, and social and genetic offspring, step-offspring, half-siblings, and unrelated immigrants of both sexes, ranging in age from 1 to at least five years old. Twenty nine percent of auxiliaries dispersed out of groups at hatching (for half, only temporarily), including all females unrelated to female breeders. Post-hatch groups were smaller (size = 2-6, with means of 3.7, in both years) and different in composition than pre-hatch ones: whereas post-hatch male auxiliaries included a sibling, half siblings, and unrelated immigrants in addition to social and genetic sons, all post-hatch female auxiliaries were the social and genetic daughters of female breeders, and all but one (the same individual in both years) were also the social and genetic daughters of male breeders. Crows in Stillwater delayed breeding for one or more years beyond sexual maturity, despite the availability of space and members of the opposite sex. Individual dispersal decisions by unpaired crows, and the behavior of paired territory owners, did not follow patterns described for other cooperative breeders. I'll discuss some aspects of the lives of crows that exemplify the complex and benign nature of this population's society.

#### **Diversity waiting in the wings: A long-term study of avian malaria in a Neotropical migratory passerine**

Paul Callo - Mary Baldwin College, Lyndhurst, VA, United States

The prevalence of avian malaria was determined for a population of Red-eyed Vireos (*Vireo olivaceus*) at the Hemlock Hill Biological Research Station in Pennsylvania between 1999 and 2012. PCR analysis of parasite mtDNA determined that an average of 86.5% of male REVs in this population were infected across all years surveyed, and in 2011 all males tested positive. DNA sequencing recovered thirty-one unique parasite lineages (*Paraheamoproteus*) with approximately ten lineages present in each year. The population of parasites in this system is dominated by the recurring presence of two major lineages (28.8% and 27.2% of all infections) and two minor lineages (7.5% and 7.5% of all infections) that are present in all years. The consistent presence of these four lineages over 13 breeding seasons indicates that tolerance is the mechanism by which REVs cope with infections by avian malaria. Of additional interest is the ever changing assemblage of rare lineages in this population. On average an additional six lineages are present each year. While most of these changed from one sampling period to the next, one lineage appeared in 2007 and persisted

in the population from that point on. This suggests that the population of parasites can be "invaded" by novel haplotypes.

#### **Distinguishing noise from signal in patterns of genomic divergence in a highly polymorphic avian radiation**

Leonardo Campagna - Cornell University, Ithaca, NY, United States; Ilan Gronau - Efi Arazi School of Computer Science, Herzliya, Israel; Luís Fábio Silveira - Universidade de São Paulo, Sao Paulo, Brazil; Adam Siepel - Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, United States; Irby J. Lovette - Cornell University, Ithaca, NY, United States

Recently diverged taxa provide the opportunity to search for the genetic basis of the phenotypes that distinguish them. Genomic scans aim to identify loci that are diverged with respect to an otherwise weakly differentiated genetic background. These loci are candidates for being past targets of selection because they behave differently from the rest of the genome that has either not yet differentiated, or that may cross species barriers through introgressive hybridization. Here we use RAD sequencing in combination with whole genome sequencing to explore patterns of genomic divergence among six species of southern capuchino seedeaters, a group of recently radiated sympatric passerine birds in the genus *Sporophila*. For the first time in these taxa, we discovered a small proportion of markers that are differentiated among species. However, when assessing the significance of these signatures of divergence, we find that some aspects can be replicated for a random grouping of individuals. A detailed demographic inference indicates that genetic differences among *Sporophila* species could be the consequence of neutral processes, which include a very large ancestral effective population size that accentuates the effects of incomplete lineage sorting. As these neutral phenomena generate genomic scan patterns that mimic those of markers involved in—or linked to—speciation and phenotypic differentiation, they highlight the need for caution when ascertaining differentiated markers between species. We propose simple controls to distinguish signal from noise in these cases and discuss the generality of our findings and the implications of different demographic processes in the context of the evolution of the southern capuchino radiation.

#### **Using target-capture to resolve gene tree discordance in an Indopacific genus: Readdressing paraphyly in the Spiderhunter (Nectariniidae: *Arachnothera*) phylogeny**

Luke Campillo - University of Kansas, Lawrence, KS, United States; Rob Moyle - University of Kansas, Lawrence, KS, United States

Spiderhunters (Nectariniidae: *Arachnothera*) are forest dwelling birds found from India to the Philippines. Recent molecular phylogenetic work has increased the number of recognized spiderhunter species and clarified many taxonomic relationships, but also questioned monophyly of this distinctive genus. In order to better assess phylogenetic relationships of spiderhunters and investigate gene tree discordance reported in previous studies, we used target-capture methods (ultraconserved elements) and next generation sequencing to produce a robust phylogenomic data matrix. Analysis of these data unequivocally supported monophyly of *Arachnothera* as traditionally delimited. Although we analyzed more sequence data than any previous study on the group, we still recovered some gene tree discordance within *Arachnothera* as well as gene tree discordance at a number of loci among the larger sunbird clade, most likely due to rapid diversification resulting

in incomplete lineage sorting. However, our estimation of the phylogenetic relationships within Spiderhunters resulted in a single, highly supported species tree topology across multiple species tree inference methods (STAR, STEAC, NJST & MPEST). Sanger sequencing datasets used in phylogenetic studies of this genus have relied on a limited number molecular markers and thus lacked the inferential power to produce unanimous species tree topology due to gene tree discordance. Target-capture methods have allowed us to recover thousands of orthologous loci throughout the genome and thus we have been able to unambiguously infer the phylogenetic relationships of Spiderhunters. In this talk, I will discuss how inferring phylogenies from molecular data produced using Sanger methods to sequence a small number of loci can lead to highly supported but paraphyletic species tree estimations and how next-generation sequencing technologies can be used to resolve gene tree/species tree discordance.

### Space use by nonbreeding Lesser Prairie-Chickens

Samantha Robinson - Kansas State University, Manhattan, KS, United States; Reid Plumb - Kansas State University, Manhattan, KS, United States; Joseph Lautenbach - Kansas State University, Manhattan, United States; David Haukos - U.S. Geological Survey, Manhattan, KS, United States; Scott Carleton - U.S. Geological Survey, Las Cruces, NM, United States; Andrew Meyers - New Mexico State University, Las Cruces, United States; Jonathan Reitz - Colorado Parks and Wildlife, Lamar, CO, United States.

The use of space by a species is integral to understanding the absolute area required for subsistence, but can also aid in the understanding of population drivers. Conservation of the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*), which was recently listed as threatened on the Endangered Species List due to range-wide declines, requires a better understanding of space use. Additionally, the nonbreeding season is understudied, but necessary for a deeper understanding of habitat use and movement. Research was conducted in three of the five states that Lesser Prairie-Chickens are found (Kansas, Colorado and New Mexico). Each state represented portions of different ecoregions (Mixed-Grass Prairie, Shortgrass/CRP Mosaic Prairie, Sand Sagebrush Prairie, and Sand Shinnery Oak Prairie). Males and females were trapped on leks and marked with GPS satellite transmitters. The nonbreeding season was classified as 15th September to the 15th of March, in 2013-2014 and 2014-2015. Overall non-breeding season home ranges were calculated using Brownian Bridge Movement Models, and compared using ANOVA between ecoregions and years. Additionally, variation in monthly home ranges was assessed. Resource Utilization Functions were used to test whether distance to lek or lek density explained or constrained space use across the range. Preliminary analyses indicate that within states, home ranges do not differ in size between sites; however, birds used more space in the early and late nonbreeding season. Differences in space use and ecological drivers among ecoregions are crucial to efficiently manage this species that occupies such starkly different regions.

### The hazard of nesting in a hail-prone area for shortgrass steppe birds

Amber Carver - University of Colorado Denver, Denver, CO, United States

Extreme hail events may strongly impact avian nest survival. However, occurrence of these events is not captured well

through temperature and rainfall data. My goal was to identify a dataset that would account for observed patterns in nest failure resulting from an intense storm that occurred during my field season in 2014. My project involved monitoring nests of ground-nesting shortgrass steppe passerines in northeastern Colorado. On June 22nd, between 2100 and 2400 UTC, a storm generating large-diameter hail passed over my study area, leading to the failure of 66% of known nests in my area, along with the death of many adult birds. This discrete event had minimal impact on an adjacent study area where another team was monitoring nests using the same protocol. Each study area has an extent of about 12 km<sup>2</sup>, and they are separated by <700 m at the closest point. Although the storm caused high mortality, nest survival models including rainfall and temperature were not well-supported by the data. Overlaying NOAA WSR-88D data on nest locations revealed that base reflectivity measurements were strong predictors of nest failure. Between 2213 and 2225 UTC, a series of >60 dBZ measurements were recorded directly over my study area, with primarily <60 dBZ on the adjacent study area. This highlights the potential impact of extreme weather on breeding birds and suggests that large-diameter hail events are more important to nest survival than rain events. A hail event may be limited in extent but cause high mortality within the area that it covers, far exceeding the impact of heavy rainfall events covering a broader area. The inclusion of NEXRAD data may improve nest survival models for bird populations breeding in hail-prone areas.

### Why come back home? Investigating the factors that influence natal philopatry in migratory passerines

Jenna Cava - University of New England, Biddeford, ME, United States; Noah Perlut - University of New England, Biddeford, ME, United States; Steven Travis - University of New England, Biddeford, ME, United States

Natal philopatry is choosing to breed at or near an individual's place of origin. Knowledge of which cues attract natal dispersers back to natal areas is important for conservation because they could be used to attract breeders to good habitat and discourage breeders from settling in poor habitat. We examined the influence of intrinsic and extrinsic variables on short-distance natal dispersal and field philopatry in two obligate grassland bird species breeding in an agricultural landscape: the Bobolink (*Dolichonyx oryzivorus*) and Savannah Sparrow (*Passerculus sandwichensis*). During 2002-2014 we detected 90 Savannah Sparrow and 129 Bobolink natal dispersers (mean±SD dispersal distances: Savannah Sparrows 917 ± 851m; Bobolinks 1,251 ± 839m). For both species, breeding field identity best explained variation in natal dispersal distance. Natal dispersal distance was partially heritable for Savannah Sparrows ( $h^2=0.153 \pm 0.087$ ), but there was no detectable heritability for Bobolinks. Of the dispersers detected, 35 (39%) Savannah Sparrows and 27 (21%) Bobolinks were philopatric to their natal field. The probability a Savannah Sparrow was philopatric increased as fledge date increased, while the probability decreased if there was an opposite-sex relative present or the field was under a late-hay management scheme. None of the variables considered explained variation in Bobolink natal philopatry. Natal philopatry and short-distance natal dispersal in these species appear to be influenced by factors humans cannot easily manage. Breeding field identity explained the most variation in dispersal distance, so further study of the conditions of habitat patches chosen as breeding sites may identify attractive

dispersal cues that could be managed for landscape conservation plans.

#### **Patterns of extraterritorial foray behavior, extra-pair mating and paternity in the Field Sparrow (*Spizella pusilla*)**

Antonio Celis-Murillo - University of Illinois at Urbana-Champaign, Champaign, IL, United States; Thomas Benson - University of Illinois at Urbana-Champaign, Champaign, IL, United States; Jeffrey Brawn - University of Illinois at Urbana-Champaign, Urbana, IL, United States; Wendy Schelsky - University of Illinois at Urbana-Champaign, Champaign, IL, United States; Michael Ward - University of Illinois at Urbana-Champaign, Urbana, IL, United States

Paternity studies have revolutionized our view of avian mating and reproductive systems, however, very little research has focused on understanding the behavioral mechanisms used by males and females to acquire extra-pair matings, how these behaviors vary among individuals, and the relative contribution of such behaviors to an individual's overall reproductive performance. One mechanism to obtain extra-pair copulations is extraterritorial foray behavior, where an individual moves off territory to search for extra-pair mates. Extraterritorial foray behavior, however, is not well studied, in part because of the logistical difficulties of following birds over large areas and long time periods, including nocturnal periods. Our research is using automated radio-telemetry to examine individual patterns of foray behavior in male and female Field Sparrows (*Spizella pusilla*). Specifically, individual's foray rate, distance traveled during forays, time during forays and temporal timing of forays (diurnal vs. nocturnal). These data is combined with data on individual's age, song performance, morphology, extra-pair mating and paternity data to provide insights into proximate and ultimate factors underlying foray behavior. Our preliminary data demonstrates that both males and females conduct short- and long-distance forays (up to 830 m). Males conduct forays during the day and night, while females conduct forays only during day. We also have found individual differences in foray behavior, where some individuals tend to stay within their territory (possibly mate guarding) while others make frequent forays. Variation in foray behavior appears to be linked to male individual phenotypic traits, e.g., birds with small tarsus foray more during the night, while birds with longer tarsus tend to foray more during the day. Our study, in addition to provide insights into proximate and ultimate factors behind foray behavior, yields novel insights into why animals seek extra-pair mates and into alternative mating tactics.

#### **Effect of flower quantity and area of flower distribution in hummingbirds territorial behavior**

Edgar Chávez-González - Universidad Autónoma del Estado de Hidalgo, Pachuca de Soto, Hidalgo, Mexico; Raúl Ortiz-Pulido - Universidad Autónoma del Estado de Hidalgo UAEH, Pachuca de Soto, Hidalgo, Mexico

For hummingbirds, a territory is a limited space where the owner restricts the use of flowers by others hummingbirds. Because hummingbirds need nectar from individual flowers to survive, flower density has been considered an important determinant of hummingbird territorial behavior. However, until now no one has examined the potentially independent effects of the overall quantity of flowers and the spatial distribution of flowers on the territorial hummingbird behavior. We monitored four hummingbird territorial behaviors (calls, attacks, pursuits and site occupancy) in

response to experimental arrangements of artificial flowers that varied in the total number of flowers and the spatial density of flowers. Our observations were assessed in relation to both the overall humminbird community and individual species. At the community level, two behaviors, call and pursuit, were positively related to flower number; whereas pursuit was related to the interaction between flower number and spatial density. At the species level, the Broad-billed Hummingbird (*Cynanthus latirostris*) showed a positive relationship between site occupancy and the number of flowers. Our results suggest that in hummingbirds, the quantity of flowers is a better predictor of hummingbird territorial behavior than flowers distribution.

#### **Thirty-year dynamics of tidal flats and land reclamation in the coastal zones of Shanghai and Jiangsu, China**

Ying Chen - University of Oklahoma, Norman, OK, United States

Tidal flats play a critical role in biodiversity and ecosystem services in coastal zones. In some parts of the world, tidal flats are under threat from land reclamation efforts, river sedimentation, and sea-level rise. We report 30 years (1984-2014) of spatial-temporal dynamics of tidal flats in the coastal zones of Shanghai and Jiangsu province of China, which differ substantially in their patterns of land reclamation and river sedimentation over the past three decades. With escalating reclamation, tidal flats in Shanghai have undergone only slight erosion due to large natural sediment inputs and effective artificial siltation due to dredging. However, tidal flats in Jiangsu have continuously declined over the past 30 years. These results highlight the need for better planning and management of tidal flats and land reclamation in coastal zones. As 30-years of Landsat images are now available, this pilot study has demonstrated the potential of developing and applying automated algorithms to map tidal flats across the coastal zones of the world.

#### **Patterns of spring and fall migration observed along the US east coast using weather radar: Impacts for wind energy**

Phillip Chilson - University of Oklahoma, Norman, OK, United States; Evan Adams - Biodiversity Research Institute, Portland, ME, United States; Kate Williams - Biodiversity Research Institute, Portland, ME, United States; Jeffrey Kelly - University of Oklahoma, Norman, OK, United States

We examine the utility of using NEXRAD data to investigate and monitor offshore avian migration during spring and fall along the Atlantic coast of the United States. Mosaicked composite reflectivity (CREF) data were used for the study with an emphasis on data from six NEXRAD sites in Upton, NY, Philadelphia, PA, Dover, DE, Wakefield, VA, Morehead City, NC, and Wilmington, NC. For each radar site we observed radar reflectivity data for 24 fixed locations, which were positioned at 30, 60, and 90 km from the radar. Data were examined over four years (2010-2013) for the months of May (spring) and September and October (fall).

The 144 locations were located over both land and water. After controlling for biases in measured levels of migratory activity, we found that there was much more migratory activity offshore in fall than in spring. In fall, there was no significant difference in migratory activity at offshore vs. terrestrial sites across the study area, suggesting that migration over open water areas may be quite common in the mid-Atlantic during this season. There were high levels of daily variation in activity at our study sites, related in part to wind conditions, which had variable effects on onshore vs. offshore migratory activity by latitude

and season. However, some offshore areas had consistently higher predicted activity levels, most notably the New York Bight (south of Long Island) and offshore of North Carolina. These findings suggest that NEXRAD data may be useful for monitoring migratory activity in offshore areas, and that the potential for interactions between migratory birds and offshore wind energy development along the Atlantic coast may be highest in certain locations, time periods, and weather conditions.

### **Severe weather impacts on birds: Past, present, and future**

Jeremy D. Ross - Sutton Avian Research Center, Bartlesville, OK, United States; Eli S. Bridge, Oklahoma Biological Survey, University of Oklahoma, Norman, OK, United States

Using weather radar to monitor the response of birds to abrupt natural hazards, numerous studies have addressed the important question of how biological species are impacted by seasonal variability, climate change, urbanization and land use effects, and other relatively slowly evolving processes. However, far fewer investigations have considered how animals respond to abrupt natural hazards: earthquakes, severe weather, flash floods, tidal waves, and so forth. This is due in part to challenges involved with being able to deploy appropriate instrumentation to observe wildlife under these conditions. However, one can utilize existing networks of instruments, which provide data with the needed spatial and temporal resolution. As we discuss, operational weather radars can be used in this regard. Indeed, our ability to discriminate between weather and biological entities is being significantly enhanced through dual-polarimetric radar capabilities. As dual-polarimetric weather radars become more common, we should be considering how to better utilize these instruments beyond just weather observations. Here we present and discuss two examples of how weather radar can be used to observe biological response to sudden natural phenomena, namely the sudden mass movement of birds initiated by earthquakes and severe weather. Observational data from several weather radars, including those with dual-polarimetric capabilities, are used to quantify these biotic responses. Supplemental data from terminal Doppler weather radars, surface meteorological stations, seismometers, and other sources are also included in the discussion. The primary objectives of the presentation are to i) discuss the utility of weather radar data for biological studies, ii) demonstrate how these data provide insight into the response of animals to abiological drivers, iii) examine how dual-polarimetric radar data can be used to discriminate between scatter from biological entities and weather, and iv) explain why such observations are important for both meteorologists and biologists.

### **Using weather radar to monitor the response of birds to abrupt natural hazards**

Phillip Chilson - University of Oklahoma, Norman, OK, United States; Victoria Ford - University of Oklahoma, Norman, OK, United States; Alexander Broom - University of Oklahoma, Norman, OK, United States; Eric Jacobsen - University of Oklahoma, Norman, OK, United States; Jeffrey Kelly - University of Oklahoma, Norman, OK, United States

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### **VertNet: Advances in biodiversity discovery and data quality improvement**

Carla Cicero - University of California, Berkeley, CA, United States; Carol Spencer - University of California, Berkeley, CA, United States; David Bloom - University of California, Berkeley, CA, United States; Michelle Koo - University of California, Berkeley, CA, United States; Robert Guralnick - University of Florida, Gainesville, CA, United States; John Wieczorek - University of California, Berkeley, CA, United States; Laura Russell - University of Kansas, Lawrence, KS, United States

Rapid access to biodiversity data resources is crucial for studying the impacts of global change. Over the past 15 years, such data on birds have been increasingly accessible through distributed data networks such as ORNIS and eBIRD. VertNet is a project funded by the National Science Foundation to create a cloud-based platform for vertebrate biodiversity records. VertNet works with a large community of vertebrate collections to mobilize their data online. Since its inception, VertNet has grown to include 183 institutions with 548 collections (birds as well as mammals, amphibians, reptiles, fish), and has published more than 166 million species occurrence records (including 150M from eBird) that are made available to other aggregators such as the Global Biodiversity Information Facility (GBIF) and Integrated Digitized Biocollections (iDigBio). In addition to data publishing, VertNet strives to catalyze critical innovations in biodiversity data standards, cloud-based data publishing, data reporting, and—most needed for research use of records—data quality. We will present an update on VertNet and its services, including data cleaning and issue tracking. Furthermore, we will discuss the challenges of maximizing data quality from diverse data sources, and will highlight the importance of high standards during data capture in the field or from museum records. We will stress the value of high quality data for maximizing the scientific impact of VertNet on the study and conservation of birds.

## **"Harmonic hopping" and non-linear evolution of sounds made by the tails of Allen's and Calliope Hummingbirds**

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Male hummingbirds in the genus *Selasphorus* produce sounds with their tail-feathers during a dive display. On most branches of the phylogeny, dive-sounds tend to evolve gradually (linearly), with small changes in tail morphology producing small changes in sound pitch. However, there are certain branches where this linear model is clearly wrong, and instead, small changes in feather morphology are associated with large changes in the sound production mechanism. I describe experiments that show how this has happened both on the branch leading to Calliope Hummingbird (*S. calliope*) and Allen's Hummingbird (*S. sasin*). Ancestral character state reconstruction shows that the ancestor *Selasphorus* produced low-pitched buzzing sounds via fluttering of tail feather R2. Calliope now produces sound with collisions between fluttering tail-feathers, while Allen's Hummingbird produces sounds via flutter of both feathers R3 and R4. I develop a 'source-filter' model of how a feather that generates sound (source) can incorporate neighbors (filters) that then may become sources. Experimental evidence supports this model, and the model provides an explanation as to how sound has evolved in the ancestor of Allen's Hummingbird. Specifically, sound production must have evolved via "harmonic hopping", in which the dominant frequency jumped from a 1 kHz 1st harmonic to a 2 KHz 2nd harmonic, without passing through the intermediate frequencies. Models of evolution often assume traits evolve gradually. In this instance, understanding the mechanism reveals that fundamental frequency often evolves gradually but on certain branches, evolves in a 'punctuated' fashion instead.

## **Harlan's Hawk, a subspecies of Red-tailed Hawk? Or not?**

William Clark - Unaffiliated, Harlingen, TX, United States

Harlan's Hawk was described by Audubon as *Buteo harlani*, based on a specimen he collected in Louisiana during the winter of 1830. The specimen, now in the British Museum, was a dark-morph adult and had a gray tail. This taxon has been deemed twice by the American Ornithological Union (AOU) check-list Committee (1892 & 1972) to be a subspecies of Red-tailed Hawk (*Buteo jamaicensis*), neither time with any taxonomic justification. In 1944 it was again deemed by this Committee to be a species, with references given to justify this decision. I will discuss these taxonomic decisions, as well as some of what I have learned about this interesting buzzard in many years of field and museum study. Specifically, that it differs consistently in five characters from Red-tails and that light-morph (but not dark-morph) adult Harlan's are interbreeding with Red-tails over a large area of western Canada. Such interbreeding in itself does not imply that Harlan's Hawk is its subspecies, as Red-tailed Hawks have interbred with four other *Buteo* species. I will briefly discuss several papers used to support Harlan's being a Red-tail subspecies and why their justifications are not convincing. I will present a possible scenario for its evolution from Red-tailed Hawk. Finally, I will discuss the criteria for assigning species rank used by the British Ornithological Union; the AOU lacks such criteria.

## **Sizes of breeding groups of Harris's Hawk in southern Texas**

William Clark - Unaffiliated, Harlingen, TX, United States

Harris's Hawks in Texas breed mostly as pairs, according to the only study of breeding Harris's Hawks (*Parabuteo unicinctus*) in Texas published in a peer-reviewed journal. This differs from breeding groups reported in Arizona and New Mexico that average more than two. Author reported that 18 of 19 breeding groups consisted of two adults in west Texas; he did not discuss or consider nest helpers. Another Texas study, as reported in a PhD Thesis, found a few instances of extra adults and one case of nest helper. However, in southern Texas for more than 10 years I had regularly encountered many groups composed of three to seven individuals all through the year; others have also published large groups. I regularly capture two adults of the same sex together and three to four Harris's together, latter including more than two adults. An Arizona study compared breeding sizes of groups determined by nest visits only to blind study of the same nests, and found the latter recorded larger group sizes. To determine true group sizes of this species in the lower Rio Grande Valley of Texas, I regularly visited the nesting areas of more than 70 groups of Harris's Hawks over the last two years and recorded the number of individuals involved in each group. By making more and longer nest area observations, especially after the chicks fledged, I found that more than two individuals occur in more than half of the groups of nesting Harris's Hawks in south Texas. The most likely reasons that the earlier Texas studies recorded mostly pairs were fewer and shorter nest visits and not looking for nest helpers.

## **The effect of urbanization on the stopover ecology of Neotropical migrant songbirds on the western shore of Lake Michigan**

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The effects of fragmentation and urbanization on breeding and wintering birds have been well-studied, but we are lacking knowledge of how urbanization affects migrating birds. I conducted spring migration point counts and vegetation surveys at 29 forest patches in the Chicago, IL metropolitan area in 2012 and 2013. The forest patch selection was designed to test the effects of forest patch area, distance from the Lake Michigan shoreline and degree of urbanization in the surrounding matrix, as well as the influence of vegetation diversity and structure within each patch. Since very few studies have been conducted during migration in urban areas, I conducted exploratory analysis to search for potential relationships. I used linear regression to fit all possible combinations of fixed effects and quantitative covariates against dependent variables of bird community composition and individual species presence and abundance. A subset of models with AICc<4 was retained and model-averaged predictions of the effect of each independent variable on each dependent variable were obtained. Urbanization, patch size and distance from the shoreline were not important for most models of species diversity, abundance or evenness. Vegetation structure variables, especially understory and subcanopy composition, were important factors for many models. Bird species determined to be area sensitive in previous studies were associated with large patches during migration, indicating that these species are also likely selective of larger patches during migration. While forest patch area, distance from the shoreline and urbanization were not frequently selected for models of the entire avian community, they were important in most models of individual species. Urbanization, patch size, and distance from the lake were important for some species, but no single combination benefitted all species. Rather, each species has different habitat requirements, so maintaining a variety of

conditions within this study area will support a diverse avifauna.

### **Managing plague in prairie dogs: Effects on bird communities associated with colonies**

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Range-wide declines in prairie dog (*Cynomys sp.*) populations during recent decades are linked to mortality and colony extirpation associated with plague. Prairie dog colonies support a diverse community of associated species, many of which are not susceptible to plague but may be indirectly affected. For example, mountain plover (*Charadrius montanus*) and burrowing owl (*Athene cunicularia*) respond to plague epizootics in prairie dogs in different ways; both species abandon colonies where prairie dogs have been extirpated, but burrowing owls in our study region actually increased nesting activity in areas that were recolonized by even a few prairie dogs. Until recently, the only management tool for plague control was insecticidal dust applied at prairie dog burrows; however, in order to conserve species such as the black-footed ferret (*Mustela nigripes*), a plague vaccination program is being developed for prairie dogs. We are currently studying avian species, including passerines and raptors, and mammalian nest predators in colonies of black-tailed (C. ludovicianus: BTPD) and Gunnison's prairie dogs (C. gunnisoni: GUPD) in Colorado before and after plague epizootics. In addition to documenting plague impacts, we eventually hope to determine whether there are differences in avian communities in managed and unmanaged areas. A second goal is to determine whether species associations exist for GUPD, which appear to have less structural impact than BTPD; thus we are collecting data at paired sites on and off GUPD colonies. On-colony GUPD sites had more bare ground and shorter vegetation than off-colony sites, and analysis of avian species is ongoing. Many avian and plant species have been recorded only in one habitat type (BTPD colonies, GUPD colonies, or GUPD off-colony sites).

### **Searching for genes associated with migratory performance: Is MYH7 a novel candidate migration gene?**

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Understanding how genetic variation is related to variation in migratory behavior requires both experiments with captive individuals as well as more challenging direct observations in nature. We used new ultra-light tracking devices to explore phenotypic variation in migration of a small (< 20 grams) Neotropical migrant, the Painted Bunting (*Passerina ciris*), and we also initiated, through a candidate-gene approach, a search for genes that contribute to regulation of avian migration. We implemented 454 next generation sequencing and generated over 48,000 DNA sequences distributed over the Painted Bunting genome and searched for sequences conserved across species. In parallel, we assembled an extensive library of candidate genes by annotations extracted from the Mouse Genome Informatics database. We focused on the following

candidate genes: ADRA1d, ANKRD17, CISH, and MYH7, in addition to the previously tested CLOCK and ADCYAP1, and we studied their polymorphism across 21 avian migratory and non-migratory species revealing a surprising degree of allelic variation in some genes. We found that the polymorphism at the gene MYH7 correlated with speed of migration (km/day) and body mass across 11 species of songbirds. We also evaluated the mutation rate of some candidate genes through an Approximate Bayesian Computation coalescent approach and studied the effect of natural selection on their allele frequencies across populations. We found that millennial scale summer temperatures likely affected the current genotypes of candidate migration genes in three Painted Bunting populations.

### **Testing stacked species distribution models: Predicting species richness and community composition in hummingbirds (Aves: Trochilidae)**

Jacob Cooper - University of Kansas, Lawrence, KS, United States

Conservation and biodiversity research worldwide has generally been limited and biased towards biodiversity hotspots and regions that are relatively easy to access. Most of what we know about species distributions is an artifact of this incomplete sampling and is therefore spatially limited from the outset. Species distribution models (SDMs), created by interpreting the species' realized environmental niche from locality data, are an important step towards estimating a species' spatial extent and centers of distribution. Multiple SDMs can be aggregated and summed (i.e., 'stacked') to produce multi-species presence-absence matrices (PAMs) that can predict species richness and community composition in any given locality. In order to test the effectiveness of stacking methodologies, SDMs were created for 315 species of hummingbird (approximately 87% of all described species) and 13 non-random localities were selected for testing throughout the neotropics. Models were thresholded at 95% of their outputs to create PAMs and stacked. Test localities were defined as a circle with a radius of 10 kilometers centered at a well-sampled location. Known species lists were aggregated from the eBird database and from official checklists when available. Theoretical species lists were defined by the same locality circles and thresholded by species for 25% presence, 5% presence and any presence for comparison to known richness. Conservative 25% presence thresholds over-predicted community composition at a rate of  $1.26 \pm 0.25$  (adjusted  $R^2 = 0.905$ ), while using no threshold over-predicted richness at a rate of  $1.48 \pm 0.26$  (adjusted  $R^2 = 0.923$ ). No significant difference was found between montane and lowland localities, indicating that landscape does not affect richness estimates ( $P = 0.623$ ). Comparing community predictions to known community composition shows that some over-predictions may be attributable to incomplete or spatially biased surveying of test localities. These results highlight the inherent problems associated with current stacking methodologies and reveal how properly used thresholds improve community and species richness predictions.

### **Quantifying habitat and apple snail density effects on prey availability to Snail Kites**

Philip Coppola - University of West Florida, Pensacola, FL, United States; Michel Therrien - University of West Florida, Pensacola, FL, United States; Philip Darby - University of West Florida, Pensacola, FL, United States

In predator-prey relationships, there is often a disparity between prey density and availability. Field methods for estimating prey density often do not account for influences of environment on availability/vulnerability of prey to potential predators. For scenarios in which prey are mobile poikilotherms, prey availability likely varies with certain environmental variables, such as temperature. This phenomenon was examined using a predator-prey system in which the predator (the endangered Snail Kite, *Rostrhamus sociabilis plumbeus*) is a dietary specialist consuming only one prey type (freshwater apple snails, *Pomacea spp.*). Snail kites forage by flying above flooded marsh and capturing snails visible to a depth of ~16 cm. Snails become vulnerable to kite capture when surfacing to breathe air. Consequently, only surfaced snails are available to kite capture. We quantified the influence of environmental factors such as temperature, dissolved oxygen, and vegetation community structure, on snail surfacing. Snail surfacing data were generated from visual counts of apple snails in mesocosms placed within Everglades wetland habitats (south Florida) typical of those targeted by foraging kites. The proportion of snails at or near the water surface (to a depth of 16cm) was recorded for 30 minutes. In another series of observations, we recorded snail detectability as the time it took an elevated human searcher to detect surfaced snails. Snail depth, density, and dominant emergent vegetation were independent variables. Data show that snail availability is positively correlated with water temperature and negatively correlated with dissolved oxygen. Apple snail detection is negatively correlated with emergent stem density and significantly different between emergent vegetation types. These data contribute to our understanding of basic predator-prey relationships for a federally-endangered dietary specialist dependent on Florida wetlands. Our observations can be incorporated into on-going modelling efforts for kites (Everkite) and snails (Eversnail) being used to evaluate alternative Everglades restoration plans.

#### **Sex biased hormonal response in en route migrants: Do males anticipate arrival more than females?**

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The changing life history stages that characterize seasonally reproducing birds require phenotypic adjustments to behavior, physiology, and morphology. Long-distance migrants in particular must make efficient adjustments if they are to keep on schedule for vernal migration and arrival on the breeding grounds. There is evidence that steroid hormones related to breeding (e.g., testosterone) increase throughout vernal migration in male songbirds. There are few studies that have examined these patterns in females. Further, concentration of hormones in the blood may not provide an adequate assessment of reproductive status if they do not reflect the ability of the tissue(s) to produce hormones. We performed gonadotropin-releasing hormone bioassays on migrating warblers to assess the gonad's ability to produce testosterone, a hormone that mediates behavioral and physiological changes in both sexes during the breeding season. An individual's hormonal response to the challenge was correlated with proximity to its breeding ground, as determined by stable hydrogen isotopes, in males but in not females. Males that were closer to their breeding grounds showed a higher capacity to

produce testosterone. While many females had a strong response to the challenge, some showed no response, and there was no relationship between challenge response and proximity to the breeding ground. Our results are consistent with the hypothesis that male songbirds who are closer to their breeding grounds are in a more advanced stage of breeding preparation. This pattern is not evident in female migratory songbirds. We speculate that this difference between sexes may allow males to arrive ready to defend territories whereas any benefit of increased testosterone production in females may not be evident until after pair formation.

#### **The effectiveness of diatomaceous earth to reduce mite load and increase reproductive success in a cavity-nesting species**

Alexandria Crawford - The Ohio State University at Lima, Waynesfield, OH, United States; Jacqueline Augustine - The Ohio State University, Lima, OH, United States

Parasites are organisms that grow, feed, and inhabit a host organism while negatively affecting that host's health. In many animals, heavy mite infestations negatively affect nestling growth and survival, adult survival and reproductive success, and parental behavior. Diatomaceous Earth (DE) is a non-chemical pest control with a natural origin and low toxicity to birds. I predicted not only a negative correlation between mite abundance and nestling size, but also that nests treated with DE would result in larger nestlings with fewer mites compared to untreated nests. DE was applied to half of the House Wren (*Troglodytes aedon*) nest boxes at three sites near Lima, Ohio, prior to nest building. Mites in the nest were quantified by removing the nests after the nestlings fledged and extracting the mites with the use of a burlap funnel trap. DE did not reduce the number of mites in the nest, but it did reduce the number of other arthropods. Mite load did not affect nestling size, the number of fledglings, or adult feeding rates. My hypothesis that DE would decrease ectoparasite load and increase reproductive success was not supported. The low effectiveness of DE may have been due to the high humidity and temperature within the nest box at our study site.

#### **Inconsistent recovery: The local decline of Least Tern colonies and nesting habitat and in central Oklahoma.**

Priscilla Crawford - Oklahoma Biological Survey, Norman, OK, United States

The endangered interior population of the Least Tern (*Sternula antillarum*) forms nesting colonies on unvegetated sand and gravel bars of wide rivers in central North America. Despite the spectacular success of breeding colonies along the lower Mississippi and Arkansas Rivers, which are managed by the US Army Corps of Engineers, other interior populations have remained steady or dropped since listing in 1985. We closely monitored and protected LET colonies in central Oklahoma during 2007-2014, finding low and highly variable colony numbers. When compared to a previous study of the region during 1991-1998, we observed significantly fewer LET and lower reproductive rates. Colony success was limited by human disturbance, predation, extreme weather events, and flooding. Due to vegetation encroachment of both native and exotic species, we observed over time nest placement in smaller open areas, closer to water's edge; creating a greater risk of nest loss during high water events. To quantify this habitat change, we analyzed the sandbar habitat on aerial imagery from 1990-2012. Suitable habitat decreased over time, with a brief expansion in 2008 after a flood season. Because flooding is

necessary to maintain habitat, we reviewed annual peak stream flow for the Canadian River from 1990-2014, finding a consistent decline, indicating a decrease in large floods. An examination of weather data of the watershed did not illustrate a change in annual rainfall or rainfall intensity. Therefore, the change in hydrology is likely a result of the documented increased tributary impoundment and groundwater withdrawal. The decline in LETE as a result of continued habitat deterioration in central Oklahoma is not unique. Further detailed examination of additional interior LETE populations is needed to make informed judgments on the recovery of the interior population as a whole.

### **Evolution of learned behaviors: Insights from birds and humans**

Nicole Creanza - Stanford University, Portola Valley, CA, United States

Birdsong is a complex cultural and biological system, and the selective forces driving evolutionary changes in aspects of song learning vary considerably among species. Studies to date have provided conflicting evidence regarding the extent to which repertoire size, the number of syllables or song types sung by a bird, is subject to sexual selection. In particular, females seem to prefer males with large repertoires in laboratory studies, but field studies have not consistently supported the hypothesis that repertoire size influences mate choice. Using mathematical modeling and phylogenetic analyses of correlated evolution, I observed that learning mode (open-ended or closed-ended learning) is associated with the size of birdsong repertoires on a species level. This indicates that sexual selection pressures on repertoire size may differ based on the length of the sensitive period for song learning, implying that repertoire size may be most salient as an indicator of male fitness in species that continue to learn throughout life.

### **Quantifying the phylogenetic and cultural content of learned song**

Nicole Creanza - Stanford University, Portola Valley, CA, United States; Fernando Nottebohm - Rockefeller University, New York, NY, United States

Birdsong provides a fascinating system to study the evolution of a learned behavior. Previous research often assumed that relatively rapid change over long evolutionary timescales might make interspecific song comparisons less tractable or useful than intraspecific comparisons. However, with a large-scale computational song analysis, I sought to quantitatively determine (1) how much phylogenetic information remains if cultural changes accumulate for millions of years and (2) how much variability exists in one species' songs over time and across habitats. To address this, I developed computational techniques for extracting syllable and song features from large song-recording databases. Analyzing the variability of these song features in light of genetic distance between species, I determined that certain song features are good predictors of genetic relatedness whereas others are quite variable within and between species. Mapping these features on genetic phylogenies, I evaluated whether song features evolve at constant rates over time, whether signatures of selection exist in birdsong, and whether correlated evolution has occurred between song features. In addition, I detected evolutionary patterns in individual species' songs over decades of recordings and across geographic distance. Combining a genetic framework with a large-scale analysis of learned behavior,

these experiments shed light on behavioral variation both within and between species.

### **Bird song along regional and site-specific noise gradients: Roles for cultural evolution, plasticity, and performance limits**

Raymond Danner - George Mason University, New Orleans, LA, United States; Julie Danner - Tulane University, New Orleans, LA, United States; Jenny Phillips - Tulane University, New Orleans, LA, United States; Kate Gentry - George Mason University, Fairfax, VA, United States; Sara Lipshutz - Tulane University, New Orleans, LA, United States; Graham Derryberry - Tulane University, New Orleans, LA, United States; Catherine Rochefort - Tulane University, New Orleans, LA, United States; David Luther - George Mason University, Fairfax, VA, United States; Elizabeth Derryberry - Tulane University, New Orleans, LA, United States

Urban anthropogenic noise is an evolutionarily recent phenomenon and has the potential to impose novel selection pressures on avian acoustic communication. Many studies have found that birds in urban environments vocalize at higher minimum frequencies compared to birds of more rural populations, presumably to be heard over the din of anthropogenic noise. Both cultural evolution and plasticity have been implicated as drivers of this divergence. Soundscapes are far from dichotomous (urban vs. rural), however, and exist as gradients at both small and large spatial scales. We compared minimum song frequencies of White-crowned Sparrow (*Zonotrichia leucophrys nuttalli*), to local background noise over two years at multiple sites along a noise gradient in San Francisco and Marin Counties in California. We hypothesized that along the regional noise gradient, birds would sing higher minimum frequencies at noisier sites. We further hypothesized that on a smaller spatial scale, within sites, birds would sing higher frequencies on noisier territories. We found that at the regional scale, site noise was the best predictor of song frequency, providing support for either cultural evolution or plasticity of song production in response to anthropogenic noise. Within sites, song frequency was positively related to territory noise only at quieter sites, supporting plasticity at those sites. At noisier sites, however, song frequency was not related to territory noise, suggesting that the birds had reached a performance limit of song production. Song frequencies did not differ by year. These results highlight the potential for anthropogenic noise to influence vocal communication at both regional and smaller spatial scales, and suggest roles for both cultural evolution and plasticity of song production, as well as performance limits in urban areas.

### **Do House Wrens signal predator type in their alarm calls?**

Alexander Davis - The Ohio State University, Lima, OH, United States; Jacqueline Augustine - The Ohio State University, Lima, OH, United States

Communication among individuals is essential for defending against predators and competitors. We hypothesized that House Wrens (*Troglodytes aedon*) would vary their behavioral response and alarm call when presented with two types of predators: a snake and an owl. These predators were chosen because they represent different modes of attack (crawling vs. flying), and have been shown to elicit responses from wrens previously. When nestlings were 11 days old, the predator models were presented. The experiment included a 5 minute trial with one predator, a 10 minute resting period, and another



5 minute trial with the other predator. After the second predator was removed, we watched until nestling feeding resumed. Audio and video recording was used to monitor the birds' reactions. The frequency, amplitude and time was analyzed in Signal 5 for each chatter. We used matched pair analysis in JMP (Ver.9.0.0) to compare the birds' behavioral and vocal reactions to two different predators. Compared to the owl, the wrens approach the snake more closely and increased the maximum frequency of their chatter call. Compared to the snake, wrens chattered longer at the owl. My hypothesis was supported: House Wrens modify their behavioral response and alarm call depending on the type of predator. This experiment also demonstrated that individuals vary in their aggressiveness to predators. A similar experiment could be used to measure changes in the level of aggressiveness with an increase in the number of young being raised or as the nest progresses through the egg laying, incubation, and nestling feeding stages.

#### **A contrast in bird conservation: California Condor and Masked Bobwhite**

Horacio de la Cueva - CICESE, Ensenada, Baja California, Mexico; Robert Mesta - USFWS, Tucson, AZ, United States

This presentation will review the decades-long efforts to conserve the California Condor (*Gymnogyps californianus*) and the Masked Bobwhite (*Colinus virginianus ridgwayi*). Historically, California Condors were distributed from southern British Columbia to northern Baja California, where they forage over tracts searching for carrion. Masked Bobwhite were distributed from Pima County AZ, to Guaymas, Sonora, in a specialized and poorly studied habitat. Both have long been listed on both the Endangered Species Act the Mexican Norma Oficial 059. Decreases in both species is attributed to human environmental modification. The decline to 25 Condor specimens is mostly attributed to lead poisoning; whereas declines in the Masked Bobwhite have been attributed to habitat modification associated with cattle ranching, including the introduction of the African buffelgrass (*Cenchrus ciliaris* syn. *Pennisetum ciliare* (L.) Link). The last count in the wild yielded < seven individual Masked Bobwhite. The California condor population was captured in 1985 as part of an aggressive reintroduction program led by the California Condor Recovery Team based in the Los Angeles Zoo. Condors were isolated from human contact and trained to avoid dangerous situations. After five years of bureaucratic wrangling, in 2002 six California condors were released in the San Pedro Mártir National Park, numbers today are above 20, and there is at least one hatched in the wild. Birds receive supplementary feeding, and are radio and satellite monitored. The captive rearing program for Masked Bobwhite at the Buenos Aires National Wildlife Refuge, has not succeeded in reintroducing birds into the wild. The effort is limited to hosting 700 birds, and there is no training of the birds in preparation for release. A small portion of the captive population has been moved to Africam Safari, Valsequillo, Puebla to initiate a second reproduction program. There birds will be reintroduced to suitable habitat in Sonora or placed in other zoos. The California Condor is well known as part of PACE, a special conservation program in Mexico; however the Masked Bobwhite recovery program is relatively unknown and poorly funded.

#### **Tree-cavity nest-site selection by the large-bodied Military Macaw**

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Mexico; Aleandro Salinas Melgoza - Universidad Autónoma de Tlaxcala, de Tlaxcala de Xicohténcatl, Tlaxcala, México; Luis Guillermo Muñoz Lacy - Universidad Nacional Autónoma de México, Mexico City, Mexico

Large-bodied secondary cavity-nesters are constrained to use cavities of sufficient size to permit access, while also selecting characteristics to reduce predation. However, no information exists on nest-site availability for large-bodied secondary cavity-nesters in tropical forests. We located 12 tree-cavity nests of the threatened Military Macaw (*Ara militaris*) in tropical dry semi-deciduous forest in Jalisco, Mexico. For each nest, we determined cavity characteristics, and compared the structure of nest-trees with nearest- neighbor trees. We also established four 100 x 50 m transects in each of deciduous, semi-deciduous, and oak forest to determine tree-cavity availability in 6 ha of forest. Military Macaw nest-sites occurred most frequently in cavities of live *Enterolobium cyclocarpum* trees. Nest-trees had significantly larger diameter and ramification height than the four nearest neighbour trees, indicating that macaws selected tall emergent trees as nest-sites. Cavities used as nest-sites by Military Macaws were also in significantly larger trees, at a greater height, and had larger entrance diameter and depth than all accessible cavities. Height above the ground was the main criteria predicting nest-cavity selection, which may relate to selection for reduced predation risk. There was also a negative correlation of nest-cavity height with depth, suggesting a trade-off in which Military Macaws may select a nest-cavity high above the ground regardless of depth, but when using lower cavities these tend to be deeper. We found a low density of cavities with characteristics suitable for nesting, and these were concentrated in semi-deciduous forest. Our results demonstrate that the Military Macaw exhibits species-specific selection of nest cavities, and we observed a low density of cavities suitable for large-bodied secondary cavity-nesters in tropical forests.

#### **Reverse movement of birds during fall migration in a coastal landscape**

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One of the most familiar and characteristic aspects of bird migration is mass movement in seasonally appropriate directions. Movements that deviate substantially from this expectation are particularly intriguing and may be motivated by a variety of circumstances and conditions, from lack of migratory cues to compensation for wind drift. To better understand these behaviors, we examined the reverse movements of migratory birds faced with the Gulf of Mexico as a potential barrier to migration. As part of a larger study, a number of species including Red-eyed Vireos, Swainson's Thrushes, and Gray Catbirds were radio-tagged after being captured at a long term banding site on the Fort Morgan peninsula in coastal Alabama. An automated tracking system

recorded the movements of these birds as they departed the peninsula. The motivation behind these reverse movements remains unclear and likely varies with species, although evidence suggests that depleted fat stores may drive some birds to seek high quality stopover habitat before engaging in trans-gulf flight. Data gathered concurrently by weather radar on migrating birds departing the broader gulf coast show that the spatial scale of reverse movement is considerably more widespread than what radio telemetry data alone suggests and likely involves more than the handful of species we studied. On any given day up to a quarter of the birds departing the Fort Morgan peninsula engaged in reverse movement. In this study, radio-tracking and weather radar prove to be highly complementary technologies. They corroborate each other and together give a sense of scale and causation to the phenomenon of reverse movement that would be nearly impossible with either technology alone.

### **Monogamy, ecology, and the evolution of cooperative breeding in birds**

Jacqueline Dillard - University of Kentucky, Lexington, KY, United States

Cooperative breeding occurs when adult offspring delay dispersal and remain on their parents' territory as "helpers-at-the-nest." The patchy distribution of this behavior among avian lineages has elicited many hypotheses regarding the factors that predispose certain species to cooperation. Certain life history traits, such as longevity and sedentariness, combined with ecological constraints are believed to have led to the contemporary distribution of cooperative breeding in birds. Recent studies, however, suggest that genetic monogamy may have also played a critical role in avian cooperation. Cooperative breeding is often preceded by genetic monogamy in evolutionary time, and promiscuity and helping effort are negatively correlated in present-day bird populations. This evidence has been taken as support for the monogamy hypothesis, which implicates monogamy as a causal factor in cooperative evolution by increasing relatedness among siblings and thus the kin selected benefits of helping. I argue that this association between monogamy and cooperative breeding may not be causal, but rather the result of ecological selective pressures that favor both monogamy and cooperation simultaneously. Both the evolution of monogamy and helping are dependent on ecological factors that increase the benefits of caring for offspring and/or decrease the benefits of dispersing to breed independently, potentially causing these two traits to covary. I test this hypothesis using a comparative phylogenetic analysis of birds with which I will determine whether ecological and life history factors known to influence both monogamy and cooperation, such as food limitation, nest predation, breeding density, and nestling development, sufficiently explain the covariance between monogamy and cooperation. If monogamy and cooperation both result from common ecological factors, I predict that the inclusion of ecological factors will reduce the variance in cooperation previously attributed to monogamy. Alternatively, if the relationship between cooperation and monogamy is still evident after controlling for ecology, monogamy may causally influence cooperation.

### **Mountain Plover ecology on prairie dog colonies in Montana**

Stephen Dinsmore - Iowa State University, Ames, Iowa, United States

Title: Mountain Plover ecology on prairie dog colonies in Montana. The Mountain Plover (*Charadrius montanus*) is a terrestrial shorebird that is an endemic breeder on the North American Great Plains. In Montana its association with black-tailed prairie dogs (*Cynomys ludovicianus*) infected by sylvatic plague has impacted local population dynamics. I studied the Mountain Plover in Phillips County, Montana from 1995 to 2014 where I individually color-marked >1,800 Mountain Plovers and monitored >1,600 nests during the 21-year study. Plovers occupy large, inter-connected prairie dog colonies, and their use of colonies is negatively impacted by the recent presence of plague. Nesting plovers readily dispersed to prairie dog colonies between years with females (4.64 km) moving farther than males (2.75 km). The presence of plague on a prairie dog colony did not affect dispersal distance the next year. Nest survival showed strong annual and seasonal variation, increased with nest age, and appeared to be greater for male-tended nests, but was unaffected by plague. I modeled age-specific annual survival using a robust design approach and found strong age effects, annual variation in adult survival, and a strong positive association between survival and drought. Annual survival rates were 0.06 from hatch to age 1 and varied between 0.74 and 0.96 for adults (>1 year old). Plovers occur at low density (< 1 bird/ha) on active prairie dog colonies and the breeding population in this region numbers approximately 250 individuals. Collectively, this information provides a better understanding of the population dynamics of the Mountain Plover and suggests several conservation strategies for its long-term persistence.

### **Prothonotary Warbler nestling diet and growth in response to variation in aquatic and terrestrial food availability**

Jenna Dodson - Virginia Commonwealth University, Louisa, VA, United States; Lesley Bulluck - Virginia Commonwealth University, Richmond, VA, United States

It is advantageous to reproduce at a time of highest energy availability because raising young is costly. Independent pulses of terrestrial and aquatic insects provide significant food resources to riparian species. However, aquatic resources are often ignored in avian food availability studies, despite the fact that they can account for 50-90% of the energy budget for some species. This study investigates the flux of both aquatic and terrestrial prey resources of the prothonotary warbler (*Protonotaria citrea*) throughout the breeding season and how these variations relate to nestling diet, growth rate and female reproductive success. This study focused on two established nest box sites along the lower tidal James River, near Richmond, Virginia. At each site, terrestrial (caterpillar) and aquatic (mayfly) food resources were quantified weekly using branch clipping, light traps, and emergence traps. Nestling diet was quantified using video observation. Caterpillar biomass peaked 10 days before the first peak in prothonotary warbler egg laying. In contrast, mayfly availability coincided with the timing of nestling provisioning, was greater at one site of our two sites, and nestlings at this site were fed a greater proportion of aquatic prey than nestlings at the other site. Within a site, mayflies emerged 2 weeks earlier along the riverfront than the back creek, but there was no difference in the proportion of mayflies brought to nests in these two areas, suggesting the importance of mayflies in the nestling diet. Our results suggest that parents feed resources consistent with local food availability, and taking advantage of fluxes in resources has implications for nestling growth rate.

## **Towards large-scale studies of animal movement: The European Network for the Radar surveillance of Animal Movement (ENRAM)**

Adriaan Dokter - University of Amsterdam, Amsterdam, Netherlands; Jose Alves - University of East Anglia, Norwich, United Kingdom; Silke Bauer - Swiss Ornithological Institute, Sempach, Switzerland; Jason Chapman - Rothamsted Research, Harpenden, United Kingdom; Hans van Gasteren - University of Amsterdam, Amsterdam, Netherlands; Ommo Hüppop - Institute of Avian Research, Wilhelmshaven, Germany; Jarmo Koistinen - Finnish Meteorological Institute, Helsinki, Finland; Hidde Leijnse - Royal Netherlands Meteorological Institute, De Bilt, Netherlands; Felix Liechti - Swiss Ornithological Institute, Sempach, Switzerland; Don Reynolds - Rothamsted Research, Harpenden, United Kingdom; Judy Shamoun-Baranes - University of Amsterdam, Amsterdam, Netherlands

The European Network for the Radar surveillance of Animal Movement (ENRAM) is a new e-COST research network aiming to merge expertise in utilizing weather radars to monitor and study the aerial movement of animals across Europe at the unprecedented scale of a full continent. In this talk I will give a short overview of the aims of ENRAM and activities being currently developed. An essential step towards establishing a large network of more than 200 radars has been the automated extraction and quantification of biological signals from weather radar data. I will explain how vertical profiles of bird (VPBs) can now be automatically retrieved from operational weather radar data, which will form the backbone of the European observation network. I will then discuss two examples where vertical profile retrievals were used to study animal movement (1) the flight altitude selection of passerines and insects, discussing the reasons underlying the formation of high altitude migration layers in both taxa, and (2) the nocturnal flight behaviour of Common Swifts, which perform highly remarkable ascent flights during twilight, of which I will discuss the potential purpose.

## **Inheritance, variability, and validation of single nucleotide polymorphisms for noninvasive monitoring of Golden Eagles (*Aquila chrysaetos*)**

Jacqueline Doyle - Purdue University, West Lafayette, IN, United States; Todd E. Katzner - U.S. Geological Survey, Boise, ID, United States; Pete H. Bloom - Western Foundation of Vertebrate Zoology, Camarillo, CA, United States; J. Andrew DeWoody - Purdue University, West Lafayette, IN, United States

The conservation of threatened avian species like eagles can benefit from long-term non-invasive genetic monitoring and studies of population structure. We recently sequenced the Golden Eagle genome in an effort to characterize genes and novel genetic markers for use in population studies. Herein, we describe a novel Fluidigm SNPtype assay that includes 85 putatively neutral markers (from gene deserts), 74 gene-associated markers (from protein-coding genes), 1 molecular sexing marker and 2 mitochondrial markers for haplotype determination. We genotyped 570 eagle samples at these 161 loci and quantified error rates, variability, and inheritance patterns at each marker in an effort to determine the efficacy of these SNP panel for noninvasive eagle population monitoring. The mean error rate (per locus per sample), established by typing multiple feathers from the same donor individual, was approximately 0.5%. The sexing assay was 100% concordant with independent results obtained using a conventional PCR/gel electrophoresis approach and sexing was informative in different species. Finally, the mitochondrial haplotypes

produced by our panel were approximately 96% concordant (per site per sample) with those generated with conventional dideoxy sequencing assays. Mean observed heterozygosity was  $0.35 \pm 0.01$  and mean probabilities of identity and exclusion (neither parent-known) were  $2.1 \times 10^{-50}$  and 1, respectively. Finally, we used eaglet samples of known provenance to test for population differentiation and evidence of selection across portions of North America. These markers should be highly informative for future studies of genetic structure, demography, and parentage in golden eagles.

## **Effects of climate variables on Lesser Prairie Chicken vital rates: A meta-analysis**

Julia Earl - Oklahoma State University, Stillwater, OK, United States; Samuel Fuhlendorf - Oklahoma State University, Stillwater, OK, United States

Climate change is expected to affect temperature and precipitation means, variability, and the frequency and magnitude of extremes. These changes will likely alter the population dynamics of many different species. However, the relative importance of different types of climate variables to population dynamics and vital rates is relatively unknown. We performed a meta-analysis of published vital rates for the threatened Lesser Prairie Chicken (*Tympanuchus pallidicinctus*) and examined the effects of the maximum temperature, minimum temperature, mean temperature, total rainfall, and the maximum rainfall in 24 hours. We additionally examined effects of habitat (sand sagebrush, sand shinnery oak, or mixed) and year of study. Preliminary analyses show nest success declined with increases in monthly mean temperature and had a positive relationship with year of study. However, monthly mean temperature also varied with habitat type, making it difficult to separate these two factors. The inclusion of additional studies may allow the separation of these two factors. Further analyses will also examine the relationship between climate variables and other vital rates, particularly clutch size, nest initiation and survival, and explore their effects on population dynamics.

## **Testing models of energy cost and tradeoffs for malaria infection in Dark-eyed Juncos**

Doug Eddy - University of Wyoming, Laramie, WY, United States; Matthew Carling - University of Wyoming, Laramie, WY, United States

In passerine birds, there are large energetic costs associated with maintaining a high internal body temperature. Similarly, mounting an immune response is energetically costly. How the interaction between these processes impact metabolic parameters is unclear. 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 thermogenesis and immune response. We captured juncos in northwestern Wyoming and diagnosed their infection state. Each bird was cold challenged with flow-through respirometry to measure metabolic output (basal metabolic rate [BMR]; and cold-induced summit metabolic rate [SMR]). Currently, we are using these data to test two alternate hypotheses: the additive cost hypothesis, and the negative-relation hypothesis. The additive hypothesis posits that the costs of mounting an immune response and those of thermogenesis are additive. For infected birds the additive model predicts an increased BMR (common in most immune responses) and the ability to ramp up metabolism in excess of normal SMR to meet a cold challenge. In the wild, this type of

response would require infected birds to obtain extra resources to meet their increased metabolic output. The negative-relation hypothesis also predicts increased BMR in infected versus non-infected individuals but also predicts an inability to increase SMR beyond what an uninfected individual could achieve. This model suggests that thermogenic and immune responses draw from a finite resource pool and that there is a limit to which a bird can generate heat while carrying a chronic infection. Preliminary analysis of metabolic data indicate that infected birds have higher SMR than non-infected birds, which is consistent with the additive cost hypothesis. In testing these trade-off hypotheses, our study investigates the still murky relationship between the costs of thermoregulation and chronic immune responses in passerines.

#### **Melanosome shape and color diversity in palaeognathous birds**

Chad M. Eliason - Department of Geological Sciences and Integrated Biology, University of Texas at Austin, Austin, TX, USA; Liliana D'Alba - Department of Biology and Integrated Bioscience Program, University of Akron, Akron, OH, USA; Matthew D. Shawkey - Department of Biology and Integrated Bioscience Program, University of Akron, Akron, OH, USA; Julia Clarke - Department of Geological Sciences, University of Texas at Austin, Austin, TX, USA

The avian integument is colored by a combination of pigments and nanostructured tissue. Melanin pigments contained in organelles (melanosomes) impart black, brown, and red colors to feathers. Such melanin-based colors are broadly distributed in birds and thought to be the ancestral color-producing mechanism. However, we lack estimates of melanosome and color diversity in the "basal" clade of birds, the palaeognaths. Palaeognaths include the volant tinamous and flightless ratites and are morphologically, behaviorally, and ecologically diverse. Ratites have a number of distinct morphological and physiological characteristics associated with a flightless lifestyle. For example, low metabolic rates, feathers lacking barbule hooks that produce the characteristic "loose" appearance of ratite plumages, and lack of feather apteria. We hypothesized that these characteristics would be associated with differences in melanosome and color diversity compared to tinamous. Here, we use a combination of UV-Vis reflectance spectrophotometry and scanning electron microscopy to construct the color palette of palaeognaths and examine associations between melanosome shape and feather color. Our results indicate that the morphospace and colorspace of palaeognaths was limited relative to neognaths. Furthermore, within palaeognaths, ratites produce a similar range of colors with less diverse melanosomes than tinamous, suggesting a decoupling between morphological and color disparity. These findings suggest convergent evolution of a novel, brown color-producing melanosome in ratites and are consistent with the hypothesis that shifts in energetics are associated with melanosome diversity. This study represents the densest sub-clade sampling of melanosome shape in any avian group and presents evidence for limited a colorspace in the basal clade of birds. The incorporation of fine-scale, objective reflectance data has implications for color reconstruction in extinct species and raises further questions about the genomic basis of the linkage between melanosome shape and color in ratites.

#### **Twenty year changes in riparian bird communities of east-central Oregon**

Mike Ellis - Oregon State University, Corvallis, OR, United States; W. Daniel Edge - Oregon State University, Corvallis, OR, United States; Pat Kennedy - Oregon State University, Union, OR, United States

Over the last half century, riparian zones in the semi-arid West have gained recognition as disproportionately important habitats for breeding bird communities and agricultural operations. Despite growing interest in exploring avian habitat relationships in these systems to better inform land management practices, few studies have attempted to identify and describe temporal changes in the region's riparian bird communities. However, understanding these background changes is critical to the interpretation and evaluation of land use, restoration, and conservation impacts. To provide a frame of reference for how riparian bird communities in the semi-arid West may be changing over time, we compared measures of avian abundance and diversity from three streamside vegetation associations in east-central Oregon during the 2014 breeding season with baseline data collected by T.A. Sanders and W.D. Edge in 1993 and 1994. After accounting for detectability, overall species richness increased slightly from 55 to 57 species, but species turnover was pronounced. We observed a 20% increase in total detections over all species but precipitous declines for two of three riparian obligate focal species – the Yellow Warbler and Willow Flycatcher. Detections of Song Sparrows, the third focal species, declined by a smaller margin. Changes in number of detections of these obligates did not reflect changes in mesic shrub volume, which had been identified as a likely driver behind obligate species population sizes by Sanders and Edge. Increases in community-level abundance were driven by increases in grassland and wetland species likely explained by differences in river size, extent of flooding, and herbaceous communities between some 2014 and 1993-94 transects.

#### **White-tipped Dove occupancy and distribution in the Lower Rio Grande Valley, Texas**

Thomas Enright - Tarleton State University, Stephenville, TX, United States; T. Wayne Schwertner - Tarleton State University, Stephenville, TX, United States; Jeff Breeden - Tarleton State University, Stephenville, TX, United States; Heather Mathewson - Tarleton State University, Stephenville, TX, United States

The White-tipped Dove (*Leptotila verreauxi*) is an elusive, resident Columbidae that reaches its northernmost distribution in south Texas. Since its designation as a game species in 1984, there has been little effort directed toward monitoring or managing the species. Research defining White-tipped Dove occupancy and distribution, critical to effective monitoring program design, has not been undertaken. The objectives of this study were to model White-tipped Dove detection probability and multi-scale habitat-based occupancy, and predict species distribution across the Lower Rio Grande Valley. A time-of-detection protocol, incorporating both passive and playback methods, was used to determine detection probability and occupancy of White-tipped Doves at 490 survey locations. Detection probability and habitat-occupancy models, integrating patch and landscape metrics, were developed through UNMARKED and assessed through AIC. The predictive distribution was determined through ROC with an optimized threshold at an 18% false positive rate. The best occupancy model resulted in an estimated detection probability of 0.82 that declined with ambient noise ( $P = 0.0001$ ). Playback calls significantly increased detection probability ( $t_{1730} = 3.71$ ,  $P = 0.0001$ ). Based on the best model, riparian forest and citrus had

the greatest occupancy probability, >0.80, while urban and wetland had the lowest at 0.20. Occupancy probability increased with the proportion of riparian forest within 1.5 km, declined with distance to nearest suitable patch, and exhibited a quadratic effect with patch area. Habitat fragmentation strongly influenced White-tipped Dove occupancy. Given the quadratic effect of patch area, occupancy was greatest within patches <60 ha suggestive of a greater relationship with edge than previously recognized. The model and distribution exemplify the value of state and federal land conservation initiatives, provide guidance for future land conservation and management, and serve as a foundation for assessing White-tipped Dove abundance and the development of a targeted monitoring program by USFWS and TPWD.

#### **Reintroduction of Scarlet Macaws in Los Tuxtlas, Veracruz**

Patricia Escalante - Universidad Nacional Autónoma de México, Mexico City, Mexico

Reintroduction efforts of Scarlet Macaws (*Ara macao*) in Mexico had not previously advanced because the captive colonies lacked genetic evidence of the taxonomic and geographic origin of their stocks, neither had evidence of absence of important psittacine pathogens in their colonies. These two pieces of information prevented them to obtain relevant permits from wildlife authorities. In 2012, with the collaboration of several experts I was able to examine the founders pairs of the breeding colony at Xcaret and determined that all the members in this captive colony belong to the northern subspecies (*cyanoptera*) and that no hybrids or individuals of the other sister species were involved in the colony. Mitochondrial and microsatellite markers were used for this purpose. All parasitological tests have indicated that the colony is clean of psittacine diseases of concern in the New World. In Los Tuxtlas, Veracruz, the second reintroduction project started in Mexico in 2014, the first was started in Palenque in 2013. To date there have been two groups of Scarlet Macaws transferred to Los Tuxtlas, in two different sites, which after three months of acclimatization, and antipredator and antihuman exercises have been released. The current success of releases is 85% but it is thought that with some modifications in the antipredator training success rate will increase. An intense campaign unfolds with the local population to raise awareness and values for sustainability and conservation. We have also started a nursery to help reforest with trees that are useful to the macaws and increase forest cover which actually is about 25 % in the lowlands. In this project biologists and veterinary graduates of the UNAM and the Universidad Veracruzana collaborate. We have also worked with Xcaret in their protocols to try to diminish imprinting in the macaws dedicated for reintroduction projects.

#### **Landscape metrics and Missouri prairie birds: How real are the results?**

John Faaborg - University of Missouri, Columbia, MO, United States; Maiken Winter - WissenLeben e.V., Munich, Germany

Nearly 20 years ago, work by Maiken Winter on a variety of Missouri native grassland remnants showed distinct effects of landscape parameters such as grassland area and presence of edge on distribution, abundance, and nesting success of grassland-obligate birds. Her work on 13 prairie fragments found different types of area-sensitivity – differences among prairie fragments based on distribution or differences based on nesting success. Some of these patterns could be explained by the effects of forest edge on the nesting success of grassland

birds. Here we compare these old results with comparable grassland bird studies done during the past two decades to see how these findings have stood the test of time.

#### **A test of parapatric speciation in the *Hypocnemoides* Amazonian complex**

Maya S. Faccio - Department of Biological Sciences, University of Toronto Scarborough, Toronto, Canada; Omar Yossofzai - Department of Biological Sciences, University of Toronto Scarborough, Toronto, Canada; Alexandre Aleixo - Department of Zoology, Museu Paraense Emílio Goeldi, Belém, Brazil; Jason T. Weir - Department of Biological Sciences, University of Toronto Scarborough, and Department of Ecology and Evolution, University of Toronto, Toronto, Canada

Many closely related species of Amazonian birds replace each other geographically with wide river barriers delimiting ranges of adjacent species. River barriers are generally believed to drive speciation in allopatry. In contrast, the two species of *Hypocnemoides* antbirds come into geographic contact and form a ca. 2200km long zone of parapatry along the eastern two-thirds of their ranges. Whether these sibling species evolved via parapatric speciation or whether speciation occurred in allopatry followed by secondary parapatric contact has never been studied. Here we apply coalescent modelling to a genome-wide SNP dataset to test for parapatric speciation. Parapatric speciation was rejected, with the best fit model supporting secondary parapatry following an initial allopatric phase. The best fit model also estimated low amounts of gene-flow between the two species. Estimated levels of gene-flow are insufficient to cause genetic collapse of the two species into a single genepool. To investigate further, we sampled along a geographic transect across the contact zone region where gene-flow is most likely to occur. Both genetics and morphology support limited genetic admixture at the contact zone, but clinal analysis suggested a geographically sharp transition between the two species over a 25km region. These results support the recognition of these sibling species as distinct, albeit cryptic, biological species.

#### **BirdCast perspectives: Autumn nocturnal bird migration in the Northeastern U.S.**

Andrew Farnsworth - Cornell Lab of Ornithology, Ithaca, NY, United States; Daniel Sheldon - University of Massachusetts, Amherst, MA, United States; Benjamin Van Doren - Cornell University, Ithaca, NY, United States; Wesley Hochachka - Cornell Lab of Ornithology, Ithaca, NY, United States; Frank La Sorte - Cornell Lab of Ornithology, Ithaca, NY, United States; Kevin Winner - University of Massachusetts, Amherst, MA, United States; Garrett Bernstein - University of Massachusetts, Amherst, MA, United States; Steve Kelling - Cornell Lab of Ornithology, Ithaca, NY, United States

Few studies describe phenology of nocturnal bird migration at broad spatial and temporal scales. Although availability of data from the existing weather surveillance radar network in the continental US (WSR-88D) addresses a fundamental challenge of how and from where to gather data describing such scales continuously, this availability does not address another fundamental challenge of how to extract meaningful information about bird migration from these data. The BirdCast project is a collaborative effort between ornithologists and computer scientists that is tackling the latter challenge. Here, we report results of an extensive processing effort to extract information about bird migration from radar data. We describe the density, direction, and speed of nocturnal migration from

13 WSR-88Ds in the Northeastern US from 1 August to 30 November 2010 and 2011. We discuss the altitudinal distribution of nocturnally migrating birds and behaviors of these migrants relative to wind. Peak nocturnal migration occurred in early in the night and later in the fall. Migrant flight direction was generally south southwesterly. Speeds were highest early in the night and showed extensive variability later in fall. Mean flight altitude was approximately 1000m above sea level with greater variation early and late in fall. Birds drifted with winds inland, compensated for winds in coastal locations. This study highlights the power of extracting bird information from radar data with a cross-disciplinary approach. Furthermore, potential for applying our results and continuing this collaborative approach is great, ranging from providing the science to inform dynamic conservation actions requiring information about the spatio-temporal distributions of nocturnally migrating birds to informing public awareness about the magnitude of these largely unseen movements of birds.

### **Comparing acoustic and radar monitoring of nocturnal bird migration: Past, present, and future**

Andrew Farnsworth - Cornell Lab of Ornithology, Ithaca, NY, United States; Justin Salamon - New York University, New York, NY, United States; Matt Robbins - Cornell Lab of Ornithology, Ithaca, NY, United States; Sara Keen - Cornell Lab of Ornithology, Ithaca, NY, United States; Juan Bello - New York University, New York, NY, United States; Steve Kelling - Cornell Lab of Ornithology, Ithaca, NY, United States

Nocturnal bird migration is difficult to study, and to quantify, in a comprehensive manner. Although many technologies and techniques exist to examine and to describe these movements in great detail, each has its limitations and imperfections preventing a holistic view. As such, the simultaneous use of multiple approaches is critical for achieving more comprehensive descriptions, quantifications, and visualizations of these movements. Here, we discuss the utility of simultaneous acoustic and radar monitoring of nocturnal bird migration. We review the results of previous studies that compare density of nocturnally migrating birds as detected on radar with call counts of nocturnally migrating birds. We also present results from a current pilot project comparing acoustic and radar monitoring. This pilot project used acoustic data from 10 recording stations in Ithaca and New York, NY and radar data from Binghamton and Brookhaven NY weather surveillance radars (WSR-88D). So far, comparative results generally agree with previous studies suggesting a positive but widely variable relationship between bird density and call counts, with the novel twist that these data were generated from automated acoustic and radar processing pipelines. These pilot results, together with previously published knowledge about radar and acoustic monitoring, highlights the power of pairing these methodologies and the capability of providing detailed information about the density, direction, speed, and identity of nocturnal migration. Furthermore, relative to other potential combinations, advances in the automated processing of data streams may make this approach much more cost and time efficient.

### **Use of a directed occupancy study and North American Breeding Bird Survey data to understand grassland bird habitat relationships in the Southeastern U.S.**

Patrick Farrell - Auburn University, Auburn, AL, United States; Conor McGowan - United States Geological Survey, Auburn University, Auburn, AL, United States; James Grand - United

States Geological Survey, Auburn University, Auburn, AL, United States; Eric Lonsdorf - Franklin and Marshall College, Lancaster, PA, United States; Wayne Thogmartin - United States Geological Survey, La Crosse, WI, United States

North American grassland bird populations have consistently declined for several decades. For conservation planning, it is important to understand regional habitat relationships of grassland birds to stabilize or reverse population trends. We conducted roadside point count surveys at 102 sites and utilized route stops from 21 routes of the North American Breeding Bird Survey (BBS) to estimate occupancy rates and habitat relationships for northern bobwhite (*Colinus virginianus*), eastern meadowlark (*Sturnella magna*), and dickcissel (*Spiza americana*) in the Black Belt Prairie region of the Southeastern U.S. We also sampled BBS route stops to decrease sites with low open habitat composition. Using Bayesian multi-season occupancy modeling, we found all species responded positively to grassland connectivity. Meadowlarks and dickcissels also had a positive relationship to open habitat composition. BBS occupancy-habitat relationships also found grassland birds had a positive relationship to open habitat composition. Our findings suggest that managing the composition of agriculture, hay/pasture, and grassland land cover types, along with increasing landscape scale distribution of grasslands, can increase occupancy of grassland birds in the Southeastern U.S. Additionally, conservation actions should focus on local and landscape scale habitat features to benefit multiple grassland bird species.

### **Potential effects of climate change on distributions of six endangered Mexican hummingbird species**

Teresa Feria - University of Texas Pan American, Edinburg, TX, United States; Carlos Lara - Universidad Autónoma de Tlaxcala, de Tlaxcala de Xicohténcatl, Tlaxcala, México; Jon Dale - Texas Citrus Pest & Disease Management Corporation, Weslaco, TX, United States; Mayra Oyervides - University of Texas Pan American, Edinburg, TX, United States

Climate change is affecting the distribution of species worldwide and in order to set sound conservation plans, special attention should be given to those species with restricted geographic distributions. We use a maximum entropy approach to forecast the potential effects of climate change (year 2050) on six endemic Mexican hummingbirds with reduced geographic distribution, potential population declines and loss/modification of their habitat: *Campylopterus excellen*, *Lophornis brachylopha*, *Thalurania ridgwayi*, *Eupherusa cyanophrys*, *Eupherusa poliocerca*, and *Doricha eliza*. We obtained distribution data from online sources (GBIF and REMIB) and personal databases, and we used current climate data from worldclim. We use 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 area under the curve (AUC) in a receiver operator characteristic. Final models and AUC were the average of the 10 models. We converted the average maps into binary (0-1) maps to calculate loss/gain areas in the future. Our findings show that all species could experience contractions in their potential distributions in the future. Some of these contractions could occur in areas where populations of the target species have been recorded. It is imperative to include these types of results in conservation strategies in order to help mitigate the effects of climate change for these species in the future. For example, buffer zones should be

created around some established natural protected areas in Mexico.

### **Grabbing a bite with peripheral vision: The avian ground forager visual paradox**

Esteban Fernandez-Juricic - Purdue University, West Lafayette, IN, United States

Birds can achieve the highest chromatic visual resolution within their foveae. However, the foveae of ground foragers, like house sparrows, do not project into their binocular fields, but to the lateral fields. This generates a paradox: when the beak goes after a food item, birds use their peripheral vision (i.e., binocular fields), which has lower chromatic resolution. We predicted that house sparrows would increase the use of their lateral fields (foveae projection) in a chromatically challenging foraging substrate (e.g., lower chromatic contrast). We first assessed intra-retinal variation in house sparrows, and found enhanced chromatic sensitivity in the foveal field and enhanced achromatic sensitivity in the binocular field. Additionally, the ratio of achromatic to chromatic cones was higher in the binocular than foveal fields. The use of head positions associated with the lateral fields did not differ significantly between substrates with different chromatic contrasts. However, birds used their binocular fields (retinal periphery) significantly more than their lateral fields (foveae projection) in both treatments. Finally, the seed finding rate was significantly higher in the treatment with higher achromatic than chromatic contrast. Overall, house sparrows explored visually more with their binocular fields and foraged more successfully in the treatment with the higher achromatic contrast. Food detection at close distances seems driven mostly by achromatic cues and the binocular fields, which are subtended by a portion of the retina with higher ability to handle achromatic than chromatic visual tasks.

### **Effects of point-count duration on estimated probabilities of detection and occupancy of breeding birds**

Erica Fleishman - University of California, Davis, CA, United States; Matthias Leu - College of William and Mary, Williamsburg, VA, United States; Matt Farnsworth - Conservation Science Partners, Fort Collins, CO, United States; David S Dobkin - High Desert Ecological Research Institute, Bend, OR, United States

There are trade-offs between the number of point counts, geographic extent of sampling, and count duration. We conducted 100-m fixed-radius point counts of breeding birds during 2012 and 2013 in the Chesapeake Bay Lowlands, central Great Basin, and western Great Basin (131, ca. 300, and 158 points, respectively). We visited each point three times per year for 8 min, the maximum duration at which no reduction in number of points was necessary. We differentiated between detections during the first 5 min and the second 3 min. We modeled single-season occupancy in 2012 and 2013 for species detected during the full 8-min counts and the 8-min counts truncated at 5 min. We estimated occupancy for all species with an annual detection probability = 0.3. We tested whether the occupancy estimates were significantly different when based on 5-min versus 8-min counts. We also evaluated the number of species for which detection probabilities increased from < 0.3 during the first 5 min to = 0.3 during the last 3 min. We calculated occupancy estimates for an average of 48% (SD 9%) of the species in a given ecosystem. In 80% of the models, mean occupancy was greater when based on 8-min than on 5-min counts. However, in no case were these differences statistically

significant, and the 95% confidence intervals overlapped. Whether these differences would affect models of species richness based on occupancy models is unclear. For an average of 6% (SD 3%) of the species detected in a given ecosystem, detection probabilities increased from < 0.3 to = 0.3 during 5-8 min. There was no clear pattern in the attributes of species that only were detected from 5-8 min. A longer count may have little effect on estimates of occupancy, but may substantially increase the number of species detected.

### **Combining citizen science derived species distribution models and stable isotope analysis reveals migratory connectivity in a secretive species, the Virginia rail (*Rallus limicola*)**

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Stable hydrogen isotope ratio (dD) approaches to understanding animal movement can achieve good latitudinal resolution. However, assignments often still have limited utility because broad longitudinal regions share similar dD of precipitation. Incorporating other sources of information may mitigate many limitations of isotope-based assignments. We developed a Bayesian framework to refine isotopic estimates of migrant animal origins conditional on species distribution models informed by thousands of observations recorded by citizen-scientists. To illustrate the utility of this approach, we analyzed the migratory connectivity of the Virginia rail (*Rallus limicola*), a secretive and declining migratory wetland game bird in North America. Incorporating species distribution models compensated for the ecological naïveté of dD models, resulting in relatively high-resolution, narrow assignments. Combined analysis of dD and species distribution models predicted that most Virginia rails wintering across five Gulf Coast sites spent the previous summer around the Great Lakes or Chesapeake Bay watershed. Conversely, the majority of migrating Virginia rails from a site in the Great Lakes most likely spent the previous winter on the Gulf Coast between Texas and Louisiana. Virginia rail seasonal connectivity does not fully correspond to the administrative flyways used to manage migratory birds, which were delineated based on data from unrelated but more conspicuous species. Our approach utilizes widely available, crowd-sourced data to improve our understanding of the movements of migratory animals.

### **The evolution of rangeland conservation thanks to one man's elegant figure**

Samuel Fuhlendorf - Oklahoma State University, Stillwater, OK, United States; Craig A Davis - Oklahoma State University, Stillwater, OK, United States; R. Dwayne Elmore - Oklahoma State University, Stillwater, OK, United States; David M. Engle - Oklahoma State University, Stillwater, OK, United States; Torre J Hovick - North Dakota State University, Fargo, ND, United States

Placeholder

### **WSR-88D dual-polarization signatures of known birds**

Sidney A. Gauthreaux, Jr. - Department of Civil and Environmental Engineering, University of Illinois, Urbana-Champaign, Illinois, United States

The dual-polarization (simultaneous transmission of orthogonally oriented pulses) upgrade to the national network of WSR-88D (Weather Surveillance Radar-1988 Doppler) radars was completed in the summer of 2013. In addition to the original radar products the upgrade enables three new moments of return: differential reflectivity, correlation coefficient, and differential phase. The new moments can be used to discriminate different types of meteorological targets, to separate meteorological and biological targets, and to characterize return from insects and birds. In nearly all studies of the polarimetric signatures of biological targets, the identity of the targets has been based on assumptions (e.g., insects during the day but migrating birds at night) and not validated. I will present data on polarimetric signatures from known bird movements and compare them with those from known insect movements and relate my findings to those reported by other investigators (e.g., Zrnić and Ryzhkov, 1998; Zhang et al. 2005; Jiang et al. 2013; and Van Den Broeke 2013).

#### **Breeding bird response to experimental forest management in the Missouri Ozarks**

Andrew George - University of Missouri, Columbia, MO, United States; Dana Morris - University of Missouri, Columbia, MO, United States; Paul Perneluzi - Central Methodist University, Fayette, MO, United States; Janet Haslerig - Missouri Department of Conservation, Jefferson City, MO, United States; John Faaborg - University of Missouri, Columbia, MO, United States

The Missouri Ozark Forest Ecosystem Project (MOFEP) is a landscape-scale manipulative study designed to evaluate ecosystem responses to silvicultural practices over broad time scales. Nine experimental plots (mean area = 400 ha) were established in southeastern Missouri in 1991 and assigned to even-aged, uneven-aged, or no-harvest management cycles within a randomized-complete block design. We spot-mapped birds and monitored nests on each plot for five years pre-harvest, 14 years following the first harvest, and three years following the second harvest. Densities of four of five mature-forest species decreased on all sites following harvests and have not returned to pre-harvest levels, including on no-harvest sites. Densities of early successional species were low on all sites prior to the first harvest, but increased on even-aged and uneven-aged sites following harvests. After peaking within six years of harvest, densities of early-successional species gradually decreased to near pre-harvest levels. Nest-survival was similar among management types for both mature-forest and early-successional species, although nest-parasitism rates were generally higher for early successional species. More frequent even-aged reentry intervals (< 10 years) may be sufficient to maintain early-successional species on the landscape, but understanding effects of management practices on mature forest species will require closer examination of the spatial and temporal sensitivity of individual species.

#### **Indirect effects of power lines on Greater Sage-Grouse demographic rates are driven by Common Ravens**

Daniel Gibson - University of Nevada, Reno, NV

Energy infrastructure has been associated with altering wildlife community dynamics by influencing survival, reproduction, and movements of individuals. Power lines, specifically, may indirectly impact habitat selection, beyond the immediate

footprint of the corridor, through avoidance behaviors related to increased harassment of predators that are positively associated with elevated structures. In addition to avoidance responses, power lines may indirectly suppress various vital rates for certain species as a function of increased predator abundance or predator foraging performance along power line corridors. Greater sage-grouse (*Centrocercus urophasianus*), a species of conservation concern across western North America, have been suspected to be indirectly affected by power lines related to changes in predator dynamics associated with power lines. Previous studies, however, have failed to provide evidence regarding the causal mechanism directly influencing vital rates, nor have they controlled for variation in demographic rates related to environmental heterogeneity. Here, our primary objective was to assess the influence of power lines on multiple sage-grouse vital rates, based on Greater sage-grouse and Common raven (*Corvus corax*) demographic data collected from 2003-2012 in central Nevada, that accounted for various sources of underlying environmental heterogeneity. We focused primarily on a single transmission line that was constructed at the beginning of our monitoring efforts, however, we also determined if similar patterns were observed with all other nearby power lines. We found that numerous demographic rates (e.g., nest site selection, nest survival, recruitment, and population growth) were indirectly affected by power lines, and that these negative effects were predominantly explained by variation in Common raven abundance or distribution. More importantly, we found that latent environmental heterogeneity in this system, if unaccounted for, could either mask or exacerbate the negative effects attributed to power lines for half of the analyses considered, highlighting the importance of both study and analytical design.

#### **Severe weather impacts on an unpredictable system: Wetland dynamics and shorebird stopover decisions in a highly-altered landscape**

Caitlyn Gillespie - Cooperative Fish & Wildlife Research Unit, University of Nebraska, Lincoln, NE, United States; Joseph J. Fontaine - Cooperative Fish & Wildlife Research Unit, University of Nebraska, Lincoln, NE, United States

Stopover habitat is essential for the success of long-distance migration; yet birds must frequently make habitat decisions in unfamiliar environments. For species such as shorebirds that depend on ephemeral wetland systems in mid-continental North America, stopover habitat is naturally unpredictable and has become increasingly altered by land-use change. The increasingly sparse distribution of wetland habitat creates challenges for management, because while managers may manipulate water levels in preparation for early spring migrants such as waterfowl, the phenology of shallow-water and mudflat habitat for shorebirds changes rapidly in response to local weather events. However, while drought and land-use change may limit wetland availability during spring migration, unpredictable severe thunderstorms also have the potential to enhance or create shorebird stopover habitat, as shorebirds will also utilize shallow agrarian wetlands in highly agricultural landscapes. In the Rainwater Basin, we monitored habitat use of *Calidris* shorebirds at managed wetlands during spring migration in 2013 and 2014 and also monitored how the size and structure of wetlands and the surrounding landscape responded to local weather events. We discuss the implications of drought and unpredictable rainfall events on the persistence of shorebird habitat in highly altered landscapes and managed wetland complexes, and suggest future avenues for research



and discussion of how severe weather events in combination with forecasted climate and land-use change may impact species that rely on highly unpredictable habitat.

### **Kin-biased conspecific brood parasitism in a native mandarin duck population**

Ye Gong - Gainesville, FL, United States

Conspecific brood parasitism (CBP) is an alternative reproductive tactic, where clutches contain eggs laid by different females but eventually tended by a single female. This is common in waterfowl, where females often return to their natal area. This raises the possibility that close relatives cooperate with each other to gain benefits from inclusive fitness, and may explain why females expend effort in raising offspring that are not their own. Here we test the hypothesis that host and parasite are more related than expected by chance in native mandarin ducks. High relatedness of host-parasite pairs driven by random interactions among neighbors was used as a null hypothesis. Parasitism and pairwise relatedness were estimated with 8 polymorphic microsatellite markers. We found that 191 of 496 (38.5%) of ducklings were mothered by females other than their hosts; and 30 of 41 (73.2%) nests analyzed contained parasitic offspring. Analyses of relatedness supported the hypothesis that high relatedness of host-parasite pairs exists: relatedness between host mother and their parasitic ducklings ( $0.123 \pm 0.018$ ) was significantly higher than that of host mothers and the ducklings in other nests ( $0.023 \pm 0.004$ ), so hosts were, on average, more related to their parasites than to the other breeding females in the population. Relatedness was higher between host-parasite pairs than between close neighbors. There was no correlation between relatedness and distance among nests, indicating that host-parasite relatedness cannot be explained by female philopatry alone. In addition, we found the relatedness to the host was positively related to the number of eggs laid by a parasite in the nest, indicating parasites made decisions about egg-laying based on relatedness. Kin selection may play a role in the evolution of CBP in waterfowl, though explicit fitness benefits to the hosts still need to be determined.

### **Structure of the bird-flowering plant network in the elfin forest of the Andes**

Oscar Gonzalez - University of Florida, Gainesville, FL, United States; Bette Loiselle - University of Florida, Gainesville, FL, United States

The plant-pollination network is an important system that helps us to understand the functioning of ecological processes and the interactions among various actors. Nectarivorous birds (hummingbirds and flowerpiercers), which play an important role in many pollination networks, may be good biological indicators for ecosystem integrity, because they have strong ties to plants. Here we investigate bird-flowering plant network in the elfin forest of the central Andes of Peru from 2011 to 2014. We chose elfin forest as it is a poorly known ecosystem located at the top of the tropical montane forest zone, and is likely among the ecosystems most affected by climate change and anthropogenic destruction. Among other bird guilds, nectarivorous birds dominate this ecosystem, making elfin forests an ideal system to study bird-pollination networks. We asked what factor - abundance, phenology or forbidden interactions (morphological mismatch) of interacting species - best explained network characteristics. To build the network of interactions between birds and plants, we used direct observations. We measured abundance of birds using mist-

nets, while we use transects to measure flower abundance. We compared the length of birds' bills to flower length to identify "forbidden interactions". The hummingbirds *Metallura theresiae* and *Pterophanes cyanoptera* were the most important flower visitors in the network. Each of these species was found in separate network modules with the plants *Brachyotum lutescens* and *Tristerix longibracteatus* respectively. The network structure was not nested as has been found in other bird-flowering plant networks. We found that phenology best explained network structure. Due to the presence of flowerpiercers, it is possible that the birds overcome the forbidden interactions and morphology was not the main driver of this network structure. Our results can help conservation efforts on the elfin forest, focusing in the species that are most connected of the network.

### **Grassland bird response to weather in the Badlands and Prairies of the U.S.**

Jessica Gorzo - University of Wisconsin, Madison, WI, United States; Anna Pidgeon - University of Wisconsin, Madison, WI, United States; Wayne Thogmartin - Upper Midwest Environmental Sciences Center, La Crosse, WI, United States; Andrew Allstadt - University of Wisconsin, Madison, WI, United States; Volker Radeloff - University of Wisconsin, Madison, WI, United States

Grassland ecosystems in the central U.S. occur in climates that are characterized by variable weather. Grassland bird species exhibit behaviors and life-history traits, including low philopatry between years, that presumably are strategies that increase their fitness under these variable conditions. We examined the response of 14 relatively abundant grassland birds to changes in weather in the Badlands and Prairies Bird Conservation Region (BCR 17) from 1980-2012 using data from the North American Breeding Bird Survey (BBS). We used Bayesian hierarchical models to compare bird abundance with weather conditions affecting breeding habitat conditions. Specifically, we considered the Standardized Precipitation Index for March-May, and average June temperatures. We found that populations of Grasshopper sparrow (*Ammodramus savannarum*), Baird's sparrow (*A. bairdii*), vesper sparrow (*Pooecetes gramineus*), Sprague's pipit (*Anthus spragueii*), and horned lark (*Eremophila alpestris*) responded to weather, whereas mourning dove (*Zenaida macroura*), eastern kingbird (*Tyrannus tyrannus*), clay-colored sparrow (*Spizella pallida*), field sparrow (*S. pusilla*), lark sparrow (*Chondestes grammacus*), Brewer's blackbird (*Euphagus cyanocephalus*), and brown-headed cowbird (*Molothrus ater*) did not. Species that responded to weather were either sensitive to SPI alone, or to SPI in conjunction with temperature. The direction of the response varied among species corresponding with their life history traits. Species that responded positively to precipitation (e.g. Baird's Sparrow, *Sprague's pipit*) are species that prefer wetter microsites or require a minimum level of vegetative cover. Species that responded negatively (e.g. upland sandpiper, vesper sparrow) either occupy drier sites or have habitat constraints beyond local site condition.

### **Avian malaria and body condition in four species of North American songbirds**

Carolina Granthon - Texas Christian University, Fort Worth, TX, United States; Dean Williams - Texas Christian University, Fort Worth, TX, United States

Avian malaria is a common disease in songbirds, caused by protozoans in the genera *Plasmodium*, *Haemoproteus*, and

Leucocytozoon. These parasites can negatively impact bird survival, reproductive success, and body condition. We tested parasite infection in four species of songbirds sampled during the reproductive season; the American redstart (*Setophaga ruticilla*), the gray catbird (*Dumetella carolinensis*), the cedar waxwing (*Bombicilla cedrorum*), and the red-eyed vireo (*Vireo olivaceus*). Blood samples from 406 individuals were collected at Powdermill Avian Research Center in southwestern Pennsylvania from May to July, 2014. The study aimed to determine parasite prevalence in each species, to evaluate a relationship between infection and body condition, and to discover if a particular age or sex group is more vulnerable to infection. Due to their different breeding strategies, we predicted that female redstarts and vireos would be more stressed than males during the reproductive season, while stress would not differ by sex in catbirds and waxwings. Results detected a high parasite prevalence using PCR (94%) but a much lower one using microscopy (37%), suggesting that prevalence is high, while parasitemia is low. Parasite infection did not affect any of the three measures of body condition (mass, hematocrit, and heterophil/lymphocyte (H/L) ratio). However, we found that within infected vireos, females had a higher H/L ratio than males, as expected, whereas there was no sex difference in H/L ratios in any of the other species. We also found an important time component in waxwings, in which breeding birds, sampled in June-July, had higher parasite prevalence than migrating birds, sampled in May. Breeding birds also had lower mass, hematocrit, and H/L ratios than migrating birds. Previous studies have associated a lower H/L ratio with infection by Leucocytozoon, a parasite genera which was common in waxwings sampled in this study, but not in the other species.

#### **Imperfect past and present progressive: Developmental and adult conditions are reflected in a secondary sexual ornament**

Jennifer Grindstaff - Oklahoma State University, Stillwater, OK, United States; Madeleine Naylor - Oklahoma State University, Stillwater, OK, United States; Loren Merrill - Oklahoma State University, Stillwater, OK, United States

Secondary sexual traits should convey information about an individual's underlying condition. Beak color in Zebra Finches (*Taeniopygia guttata*) is a dynamic trait that can change over the course of a few hours or days as circulating levels of carotenoids vary. In addition, early life stressors can influence the expression of the red coloration in the beak. In this study, we were interested in the capacity for exposure to the antigen keyhole limpet hemocyanin (KLH) during the early post-natal stage of life to impact beak color expression in captive adult zebra finches. In addition, we tested whether antigen challenge during adulthood impacted beak color, and if early life experience influenced changes in beak color after challenge. Offspring were challenged with KLH on days 5 and 28 post-hatch. We examined the proportion of the beak that was red on days 50 and 65 post-hatch to assess rate of beak color development. When the birds were 3 years old, we assessed beak color prior to and following KLH challenge. We found that individuals exposed to KLH as nestlings exhibited delayed development of the red beak coloration, and males exposed to KLH as nestlings had reduced red coloration as determined by hue and saturation in adulthood. Following adult KLH challenge, males exhibited a decrease in bill saturation and brightness. However, there was a significant interaction between post-natal treatment and antibody production in response to KLH challenge. Among males that were not

exposed to KLH as offspring, individuals that exhibited larger changes in brightness and saturation of the beak color mounted weaker antibody responses. These results provide strong evidence that beak color reflects both developmental conditions and current conditions, and that the signal is honestly linked to critical physiological processes.

#### **Pre-hatch gut microbiota of shorebird chicks: Sterile or not?**

Kirsten Grond - Kansas State University, Manhattan, KS; Richard B. Lanctot - U.S. Fish and Wildlife Service, Anchorage, AK, United States; Ari M. Jumpponen - Kansas State University, Manhattan, KS, United States; Brett K. Sandercock - Kansas State University, Manhattan, KS, United States

Gut microbiota play an important role in maintaining organismal health and growth. Unlike organisms that establish their gut microbiota through the process of birth, avian embryos have been hypothesized to be sterile prior to hatch and gain their microbiota solely from environment. In the high arctic environment where the growing season is short, self-feeding precocial chicks of shorebirds may benefit from hatching with basic microbial communities in their gut. There are several mechanisms through which microorganisms could be transferred to the embryo. Microorganisms can penetrate from the outside, through the eggshell and membrane, or be present in the egg from the moment of egg formation. We tested the hypothesis that chicks hatch sterile through identification of gut microbial communities of shorebird chicks prior to hatch. We predicted that shorebird embryos have a rudimentary gut microbiota existing of few bacterial taxa in low abundances, and that they acquire these microbes from the mother during egg formation. In 2013, we collected embryos of 30 Dunlin and 21 Semipalmated Sandpipers 1-3 days before hatch in Barrow, AK, as well as maternal fecal samples. We extracted DNA from embryo gut and fecal samples, and are in the process of sequencing the 16S rRNA region of the bacterial genome with use of the Illumina sequencing platform. Preliminary results from our pre-sequencing PCR indicated the absence of bacteria in our embryo gut samples, or very low abundances that are below our detection limit. We will sequence the embryo microbial communities and, if present, discuss bacterial composition, transmission routes, and individual, clutch and species-related variation in gut microbiota. In addition we will contrast gut microbial communities of Dunlin and Semipalmated Sandpiper identified from the collected maternal fecal samples.

#### **Systematic ID biases in citizen science, and implications in research databases**

Joseph Grzybowski - University of Central Oklahoma, Edmond, OK, United States

Citizen science is the collection of data by members of the general public that can be used to assess various dimensions of avian population dynamics and distribution. It includes such efforts as Christmas Bird Counts begun in the early 1900s, and expanded to Breeding Bird Surveys, atlasings, etc. Ornithologists mining such data recognize that errors will be embedded, but operate under general assumptions that this "noise" is low relative to the biological patterns depicted. eBird only came on the scene in 2002, but its data of individual checklists can be used to examine the presence and effects of one issue—systematic ID biases, and their potential influence on biological patterns. Specifically here, I examined data on spring departure dates of a common species, the Song Sparrow (*Melospiza*

*melodia*) from Oklahoma and Texas. This perceived departure overlaps with migrations of other similar sparrow species, in particular Lincoln's Sparrow (*M. lincolni*) creating the potential for ID biases. ID biases in this group occur because of focus on single character ID, but also observer exposure to each species reflected by observer zipcode—in-state or out-of-state. Out-of-state observers from areas where Lincoln's Sparrows are rare relative to Song Sparrows have a substantially higher chance (~0.7) of recording their ID bias than Texas observers, although Texas observers are not without bias (~0.3). This bias involved hundreds of observations in the eBird database. It is likely widespread, and should be considered not only in citizen science efforts, but also for individuals collecting survey data for various research projects.

#### **Genetic and isotopic population assignments reveal limited connectivity between coastal and inland populations of rails**

Laurie Hall - University of California, Berkeley, CA; Steven R. Beissinger - University of California, Berkeley, CA

Connectivity of populations, via dispersal and gene flow, can reduce inbreeding and increase the persistence of species across landscapes. We observed a single band return from a California black rail (*Laterallus jamaicensis coturniculus*) that dispersed 128 km between a coastal and an inland population in Northern California. To assess the degree of connectivity between these populations, we used genetic and isotopic population assignments to estimate the number of migrants between them. Genetic population assignments of 336 rails were performed in program Structure with 16 microsatellite loci, and isotopic population assignments were performed for 251 rails with a quadratic discriminant function generated from stable carbon, nitrogen, and sulfur isotope data measured in secondary feathers. We assessed accuracy by performing genetic and isotopic population assignments on simulated genotypes and isotopic signatures. No migrants were identified with genetic or isotopic population assignments. The discriminant function assigned eight rails to a population that differed from their capture location, but the isotope values in these rails may have been caused by isotopic anomalies in the environment at the capture location, rather than by migration between populations. Accordingly, these individuals were not classified as migrants. Genetic population assignments of simulated genotypes or discriminant function analysis of simulated isotopic signatures were highly accurate (99% and 96%, respectively). Long distance dispersal events between the coastal and the inland populations appear to be extremely rare. Management actions may be necessary to increase connectivity of these populations, thereby increasing the persistence of black rails in Northern California.

#### **Projecting the effects of landscape change on connectivity of bird communities**

Laurie Hall - University of California, Berkeley, CA; Steven R. Beissinger - University of California, Berkeley, CA

Laurie has nearly completed her dissertation research at the University of California, Berkeley and will be teaching conservation biology next year at Humboldt State University. She employs a number of methods to measure connectivity of threatened and endangered birds, including radio-telemetry, genetics, and stable isotope chemistry. With a B.S. and a M.S. in Marine Science, and a Ph.D. in Environmental Science, Policy, and Management, Laurie has worked in marine and terrestrial systems with diverse anthropogenic effects. Her research

helped prevent the de-listing of Marbled Murrelets (*Brachyramphus marmoratus*) from the California Endangered Species List and parameterize landscape resistance surfaces to inform wetland restoration efforts for the threatened California Black Rail (*Laterallus jamaicensis coturniculus*). Laurie's future research will examine changes in connectivity between historic and contemporary landscapes, and will compare connectivity among species to project the future effects of development and climate change on bird communities. To learn more, please visit

[https://www.cnr.berkeley.edu/beislab/BeissingerLab/?page\\_id=245](https://www.cnr.berkeley.edu/beislab/BeissingerLab/?page_id=245).

#### **A pedigree gone bad: Increased offspring survival using DNA-based relatedness to minimize inbreeding in a captive population**

Susan Hammerly - University of North Texas, Krum, TX, United States; David de la Cerda - University of North Texas, Denton, TX, United States; Hannah Bailey - Houston Zoo, Houston, TX, United States; Jeff Johnson - University of North Texas, Denton, TX, United States

Captive breeding programs often use a pedigree to identify breeding pairs that maintain genetic diversity and limit inbreeding. However, unintentional breeding of closely related individuals can occur when errors exist in the pedigree and may subsequently result in inbreeding depression. In this study, a DNA-based approach was used to identify parentage assignment errors in the captive pedigree of the critically endangered Attwater's Prairie-Chicken (*Tympanuchus cupido attwateri*), and then explore how such errors may influence chick survival post-hatch. Parentage assignment error was observed in each year surveyed ranging from 2.4 to 7.3%. After correcting identified errors prior to the 2013 breeding season, 11 of 38 assigned breeding pairs still possessed DNA-based relatedness coefficients ( $r_{DNA}$ ) = 0.125 suggesting that additional errors remained in the pedigree. Two approaches were used to prevent breeding among close relatives in 2013 and 2014. In 2013 pedigree assigned breeding pairs that possessed  $r_{DNA}$  = 0.125 were reassigned unrelated breeding partners, while in 2014 breeding pairs were assigned to minimize  $r_{DNA}$  for the breeding population without reference to the pedigree other than to verify founder representation. Both years resulted in a significant reduction in mean parental relatedness among chicks ( $p < 0.001$ ) and a significant increase in the proportion of the clutch surviving to five weeks post-hatch ( $p = 0.006$ ) compared to 2012 when breeding pairs were assigned based solely on the pedigree. Despite 2014 resulting in a significantly reduced overall parental  $r_{DNA}$  among offspring compared to 2013 ( $p < 0.001$ ), no significant difference in the proportion of the clutch surviving was observed between the two years ( $p > 0.300$ ). These results have important implications for the captive management of endangered species, and highlight the importance of periodically evaluating pedigrees for errors to ensure they accurately represent relationships within the population.

#### **Birds in space: Genetic consequences of habitat fragmentation in Brown-headed Nuthatches (*Sitta pusilla*)**

Kin-Lan Han - University of Florida, Gainesville, FL, United States; Jim Cox - Tall Timbers Research Station, Tallahassee, FL, United States; Rebecca Kimball - University of Florida, Gainesville, FL, United States

In the southeastern U.S., land management practices such as land conversion, logging, and fire suppression have resulted in

fragmentation and loss of pine habitat. The degree of fragmentation and habitat loss varies. In northern Florida, pine forests remain in large patches, whereas in central and southern Florida, the pine forests are much more fragmented and found in smaller patches. Therefore, populations of pine-restricted species in central and southern Florida should show lower genetic variation and greater genetic structure compared to northern populations. We assessed the effect of habitat fragmentation on genetic structure in Brown-headed Nuthatches (*Sitta pusilla*), a cooperatively breeding bird endemic to mature southeastern old growth pine forests. We genotyped nine microsatellite markers for 390 individuals from 13 populations located throughout Florida. We found no differences in heterozygosity or effective numbers of alleles among populations. AMOVA results indicate that most variation in our samples is found within populations with very little found among populations and pairwise  $F_{ST}$  values were low. STRUCTURE analyses found  $K=3$  clusters corresponding to a northern cluster, a southern cluster, and a unique population that was likely isolated by scrub and grassland vegetation, and not due to anthropogenic activities. However, the use of sampling localities as prior information in STRUCTURE analyses supports  $K=6$  clusters, suggesting the presence of weak population structure. The additional structure is found in our central and southern populations suggesting that Brown-headed Nuthatches may be affected by habitat fragmentation though insufficient time has passed for us to see a strong effect following anthropogenic changes.

#### **At the intersection between perception, behavior, and evolution: How I study nature's colors**

Daniel Hanley - Palacký University, Olomouc, Olomoucký kraj, Czech Republic;

My research program is broadly integrative and examines the ecological and selection pressures that shape natural colors. The questions I address are guided by natural history and have three major themes: perception, behavior, and evolution. I use avian eggshell coloration as a model system, because despite striking diversity in colors and patterns, the ultimate and proximate mechanisms causing this variation are still uncertain, and only two pigments are thought to be responsible for all egg colors. This simplicity makes avian eggshell coloration ideal for understanding evolutionary or ecological theory, and for experimental design. My research has shown that egg coloration may be a costly cue, as perceived by humans or birds, a valuable signal impacting parental behavior and behavior-related morphology, and that various environmental and ecological factors shape the colors of birds' eggs from all avian orders. This research applies state-of-the-art chemistry, custom-written programs, as well as novel evolutionary theory. By addressing a diversity of questions and using various approaches my research has provided a better understanding not only about why our world is colorful, but also how it got that way.

#### **The role of pigments in the (limited) diversity of avian eggshell colors**

Daniel Hanley - Palacký University, Olomouc, Olomoucký kraj, Czech Republic; Tomáš Grim - Palacký University, Olomouc, Olomoucký kraj, Czech Republic; Phillip Cassey, University of Adelaide, Adelaide, Australia; Mark Hauber - Hunter College, New York, NY, United States)

Birds' eggshells are renowned for their striking colors and varied patterns that are often considered exceptionally diverse.

Nonetheless, we report that avian eggshell coloration occupies only 0.08–0.10% of the avian perceivable colorspace. In theory we would expect that the concentrations of the two known tetrapyrrole eggshell pigments (protoporphyrin and biliverdin) should predict colors, but they are generally poor predictors of eggshell color, both intra- and inter-specifically. Here, we show that the constrained diversity of eggshell coloration can be accurately predicted by color mixing models based on the relative contribution of both pigments and we demonstrate that the models' predictions can be improved by accounting for the reflectance of the eggshell's calcium carbonate matrix. The establishment of these proximate links between pigmentation and color will enable future tests of hypotheses on the functions of perceived avian eggshell colors that depend on eggshell chemistry. More generally, color mixing models are not limited to avian egg colors but apply to any natural color. Our results also illustrate how modelling can aid the understanding of constraints on phenotypic diversity.

#### **Investigating the influence of stand and landscape-scale factors on priority bird occupancy to aid in open pine restoration**

Taylor Hannah - Mississippi State University, Starkville, MS, United States; John Tirpak - Gulf Restoration Program, USFWS, Lafayette, LA, United States; Zachary Loman - Mississippi State University, Starkville, MS, United States; Greg Wathen - Gulf Coastal Plains & Ozarks LCC, TWRA, Nashville, TN, United States; Scott Rush - Mississippi State University, Starkville, MS, United States

Identifying species occurrence in ecosystems of high conservation concern is especially important in the context of modern landscapes. This study investigated how stand-scale and landscape-scale factors affect priority birds associated with longleaf pine (*Pinus palustris*) ecosystems. Longleaf pine historically occurred across the Atlantic and Gulf Coastal Plains of the United States but today remains in only ~ 3% of this historic range. Conservation and restoration of longleaf ecosystems is now considered a high priority by a number of organizations. However, increasing the acreage of longleaf habitat alone may not translate to a proportional increase in species occurrence, abundance, or diversity. Species such as Bachman's Sparrow (*Peucaea aestivalis*), Red-cockaded Woodpecker (*Picoides borealis*), Brown-headed Nuthatch (*Sitta pusilla*), and Northern Bobwhite (*Colinus virginianus*) have been identified as priority species in open pine ecosystems. Incorporating field sampling, geospatial analysis and occupancy modeling, my study investigated how landscape and stand-scale factors relate to the distribution of priority avian species that reflect "high quality" longleaf ecosystems. I compared priority bird occupancy among 12 stand types throughout the historic range of longleaf pine. I found open pine stands positively influenced Red-cockaded Woodpecker and Bachman's Sparrow occupancy, but were not significantly linked to northern bobwhite and brown-headed nuthatch occurrence. Landscape and stand-scale factors affected Red-cockaded Woodpecker, Bachman's Sparrow, and Brown-headed Nuthatch occupancy. Northern Bobwhite occupancy was influenced solely by landscape-scale factors. Red-cockaded woodpecker and Bachman's sparrow were positively influenced by metrics associated with longleaf pine ecosystems suggesting they are effective indicator species. My analysis suggests that using this multi-scale approach is valuable to identifying areas on the landscape of conservation and restoration priority.

## **Avian malaria diversification across contrasting regions of Africa**

Johanna Harvey - Texas A&M University, College Station, TX, United States

Avian haemosporidians, the broad suite of malaria and related parasites (*Plasmodium*, *Leucocytozoon* and *Haemoproteus*), demonstrate a high degree of diversification, with 1,873 currently known unique molecular haplotypes (Malawi database; Bensch 2009). Despite this diversity little is known about their distributions and host associations, particularly in underexplored regions like Africa. Our research examines malaria parasites sampled from avian hosts collected in Benin and the Democratic Republic of the Congo (DRC) (n=211 and n=427 hosts respectively), two countries where no avian malaria parasite sampling has been done. These countries contrast sharply in habitat types and environmental variables: the DRC has tropical to subtropical forests while Benin has some subtropical forest along with savanna and savanna forest mosaics. This difference in environment and habitat leads us to hypothesize that DRC will have a higher *Plasmodium* infection rate due to the climate and the vectors characterizing this sampling region as compared to Benin. We collected mitochondrial DNA sequence data from the Cytb gene of infected hosts. We use maximum likelihood and Bayesian analyses to reconstruct a phylogenetic hypothesis and provide estimates of support for haemosporid diversification and relationships. Further, we assess the diversity across contrasting sampling regions, habitats and in the context of the already known haemosporid diversity to inform the broader avian haemosporid phylogeny.

## **Parallel molecular evolution on the Z-chromosome in species of ducks with parallel transitions in sexual dichromatism/ monochromatism**

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There are numerous examples of phenotypic parallel evolution, but there is a lack of in-depth analysis of its genetic basis. Recent advances in sequencing technologies and improvements in population genetic modeling techniques have made it possible to better assess genomic signatures of parallel evolution. In this study we used a genomic scan to test for parallel molecular evolution in three pairs of *Anas* dabbling ducks that show parallel transitions in sexual dichromatism/monochromatism. Each species pair includes one dichromatic species (males have brightly colored plumage, whereas females have dull plumage) and one monochromatic species (both males and females have dull plumage). We used double digest restriction site associated DNA sequencing to obtain ~3,000 loci which allowed us to characterize levels of divergence. We found overall elevated Z differentiation and an island of divergence within the same region of the Z chromosome between each monochromatic-dichromatic pair. In contrast, we found no evidence of elevated Z-differentiation between closely related species with the same plumage type (e.g., monochromatic vs. monochromatic). Given that traits involved in plumage and female preference have been linked to the Z chromosome, our results suggest a candidate genomic region responsible for the parallel plumage evolution. A better understanding of the regions of the genome associated with speciation and inferring whether diagnostic morphological

characters are associated with certain islands of divergence will allow us to better understand parallel evolution and the speciation process from a combined morphological and molecular standpoint.

## **Complexity in the songs of Cassin's Vireos: Markov properties and higher-order dependencies in song sequences**

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Bird songs are often said to be 'complex', but what is the nature of that complexity, and why has it evolved? Avian vocal complexity can arise in one of two ways: through an increase in vocal repertoire size, or through an increase in the complexity of syntax. While repertoire size has been studied at length for decades, we are only beginning to understand the syntax of the songs of birds and its role in communication. Here I present results from research on the songs of a wild population of fourteen male Cassin's Vireos to illustrate the complexity contained within their song sequences, and discuss possible functional explanations for the observed patterns. I ran simulations based on a large recording corpus of over 50,000 phrases to compare three potential models for the syntax of the species: a zero-order Markov model, a first-order Markov model, and a second-order Markov model. The zero-order Markov model, which is akin to a random ordering of song, clearly did not reproduce the syntax of this species. The first-order Markov model – a more complex model – provided a better fit, but was surpassed by the performance of the second-order Markov model. Though the second-order Markov model is the most complex of the three used here, it is still a relatively simple model for the description of sequences, suggesting that this species possesses a moderate level of syntactic complexity. I then show that although the second-order Markov model closely approximates the singing style of the species, the assumption of time-homogeneity in the songs was not completely satisfied. I discuss these findings in the context of both the flexibility afforded by the syntax and the predictability of the sequence, and how these factors may relate to the territorial and social dynamics of the species.

## **Explaining contrasting patterns in spatio-temporal abundance in the European Starling *Sturnus vulgaris* across Europe**

Henning Heldbjerg - BirdLife Denmark, Aarhus University, Copenhagen, København, Denmark

The European Starling (*Sturnus vulgaris*) is a widespread and common species in Europe which is declining in some parts of its range. We analysed and compared breeding population trends across Europe to investigate the causes of the declines. We fitted log-linear Poisson regression models to European Bird Census Council data from 27 national breeding bird monitoring schemes across Europe to compare and contrast annual indices of changes in abundance using TRIM software. At the continental scale, the European population declined at a mean annual rate of  $-2.01 \pm 0.26$  % during 1980-2012. However, results from national monitoring programmes showed a general cline across Europe, with most severe declines in north and west Europe in contrast to stable or increasing trends in central and eastern Europe. To investigate the fine-grained causes of these differences, we investigated the drivers behind the regional variations in Starling abundance within Denmark shown by the Danish Common Bird Census point counts carried out since 1976. Using municipal

agricultural statistics, we demonstrate a strong relationship between numbers of dairy cows and local Starling density which explains the variation in breeding abundance and trends in relation to contrasting patterns of agricultural across the country. Finally, we use agricultural statistics at the European scale to show that the Danish experience can help explain the contrasting trends in the different European countries. The current trend to keep dairy cows indoors all year round is likely to have an increasing adverse effect on breeding starlings in the future.

#### **Purple Martins, flight altitudes and fire ants: Using aerial predators to study atmospheric animal communities**

Jackson Helms - University of Oklahoma, Norman, OK, United States

Purple Martins (*Progne subis*) are one of North America's most abundant and high-flying aerial insectivores. Because of the difficulty of observing atmospheric animal communities, however, little is known about Purple Martin foraging altitudes and prey choice. We developed lightweight altitude loggers and deployed them on nesting Purple Martins in southeast Oklahoma to measure their foraging altitudes. At the same time we used nest collars to monitor the prey items that logged parents delivered to nestlings. By combining altitude data with prey identity and abundance, we not only determined what insect prey the young Purple Martins ate, but also mapped where in the atmosphere the prey species occurred. Nesting Purple Martins in this population fed predominantly on mating swarms of social insects, in particular the invasive Red Imported Fire Ant (*Solenopsis invicta*). Winged fire ant queens and males—by far the most abundant prey item—were captured on 32% of Purple Martin foraging trips and made up 56% of the total prey items and 27% of the total prey biomass delivered to nestlings. Other social insects captured in large numbers were exotic honeybees (*Apis mellifera*), subterranean termites (*Reticulitermes* sp.), and several native ant species (*Camponotus pennsylvanicus*, *Dorymyrmex flavus*, *Crematogaster laeviuscula*). Some potential agricultural pests were also heavily preyed on (*Leptoglossus* leaf-footed bugs, *Melanoplus* grasshoppers, *Tabanus* horseflies). Our method provides a novel way to study insect flight altitudes and atmospheric predator-prey networks. In addition, by quantifying Purple Martins' consumption of exotic species and agricultural pests, we take a crucial step towards calculating the ecosystem service value of these abundant aerial predators. Finally, mapping how Purple Martins use the atmosphere may prove useful in guiding the design or placement of human structures such as wind turbines and communication towers.

#### **Trails, and trail use, change avian species assemblages in forested protected areas**

Max Henschell - University of Wisconsin, Madison, WI, United States; Anna Pidgeon - University of Wisconsin, Madison, WI, United States

Many of the world's protected areas serve the dual purpose of providing wildlife habitat and public access. Typically, trails serve as corridors for humans into otherwise mostly contiguous habitat in protected areas. Trails, and trail use, may alter the avian community in forested protected areas by (1) displacing species that are sensitive to human disturbance, and (2) altering habitat characteristics along a trail corridor such that they become less suitable for forest breeding species. Here we tested whether the presence of a trail and amount of trail foot traffic affected avian community composition in forested

protected areas. We conducted point counts in 27 forest plots in the Baraboo Hills of southern Wisconsin during the summers of 2012 – 2014 in three different plot types; constructed trails, trails on old road corridors, and interior plots without trails. We measured the average number of groups of trail users per daylight hour (GPH), during the breeding season within each plot, the average tread width (WTR), and the width of the space that was vegetation free at 1.3 m above the ground (WBH). We tested whether plot type, GPH, WTR, or WBH were related to the richness of forest breeding birds and non-forest breeding species (rarefied species richness from naïve estimates of abundance of each species) using linear regression. We found that richness of forest breeding species was inversely related to GPH ( $P < 0.10$ ), while richness of non-forest breeding species was positively related to WTR ( $P < 0.01$ ). We found that the richness of non-forest breeding species along old road trails was significantly higher than interior plots (ANOVA;  $P < 0.05$ ). Our results suggest that recreational trails and trail use within forests degrade the quality of habitat for forest breeding birds, and create conditions suitable for habitat generalist species within the forest interior.

#### **Avian assemblages on altered grasslands revisited**

Jim Herkert - IL Department of Natural Resources, Springfield, IL, United States

In the early 1990s, a new guild-based approach to analyzing data from the North American Breeding Bird Survey revealed that as a group, populations of grassland birds had declined more than any other behavioral or ecological grouping of birds. That finding spurred a large increase in grassland bird research aimed at understanding the causes of declines and also spurred a large increase in conservation efforts trying to stabilize populations. In the nearly 25 years since their population declines first became widely known, a much better understanding of grassland bird ecology has been developed. Yet survey data continue to show that grassland birds remain the group of North American birds with the steepest and most widespread population declines. Conservation projects throughout the range of these species have provided local benefits, but population-level benefits have been elusive. Large-scale conservation programs, such as the Conservation Reserve Program, have reversed population declines for at least one species (Henslow's sparrows) and appear to have lessened the rate of decline for a few other species (Bobolink, Dickcissel, and Grasshopper Sparrow), but a majority of grassland bird species have long-term population trends that are worse now (1966-2013) than they were more than 20 years ago (1966-1991). Limited knowledge of the full life cycle needs of these species, along with large global population sizes for many species are major factors limiting the success of current conservation efforts

#### **Influence of ambient light on the evolution of plumage color signals**

Angélica Hernández-Palma - Louisiana State University, Baton Rouge, LA, United States; Stouffer, Philip C. - Louisiana State University, Baton Rouge, LA, United States

Plumage coloration plays an important role in bird communication; however it can be strongly affected by the type, intensity, and directionality of ambient light available in a particular habitat. The 'Light Environment Hypothesis' predicts that plumage color signals are related to the amount of light available in a bird's habitat, either to increase conspicuousness or crypsis. To test this hypothesis, we selected 33 drab, sexually

monochromatic species from the superfamily Furnarioidea (Formicariidae, Scleruridae, Dendrocolaptidae, and Furnariidae), whose distributions are within the Amazon River basin. We classified species into three groups according to the amount of ambient light available in each species' habitat: low, intermediate, and high. We then measured reflectance spectra from males and females of each species, and calculated seven color variables using the tetrahedral color space model to explain color contrast, saturation, diversity, brightness, and cryptic dichromatism. Using phylogenetic comparative methods (Brownian motion, Ornstein-Uhlenbeck with a single optimum, and with three selective regimes based on the amount of ambient light available at each habitat), we found that overall plumage saturation and brightness best fit a model that includes selective regimes based on the amount of ambient light available. Birds with lower chroma and brightness were associated with lower levels of ambient light, which suggests that plumage in these species is selected to be cryptic, matching the background of their particular habitats. This corresponds with previous findings in other clades, suggesting that light plays an important role in the evolution of plumage color even in dull-colored birds like furnariids.

#### **To everything there is a season: The role of prescribed fire seasonality on nest survival and renesting potential of the endangered Florida Grasshopper Sparrow**

Erin Hewett Ragheb - Florida Fish and Wildlife Conservation Commission, Gainesville, FL, United States; Karl Miller - Florida Fish and Wildlife Conservation Commission, Gainesville, FL, United States

The Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*) is a critically endangered subspecies endemic to the dry prairies of south-central Florida. It is dependent on prairies burned every 2-3 years, but the role of fire seasonality on demographic rates is less clear. Prescribed fires during the growing season (April-September) may mimic natural lightning ignited fires, effectively reduce hardwood encroachment, and initiate robust flowering of native grasses. However, growing season fires overlap with the nesting season and may delay nest initiation or destroy active nests. The impacts of fire on nest predation have been difficult to quantify given low nest sample sizes in previous studies. In 2013, we initiated a three-year study to examine the role of fire interval and seasonality on nest survival rates at Three Lakes Wildlife Management Area in Osceola County, Florida. The study area was divided into 32 units each receiving a prescribed fire in either the dormant (February-March) or growing (April-July) season on a two-year rotation. Daily nest survival was estimated by comparing logistic nest survival models with covariates for seasonal effects, year, nest stage, fire year, and fire season using AICc methods. The null model showed the strongest support. The mean probability of nest success (n=58 nests) was only 11% (95% CI: 1-34%). Predation was the most common cause of nest failure and did not differ substantially among any of the fire treatments. However, nest initiation dates were delayed by fires that occurred later in the season, leading to a potential reduction of the number of nest attempts and thus the total annual reproductive output. Florida grasshopper sparrows can reneest at least four times after failure at this site. Strategically scheduling prescribed fire at least one month before the nesting season may create optimal conditions for population recovery given the current high rates of nest predation.

#### **Speciation via adaptive divergence in mitonuclear respiratory genes**

Geoffrey Hill - Auburn University, Auburn, AL, United States

Species are most commonly defined as reproductively isolated populations. In conventional models of animal speciation, reproductive isolation evolves after gene flow is disrupted by discontinuities in space, time, or ecological niche. I propose a new model for speciation in animals whereby novel sets of interacting mitochondrial and nuclear genes, which create critical function in electron transport complexes, evolve as adaptive physiological responses to environmental conditions. Mitonuclear incompatibilities between populations for these novel pairs of mitochondrial and nuclear genes establish low fitness for hybrid offspring, creating barriers to gene flow. Cytochrome c oxidase subunit 1 (COX1) is implicated as the likely gene to initiate such a process because of its intimate interactions with nuclear genes that code for electron transport complex proteins and the key role that it plays in physiological innovation. By this model, the COX1 barcode gap defines species. The tight congruence between population grouping by barcode gap and population grouping by expression of ornamental traits both supports this model of speciation and suggests that ornaments serve as signals of co-adapted mitonuclear complexes.

#### **Estimating occupancy and detection of birds using stops along Breeding Bird Survey routes as replicates**

James Hines, U. S. Geological Survey

Survey locations (stops) are systematically spaced along North American Breeding Bird Survey (BBS) routes, and are surveyed sequentially in the same way each year. This systematic spatial and temporal aspect of sampling is an issue for many analyses of stop data, as (1) detectability and occurrence of birds likely varies along the routes; (2) that variation is likely associated with location on the routes (i.e., it is spatially correlated), and (3) stops within routes are more likely to be similar to each other than to stops on different routes. These concerns limit many simple analyses of stop data, as investigators must either ignore them or develop analyses that control for these sources of variation. We describe an analyses in which adjacent (and possibly spatially-autocorrelated) counts along routes are used as replicates to estimate occupancy and detection of birds on BBS routes. This analysis allows for estimation of time of day effects in detection along routes as well as time and covariate effects in occupancy. Multi-year extensions of the model permit estimation of local extinction and colonization rates of bird populations. These occupancy-based models provide a realistic alternative to the abundance-based models traditional used to evaluate spatial and temporal patterns in bird populations, and offer new views of difficult-to-evaluate concerns such as time-of-day effects on detectability at stops. We describe the models in broad conceptual terms, then discuss several applications of these models to BBS data, including an analysis of Brown-headed Nuthatch (*Sitta pusilla*) in the Southeastern Coastal Plain Bird Conservation Region. The BBS provides a unique extensive data set for evaluation of climate change effects, and we show how occupancy models provide new opportunities for climate change analyses by providing a framework for hypotheses tests regarding spatial patterns in colonization, extinction, and occupancy rates.

#### **Behavioral interactions in parrots provide insight into social and cognitive skills**

Elizabeth A. Hobson - National Institute for Mathematical and Biological Synthesis, Knoxville, TN, United States

I study how individuals interact in social contexts and how this leads to the emergence of the complex societies. I investigate factors underlying animal sociality through the collection of social data from field and lab experiments, theoretical development, and quantitative analysis, mostly in social avian species like parrots. Although parrots share many characteristics with primates, very little is known about how parrot groups structure their social relationships or how parrot sociality compares to other species. Through a combination of field observation and experimental manipulation, I found that parakeet social network structure and dominance hierarchies formed and stabilized quickly in novel groups. I also found that individuals appear to perceive their own rank and the rank of others, and dynamically use this information to make decisions about how and when to aggress. These results provide important insight into the social and cognitive skills of highly social birds.

### **Social feedback and the emergence of rank in avian society**

Elizabeth Hobson - National Institute for Mathematical and Biological Synthesis, Knoxville, TN, United States; Simon DeDeo - Indiana University, Bloomington, IN, United States

Individual actions are fundamentally important in the emergence of group-level social structure. Dominance hierarchies are group-level properties that emerge from the aggression of individuals. Although individuals can gain critical benefits from their position in a hierarchy, we do not understand how real-world hierarchies form, or what signals and decision-rules individuals use to construct and maintain them in the absence of simple cues such as visual characteristics or spatial patterns. We analyzed aggression in two novel groups of captive monk parakeets (*Myiopsitta monachus*) (1) to determine whether rank affected an individual's choices about which others to target with aggression and (2) to evaluate potential cognitive mechanisms that individuals could use to infer their own rank and the rank of others. We found that rank affected target choice. Following the first week of interaction, patterns in the choice of targets of aggression underwent a transition to large-scale ordered aggression, with individuals thereafter preferring to direct aggression against those nearby in rank. We also found that individuals could use subsets of the aggression network, or chains of aggression, to infer rank differences. These chains of aggression provided a cognitively-accessible structure that individuals could use to infer third-party relationships and avoid unnecessary and potentially costly social interactions. This mechanism was predictive of individual decisions about which others were targeted with aggression. Based on these results, we present a new theory, of a feedback loop between knowledge of rank and consequent behavior, which explains the transition to strategic aggression, and the formation and persistence of dominance hierarchies in groups capable of both social memory and social inference.

### **Influence of atmospheric properties on detection of wood-warbler nocturnal flight calls**

Kyle Horton - University of Oklahoma, Norman, OK, United States; Phillip Stepanian - University of Oklahoma, Norman, OK, United States; Charlotte Wainwright - University of Oklahoma, Norman, OK, United States; Amy Tegeler - United States

Avian migration monitoring can take on many forms; however, monitoring active nocturnal migration of land birds is limited to a few techniques. Avian nocturnal flight calls are currently the only method for describing migrant composition at the

species level. However, as this method develops, more information is needed to understand the sources of variation in call detection. Additionally, few studies examine how detection probabilities differ under varying atmospheric conditions. We use nocturnal flight call recordings from captive individuals to explore the dependence of flight call detection on atmospheric temperature and humidity. Height or distance from origin had the largest influence on call detection, while temperature and humidity also influenced detectability at higher altitudes. Because flight call detection varies with both atmospheric conditions and flight height, improved monitoring across time and space will require correction for these factors to generate standardized metrics of songbird migration.

### **Method and application developments for migrant flight orientation profiles using polarimetric radars**

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Flight strategies of nocturnal migrants in reference to winds aloft have been of great interest, yet have continually yielded mixed results. Much of this attention has been devoted to understanding how migrants organize in reference to wind fields, and whether strategies of compensation or drift are more frequently observed. Migration theory supports the contention that energetic cost should be minimized while maximizing the distance covered in the direction of the intended destination (e.g. breeding grounds, wintering grounds, etc.), but how migrants optimize this strategy is unclear. The 2013 upgrade of all WSR-88D radars to dual-polarization offers a direct assessment of these behaviors. Because animal migration is characterized by the aligned flight of airborne organisms across large spatial expanses, alignments (i.e. migrant orientation) are revealed in polarimetric radar products. These patterns are especially prominent in the polarimetric radar product of co-polar correlation coefficient ( $\rho_{HV}$ ). We introduce a technique for the extraction of these alignments and an assessment of migrant strategies across multiple spatial domains. Using independent radar measures of migrant heading and orientation we explore the propensity of drift and compensation at single radar sites, contrast interior and coastal sites, and explore latitudinal differences.

### **Rapid and recent diversification of curassows, guans, and chachalacas (Galliformes: Cracidae)**

Peter Hosner - University of FL, Gainesville, FL, United States; Edward Braun - University of Florida, Gainesville, FL, United States; Rebecca Kimball - University of Florida, Gainesville, FL, United States

The Cracidae (curassows, guans, and chachalacas) include some of the most spectacular and endangered New World bird species. The group lacks a synthetic and well-resolved molecular phylogenetic hypothesis, hence their geographic origin and the history of their diversification is unclear. We present the first species-level phylogeny for Cracidae using a supermatrix of over 4000 ultraconserved elements (UCEs; at least one species sampled per genus) and eight more variable loci (introns and mtDNA; each species sampled). The resulting phylogeny strongly supported relationships among genera, but relationships within genera were poorly resolved due to short internal branches characteristic of rapid radiations.



Biogeographic inference supports the hypothesis that crown Cracidae originated in Central America, and that current South American diversity is the result of multiple colonization events coupled with rapid diversification and evolution of secondary sympatry. The only major cracid lineage that failed to colonize South America was the monotypic Horned Guan (*Oreophasis derbianus*), which is sister to curassows and chachalacas rather than other guans. Fossil-calibrated divergence time estimates suggest crown Cracidae originated in the late Miocene, and that the species-rich genera *Crax*, *Penelope*, and *Ortalis* began diversifying as recently as 1.1–1.4 Mya. Biogeographic reconstructions and divergence time estimates support that Cracids are another example of a bird group of Central American origin that colonized South America and diversified following Panamanian Isthmus closure.

#### **Behavioral syndrome variation across rural and urban habitats in Northern Cardinals (*Cardinalis cardinalis*)**

Ping Huang - University of Florida, Gainesville, FL, United States

Behavioral syndromes, also known as animal personalities, denote consistent variation in suites of correlated behaviors across different contexts. This concept provides a chance to understand the selection pressures posed by human-modified environment in a more comprehensive way, because urbanized environments may favor certain combinations of behaviors. Thus far, avian studies targeting the impact of urbanization on behavioral syndromes have primarily focused on only one or two personality traits associated with human presence (i.e. boldness when approaching by human). This study sought to broaden our knowledge of how birds respond to major alterations in their habitat by providing an overall examination of syndrome variation along a rural-urban gradient based on measurements of all commonly used personality traits. We measured five personality traits (exploration, neophobia, neophilia, aggression and boldness) of Northern cardinals (*Cardinalis cardinalis*) sampled from four sites (20 individuals per site) that varied in their urbanization level in Central and Northern Florida. Using principle component analysis (PCA) and multivariate analysis of covariance (MANCOVA), we found that cardinals inhabiting more urbanized areas are both more aggressive ( $p=0.017$ ) and more neophilic ( $p<0.01$ ) than their rural conspecifics. Moreover, a variation in behavioral correlation structure of syndromes across different habitats was noted, which suggests changes in habitat quality due to human activities. Our results suggest that urban environments may select for more neophilic and aggressive individuals and that urbanization appears to not only alter a personality trait itself but also leads to syndrome breakdown. Our next step will be to incorporate stress hormone responses with our syndrome data to test hypotheses that stress hormone variation associated with environmental challenges can potentially serve as a mechanism underlying syndrome variation. As urbanization increases, such knowledge may help in management, particularly for species in urban habitats with declining populations.

#### **Exploring cryptic diversification in Afrotropical lowland forests: The phylogeography of the genus *Bleda***

Jerry Huntley - Texas A&M University, College Station, TX, United States; Gary Voelker - Texas A&M University, College Station, TX, United States

For the past two decades, researchers exploring potential centers of diversification for Afrotropical avian lineages have focused largely on montane forest zones. The focus on montane

forests has led to the view that Afrotropical lowland forests are “evolutionary museums”, regions where lineages have persisted unchanged until present day. As a result, potential diversification in lowland forests has been overlooked. Here we focus on the genus *Bleda*, the Bristle-bills, a group of passerines endemic to lowland tropical forests in Africa. *Bleda* provides an excellent model for testing the assumption that lowland forests are not centers of diversification and are, instead, “evolutionary museums”. We perform the first full phylogeographic assessment of the genus *Bleda*, amplifying two mitochondrial and three nuclear genes for all five recognized species. Our results demonstrate that a high amount of intra and interspecific genetic diversity exists within *Bleda*, and the distribution of this genetic diversity correlates strongly to discrete geographic units. The relatively young age of these highly divergent intraspecific lineages suggest diversification resulting from historical and ongoing processes within African lowland forests. This high level of genetic divergence casts doubt on the veracity of the “evolutionary museum” hypothesis and instead demonstrates the potential importance of Afrotropical lowland forests as centers of diversification.

#### **The influence of severe weather and climate change on the productivity of American White Pelicans at a large nesting colony in the northern Great Plains**

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In the past decade, severe weather and West Nile virus were major causes of chick mortality at American White Pelican (*Pelecanus erythrorhynchos*) colonies in the northern plains of North America. At one of these colonies, Chase Lake National Wildlife Refuge in North Dakota, spring arrival by pelicans has advanced approximately 16 days over a period of 44 years (1965–2008). We examined phenology patterns of pelicans and timing of inclement weather through the 44-year period, and evaluated the consequence of earlier breeding relative to weather-related chick mortality. We found severe weather patterns to be random through time, rather than concurrently shifting with the advanced arrival of pelicans. In recent years, if nest initiations had followed the phenology patterns of 1965 (i.e., nesting initiated 16 days later), fewer chicks likely would have died from weather-related causes. That is, there would be fewer chicks exposed to severe weather during a vulnerable transition period that occurs between the stage when chicks are being brooded by adults and the stage when chicks from multiple nests become part of thermally protective creche. Additional information will be discussed concerning the early arrival of other waterbirds in the region.

#### **Bare parts and plumage: Multiple messages or redundant signals?**

Erik Iverson - Tulane University, Belmont, CA, United States; Jordan Karubian - Tulane University, New Orleans, LA, United States

Honest sexual signals include condition-dependent ornaments that facilitate competition and mate choice. Many species exhibit multiple sexual ornaments, which may be Fisher traits, redundant or back-up signals, or distinct signals sending multiple messages with unique information. In birds, plumage and bare parts (bill, legs, combs) provide two separate systems of condition-dependent visual ornaments. However, bare part

signals are poorly characterized, and it is not understood why birds have multiple visual ornaments. This paper thoroughly reviews the signaling role of bare parts in the literature and then addresses the question of whether bare parts are redundant or complementary to plumage ornaments. We reviewed 141 studies of 60 species with established bare part signals. We found that although bare parts and plumage share the same mechanisms of color production, there are important differences making them primarily distinct signals or multiple messages. Bare parts signal information on a short time-scale and are highly flexible, mirroring the physiological conditions they represent. They can signal unique information, reflect many inputs simultaneously, and may have different functions in different contexts. Bare parts are particularly important in monogamous, biparental species, in which they are continuously evaluated by partners that adjust their reproductive effort accordingly. Our results indicate that plumage more reliably reflects inherent or genetic qualities such as innate immunity, resting metabolic rate, body size, or allelic diversity, while bare parts better reflect environmentally-influenced traits such as acquired immunity, body condition, hormone levels, and recent stress. This supports the hypothesis that static or fixed signals are better signals of genetic quality because they integrate condition over a long time period and are unaffected by short-term fluctuations. The value of flexible signals in addition to static signals for conveying a wider range of information may contribute to the evolution of multiple ornamentation across taxa.

#### **Mismatch between daytime home ranges and roosting areas in the Wood Thrush: Why are males sleeping around?**

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Despite its necessary importance for understanding the complete avian circadian cycle, behavior of roosting birds has received little attention from ornithologists. We examined the spatial arrangement of roosts in relation to diurnal home ranges for the declining Wood Thrush (*Hylocichla mustelina*) on its breeding grounds in coastal Virginia. To our knowledge, this is the first broad description of roosting ecology for a North American migratory passerine during the breeding season. The primary objective of this study was to determine if day and night use regions overlap. Secondly, we tested the hypothesis that birds roost at sites with higher local vegetation density using LiDAR and explored the effect of nest status on roosting pattern in bird pairs. We captured and radio-tracked 37 males to construct 95% kernel diurnal home ranges. In 10 home ranges we also tagged female mates. Both sexes were tracked at night to roosting locations. Of 74 male roosts, 31% were located outside diurnal home ranges. LiDAR-derived vegetation density was ~7% higher at roost sites than at random points within diurnal home ranges, and young birds roosted farther from peak diurnal use areas than older birds, suggesting a role of roost habitat quality. Nest status had a significant effect on pair roosting pattern, as females with active nests roosted exclusively in nest cups while males roosted an average of 121.8 m (CI = 72.6 – 204.2, n = 11) away on equivalent nights. Once nests fledged or failed, males roosted within diurnal home ranges while guarding females. We propose that the observed mismatch in male diurnal home ranges and nocturnal roost

sites may be based on optimal roosting conditions at those sites, but male solicitation of extra-pair copulations from fertile neighboring females during the morning and evening insemination windows should also be considered.

#### **Whole genome sequence analysis reveals evolutionary history of extinct Heath Hen**

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The Heath Hen (*Tympanuchus cupido cupido*) was extinct on the mainland by 1870, and by 1890, only 200 individuals survived on Martha's Vineyard, an island ~6.5km off the coast of Massachusetts. For the next forty years, efforts were made to prevent its extinction, but the population never exceeded 2000 individuals, with reproduction ceasing after 1924. The last living Heath Hen was observed on 11 March 1932. Despite tremendous effort to prevent its extinction, the Heath Hen's demise was due to multiple factors including habitat loss, over-exploitation, disease, and fire. Recent research in "de-extinction" has stimulated interest in the Heath Hen as a candidate species, but its validity as a candidate requires first resolving uncertainty about its demographic history and most recent common ancestry. Mitochondrial sequence data suggests that the Heath Hen is as divergent from its conspecific, the Greater Prairie-chicken (*T. c. pinnaatus*) as it is from the Lesser Prairie-chicken (*T. pallidicinctus*) and Sharp-tailed Grouse (*T. phasianellus*), two morphologically and behaviorally distinct prairie grouse species. A recent study investigating the phylogenetic relationships among extant prairie grouse identified sex-biased introgression among species depending on marker type (mtDNA, autosomal, and Z-linked) suggesting that sexual selection has played an important role maintaining species boundaries in areas of sympatry in the Midwestern US and Canada. Here we use whole genome analysis to investigate the evolutionary history of the Heath Hen with samples collected from both the mainland and Martha's Vineyard. Species tree analyses will be conducted using genomic sequence data from all extant prairie grouse species including the critically endangered Attwater's Prairie-chicken (*T. c. attwateri*). These results will be useful for assessing the distinctiveness of the Heath Hen and provide insight on both genomic and demographic factors that may have contributed to its extirpation.

#### **Applications of behavioral and community research on Golden-winged Warbler conservation**

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To mitigate the rapid decline of worldwide biodiversity, conservation biologists need integrative approaches that focus

on spatial habitat requirements as well as the behavioral ecology of at-risk species. Indeed, it has become apparent that a better understanding of behavioral characteristics between sympatric species can aid in conservation efforts. Although Golden-winged Warblers (*Vermivora chrysoptera*) are a conservation priority and despite the significance of interspecific competition on community structure, little research has focused on competition with (non-*Vermivora*) heterospecifics. In northwestern NC, agonism frequently occurs between Golden-winged and Chestnut-sided warblers (*Setophaga pensylvanica*); thus, we explored the potential consequences of sympatry. We found that the Golden-winged Warblers that settled among high densities of Chestnut-sided Warblers displayed more aggressive behaviors. Moreover, we found that highly-ornamented Golden-winged Warblers settled in areas with fewer Chestnut-sided Warblers and in locations with less open habitat. However, we found little evidence that Chestnut-sided Warblers reduce the reproductive success of Golden-winged Warblers, suggesting that coexistence may not be detrimental to Golden-winged Warbler fitness but that the agonism that occurs between these two species may be a product of misidentification. Additionally, although the plumage coloration male Golden-winged warblers does not predict their reproductive success, our data suggest that plumage may signal competitive ability because it was associated with territory habitat structure. Our research highlights how integrating behavioral ecology with conservation efforts may improve management efforts.

#### **Genetic identification of *Archilochus* hybrids for comparison of three ecological niche models**

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Two species of hummingbirds whose breeding ranges and timing overlap in the great plains from south Texas to northern Oklahoma were hypothesized to be producing hybrids in this area. Black-chinned Hummingbirds (*Archilochus alexandri*) and Ruby-throated Hummingbirds (*Archilochus colubris*) have been postulated to hybridize based on variation of gorget color within the proposed hybrid zone. In summer 2010 and 2011, during the breeding season, 200 *Archilochus* individuals were captured and feathers were taken for DNA analysis. The mitochondrial cytochrome oxidase 1 (CO1) gene was sequenced and 3 microsatellite markers were genotyped in order to identify hybrid individuals. Seventy-two unique haplotypes were identified in the sequence data and phylogenetic trees constructed showed very close relationships among the haplotypes. The 3 microsatellite loci were not useful in identifying hybrids, so sequence variations were recoded as alleles and combined with the microsatellite data. Based on the difference between field identification and population assignment in Structure, 57 hybrids were identified (95% probability interval > 0.75). Their distribution was modeled using GARP, ENFA, and Maxent and an AUC measure of model accuracy indicated that GARP best represented the distribution of *Archilochus* hybrids (AUC = 0.94). Future research should include multiple microsatellites designed specifically to differentiate between the two *Archilochus* species as well as sequencing additional mitochondrial genes to determine if a genetic cline exists across the US.

#### **Integrative responses to environmental change**

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Birds face increasingly variable and unpredictable environmental conditions on their breeding grounds. The mechanisms that enable individuals to adjust their reproductive effort to respond to changes in their environment are vital to their survival and reproductive success, and are important to the stability of their populations. My research explores how behavioral and physiological mechanisms integrate to provide birds with the capacity to respond to dynamic environments and global change. I combine field experiments with long-term datasets on population demographics to examine the consequences of environmental change on the behavior, physiology and fitness of individuals and population dynamics. I use an interdisciplinary approach to study questions of conservation significance for birds that provide basic scientific understanding of the selective ecological and social factors that shape reproductive investment strategies and life histories. My research has focused on thrush, sparrow, and warbler populations across North America and comparisons between temperate and Neotropical bird species. My current work expands the geographical scope of my research into the threatened tropical forests of Malaysian Borneo.

#### **Population dynamics of Northern Cardinal and Carolina Wren in an urban forest: Safe refuge or ecological trap?**

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Conserving bird populations in fragmented landscapes in the Southeastern United States depends on interactions between extinction, recolonization and survival in degraded forests. Bird populations may persist in degraded landscapes through the preservation of small nature preserves. Thus, determining the ecological value of small nature preserves to birds is a necessary step towards an informed conservation strategy. As such, we conducted a capture-mark-recapture study from April 2010 to March 2014 to study the dynamics of Northern Cardinals (*Cardinalis cardinalis*) and Carolina Wrens (*Thryothorus ludovicianus*) in a 41.7-ha nature preserve embedded in an urban matrix to investigate whether the reserve serves to maintain local populations or acts as an ecological trap. An ecological trap is a habitat where populations experience negative effect on vital population parameters. We examined the demographic and environmental variation in survival, recruitment and realized population growth rates to better understand population dynamics. The overall annual apparent survival rate of Northern Cardinals ( $0.520 \pm \text{SE } 0.050$ ) was higher than of Carolina Wren ( $0.349 \pm 0.050$ ), however, these estimates were similar to the regional baseline estimates. The survival rate for adults were significantly higher than immatures in both species with body size having positive influence on survival. Average annual population growth rate was slightly greater than 1.0 for both species, indicating stable or perhaps modestly increasing populations. These results suggest that urban forest can serve as a safe refuge for local resident birds. This study revealed the detailed dynamics of healthy populations of passerine birds in an urban forest and provided a realistic demographic target for the conservation of more sensitive species inhabiting human-modified landscapes.

### **Interannual consistency of Purple Martin roost phenology**

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We use weather surveillance radars (WSRs) to monitor the phenology and persistence of roosts of a common migrant bird in eastern North America, the Purple Martin (*Progne subis*). Purple Martins, and some other swallow species, are unusual among migrant songbirds in their habit of forming large nocturnal roosts during the non-breeding season. These roosts are identifiable in WSR data because the birds leave roosts en masse near sunrise and fly high above the ground. Using continentally mosaicked radar reflectivity data from June through August of 2009 through 2014, we located 235 roosts that were active in this period. We have previously documented that about half of these roosts are relatively persistent between years whereas the other half are intermittent. In addition we have documented strong positive latitudinal trends in both the day of year when roosts first became active and the day roosts were last active. Here we examine the consistency of the dates roosts form and disband between years. We predict that persistent roosts will have more consistent start and end dates among years than intermittent roosts.

### **Sorting out phylogenetic relationships among the grouse and ptarmigan**

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The grouse and ptarmigan are a well-studied clade of 19 taxa. They are found in the northern regions of both the Old and New World, where they are important game species. Species vary in mating system, from monogamy and biparental care to lek systems characterized by exclusive female parental care and a high skew in male mating success. In addition to a large number of behavioral and ecological studies, there have been multiple phylogenetic studies, most of which have included samples from all taxa. While such studies have suggested some genera are not monophyletic, results from these studies (several of which only included mitochondrial data) have led to conflicting hypotheses regarding the relationships among genera. Thus, comparative studies that explore patterns of trait evolution could be affected by an incorrect estimate phylogeny. We sampled multiple nuclear loci, as well as mitochondrial data, from all typically recognized species to estimate a well-resolved and well-supported phylogeny. Our data provides strong support at most nodes, and also demonstrate differences between phylogenies estimated from nuclear versus mitochondrial data. While we supported previous studies that have questioned monophyly of some genera (e.g., *Bonasa*), we also found strong support that *Falcipecten* is not monophyletic suggesting further revision in this group is warranted. Biogeographic analyses support a Nearctic origin for grouse and ptarmigan, and support that frequent transitions between Nearctic and Palearctic regions influenced their diversification.

### **Use of hydrogen stable isotopes to infer the annual migration patterns of Gray Catbirds (*Dumetella***

### ***carolinensis*) visiting a Florida Gulf Coast spring migratory stopover site**

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Many Nearctic-Neotropical songbird species are experiencing significant population declines. This decline may be in part attributed to the loss of suitable stopover sites during migration. Although research has been performed on the central and western Gulf Coast, less is known about the stopover significance of the Florida Gulf Coast barrier islands during spring migration. During spring of 2013 and 2014, Gray Catbird (*Dumetella carolinensis*) was the most abundant Nearctic-Neotropical species captured at a banding station on St. George Island, Florida. Flight feather samples (n=140) and claw keratin samples (n=120) were collected from Gray Catbirds for analysis of hydrogen stable isotope ratio (dD). The dD values from flight feathers were used to estimate breeding latitude of individuals, while dD values in claw keratin were used to discriminate among wintering populations. The dD values were also correlated to mist-net capture data to explore temporal variability and the spectrum of arriving physical condition within the species. This study provides context for better understanding the annual cycle of Gray Catbirds in this region and emphasizes the need to protect barrier island stopover habitat to lower pressure on this species during migration.

### **Comparative reproductive biology of co-occurring endangered and common shrubland birds**

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What restricts the distribution and abundance of endangered species relative to similar common species? Black-capped vireos (*Vireo atricapilla*) and white-eyed vireos (*Vireo griseus*) are closely related, morphologically and ecologically similar, and often nest in similar habitats. Despite these similarities, white-eyed vireos are widely distributed and thriving, while the black-capped vireo has a restricted range and is federally endangered. Here we address this apparent paradox with a comparative ecological study of co-occurring black-capped and white-eyed vireos. We studied vireos in shrublands and woodlands in central Texas, USA in 2013 and 2014. We used point count surveys (n = 256) and nest monitoring (n = 142) to determine arrival dates, settlement patterns, nest site selection, and ultimately, nest survival relative to temporal and habitat factors. Point count data show that white-eyed vireos arrived first and established territories in shrub and woodland habitat with equal probability. Black-capped vireos arrive after white-eyed vireos and settled in shrubland habitat first, only later establishing territories in wooded areas. White-eyed vireos begin initiating nests earlier than black-capped vireos and selected nest sites with taller, more mature, and more densely wooded vegetation. For both species, survival decreased as the season progressed, and was higher for nests located in taller, more mature habitat. Accordingly, overall nest survival was higher for white-eyed vireos than black-capped vireos suggesting that the flexibility demonstrated by white-eyed

vireos in where and when they nest confers a reproductive advantage.

### **Landscape characteristics of home ranges of Lesser Prairie-chickens**

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Grasslands are among the most imperiled habitats worldwide. The deterioration of these ecosystems has jeopardized the status of many wildlife populations dependent on large contiguous prairie. This trend is evidenced within the Southern Great Plains by the decline of the Lesser Prairie Chicken (*Tympanuchus pallidicinctus*; hereafter LPCH). As a threatened species under the Endangered Species Act, this grassland-obligate grouse is the target of increased conservation activities. To inform these conservation actions, we evaluated LPCH breeding and non-breeding season home ranges in terms of habitat composition and patch characteristics among varying landscapes across the northern range of the species. Female LPCHs were trapped on leks and fitted with either a 15-g VHF bib-style transmitter or a 22-g model 100 GPS Platform Transmitter Terminal (PTT) using a rump-style harness. Seasonal home ranges were created using Brownian bridge movement models and random home ranges were distributed within each sampled landscape. Habitat use data within these landscapes were quantified using categorical (landcover) and continuous (anthropogenic structures and habitat patch characteristics) variables. Variables separating used and random home ranges were ranked by employing resource selection functions. Preliminary results indicate that used home ranges consist of greater amounts of grassland habitats (grazed and non-grazed) than random home ranges, although cropland use appears to increase during the non-breeding season. Moreover, used home ranges consist of fewer habitat patches, greater patch size, and less fragmentation. As conservation efforts continue to increase for this imperiled prairie grouse, understanding habitat selection as landscapes change will be important for agencies directing management actions across differential portions of the species range. More specifically, these results can reduce uncertainty of future conservation and easement efforts by targeting areas more conducive for LPCH seasonal needs.

### **Migration and movement ecology of Golden-winged Warblers derived from light-level geolocators**

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Golden-winged Warblers (*Vermivora chrysoptera*) are a neotropical migrant songbird that have experienced severe population declines across portions of their range. Demographic studies report relatively high nest success throughout the breeding distribution, suggesting that differences in observed population trends are influenced by

juvenile survival (i.e., survival once young birds leave the nest), adult survival on population-specific wintering sites, or survival during migration. To assess the potential influence of migratory and wintering ground factors on golden-winged warbler population trends, we set out to document migratory connectivity in golden-winged warblers and identify wintering sites and migratory routes using light-level geolocators. In 2013, we deployed geolocators on territorial, male golden-winged warblers in both Minnesota and Tennessee and recaptured them upon their return to breeding areas in the spring of 2014. In addition to recapturing geolocator-marked birds in 2014, we deployed geolocators on male golden-winged warblers at the same site in Minnesota, and at a site in eastern Pennsylvania. We present preliminary findings from those efforts including effects of geolocators on return rates, body condition, and arrival date. We describe the wintering locations and migratory routes of geolocator-marked golden-winged warblers from each of these populations.

### **Breeding in an extreme environment: Physiological and morphological responses to inter-annual environmental variation, snow storms, and range distribution**

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Lapland Longspurs breeding in the Arctic encounter conditions that can be highly erratic across years with the potential for severe weather events. To cope with unpredictable conditions, birds activate the hypothalamic-pituitary-adrenal (HPA) axis to induce the synthesis of the stress hormone, corticosterone, that promotes survival by regulating changes in physiology and behavior. The degree of HPA axis activation is thought to be a function of environmental harshness. For instance, Lapland Longspurs breeding at the northern limits of its breeding range in the high Arctic of Greenland have greater HPA axis activation in response to acute stress compared to birds breeding in the low Arctic of Alaska. Few studies have addressed inter-annual variation in morphology and physiology in response to environmental conditions and snow storms. We collected data from Lapland Longspurs breeding in the low Arctic of Alaska from 2011-2014. Environmental conditions fluctuated greatly across years but 2013 was characterized as having unusual late and extensive snow cover that caused birds to arrive later and likely limited access to food resources. Lapland Longspurs in 2013 had lower fat levels, decreased body condition, and elevated levels of corticosterone in response to acute restraint handling. In three out of the four years, snow storms occurred early in the breeding season resulting in birds abandoning territories in search of food. During snow storms, only males showed reductions in body condition while fat levels did not show a clear pattern. HPA axis activity, in response to snow storms, was increased in 2012 and 2014 while not in 2013. Failure to detect elevations in response to snow storms in 2013 is likely attributed to the overall elevation of the stress response in that year. In conclusion, HPA axis activity is highly plastic and adapts to environmental conditions to help individuals cope with unpredictable events.

### **Increased perceived predation risk increases maternal yolk androgens in migratory passerine**

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Maternal exposure to predation risk may alter female behavior and physiology, which can result in changes to offspring phenotype. These phenotypic changes can last into adulthood. Maternal steroids are one possible mechanism that produce phenotypic changes to offspring. Egg yolks contain high concentrations of maternal hormones that affect the development of the embryo. In 2014, we exposed female black-throated blue warblers (*Setophaga caerulea*) to vocalizations of common predators and collected 2 eggs from their clutches (n=17 eggs). These eggs were compared to eggs of females that did not receive a treatment (n=11 eggs). Egg mass, yolk mass, clutch size, and yolk hormones (androstenedione (A4), testosterone (T), dihydrotestosterone (DHT), estradiol (E2) and corticosterone (B)) were compared among treatment groups. We then continued to monitor the siblings remaining in clutch-reduced nests. Growth rate and morphometrics of nestlings were compared between treatment groups. Yolk concentrations of T and A4 were higher in eggs laid by females exposed to the predator treatment than eggs from females in the control group. Egg size, yolk size, DHT, E2 and B were not significantly affected by the treatment. Only one control nest survived to the late nestling phase, thus data are not currently available to interpret downstream effects. We interpret the increase in A4 and T to be a potentially adaptive response. Androgens are associated with an increase in growth rate, which may aid in predator escape. We did not find any effects associated with a stress response to the predation treatment. Black-throated blue warblers nest in open cups in the shrub-layer, and appear to have plastic physiological mechanisms to cope with high predation exposure. We are currently repeating this experiment in the 2015 breeding season.

#### **Migration and local movements of Crab Plover *Dromas ardeola* wintering in Barr Al Hikman, Sultanate Oman**

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Crab Plovers *Dromas ardeola* are prominent waders of desert coasts with their nesting areas confined to a few colonies in the northwestern Indian Ocean and the Red Sea. However, little is known about their breeding, staging and wintering areas. GPS tracking offers an unparalleled means to monitor their mobility patterns and behavior. Between 2011 and 2013, 23 Crab Plovers caught at Barr Al Hikman, a vast pristine coastal wetland in southeast Oman, were fitted with solar-powered GPS-loggers which measure their position and behavior. Among other shorebirds, the Barr Al Hikman area is home to 7000-9000 wintering Crab Plovers, accounting for about 10-15% of the world's population. Data from five birds were downloaded between 2011 and 2014 and analyzed for their yearly migration, wintering and other patterns. Between February 28 and May 7, the birds migrated for approximately 1400 km from Barr Al Hikman to their breeding colonies in northwest Arabian Gulf. They all followed a similar route along the east coast of the Gulf with the total migration lasting 7-24 days. They spent between 96-143 days on the breeding islands located in Iran and Kuwait. The autumn migration back to Barr Al Hikman was mostly along the eastern coast of the Gulf, and occurred

between July 20 and October 24, lasting 3-91 days. The bird that took 91 days to migrate followed a route on the western coast of the Arabian Gulf and flew over the desert regions of Saudi Arabia and Oman for about 600 km to Barr Al Hikman. One individual with two consecutive years of data showed between-year consistency in migration, breeding and wintering patterns. During the wintering months, the birds stayed mainly on the mudflat at Barr Al Hikman, except for one individual that stayed mostly at Masirah Island, 35 km east of Barr Al Hikman.

#### **Temporally mediated geographic effects on the intensity of phenological mismatch**

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Responses to climate change vary across functional groups and trophic levels, which can cause decoupling of biological interactions or a 'phenological mismatch'. Despite fast accumulating examples of phenological mismatch, single-species studies at relatively small spatial scales impede our understanding on why we see varying degrees of mismatches within various bi-trophic interactions. We tested the phenological mismatch hypothesis using bi-trophic interaction between six shorebird species and their invertebrate prey at ten breeding sites which span ~13 degrees of latitude and ~84 degrees of longitude along the Arctic coast of North America. We estimated the degree of phenological match between invertebrate and shorebirds at 1) individual nest level as the temporal distance to the food peak and at 2) population level as the overlapped area under two fitted curves for estimated hatching and total daily biomass. Using Structural Equation Modeling, we tested causal relationships among exogenous factors (geographic gradient, current temperature, slope of climate change), phenology of shorebirds and invertebrate, and the degree of phenological match between the two trophic levels. Among three exogenous factors tested, geographic gradient was the most important factor determining the degree of match. Latitude and longitude had negative direct effects on the degree of match at both the individual and population level. Spring timing of invertebrate and shorebirds were later at northerly latitude and easterly longitude after controlling for spring temperatures. At individual nests, delayed spring timing of invertebrate increased the phenological match whereas delayed spring timing of shorebirds reduced the phenological match. Overall, the delayed spring at westerly longitude improved the phenological match of individual nests. At population level, however, negative direct effects of latitude and longitude override the temporally mediated positive effects on the phenological match. Our results indicate broad geographical pattern with the phenological mismatch which has never been tested before.

#### **Pixel-based ornithology on "weather" radars**

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Today, operational "weather" radars and the research units that support them are nearly all large scanning pulsed Doppler units that record digital data about water in the atmosphere. Some of the water is liquid, some frozen, and some in the bodies of high-flying insects, birds, and bats. However the

usefulness of the staggering amount of ornithological and other biological information recorded this way is diluted by uncertainty about what the radar is detecting. Some key publications in the field of Radar Meteorology on the properties of flying animals on these radars lack good information about the taxonomic identity of the study subjects. Ornithologists' perspective on such phenomena is limited partly because the solidly empirical field of Radar Entomology is mainly disconnected from current "weather" radar data in North America. The bodies of moderate-to-large insects that migrate seasonally for long distances can generate strong radar return and some moths migrate high aloft even over snow. Things flying faster than 6 m/s are often classified as "birds" (a value based on research by the author) in absence of valid local wind data and despite long migrations and frequent flights as high as 2 km by several species of North American bats. The presentation includes images from large Doppler radars on weather, insects, bats, and birds that have been "ground truthed" by various independent methods.

### **Bald Eagle nest destruction relative to tornadic wind conditions**

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Nests of Bald Eagles (*Haliaeetus leucocephalus*), often placed high in large and mature trees, are reused for multiple years and regularly weigh hundreds of kilograms. Because of these characteristics the nests are prone to catastrophic destruction during high winds, especially during severe weather. In March 2015, a severe weather outbreak in Tulsa County, Oklahoma caused widespread loss of structures, one human fatality, and severely damaged trees along the Arkansas River. This stretch of river supports one of the highest concentrations of nesting Bald Eagles in the state and has been continuously monitored for eagle nests for 20+ years. We conducted field surveys to determine the extent of nest loss in the area and consulted weather and nesting data to determine what characteristics of the storm (maximum wind shear) and nests (years of use) were associated with nest destruction versus persistence. We found that 5 of 9 nests within a ~25km stretch of the river were destroyed during the storm, causing the death of at least 8 eaglets. The mean number of years of use did not significantly differ between destroyed nests (4.8) and surviving nests (4.0). However, during the storm, the degree of maximum azimuthal shear (i.e., wind rotation) within 800m of the nests did significantly differ both in terms of maximums (0.0158 vs 0.0095 per second) and means (0.0094 vs 0.0066 per second) for destroyed versus persisting nests, respectively. Our findings suggest a threshold of tornadic wind shear beyond which Bald Eagle nests, irrespective of age, are likely to be blown out of riverside trees.

### **Does occupancy monitoring capture population trends for a sparsely distributed species?**

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Land managers require estimates of population trends to establish species conservation status. Rare or sparsely distributed species are often of greatest concern, but are also more difficult to monitor. Collecting occupancy data is an attractive option for monitoring, but it is unclear how well occupancy reflects trends in population size. We evaluated regional occupancy monitoring for detecting trends in population abundance for White-headed Woodpeckers (*Picoides albivartus*, WHWO), a sparsely distributed species of conservation concern. We used the rSPACE package in R to simulate WHWO populations and mimic the sampling design established for regional monitoring in Oregon and Washington. We set initial abundance along transects and the size and spacing of home ranges to match pilot data collected for WHWO. We then simulated monitoring of populations under scenarios with varying abundance trends ( $\rho = 1.0, 0.9$ , or  $0.8$ ), sampling durations (6, 9, or 12 years), and intensities ( $n = 30$  or 60 transects). For  $n=30$  transects and  $\rho=0.8$ , estimated occupancy trends ( $\hat{\rho}$ ) provided weak statistical power over 6 years but strong power over 9 years. Longer durations were needed to attain sufficient power to detect a weaker trend ( $\rho = 0.9$ ). Increasing sampling intensity did not improve statistical power as readily as increasing sampling duration. When population trends were relatively weak ( $\rho=1.0, 0.9$ ),  $\hat{\rho}$  were similar in magnitude to  $\rho$  but this correspondence was weaker with a stronger trend (average  $\hat{\rho} \sim 0.85$  when  $\rho = 0.8$ ). These results suggest occupancy trends may underestimate true population trends when declines are most dramatic. This study provides guidance for monitoring design and model-based inference for WHWOs, and it exemplifies use of spatially explicit simulations to evaluate the relationship between occupancy and abundance.

### **Effects of pair-bond dynamics on rates of survival and breeding in adult Black Brant**

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Survival and breeding probability are important fitness components for long-lived vertebrates. Given the socially monogamous mating system of Arctic nesting geese including Black Brant (*Branta bernicla nigricans*) we hypothesized that mate change (due to apparent death of the previous mate or divorce) may influence the probability that adult brant survive and breed. To examine these questions we used longitudinal data from a long-term mark-recapture study of black brant at the Tutakoke River brant colony (TRC) on the Yukon-Kuskokwim Delta in southwestern, AK. From 1990-2014, we encountered 3,039 adult females and 3,063 adult males breeding at TRC who had at least one marked mate during their lifetime. We conducted analyses using the Barker robust design implemented in Program Mark. We found that if an individual's mate apparently died after a breeding attempt the probability the surviving partner would breed the next year was reduced for females ( $\beta = -0.25$ ; SE = 0.05) and males ( $\beta = -0.27$ ; SE = 0.06). Survival was reduced for females ( $\beta = -0.24$ ; SE = 0.04) following the initial breeding attempt with a new mate after the previous mate apparently died. Interestingly, individuals who were divorced from their previous mate seemed to not suffer reduced survival. Alternatively, a reduction in breeding probability is experienced by divorced females ( $\beta = -0.22$ ; SE =

0.04) while divorced males are more likely to permanently emigrate ( $\beta = -0.34$ ;  $SE = 0.05$ ) from TRC after breeding once with a new mate. These results suggest that mate change affects vital rates of adult black brant even after individuals successfully re-mate and breed again. At this time we are unsure if this results from remating with a low quality mate or from a lack of familiarity with the new partner.

### **Sociable Weavers use aggression to induce cooperative nest construction**

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The maintenance of communal resources, i.e. public goods, is an evolutionary conundrum because selection should promote selfishness, and therefore erode cooperative behavior. Sociable weavers cooperatively construct a communal nest that provides thermal benefits to other individuals in the nest. The nest construction of sociable weavers is exposed to exploitation, suggesting that mechanisms exist to maintain the behavior. Although individuals likely obtain indirect benefits from nest construction, weavers may perform other behaviors to protect cooperative investment in the nest. I observed three nests of sociable weavers in Namibia and recorded several measures of nest construction, as well as the main aggressive behavior: chasing. I find that the most cooperative individuals are also the most aggressive, and that individuals contributing to the nest chambers receive the most aggression. After suffering aggression, individuals significantly increase their cooperative nest construction. These results are consistent with the hypothesis that sociable weavers are punishing selfish individuals. Sociable weavers may therefore be maintaining cooperative behavior through aggressive behavior.

### **Estimation of occupancy parameters for breeding birds on the basis of single-visit and multiple-visits point-count designs**

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Occupancy estimates adjusted for imperfect detection commonly are used to investigate persistence of bird species and to identify factors associated with bird distributions. To estimate probabilities of occupancy and detection, sites must be visited multiple times within a given period (e.g., breeding season), with surveys conducted either consecutively on a single day (the single-visit design) or on multiple days (the multiple-visits design). We evaluated the two designs with respect to potential differences in estimates of occupancy and violations of the assumptions of occupancy models for one woodpecker and 25 songbird species that breed in forests in Virginia. We visited 131 sites three times both on a single day and over multiple days during each of two breeding seasons. On each visit we conducted 8-minute point counts. We built single-season occupancy models that included all detections within 100m of the observer. We derived model-averaged estimates of occupancy on the basis of six models of detection probability that included different covariates, including independence of observations. Estimates of occupancy that were based on the multiple-visits design were consistently higher than those based on the single-visit design, but the 95% confidence intervals overlapped for 20 of 23 species in 2012 and all 22

species in 2013. Estimates of occupancy that were based on the multiple-visits design reflected higher proportions of sites where a species was detected on one or two of the three surveys and lower estimates of detection probability. Although surveys were more closely spaced in time under the single-visit design, we found no evidence of a lack of independence among observations. Our results suggest that the multiple-visits design does not meet the closure assumption and, consequently, that the design estimates habitat use rather than occupancy.

### **Characterization of the gut microbiota of migratory passerines in relation to the Gulf of Mexico**

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Although the gut microbiota provides many beneficial functions to animal hosts, including enhanced digestion, fat metabolism, and immune function, relatively little is known about the gut microbiota of passerines. Migrant passerines may be especially dependent on the beneficial functions of gut microbes to meet the energetic and physiological demands of migration; however gut atrophy experienced during prolonged migratory flight may cause disruptions of a stable microbiota and potentially a loss of function. To examine the gut microbiota, fecal samples were collected from Gray Catbirds and Swainson's Thrushes immediately after crossing the Gulf of Mexico during spring migration. As a proxy for pre-flight microbiota, fecal samples were additionally collected during fall before crossing the Gulf of Mexico. DNA was extracted from fecal samples and analyzed using next-generation sequencing. Microbiota communities were generally dominated by Proteobacteria and Firmicutes, with potential pathogens as well as potentially beneficial bacteria identified in all birds. Energetic condition of migrants was not significantly related to overall microbiota community structure, though it cannot be conclusively stated that gut atrophy experienced during flight does not impact the microbiota. Spring and fall migrants showed clear differences in microbiota communities, though only fall migrants showed species-specific profiles. These season and species differences may reflect the differing conditions and environments experienced by migrants in each stage, with the microbiota of spring migrants potentially reflecting tropical wintering areas and the microbiota of fall migrants reflecting breeding areas in North America. The results of this study suggest that the microbiota of migratory passerines do not show innate differences based on host species, but rather are heavily influenced by environmental factors.

### **Stress responses of corticosterone and plasma metabolites during different breeding stages in male Eurasian Tree Sparrow, *Passer montanus***

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In free-living birds, acute stress stimulates the hypothalamic-pituitary-adrenal (HPA) axis to release glucocorticoids that promote self-maintenance (e.g. the "emergency life history stage"). Such physiological and behavioral changes include



mobilization of stored energy sources and inhibition of reproductive behavior. Although the changes of corticosterone (CORT) and corticosterone binding globulin (CBG) in response to acute stress have been well demonstrated, there is very limited information on the changes of downstream plasma metabolites during the emergency life history stage. In the present study, we investigated the changes of plasma CORT, CBG, and metabolites including Glucose (Glu), triglyceride (TG), total cholesterol (TC), uric acid (UA), total protein (TP) in free-living male Eurasian tree sparrows (*Passer montanus*) during the nest building, early egg-laying, and later egg-laying sub-stages of breeding using the standardized capture-restraint stress protocol. We predicted that (1) tree sparrows would have higher stress-induced CORT levels during later egg-laying than their early egg-laying stages, and (2) have better body condition (e.g. TP and TG levels) during the nest building and early egg-laying than those of later egg-laying sub-stages. Our results showed that male sparrows exhibited significantly increased plasma total CORT and Glu levels, and decreased plasma TG, TC, UA levels in response to capture stress at different time points. Plasma CBG binding capacities, free CORT, and TP levels did not show any significant changes. Male sparrows had significantly higher stress-induced CORT (maximal CORT and total integrated CORT) levels during the later egg-laying sub-stages. Moreover, TG, Glu, UA, and TP levels did not change across different breeding sub-stages except that TC levels were significantly higher during nest building than those of later egg-laying stages. Our results provide more information for our understanding of the changes of CORT and plasma metabolites in response to acute stress in free-living birds.

#### **Migratory birds and bird flu, a dreadful alliance?**

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Migratory birds are considered to play an important role in connecting distant locations. During their migratory journeys, they transport nutrients, energy and other organisms such as pathogens. In doing so, migratory birds may enhance the global spread of pathogens but also modulate local infection dynamics. Avian Influenza Viruses (AIV) naturally occur in wild birds and infection dynamics often show marked seasonal variation. Notably, the peak in AIV prevalence during fall migration suggests a strong correlation of the presence of migrants and virus transmission. Here, we disentangle the various ecological drivers influencing local and global AIV infection dynamics using surveillance data from across the North American continent, and SIRS models fitted to data of an one-year study conducted on a small pond in the Netherlands. Our results indicate that all regions in North America showed a peak of infection in late summer that reflects the underlying seasonal dynamics of the environment, most likely driven by changes in population densities and the local proportion of susceptible individuals. However, epidemiological models fitted to the observed regional prevalence pattern in Mallards (*Anas platyrhynchos*) from the Dutch pond clearly identified migrants as the major driver of the late-summer infection peak. Moreover, our models suggest that the degree of migratory connectivity within and between migrant populations, particularly their phenology and synchrony, significantly affects local AIV dynamics. Our results lead to the conclusion that the

role of migrants in the spread of AIV and the amplification of local infection dynamics vary geographically and is thus expected to be different amongst the major global flyways.

#### **Using abundance and occurrence data to evaluate avian trends from Breeding Bird Survey data in Taiwan**

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Monitoring the changes in population is essential for conservation of biodiversity. However, different indices emphasize on various aspects of the data, which may lead to different interpretations and hence conservation strategies. Our objective was to compare and evaluate the effectiveness of avian trends using abundance index and occupancy index. We selected 9 common species from Breeding Bird Survey in Taiwan collected from 2009 to 2013. We selected 195 plots and divided the habitats into forest, cultivated land and the mosaic habitat. To account for the imperfect detection, we chose plots with at least five linear sampling points as spatial replicates in correlated detections model using Program Presence. Abundance data were analyzed using the TRIM software (TRENDS and Indices for Monitoring data). For 19 out of the 21 available species-habitat combinations, the trends for abundance index and occupancy index were consistent. While the majority of these trends indicated no significant trends, Eurasian Tree Sparrow (*Passer montanus*) in cultivated land showed consistent significant decreasing trends for abundance and occupancy indices. Chinese Bamboo-Partridge (*Bambusicola thoracicus*) in cultivated land showed decreasing trend in occupancy index while no significant trend in abundance index. On the other hand, Taiwan Scimitar-Babbler (*Pomatorhinus musicus*) in mosaic habitat did not show significant trend in occupancy index while having increasing trend in abundance index, suggesting species increase in terms of abundance but not in distribution. The preliminary analyses showed that different indices provided different perspectives on avian trend and using multiple indices may be beneficial in conservation planning. Future analyses will focus on species-habitat relationship and incorporating different habitat types.

#### **Analyzing community-level nest survival using a hyperprior-based hierarchical approach**

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Ecologists are often concerned with community-level responses to perturbations, environmental gradients, or experimental treatments. However, for population parameters such as nest survival only species-level estimation has been analytically possible, thus, requiring cumbersome inference at the community level. Hierarchical community models incorporate information from a suite of common and rare species to inform a more complete understanding of

distributions for bird communities, or guilds. This method has largely been used in occupancy estimation, but here we illustrate the usefulness of this approach in generating estimates of daily survival rates for songbird nests. We analyzed nest data from a designed experiment to test for differences in habitat use for songbirds in forest plots managed for biofuel feedstock production using switchgrass (*Panicum virgatum*) intercropping within a loblolly pine (*Pinus taeda*) plantation in Mississippi, USA on land owned and managed by Weyerhaeuser Company. We applied a hyperprior-based approach to nest survival modeling within a Bayesian framework for 555 nest of 17 species of open cup-nesting bird species. We found intercropping did not reduce nest survivorship for any guild. In smaller guilds, insufficient data are available to generate a sufficiently informative hyperprior to generate nests survival estimates for rare species. In guilds with large numbers of nests, we found our method allows estimating nest survival for guild members with as few as two nests. However, a tradeoff exists between ability to generate survival estimates for rare species by including them in guilds with many nests, and having survival estimates unduly influenced by large guilds (whose members may exhibit varying survivorship responses to similar ecological conditions). Therefore this method is a viable alternative method for estimating nest survivorship incorporating limited data for rare, or rarely detected songbird species to inform a community or guild response.

#### **Avian interactions with energy infrastructure in the context of other manmade mortality sources**

Scott Loss - Oklahoma State University, Stillwater, OK, United States

The global expansion in the development of renewable and non-renewable energy and its associated infrastructure is ongoing and will continue in the coming decades. The effects of this rapidly expanding energy infrastructure on bird populations and communities has become a major focus of research, management, and policy attention. To place the known effects of energy development in context, I draw upon several quantitative reviews that have produced large-scale estimates of bird mortality for manmade mortality sources. These studies illustrate a vast range of variation in the amount of overall mortality caused by different threats. Comparisons between mortality sources are useful in the context of energy development for attracting public, scientific, and policy attention, for highlighting major research gaps, for providing scientific evidence to inform resource allocation decisions, and for developing mitigation schemes whereby mortality from one threat is offset by reducing mortality from another threat. However, I contend that these estimates and comparisons have some limitations and should not be used to: (1) draw conclusions about population-level effects of manmade threats in the absence of detailed avian demographic data, (2) conclude that a small amount of total mortality or a paucity of information for a threat precludes biologically significant effects or the need for management and policy concern, and (3) develop mortality trading schemes when little species-specific mortality data is available to inform equivalent trades. Additional data collection on species-, location-, and season-specific mortality is needed to improve the understanding of energy infrastructure's impacts on birds, and therefore, for informing an optimal tradeoff between energy development and bird conservation.

#### **Out on their own: Brown-headed Cowbirds and the avoidance of mis-imprinting on the host**

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Sexually imprinting on the host species is considered one of the greatest constraints to the evolution of interspecific avian brood parasitism. While non-parasitic juvenile birds learn the behaviors and mate choice preferences of their parents, brood parasites must avoid mis-imprinting on their host's phenotype and recognize conspecifics. Here we test the 'first contact' hypothesis, where juvenile cowbirds are predicted to avoid mis-imprinting on the host by following female cowbirds to conspecific foraging flocks. Using an automated radio telemetry system, we determined the presence or absence (every 1-2 minutes for 3 breeding seasons; 516,315 search occasions) of radio-tagged juvenile cowbirds and their genetic mothers within a nest box study site. Contrary to our predictions, we found no support for facilitation by adult female cowbirds of juvenile cowbirds dispersing from their hosts. Juvenile cowbirds typically are not located within their mother's home range when departing the forest and, likewise, juvenile departure events rarely (< 2%) temporally overlapped with the departure of the genetically assigned mother or any radio-tagged female cowbird. We also found no statistical differences between natal and experimentally transplanted juveniles' behaviors in this study, implying a lack of direct kin recognition in parasitic cowbird mothers. Surprisingly, we demonstrate that juvenile cowbirds primarily depart from the host at sunset and roost solitarily. Our results suggest that juvenile cowbirds use an innate roosting preference that facilitates independence from their host, thus minimizing the risk of mis-imprinting on the host. This strategy may also indirectly promote conspecific interactions, providing further evidence for the importance of inherited preferences within the evolution of brood parasitism.

#### **Association of Rufous-winged Sparrow nest success to climate, vegetation, and land use in the Sonoran Desert of Mexico**

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Global circulation models predict an increase in aridity over northern Mexico and southwestern United States. Bird species specialized in arid ecosystems are then potential indicators of climate change in the region, such as the Rufous-winged Sparrow (*Peucaea carpalis*), whose timing of breeding is closely associated to the onset of monsoon rains. In this regard, we explored the association of the seasonal changes in vegetation density due to summer rainfall distribution on nest survival of *P. carpalis* in central Sonora, Mexico, as well as the effect of the exotic buffelgrass and habitat structure in a region under intense grazing by domestic cattle. We monitored 217 nests in the breeding seasons (July-September) of 2013 and 2014. We analyzed nest survival data implementing logistic-exposure models in program WinBUGS, with the normalized difference

vegetation index (NDVI), measures of habitat structure (density and cover of woody plants), buffelgrass cover, Julian date, and factors YEAR (2013 and 2014) and STAGE (incubation, nestling, fledgling) as explanatory variables. We found that differences in habitat structure, buffelgrass cover, and vegetation density (NDVI) among nests did not explain variation in nest daily survival probability. Our analysis identified no temporal trends in nest success within and between years. Nest success was higher during the incubation stage. The intercept-only model yielded a mean nest daily survival probability of 94.79% (95% Credible Confidence Interval: 90.54-97.19%). Given that nest survival seemed unaffected by the habitat alteration in pastures at Sonoran Desert scrublands and buffelgrass prairies, we conclude that the Rufous-winged Sparrow may be resilient to habitat transformation in the center of its distribution.

#### **Evaluation of intercropping switchgrass (*Panicum virgatum*) in southeastern loblolly pine (*Pinus taeda*) forests on avian communities**

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Intercropping switchgrass (*Panicum virgatum*) between beds of newly planted pines serves as a potential method to cultivate herbaceous biofuel feedstocks within intensively managed loblolly pine (*Pinus taeda*) forests. Intensively managed loblolly pine forests support a diverse assemblage of avian communities potentially affected by the establishment and maintenance of intercropped switchgrass via alterations to the structural complexity and diversity of the vegetative community. Structurally complex and taxonomically diverse vegetative communities are considered to support greater biological diversity. We assessed early successional scrub-shrub avian community response to within stand alterations to heterogeneity due to intercropping switchgrass in intensively managed loblolly pine forests. We posited that a reduction in structural complexity of the vegetative community would result from intercropping switchgrass, ultimately altering early successional scrub-shrub avian communities. We predicted that intercropping switchgrass would reduce the density of early successional scrub-shrub species and alter the overall species composition of intercropped stands as compared to traditionally managed pine stands. Avian abundances and species composition were assessed using point counts conducted from May–July 2014 coinciding with the avian breeding season. Preliminary results indicate that early-successional scrub-shrub avian density and overall species composition did not differ between intercropped and traditionally managed pine stands. These data provide forest managers a better understanding of early successional scrub-shrub avian community response to intercropping switchgrass in intensively managed loblolly pine forests. However, it is unclear how avian community assemblages will respond as stands age.

#### **Bird conservation experiences in Mexico**

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The Socorro Dove (*Zenaida graysoni*), endemic to Socorro Island, became extinct in the wild between 1972 and 1978. The

species survived because Edward Gifford, a member of the California Academy of Sciences expedition of 1925, brought several doves to Oakland. Doves were bred in the United States and soon were sent to Herbert Bright in the United Kingdom. Later, Nicolai Jurgen organized breeding efforts in Germany. In 1995, Stefan Stadler began the institutional coordinated efforts of the European Association of Zoos and Aquaria (EAZA/EEP) providing a solid basis to maintain a viable population under human care. In 2008, Peter Shannon at the Albuquerque Zoo received 12 birds from the United Kingdom and continued conservation efforts in North America with 4 additional institutions. In 2013, Frank Carlos Camacho at Africam Safari in Mexico received six individuals from the Albuquerque Zoo thus achieving the return of the species to its home country. In 2014, the first chicks hatched in Mexico almost 40 years after its disappearance from Socorro Island. Currently, about 30 zoos in Europe, the US and Mexico participate in the ex situ conservation efforts for the species. The in situ conservation strategy contemplates the restoration of critical ecological interactions for Socorro Dove and includes a habitat restoration program in areas where birds might be released. Selected plant species are endemic to Socorro Island and will provide food, shelter and nesting sites as well as a place where native herbaceous species and shrubs will facilitate recolonization of arthropod species present at undisturbed sites. The international reintroduction team already identified critical components of the overall reintroduction project. Both an experimental and establishment release stages will be implemented. Given current demographic conditions in the ex situ conservation program there will be a window of opportunity for a reintroduction attempt in 2017.

#### **Evolutionary rate heterogeneity of learned and innate vocal displays among two prominent clades of Neotropical passerines (Thraupidae and Furnariidae)**

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Sexually selected traits play an important role in species recognition and as prezygotic barriers to gene flow during speciation. At deeper evolutionary time scales, however, it is unclear if evolutionary rates of sexually selected traits are coupled with speciation rates. Additionally, certain sexually selected traits, such as avian vocal displays, vary in the degree to which they are innate or learned. Learning is a form of cognitive phenotypic plasticity that may accelerate trait evolution, and consequently, speciation rates. Here, we examine patterns of evolutionary rate heterogeneity among speciation rates, avian vocalizations, and body mass across two prominent Neotropical lineages of passerines: tanagers (Thraupidae) and ovenbirds (Furnariidae). Importantly, tanagers learn their songs, whereas ovenbirds' songs are innate. We compare the prevalence, directionality, and magnitude of evolutionary rate shifts among 321 species of tanagers and 276 species of ovenbirds. We infer substantial variation in the prevalence of evolutionary rate heterogeneity among characters and find limited evidence that oscine songs evolve at faster rates than suboscine songs. Finally, speciation rates are positively correlated with evolutionary rates of multiple vocal characters and body mass, suggesting rates of

speciation and trait evolution involved in sexual selection are coupled across two distantly related avian lineages.

#### **Demography of the American Kestrel lends insight into potential causes of population declines and suggests future research needs**

Christopher McClure - The Peregrine Fund, Boise, ID, United States; Jessi Brown - University of Nevada Reno, Reno, NV, United States; Karen Steenhof - Owyhee Desert Studies, Murphy, ID, United States; Julie Heath - Boise State University, Boise, ID, United States

Population declines are, in essence, emergent properties of demographic processes, but not all processes affect the growth (or decline) of a population equally. Demographic models often are used to identify the factors that most affect the growth rate of a population and may identify vital rates that should be targeted for management or further research. Raptors are typically long-lived species and, therefore, are generally considered “survivor” species because changes in survival rates tend to affect population more strongly than changes in reproduction. Many populations of American Kestrels (*Falco sparverius*) have declined steadily over past decades but the underlying causes remains unknown. Although there are many hypothesized drivers of kestrel declines, the hypotheses tested to date have been related to reproduction or threats on the breeding grounds. Here, we use data from thousands of banded kestrels as part of two nest-box programs in Florida and Idaho to examine American Kestrel demography and test the hypothesis that, like other raptors, the growth rate of a typical population is more sensitive to changes in survival, than to changes in fecundity. Our results support this hypothesis and suggest that future research should examine threats to American Kestrels during the post-fledging, migratory, and wintering periods.

#### **Urbanization alters molt dynamics in a common desert songbird**

Kevin McGraw - Arizona State University, Tempe, AZ, United States; Pierce Hutton - Arizona State University, Tempe, AZ, United States

Earth’s terrestrial surface is being urbanized rapidly. Knowledge of how urbanization affects the physiology and behavior of animals is vital for conserving natural populations. In birds, most work has focused on urban impacts on stress physiology, reproduction, and migration, but we know little about how urbanization affects the temporal dynamics of molt. We studied molt onset and progression in urban and rural House Finches (*Haemorrhous mexicanus*) from Phoenix, AZ and found that, although urban birds started molting earlier, rural birds molted at a faster rate, such that there was no difference in timing of molt completion. Urban birds remained in poorer body condition than rural birds throughout the molt period. These results suggest that molt is less condition-dependent than previously thought, at least among urban birds, and/or that other annual activities help explain molt timing; in particular, earlier breeding (and breeding cessation) among urban birds may permit them to start molt sooner. It is also possible that narrower peaks in food availability in natural desert areas (i.e. where they are more reliant on monsoon rains and less on access to sustained seed feeders in cities) may more finely-tune molt timing in rural birds. We will also discuss links between molt and plumage coloration in urban and male finches to provide further insights into the relationships

between urbanization, individual quality, and molt in this common passerine.

#### **Predictive models of stopover incidence by migrant landbirds**

James D. McLaren - University of Delaware, Newark, DE, United States; Jeffrey J. Buler - University of Delaware, Newark, DE, United States; Deanna K. Dawson - Patuxent Wildlife Research Center, Laurel, MD, United States; Jaclyn Smolinski - University of Delaware, Newark, DE, United States; Matt Boone - University of Delaware, Newark, DE, United States

Analysis of spatial patterns of migrating landbirds at the onset of nocturnal flight using weather radar can enhance our understanding of the relationship between stopover site use and environmental variability at both landscape and geographic scales. We used cross-validation together with 7 seasons of reflectivity data from a network of 16 weather surveillance radars (NEXRAD) to assess predictive models of autumnal stopover incidence in north-eastern U.S. based on spatially explicit regression and machine learning approaches. We focus on boosted generalized models (GAMs), which both avoid overfitting via boosting and facilitate distinguishing geographic-scale and landscape-scale effects. Similarly to previous studies, the geographic effects dominated, and landscape composition predictors at 5 km scales outweighed those at 1 km scales. Predicted stopover density increased with increasing hardwood coverage, increased with urban coverage within cities, decreased in heavily agricultural locations and decreased away from the coast within 75 km, more steeply away from the Atlantic seaboard than from the Great Lakes. These functional relations can be further validated using dynamic weather data and individual-based simulations, including assessing robustness of stopover quality to environmental change. However, the accuracy of predicted reflectivity outside radar viewsheds remains uncertain.

#### **Niche and song divergence for hybridizing and non-hybridizing passerines**

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Identifying the factors that currently contribute to reproductive isolation is a necessary first step in determining how reproductive isolation arises. In this project we examine how patterns of environmental niche divergence and song divergence contribute to reproductive isolation in passerine birds. In previous work we examined environmental niche divergence for several hybridizing passerine species pairs (e.g., Baltimore and Bullock’s Orioles) and sympatric but non-hybridizing species pairs (e.g., Hooded and Orchard Orioles). We found that hybridizing species pairs tend to be less divergent, that is they partition available habitat less finely, than are non-hybridizing pairs, along most environmental variable axes. Divergence in vocalizations can also be a strong driver of reproductive isolation in passerines because song is widely used as a basis for mate choice. Song divergence can easily become a prezygotic isolating mechanism under sexual selection, paving the way for further divergence between populations. Alternatively, song divergence may be a secondary result of ecological divergence: because song production is constrained by morphological characteristics such as body size, divergence in song can be a result of ecological selection on those traits. We quantified song divergence for our hybridizing and non-hybridizing species pairs and examined degree of song

divergence in conjunction with environmental niche divergence. Although our project cannot determine whether song divergence preceded environmental divergence or vice versa during the evolution of reproductive isolation between two species, we can identify which instances of isolation are more likely due to environmental niche divergence or song divergence.

#### **Examining ecosystem services and disservices of bear damage on Hoopa Valley Reservation**

Shannon Mendia - Humboldt State University, Arcata, CA, United States; Matthew Johnson - Humboldt State University, Arcata, CA, United States; J. Mark Higley - Hoopa Tribal Forestry, Hoopa, CA, United States

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 damage to trees from bears may negatively affect timber production, it also alters forest structure and habitat that may contribute to forest wildlife diversity. To the Hupa people on the Hoopa Valley Indian Reservation in northwestern California, Pileated Woodpeckers (*Dryocopus pileatus*) and other woodpecker species are considered a culturally significant. We studied the relationship between bear damage to Douglas fir (*Pseudotsuga menziesii*) trees and bird community composition and structure, focusing on cavity-nesting birds such as woodpeckers. We surveyed 40-60 year old stands that were historically clear-cut and pre-commercially thinned. To measure disservices from bears, we determined the extent of damage in terms of financial loss and what impacts that damage will have on future harvests. We measured ecosystem services by calculating encounter rates and densities (individuals/ha) of each bird foraging guild. We used resource selection functions for woodpecker species with home range sizes larger than our sample unit to determine habitat selection. Bear damage negatively affected tree growth and estimated lumber recovery. Bear damage was significantly correlated with large dead and decaying trees (>10in DBH). Woodpecker activity and site selection increased with increasing number of dead and decaying bear damaged trees/stands. Information from this study can better inform our current understanding of the potential for bear foraging to negatively affect economic revenue and the trade-offs which help to create habitat conditions favoring other important wildlife species. 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.

#### **Breeding bird communities of first-year eucalyptus plantations in southwest Louisiana**

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Eucalyptus (*Eucalyptus spp.*) plantations have potential to boost availability of small-diameter hardwoods for traditional wood products and bioenergy feedstocks, and they can be grown on sites accessible during wet weather. Eucalyptus is currently

being grown on selected sites in southwest Louisiana and southeast Texas, and the extent of plantings is expected to increase in the future. Biodiversity response to eucalyptus plantations in the U.S., however, has not been investigated. Thus, in summer 2014 we sampled assemblages of breeding birds in five 1-year-old eucalyptus plantations in southwestern Louisiana and reference slash pine (*Pinus elliotii*) stands of both the same age (1-year post establishment; n = 5) and height (6-year-old; n = 5). Prey availability was assessed by sampling invertebrates using pitfall traps and insecticide knockdown. Avian species diversity and richness in eucalyptus plantations were intermediate to diversity and richness in pine plantations of the same age and height. Neotropical migrants, foliage gleaning and shrub nesting species were less common in 1-year-old pine stands than other stand types. Although abundance of avian guilds was similar between six-year-old pine stands and eucalyptus stands, guild species composition varied between these stand types. Prey composition also differed, with tree-dwelling arthropods least diverse in eucalyptus stands and ground-dwelling arthropod diversity greater in eucalyptus than in 6-year-old pine stands.

#### **Genetic and phenotypic evidence for species-level differences between Martinique and St. Lucia populations of an Endangered mimid (*Ramphocinclus* sp.)**

Matthew J. Miller - Villanova University, Villanova, PA, United States; Jennifer L. Mortensen - Tufts University, Medford, MA, United States; Katherine Freeman - Villanova University, Villanova, PA, United States; J. Michael Reed - Tufts University, Medford, MA, United States; Robert L. Curry - Villanova University, Villanova, PA, United States

While the Antillean avifauna has provided fundamental insights in our understanding of island biogeography, taxon cycles, and the evolution of behavioral systems in birds, the implications of these studies have been hindered by uncertainty over the taxonomic status of endemic island populations, some of which have never been sampled. Thrashers in the genus *Ramphocinclus* are known only from the islands of Martinique and St. Lucia, and the combined population estimate for both islands is less than 2000 individuals. As a consequence, the taxon has been formally red-listed as Endangered. Here we provided novel genetic evidence that combined with phenotypic evidence unambiguously supports species-level differences between the island populations of *Ramphocinclus* thrashers. The two populations are clearly diagnosable by plumage traits, mensural characteristics, quantitative analysis of vocal characteristics, and degree of sexual dimorphism. Mitochondrial DNA divergence levels between the two populations equals or exceeds differences found among other mimid species, while individual gene trees from both mitochondrial and autosomal loci demonstrate reciprocal monophyly and provide no evidence of on-going gene flow between the two islands. Proper recognition of species-level differences indicates that the Martinique endemic species (*Ramphocinclus brachyurus*) should be reclassified as Critically Endangered, while the St. Lucia species (*Ramphocinclus sanctaেলুচiae*) merits continued classification as Endangered. Finally, our species tree phylogeny provides some support for an insular radiation of Antillean mimids, but additional genomic sampling is required to confirm this finding.

#### **Are forager responses to different types of novelty part of a behavioral syndrome?**

David Moldoff - University of Kentucky, Lexington, KY, United States; David F. Westneat - University of Kentucky, Lexington, KY, United States

Foraging birds must often deal with different forms of novelty, from unfamiliar organisms or objects near food that might or might not be dangerous, to shifts in the type or appearance of food resources. Behavioral responses to novelty include neophobia (delays to approach a desired resource in the presence of novel object), subsequent habituation, and associative learning. We measured these responses in captive house sparrows when novel elements were added to a familiar foraging location and we assessed patterns of among individual variation within and between contexts. Among-individual variance (personality) existed in most measured responses. Sparrows exhibited repeatable differences in latencies to approach food (boldness) when there was no change in conditions. They also showed repeatable changes in latency (individual plasticity) when novel objects were added. Birds habituated to the novel objects and individuals habituated at significantly different rates. When faced with a novel association task (where a novel color cue indicated food), sparrows again showed repeatable differences in latency across all trials even though average latency declined as experience increased. However, the rate of learning did not significantly differ between individuals. We tested for a syndrome by assessing among-individual covariance for responses in the three contexts (baseline, novel object, and novel association). We found no support for a general response to novelty. Our results suggest that different types of novelty employ different mechanisms, and while individuals vary within a context, those differences do not predict differences in other situations. Such domain specificity may complicate hypotheses about invasibility and adaptation to rapid environmental changes.

#### **The lateral export of an algal bloom toxin from aquatic ecosystem into the Prothonotary Warbler via emerging aquatic insects**

Nicholas Moy - Virginia Commonwealth University, Richmond, VA, United States; Lesley Bulluck - Virginia Commonwealth University, Richmond, VA, United States; Paul Bukaveckas - Virginia Commonwealth University, Richmond, VA, United States

Emerging aquatic insects are a substantial food source for bats, herps, spiders, and birds. As this energy flux crosses habitat boundaries it is shadowed by the movement of pollutants- this has been referred to as the dark side of subsidies. This study expands this developing field to address the growing threat of harmful algal blooms. These blooms are directly related to human-caused nutrient enrichment of freshwaters and can be toxic. The green-blue algae species *Microcystis aeruginosa* produces microcystin, a toxin that has been linked with mass mortalities and illness of many taxa. Aquatic ecosystems are affected at every trophic level. However, the extent to which microcystin can move into terrestrial food webs has yet to be explored. Here we show that microcystin is not constrained by the aquatic terrestrial ecotone. We detected the toxin at relatively medium levels in all three taxa of a cross-habitat food chain; in a primary algae consumer and emerging aquatic invertebrate (*Hexagenia* Mayfly), a terrestrial insect and obligate aquatic insect consumer (*Tetragnathidae* Spider), and a vertebrate consumer that consumes a combination of aquatic and terrestrial food (Prothonotary Warbler). Prothonotary warbler toxin levels varied temporally and by age class. The study was conducted in 2014 on the lower tidal James River

near Richmond, Virginia. Stable isotope analysis and video monitoring of nestling provisioning of prothonotary warbler nests were used to establish food web connections. Fecal sacs of nestlings were tested and were positively related to the amount of aquatic food in nestling diet, however the liver concentrations of nestlings were not related to either. Liver concentrations were also not significantly related to nestling body condition. This study shows that human-induced algal blooms have impacts outside of aquatic ecosystems - microcystin can be exported via food web and has the potential to affect terrestrial organisms.

#### **Female song in New World wood-warblers (Parulidae)**

Nadje Najar - University of Northern Colorado, Greeley, CO, United States; Lauryn Benedict - University of Northern Colorado, Greeley, CO, United States

Recent advances have revealed that female birdsong is widespread and multifunctional. Female song was likely ancestral among songbirds and persists in many lineages today. Nevertheless, many species lack female song, and researchers are interested in understanding the selective factors that promote and counter the persistence of this trait. Female song is associated with life-history traits including year-round territoriality, non-migratory behavior, sexual monochromatism, and monogamy. Most studies examining these relationships have looked at clades with a sedentary ancestor and have found that gains of migratory behavior are strongly correlated with losses of female song (and duetting). Here we ask if the reverse pattern exists: in a large clade of songbirds with a migratory ancestor, do losses of migratory behavior correlate with gains of female song and visual signaling traits? We investigated correlations between female song, migration and dichromatism in 107 species of New World Warblers (Family Parulidae). All of these species are predominantly monogamous and territorial when breeding, 50 (47%) are migratory, 49 (46%) are monochromatic, and 25 (23%) show female song. On a robust genetic phylogeny both parsimony and maximum likelihood methods recover migration and monomorphism as the ancestral state in warblers. Female song is generally not reconstructed as present in any deep nodes of the phylogeny, indicating that most extant species with female song evolved this trait independently and relatively recently. Gains of female song do not correlate with losses of migration. Losses of dichromatism do correlate with losses of migration. Thus, in this clade, visual signals are associated with sedentary versus migratory lifestyles, but female acoustic signals are not. Our results show a different pattern from that seen in similar studies and support the hypothesis that losses, but not gains, of female song are driven by life history.

#### **Bond at first sight: Examining the effects of synthetic estrogen on male zebra finch courtship behaviors and pair bond formation**

Madeleine Naylor - Oklahoma State University, Stillwater, OK, United States; Jennifer Grindstaff - Oklahoma State University, Stillwater, OK, United States

Estrogen has organizational and activational effects in birds. Females require estrogen for development of reproductive anatomy and the courtship and reproductive behaviors of both sexes are associated with estrogen levels. Therefore, exogenous estrogen exposure might cause significant changes in physiology and behavior. 17 $\alpha$ -Ethinylestradiol (EE2), a synthetic estrogen in oral contraceptives, is found ubiquitously

in wastewater effluents. EE2 exposure is known to alter avian embryonic development, but it is not known if there are activation effects on adults. We tested the potential for EE2 to disrupt male courtship behavior of zebra finches (*Taeniopygia guttata*) as a model for environmental exposure of avian species. We used three different treatments, control or 0 ng EE2; 4 ng EE2, which is an environmentally relevant concentration found in streams near wastewater effluent sites; and 100 ng EE2, which serves as a positive control. Males were dosed orally every other day for three weeks prior to pair introduction and until nestlings hatched or for up to five weeks after pair introduction, if no eggs were laid. We recorded male and female courtship behaviors upon introduction and over the subsequent 48-hour time period to test whether the time required to initiate pair bond behaviors was affected by treatment. A total of nine 20-minute trials were recorded per pair over this 48-hour period for a total of 39 pairs (13 per treatment group). Approximately one week after pair introduction, nest boxes were provided and then monitored for egg laying and hatching. In preliminary trials, we found that EE2 treated males made fewer mounting attempts than control males but produced more offspring than control males. If this is supported in a larger dataset, then this will suggest that EE2 exposure in adulthood may influence avian reproductive success.

#### **Genomics of speciation in the globally distributed shovelers**

Joel Nelson - Wright State University, Fairborn, OH, United States; Kevin G. McCracken - The University of Miami, Miami, FL, United States; Jeffrey Peters - Wright State University, Fairborn, OH, United States

Geographically widespread lineages potentially are subjected to diverse speciation mechanisms, including allopatric divergence, divergence with gene flow, and adaptive divergence. This diversity of processes offers an opportunity to examine the genomics of speciation in a comparative context. The shovelers (genus *Anas*) are a recently radiated and globally distributed dabbling duck lineage comprising four species, each found on a different continent. Although these species are widely allopatric, high dispersal abilities potentially make gene flow likely. We used restriction associated DNA sequencing (RADseq) to characterize genomic divergence at different stages along the speciation continuum and to test for evidence of gene flow during speciation. We recovered a total of 3,307 RADseq loci that were shared among the four species. Overall, the highest divergence was observed between the South American red shoveler (*A. platalea*) and the other three species, and the distributions of *F<sub>st</sub>* were fairly uniform and consistent with neutral, allopatric divergence. However, weak measurements of relative divergence and non-zero values of gene flow suggest that the northern (*A. clypeata*), the Australasian (*A. rhynchotis*), and perhaps the Cape shoveler (*A. smithii*) are diverging in the presence of gene flow. In particular, the Australasian shoveler inhabiting New Zealand seems to have a high frequency of introgressed alleles derived from the northern shoveler. We did not find evidence of adaptive divergence between any pair of species, but background levels of divergence might have been too high to detect outlier loci. Overall, our series of genomic comparisons suggest that models of speciation with gene flow, rather than allopatric speciation, may better characterize highly vagile species, despite being distributed on separate continents. Furthermore, our results illustrate the progression of genomic divergence throughout the speciation continuum.

#### **The response of a mature forest dependent species to silvicultural treatments**

Claire Nemes - Ball State University, Muncie, Indiana; Kamal Islam - Ball State University, Muncie, IN, United States

Cerulean Warbler (*Setophaga cerulea*) populations have declined at a rate of nearly 3% per year between 1966 and 2010. This Neotropical migrant wood-warbler breeds in mature deciduous forests in the eastern US and Canada, including Indiana, where it is classified as state endangered. In 2007, we began monitoring the breeding population of Cerulean Warblers in Morgan-Monroe and Yellowwood state forests near Bloomington as part of the Hardwood Ecosystem Experiment (HEE), a 100-year collaborative research project investigating the impacts of different forest management practices on the flora and fauna of southern Indiana forests. Nine experimental units within the state forests were assigned one of three management types: control (no timber harvest for the duration of the study), even-aged treatment (clearcut and shelterwood harvests), or uneven-aged treatment (group cut and single-tree selection). The first round of timber harvest occurred in 2008 – 2009. Here we present data on Cerulean Warbler responses to these different silvicultural strategies taking place in the HEE. Relative abundance, measured in number of males per square kilometer, declined in uneven-aged units in the year following timber harvest, and declined in all three unit types two years after harvest; however, relative abundance in each unit has fluctuated since these initial results. Nest success in the different unit types is likewise variable based on year, and was negatively influenced in all three unit types by severe drought in 2012. Future research will continue to monitor Cerulean Warbler nest success and relative abundance, as well as habitat use and site fidelity, in order to gauge long-term responses to forest management in southern Indiana.

#### **The songbird transcriptome in response to West Nile Virus**

Daniel Newhouse - East Carolina University, Greenville, North Carolina, United States; Erik Hofmeister - USGS National Wildlife Health Center, Madison, WI, United States; Christopher Balakrishnan - East Carolina University, Greenville, NC, United States

West Nile Virus (WNV) has infected over 30,000 people in the United States since its initial outbreak in 1999 with a recent severe outbreak in 2012. WNV is a ssRNA flavivirus that exists in a bird-mosquito transmission cycle where mammals, such as humans, act as dead-end hosts and passerines act as the primary reservoir host. WNV has received considerable attention regarding transmission dynamics and the mammalian immune response to the virus. However, very little is known about the avian immune response to WNV. Avian taxa show variable susceptibility to WNV and what drives this variation is unknown. To study the effects of WNV in birds, we experimentally infected captive zebra finches (*Taeniopygia guttata*). Zebra finches provide a useful model, as they are moderately susceptible to WNV, are easily manipulated, provide sufficient viremia to infect mosquitoes, and have a sequenced genome. Individuals were sampled (n=3 each) prior to infection and on Days 3 and 5, which corresponds to peak viremia. We then sequenced splenic RNA (Illumina RNAseq) to provide an overview of their transcriptional response. We then quality-trimmed RNAseq reads, mapped them to the zebra finch genome and performed differential gene expression analyses using DEseq2. Overall we find only ten genes differentially expressed between Control and Infected cohorts,

but none of these were immune-related. However, when comparing Control vs. Day 3 and Control vs. Day 5, we find 5-11 immune genes significantly differentially expressed covering both the innate and adaptive immune response (e.g. toll-like receptors and MHC Class II). We also observe significant Gene Ontology (GO) enrichment pertaining to the immune response. Together with complementary immunological assays, we provide a model of the avian immune response to WNV. This sets the stage for future studies assessing variable immune response to WNV among populations and taxa.

#### **Migratory bird conservation planning and assessment using spatial models developed from stop-level BBS data**

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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 are able to accommodate BBS survey design, refine estimates for important habitat predictors, improve model fit, and reduce positive spatial autocorrelation in model residuals. Predictive power of models is greatly increased by inclusion of variables characterizing wetland water regimes, annual and long-term water conditions, and landcover attributes not available from satellite-derived landcover data. Our models indicate that the USDA's Conservation Reserve Program and historic waterfowl conservation efforts in the joint ventures have provided extensive benefits for grassland birds, waterbirds, and shorebirds. However, our models also show that habitat for several priority species is at risk in areas without active conservation programs.

#### **Challenges and opportunities in the use of BBS data for ecological condition assessments**

Timothy O'Connell - Oklahoma State University, Stillwater, OK, United States

Data from the North American Breeding Bird Survey (BBS) are integral to conservation planning as source data on population trend for hundreds of species. These data also provide a wealth of information on the ecological implications of species' distributions across broad areas. When fed into ecological indicators that incorporate species assemblage information, BBS data have the potential to fuel robust analyses of ecological condition across entire ecoregions and compare among different ecoregions historically to the 1960s. For these potential benefits to be realized, however, several challenges to the use of BBS data for these purposes should be addressed. As with the use of BBS data for any analysis, there are limitations with geographic coverage owing to the variability in sampling density across North America and the regularity with which routes are surveyed. Detection rates among observers and low detections of various species that are undersampled by the BBS can be problematic. More relevant to ecological assessment is the question of how representative are the landscapes

surrounding BBS routes compared to total ecoregion land cover. Also, the scales at which indicators have been developed differ from the standard sampling scale of the BBS. We compared ecological assessments using the Bird Community Index (BCI) and Partners in Flight Conservation Value (CV) scores from the Mid-Atlantic Highlands. To best match spatial and temporal scale used to develop the BCI, we used 10-stop subsamples of BBS data that also provided the maximum opportunity to compare current to historical assessments. Land cover analysis revealed that BBS routes sampled land cover types in proportion to their actual prevalence in the region. We conclude that BBS data are appropriate as source data for ecological assessments with indicators such as the BCI.

#### **Functionally significant sensitivity to ultraviolet wavelengths in the Pileated Woodpecker (*Dryocopus pileatus*): Implications for woodpecker interactions with wood decay fungi and anthropogenic structures**

Sean O'Daniels - University of Missouri, Independence, MO, United States; Scott Werner - National Wildlife Research Center, Ft. Collins, CO, United States; Dylan Kesler - University of Missouri, Columbia, MO, United States; Lisa Webb - Missouri Cooperative Research Unit, Columbia, MO, United States; Jeanne Mihail - University of Missouri, Columbia, MO, United States

Birds rely on eyesight for many aspects of their behavior and ecology, and most diurnal species have evolved complex visual systems that include sensitivity to near ultraviolet (UV; 300-399 nm) wavelengths. We report on a novel foraging-based behavioral assay designed to test UV sensitivity in woodpeckers, using the pileated woodpecker (*Dryocopus pileatus*) as a model organism. We acclimated 6 wild-caught woodpeckers to foraging for frozen mealworms within 1.2 m sections of peeled cedar (*Thuja spp.*) poles. We then tested the functional significance of UV cues by placing frozen mealworms behind UV-elevated covers (0.07% MgCO<sub>3</sub>, wt/wt) or behind UV-reduced covers (0.07% MgCO<sub>3</sub> + "UV Killer") within these 1.2 m poles in independent experiments. The UV reflectance was not modified on untreated control covers, nor were mealworms placed behind control covers. Over 10 trials, the probability of contact, probability of removal, and handling time were greater for UV-elevated covers than for control covers. Test subjects therefore reliably attended to two distinct UV conditions of a substrate. Sensitivity to UV is undescribed in piciforms, and may be useful to woodpeckers when making foraging or nesting decisions. For example, some wood decayed by fungi has elevated UV reflectance compared to sound wood, and some woodpeckers preferentially excavate food items from decayed wood. Further, some woodpeckers place cavities within trees decayed by specific fungi. Mechanisms by which woodpeckers might select wood decayed by specific fungi remain unknown. UV cues may also be useful in modifying woodpecker behaviors. For example, UV-reflective films may be used to limit woodpecker strikes to windows, and avian repellents paired with UV cues may be effective for altering woodpecker damage to anthropogenic structures.

#### **Impacts of specialists on mixed-species associations: Do obligate antbirds alter the structure of bird flocks army ant raids (Thamnophilidae)?**

Sean O'Donnell - Drexel University, PA, Pennsylvania, United States

Multi-species foraging associations often comprise a range of specialized-to-generalized species. I used mixed-species flocks



of birds that attend army ant raids to assess how the community of birds that co-exploit a single resource (prey at army ant raid fronts) is affected by the presence of specialized species. Obligate antbirds (Thamnophilidae) are specialized foragers at army ant raids and exhibit behavioral adaptations that enhance their ability to exploit army ant raids for food. I compared the composition of bird flocks at army ant raids in four geographically adjacent sites with and without thamnophilid antbirds. I measured the number of birds, weight of birds, and species diversity of birds in flocks in each life zone. I also divided bird species into guilds based on the substrates they used when foraging at raids: ground-, pouncing-, and vegetation-foragers and asked whether birds in these foraging substrate guilds differed in body size within and among life zones, and whether guild abundance at raids differed among life zones. There was a high degree of turnover in the set of bird species attending raids among life zones. Obligate thamnophilids were most abundant in Atlantic slope PMRF; thamnophilids were relatively rare on the Pacific slope and absent from the PMWF life zone. Some basic parameters of flock composition- the number and total weight of birds present, and the number of species of birds in the flock, did not vary among life zones. By these measures the cost of avian raid attendance to the army ants is constant and obligate thamnophilids had little impact on flock composition.

#### **Estimating stopover duration of ducks using weather radar and aerial surveys**

Benjamin O'Neal - Franklin College, Franklin, IN, United States; Joshua Stafford - USGS/South Dakota State University, Brookings, SD, United States; Ronald Larkin - Illinois Natural History Survey, Champaign, IL, United States

The amount of time that birds spend at stopovers (i.e., stopover duration) can have a considerable effect on populations of migrants and plans for their conservation. This is especially true for migrant waterfowl, which are explicitly conserved through Joint Venture (JV) partnerships under the North American Waterfowl Management Plan. The formal conservation plans of many mid-migration JVs rely on estimates of stopover duration to estimate energetic requirements. Although waterfowl are well studied in general, considerable uncertainty remains regarding their stopover behavior due to the inherent challenges of investigating migratory phenomena. We used weather surveillance radar and thermal infrared-based ground-truthing to identify and enumerate ducks emigrating from an important stopover area in central Illinois. By combining radar data with weekly aerial inventories, we estimated an average stopover duration for fall-migrating dabbling ducks (tribe Anatini) of 28 days (SD = 12) over 8 years (1996, 1997, 2003, 2005–2009). Our estimate was similar to the historical estimate of 28 days (1940–1966), which serves as the primary reference for the Upper Mississippi River Great Lakes Region JV conservation plan. In addition to a corroborative mean, we also found considerable inter-annual variation in stopover duration. Estimated annual stopover duration was correlated positively with an index of annual foraging habitat quality (Spearman rank correlation;  $r_s = 0.83$ ), suggesting ducks may have assessed local conditions and adjusted the spatiotemporal course of fall migration. If the stopover behavior of fall-migrating ducks is flexible and forage-dependent, it is possible ducks allocate their time among sites in a somewhat ideal and optimal fashion, which could substantially affect the way conservation resources are allocated within the spatial context of a JV region.

#### **Female and male song in Troupials: Comparing structure and diel patterns of solos and duets during the breeding and non-breeding season**

Karan Odom - University of Maryland, Baltimore County, Baltimore, MD, United States; Kevin Omland - University of Maryland, Baltimore County, Baltimore, MD, United States; David Logue - University of Lethbridge, Lethbridge, AB, Canada

Recent research emphasizes that female song in birds is more common than previously thought, yet there are still very few species for which we have quantified the similarities and differences between male and female song. Understanding when, what, and how often females and males are singing is a necessary first step to forming hypotheses about possible functional differences between female and male song. Such differences may be indicative of the selection pressures that are acting on the songs of each sex. Our goal was to compare the structure and timing of female and male songs in the Venezuelan Troupial (*Icterus icterus*), a tropical, duetting songbird in Puerto Rico. We compared song structure and diel patterns of singing behavior in males and females for both solos and duets. Male and female songs had similar duration and frequency characteristics. However, singing rates varied substantially between males and females, particularly comparing dawn and day time singing rates. Dawn singing was predominantly by males during the breeding season, whereas females sang the majority of daytime solos and sang at similar rates during the breeding and non-breeding season. Duets were the most common vocalization sang during the day. Interestingly, duets occurred at higher rates in the non-breeding season than in the breeding season, indicating that duets are functionally important throughout the year and not specifically tied to breeding. Our finding that females sing more during the day year-round while males sing more at dawn during the breeding season emphasizes the need to explore alternative functions and selection pressures contributing to the evolution of female and male song in birds.

#### **Speciation reversal in Common Ravens: Genomic evidence of the collapse of cryptic lineages in western North America**

Kevin Omland - UMBC - University of Maryland, Baltimore, MD, United States; Anna Kearns - University of Oslo, Oslo, Norway; Marco Restani - Saint Cloud State University, Saint Cloud, MN, United States; Ildiko Szabo - University of British Columbia, Vancouver, BC, Canada; Arild Johnsen - University of Oslo, Oslo, Norway

There is increasing evidence that gene flow between phenotypically distinct species is a common and important evolutionary process. Introgressive hybridization can result in at least three different outcomes: simple introgression, hybrid speciation or speciation reversal (i.e., collapse of distinct lineages). However, only speciation reversal results in a decrease in species diversity, and only speciation reversal requires the complete breakdown of reproductive isolation. More and more cases have been documented in several animal lineages (esp. fishes), however cases in birds seem to be much older and show no role for human disturbance. Common Ravens have two deeply diverged mitochondrial clades that are widely sympatric over the western US. Our previous work found no evidence of phenotypic differences between the clades and no evidence of assortative mating or reproductive isolation. Extensive new data from nuclear introns and RAD SNPs provides strong support for two formerly distinct lineages that now hybridize across most of western North America. We

are now using a range of next generation and multilocus coalescent approaches to further the hypothesis that ravens represent a striking example of speciation reversal.

#### **CIPAMEX contribution to avian conservation in México**

Raul Ortiz Pulido - Universidad Autonoma del Estado de Hidalgo, Pachuca, Hidalgo, Mexico; Fernando Villaseñor - CIPAMEX, La Sociedad para el Estudio y Conservación de las Aves en México, Morelia, Mexico

Here we will show and discuss the CIPAMEX contribution to the bird conservation in Mexico. The Society for the study and conservation of birds inhabiting Mexico (better known as CIPAMEX) is the oldest and biggest ornithological professional society in Mexico. It started at 1947 as part of what now is known as Birdlife International. Its past and current members include more than 500 ornithologists that had been working with Mexican birds. During its life this organization has been a keystone in the implementations of avian conservation in the country. By example, at 1985 defined the first Mexican endangered bird list, at 1999 created and assembled the Importance Bird Areas of the country, and since 2001 is the sponsor of HUITZIL, the Mexican Journal of Ornithology. Besides, CIPAMEX organizes the Congress for the study and conservation of birds inhabiting in Mexico, which now is on its XV edition, and it have published three books: 1) Important bird conservation areas in Mexico, 2) Bird conservation, perspectives from Mexico, and 3) Mexican states avian faunas. Even such contributions, there are some areas of opportunity where CIPAMEX can increase its influence to help to reach a better bird conservation in the country. In order to do that CIPAMEX is now part and founder of the Mexican Avian Thematic Network (MATNet), where is planned that CIPAMEX could be playing a key role.

#### **Investigating migration and divergence in Mountain Plover using genomic methods**

Sara Oyler-McCance - US Geological Survey, Fort Collins, CO, United States; Scott Cornman - US Geological Survey, Fort Collins, CO, United States; Jennifer Fike - US Geological Survey, Fort Collins, CO, United States

Mountain Plover (*Charadrius montanus*) distribution and abundance have been reduced and the conversion of shortgrass prairie to agriculture has caused breeding populations to become geographically isolated. Additionally, Mountain Plovers are thought to show fidelity to breeding grounds, leading to the prediction that the isolated breeding populations would be genetically distinct. Previous genetic work using traditional population genetic markers (mitochondrial DNA and microsatellites) failed to reveal detectable genetic differentiation among populations, despite their geographic isolation and fidelity to breeding locations. Rapidly advancing molecular techniques have revolutionized conservation genetics and have provided an array of new genomic tools that allow us to begin understanding how and why genetic variation is distributed across the landscape and the functional significance of that variation. This type of data provides more powerful ways to assess gene flow, demography, patterns of migration and even local adaptation of species. The objectives of this study were to re-examine patterns of genetic variation among breeding locations using many more markers, spread throughout the genome, some of which are potentially under selection. We used next generation sequencing methods to discover and interrogate single nucleotide polymorphisms with the goal of characterizing genome wide variation including

non-neutral variation. These data should provide a much more comprehensive understanding current and historical population patterns as well identifying diagnostic markers to help track migration patterns and timing in Mountain Plover.

#### **Grasslands protection in the Great Plains of North America: Progress, future needs, and context**

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The landmark volume, "Prairie Conservation: Preserving North America's Most Endangered Ecosystem", edited by Fred Samson and Fritz Knopf (1996), assessed the current status, unique conservation values, and social context of prairie conservation. The work was timely because grasslands conservation in North America had recently gained momentum and the interest of many partners and people from politicians and conservationist to ranchers and land planners. The social context had changed from totally antagonistic to the development of islands of cooperation and inclusiveness providing a launching pad for the volume and the following conservation efforts informed by it. A key contribution of that volume was in synthesizing large amounts of information and suggesting a strategy or framework for moving toward conservation success. It was the first major effort to identify that conservation success would, of course, need to include the science that was available and quickly evolving. The framework identified the need to include protection, restoration, improved grazing systems, economic sustainability, and local and regional culture and social systems. In fact, of the large scale human land uses, livestock grazing is singular in its compatibility with prairie conservation. Within that framework, we evaluate trends and current conditions of protection of grasslands in North America. We compare the area of protected lands over the past 4 decades throughout the Great Plains region to show progress and gaps. We focus on Colorado's land protection as a case study. Land protection now includes several categories, including easements, public lands, private reserves, and others. The number of land trusts and other organizations that have embarked on conservation of grasslands has increased. Finally, we comment on the need to focus on "whole systems" as a clarification of the concept or framework for grasslands conservation. Protection of key lands and waters in the context of landscape or regional conservation is a necessary way to use limited resources and improve the pace, scale and outcomes of conservation. This framework was identified in Prairie Conservation: Preserving North America's Most Endangered Ecosystem. Fritz Knopf has spent his professional lifetime studying the life of grasslands and the ecosystems within. As his experience and knowledge increased, he began to understand about the entire system, including people who live there in advance of the trends of that time. His outreach to partners and agencies, development of important relationships, and his mentoring of biologists and conservationists has changed the dynamics of grasslands conservation in North America – indeed, in the world. A regular way of assembling such groups as this to measure our progress and develop new and improved ways of achieving conservation success are warranted.

#### **A meta-analysis of response to playback of foreign songs: Reduced response to unfamiliar stimuli or adaptive reaction to weak threats?**

Timothy Parker - Whitman College, Walla Walla, WA, United States

Geographic structure in song sharing has interested ornithologists for half a century. As part of the process of exploring explanations for the emergence of dialects, researchers have frequently assessed birds' responses to playback of local versus foreign songs. A casual examination of this literature suggests that male birds commonly respond more strongly to local song than to foreign song. To quantify this observation and explain variation in strength of response to foreign song with meta-analysis, I located 40 published studies from 29 species comparing responses of territorial male songbirds to local vs. foreign songs. Of these, 36 studies of 27 species presented data in sufficient detail for inclusion in meta-analysis. Effects varied dramatically in strength, though as expected, a clear trend emerged for stronger responses to local than to foreign songs. The strength of this trend is overestimated by my analysis, however, because many studies presented details only from statistically significant relationships. Responses to songs produced by different subspecies were not consistently weaker than responses to foreign songs produced by different populations within a subspecies. This suggests that simple lack of familiarity, rather than adaptive variation in response, determines the strength of songbird response to foreign song. To further test this hypothesis, I am assessing the strength of response to foreign song as a function of variables that may predict prior exposure to foreign song, including the distance between the local playback site and the foreign song recording, the tendency to travel outside local dialect areas, and the tendency to sing during migration or on wintering grounds where individuals from divergent dialects interact.

#### **Flexibility of parental behavior in the face of unusual changes in nestling demand**

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Phenotypic plasticity is a widespread phenomenon but our understanding of how it works is surprisingly limited. Parental care in altricial songbirds is one such example. Parents provisioning dependent young adjust their care to a variety of variables, including nestling age. In the house sparrow, individual parents exhibit differences in the rate at which they change provisioning as the brood matures. To understand this variation, we need to know more about the mechanism of plasticity. Do parents count the days since hatching, integrate changes in offspring need over a scale of days, or do they respond to cues that change on a visit by visit basis? We performed a series of temporary cross-fostering experiments in which broods with differently-aged nestlings were exchanged for ~ 2hrs before being restored. We found that mean provisioning rates, the length of foraging trips, and the time spent on the nest after arriving with food were all different in nests with younger nestlings compared to nests with older nestlings, and parents switched their behavior almost immediately upon encountering experimental broods with older or younger nestlings. The load size of prey brought per visit did not differ by nestling age nor did it change during the experiment. For most behaviors there was no difference between the sexes, but the length of brooding bouts was significantly longer for females than for males. Our results indicate that parents are able to respond to rapid changes in

nestling age and need, suggesting that the likely mechanism of plasticity to brood age is one that focuses on cues (such as begging behavior) that can vary from one visit to the next. Individual variation in plasticity thus seems likely to arise from individual differences in assessing or responding to such cues.

#### **Historical demography of European Green Woodpecker: Evidence of extra-Mediterranean refugia**

Utku Perktas - Hacettepe University, Ankara, Turkey;

In this study, we re-evaluated historical demography of European green woodpecker (*Picus viridis*) based on previously published multi-locus DNA data and ecological niche modeling analysis including landscape genetics. We tested whether multiple refugia existed for European green woodpecker during the Last Glacial Maximum or the species survived in a big refugium along the southern Europe, including Caucasus, Anatolia, Balkan, Italy and southern France. To test this hypothesis, an ecological niche model was developed to predict the geographic distribution of European green woodpecker under reconstructed past (the Last Glacial Maximum) and present bioclimatic conditions. In addition, robust coalescent-based analyses (e.g. the Bayesian-based coalescent simulations) were used to assess demographic events over the history of European green woodpecker. Results based on genetic and ecological niche modeling analyses showed that European green woodpecker survived the Last Glacial Maximum in a big continuous refugium along southern Europe including southern France and southern United Kingdom. Therefore, this study includes evidence of an extra-Mediterranean glacial refugia located in southern France for this woodpecker species.

#### **Speciation genomics in mallards and American Black Ducks**

Jeffrey Peters - Wright State University, Dayton, OH, United States; Philip Lavretsky - Wright State University, Dayton, OH, United States

Genomic scans provide an unprecedented opportunity for detecting subtle population differences and testing factors contributing to divergence and speciation. Mallards (*Anas platyrhynchos*) and American black ducks (*A. rubripes*) are closely related species that differ dramatically in plumage coloration, but regularly hybridize in the wild. On the basis of our previous genetic work using DNA sequences from mitochondrial DNA and 17 nuclear introns, these two species have been genetically indistinguishable. In this study, we used a genomic scan of >3,500 loci obtained from double-digested restriction associated DNA sequences (ddRADseq) and found black ducks and mallards were genetically distinguishable in assignment tests. Although background levels of differentiation for autosomal loci were low (mean  $F_{st}$  = 0.012), average differentiation at loci from the Z-chromosome was 8.5 times higher (mean  $F_{st}$  = 0.102). Furthermore, BayeScan analyses revealed that one of 3,642 (0.03%) autosomal loci and five of 142 (3.5%) Z-loci were more differentiated than expected given background levels of differentiation. Overall, the skewed frequency distribution of  $F_{st}$  between black ducks and mallards suggests that selection acting on traits coded by the Z sex-chromosome and a few autosomal loci is a prominent force contributing to divergence. Furthermore, we found that most of the highly differentiated Z-loci were located within a narrow region of the chromosome, suggesting an island of divergence. Given evidence that female hybrids have reduced viability relative to male hybrids, we hypothesize that this region

experiences reduced introgression as a result of Z-linked incompatibilities (dominance theory) and that it may be important in the maintenance of species integrity. Future work will include characterizing this region by sequencing candidate loci that might be involved in the speciation process.

### **Singing through the urban racket: Functional consequences of decreased vocal performance**

Jennifer Phillips - Tulane University, New Orleans, LA, United States; Elizabeth Derryberry - Tulane University, New Orleans, LA, United States

Cities present selective pressure on vocal communication, and organisms have responded with changes in signaling behavior. Many species of birds sing higher pitched songs in urban areas, likely to avoid masking by loud, low frequency anthropogenic noise, which subsequently can reduce the bandwidth of song. Male bird song is also under sexual selection pressure, with females often preferring the most complex songs. In birds with trilled notes, there is a tradeoff between the rate of trills and the bandwidth of those notes, such that males can only produce narrow bandwidth at faster note rates. The ability of a male to perform this tradeoff is called vocal performance, and is thought to be an honest signal of male quality. In male-male competition, high performance songs typically elicit aggressive responses, and females tend to prefer songs that also maximize vocal performance. Most studies test receiver response to vocal performance by changing trill rate and not bandwidth, and we know little about how changes in bandwidth relative to changes in trill rate affect receiver response to overall vocal performance. I test the hypothesis that changes in bandwidth in response to anthropogenic noise reduce the potency of song because these changes reduce vocal performance, using the white-crowned sparrow (*Zonotrichia leucophrys nuttalli*) as a model species in San Francisco, CA. I manipulate both bandwidth and trill rate to determine if songs of the same vocal performance, but different in bandwidth and trill rate, elicit equal responses. Alternatively, changes in one trait might have a greater impact on response than changes in the other trait. I test these alternative hypotheses in the context of a gradient of anthropogenic noise to determine if noise levels change relative to response to these song traits.

### **The effects of extreme weather on birds: Data, tools, and insights for conservation**

Anna Pidgeon - University of Wisconsin, Madison, WI, United States; Brooke Bateman - University of Wisconsin, Madison, WI, United States; Andrew Allstadt - University of Wisconsin, Madison, WI, United States; Ana Maria Venegas - Santiago, Chile; Steve Vavrus - University of Wisconsin, Madison, WI, United States; Volker Radeloff - University of Wisconsin, Madison, WI, United States; Wayne Thogmartin - USGS, LaCrosse, WI, United States; Patricia Heglund - US Fish and Wildlife Service, LaCrosse, WI, United States

Climate is warming and extreme weather events may become more likely. This poses challenges for conservationists charged with safeguarding species and managing protected areas. Our goal was to assess future changes in extreme events, and predict how bird populations may be affected by them. We analyzed past and predicted frequency of extreme weather for the U.S. and are providing this data in easily accessible formats. We found, for example, that widespread advances in spring onset in the future will occur with considerable spatial variation in rates of change and risk of false springs. We also examined distributional changes of climate niche space for

about 400 land bird species over a recent 60 year period, juxtaposed with current landcover. We found that in many of the areas where climatic suitability has increased for the most species, landcover is dominated by agriculture and development, making it unlikely that gains in species in these areas can be realized. Similarly, we examined the interactive effect of weather and landcover on an index of avian productivity for selected species, and found that in years of extreme weather but not average weather, landscape context influenced productivity. Our data products and findings can help conservationists manage and plan more effectively for the maintenance of bird populations as climate changes and certain extreme weather events increase in frequency.

### **Does ecological divergence explain the position and narrowness of the MacGillivray's/Mourning Warbler (*Geothlypis tolmiei/philadelphia*) hybrid zone?**

Alison Porter - University of British Columbia, Vancouver, British Columbia, Canada; Julie, Lee-Yaw - Neuchâtel - University of Neuchâtel, Neuchâtel, Switzerland; Christine Grossen, Zurich, Austria; Darren Irwin - University of British Columbia, Vancouver, Canada

Speciation in birds is thought to be influenced by ecological diversification, which may form barriers to reproduction between species. Ecological selection can form premating barriers by reducing interactions between species, or postmating barriers if hybrids have unfavorable ecological traits. We explored the role of ecology in maintaining isolation between the MacGillivray's (*Geothlypis tolmiei*) and Mourning warblers (*G. philadelphia*), which are two songbird species that form a narrow hybrid zone in northeastern British Columbia. We generated ecological niche models for each species to understand if the niche has a role in explaining the location and width of the hybrid zone by comparing niche and range limits, and testing for niche divergence. We show that the species have somewhat divergent niches, which may partly explain why the niche models predicted that regions within a species' own range were the most suitable for that species. The contact zone was the only region where both models predicted high suitability, suggesting that hybridization occurs only where conditions are suitable for both species. We also investigated how genotype is related to ecological characteristics in the hybrid zone. We used the niche models to predict the relative suitability of breeding territory locations in the hybrid zone and compared the relative scores among a gradient of hybrid genotypes. At those same hybrid zone territories we measured microhabitat characteristics of breeding territories and examined the relationship between microhabitat of breeding territories with genotype. We found no evidence that genotype was related with ecological traits in the hybrid zone. This suggests that when under the same ecological conditions the two species are ecologically equivalent, and that hybrids likely do not experience a disadvantage in terms of territory establishment. Overall, these results suggest that niche divergence likely had a small role in the diversification between the MacGillivray's and Mourning warblers.

### **Comparison of individual and population estimates of migration for Tree Swallows**

Eldar Rakhimberdiev - Royal Netherlands Institute for Sea Research and Cornell University, Den Burg, Netherlands; Ryan Norris - University of Guelph, Guelph, ON, Canada; Daniel Fink - Cornell University, Ithaca, NY, United States; David Winkler - Cornell University, Ithaca, NY, United States

Different sources of information on migratory routes and schedules have become available over the past decade. These can be divided generally into individual (e.g. capture-resight, capture-recapture, GPS tracking and solar geolocation) and population level schemes (e.g. survey data). For migratory animals the relationship and differences between the movements of populations and the individuals comprising them are unclear. We compare two sources of dynamic distribution data: tracks estimated by the FLIGHTR model from 15 solar geolocator archival tags put on and retrieved from breeding Tree Swallows (*Tachycineta bicolor*) at different breeding locations in the northeast US vs. spatiotemporal estimates of probability of occurrence of this species inferred from the eBird citizen science data by spatiotemporal exploratory models (STEM). The individual tracks and STEM estimates correspond quite well, though the individual tracks are much less gradual in their seasonal trajectories of movement, an effect which shows differences between micro- vs. macroscopic scales.

### **Evolutionary machinery of rapid body-size decline in a migratory bird**

Eldar Rakhimberdiev - Royal Netherlands Institute for Sea Research and Cornell University, Den Burg, Netherlands

Female Bar-tailed godwits *Limosa lapponica lapponica* wintering in the Wadden Sea and breeding in Scandinavia have declined in body size. Body-shrinkage is now seen as a common response to climate change, especially in Arctic animals. With 15 years of capture-resight data we estimated nonlinear bivariate fitness (survival) surfaces for these birds and showed strong directional selection for shortening bill length. Seasonal survival capture-recapture models localized this selection (mortality biased towards the longer billed females) on the wintering grounds in the Wadden Sea rather than the Arctic. With a greater ability to reach deeper-living polychaete worms in the harshest of times, in winter long-billed females have been shown to stay put even during cold snaps. This now turns out the wrong decision when food abundance is low, a strategy now being eliminated by natural selection and reducing body size.

### **How climate influences demography through bottom-up processes in Hawaiian forest birds**

C. John Ralph - US Forest Service, Klamath Bird Observatory, Arcata, CA, United States; Jared Wolfe - US Forest Service, Klamath Bird Observatory, Arcata, CA, United States

Individual bird species numbers and community composition are regulated through several processes, including density dependent, top-down, and bottom-up interactions. 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, yet complex, and have easily measurable 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 recently constructed Structural Equation Models that combine multivariate and regression techniques to measure the direct

and indirect effects of exogenous and endogenous variables on these species. We have found that they structured their life-cycle events around climatically-induced food availability, as well as trophic interspecies interactions. We also found that the principal food resources for the nectivorous and frugivorous specialists have a profound effect in driving the timing of events such as breeding and molt, as well as influencing survival. Importantly, competitive interactions between species also had a major regulatory effect. Over the ensuing 30 years, increasingly dry conditions in these forests has likely had important consequences for the species and their interactions, thereby presenting new opportunities to address emerging threats involving climate change.

### **Modeling stopover habitat relations for landbirds in the western Gulf of Mexico region**

Lori Randall - U.S. Geological Survey, Lafayette, LA, United States

Millions of landbirds migrate through the Gulf of Mexico region each spring and autumn. These migrants depend on stopover habitats to provide the food and cover needed to complete their journey. For some species, as much as 85% of annual mortality occurs during migration. Knowing the location and landscape composition where peak numbers of migrating birds consistently stop to rest and forage is critical for conservation planning. We used Weather Surveillance Radar-1988 Doppler (a.k.a., NEXRAD) data and landscape-scale habitat metrics to model bird-habitat relations within 80 km of the Corpus Christi, TX radar station. We quantified the distribution of landbirds during stopover by using reflectivity data collected during spring and fall migration 2008–2012. We used land cover, distance, and length metrics to characterize the landscape around stopover sites. Using reclassified National Oceanic and Atmospheric Administration Coastal Change Analysis Program (C-CAP) 2006 data, we measured the percent cover and habitat patch characteristics of 11 land cover types. We calculated the distance from a stopover site to the nearest water feature based on the U. S. Geological Survey National Hydrography Dataset and measured the total length of roads within the landscape from 2010 U.S. Census Bureau roads data. After exploratory analyses with ordinary least-squares and geographically-weighted regressions, we used structural equation modeling to assess the relative strength and the direct and indirect nature of the causal relations among variables. Results will be used to inform conservation planning by the Gulf Coast Joint Venture.

### **Island and continental biogeography dynamics in the assembly of the Western Ghats**

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The Indian subcontinent is a biogeographic enigma with high species richness yet low endemism, despite a long history of isolation before reaching its current geographic position. The origins of montane species in the Western Ghats, a biodiversity hotspot in southwestern India, have long been debated. The prevailing hypothesis for birds is that Himalayan taxa were able to disperse to the Western Ghats at cooler times when peninsular India was covered in moist forest and later these populations were isolated as the subcontinent dried up. We

investigated the origins of more than 20 Western Ghats endemic species by examining phylogenetic relationships and ancestral area reconstructions to decipher potential routes of colonization. Western Ghats endemics have their closest relatives in different geographic regions and appear to have colonized India from all four possible source directions and at different times. The assemblage of the Indian avifauna appears to be driven as much by island biogeography dynamics as vicariance events.

### **Landscapes, grassland birds, and agroecosystems, a Wisconsin perspective**

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Grassland bird populations continue to decline faster than other bird guilds in spite of the attention called to them over 30 years ago. The initial focus of grassland bird conservation was protecting or restoring grassland and native prairie fields; research focused on understanding the habitat requirements of birds, as well as their responses to habitat management, at the patch level. Subsequently, Samson and Knopf started to investigate area sensitivity in grassland birds and define how big patches needed to be when developing conservation plans. Looking at landscape composition and structure was a natural outgrowth of the area-sensitivity work, as researchers started to grapple with what a patch of grassland actually was and how the “effective” size of a patch is influenced by the habitats adjacent to it. In the 1990s, a grassland bird conservation area (GBCA) model was developed in Wisconsin to help reverse population declines by combining grassland conservation and working agriculture. The key concept of the GBCA model was that management must be conducted at the landscape scale rather than at the individual property level. In the Upper Midwest, grassland bird conservation has evolved from the area sensitivity paradigm (managing for “large enough” patches) to the landscape paradigm (managing for “bird friendly” habitats and management around focal patches). The challenge is how to implement such a vision, given the current conservation status of grassland birds, the fact that the composition of most of the Midwestern landscapes they occur in are determined by the cumulative decisions of private landowners, and the various human-induced pressures being put on their habitats at all stages of the birds’ life history. Grassland bird conservation thus becomes not only an ecological problem, but also a social and economic one.

### **Building facade characteristics affect bird-window collision rates**

Corey Riding - Oklahoma State University, Stillwater, OK, United States; Timothy O’Connell - Oklahoma State University, Stillwater, OK, United States; Scott Loss - Oklahoma State University, Stillwater, OK, United States

Recent estimates indicate that hundreds of millions of birds die annually in North America from collisions with glass surfaces at buildings. Previous studies have assessed building- or neighborhood-level correlates of avian collision rates. However, we hypothesize that smaller-scale characteristics of individual building façades are also correlated with bird-window collision rates. We surveyed for window-killed birds in Stillwater, OK during fall migration in 2013-2014. We conducted surveys for 21 consecutive days at six buildings in 2013 and ten buildings in 2014. We continued surveys for an additional 25 days at one building and 30 days at another building in 2014. The façade-

scale factors we evaluated include (1) proportion of the façade covered by glass surfaces, (2) façade type as defined by length, shape, and position relative to adjacent façades, (3) façade height, and (4) amount of vegetation at the façade base. We found 29 carcasses of 14 species and 7 additional carcasses that we could not identify to species. Twenty-seven carcasses were for species (n=11) considered more vulnerable to collisions than average at a national scale. We found 28 (81%) carcasses at façades defined as alcoves or porticos. These façade types ostensibly produce a tunnel-like effect that may funnel birds towards windows or mask the presence of windows, especially under low ambient light levels. We also found 28 (81%) carcasses at façades that lacked vegetation at the base and instead had artificial surfaces (e.g., metal grates, concrete walkways, brick patios). Thus, vegetation in the immediate vicinity of building façades may be less important than façade shape for causing fatal collisions. Our results suggest that a more complete understanding of the drivers of bird-building collisions—and therefore, development of approaches to effectively reduce collisions—requires the study of a hierarchy of factors that includes fine-scale features of individual building façades.

### **How do long-lived birds respond to latitudinal variation in fitness?**

Thomas Riecke - University of Nevada, Reno, NV, United States; Alan Leach - University of Nevada, Reno, NV, United States; Jim Sedinger - University of Nevada, Reno, NV, United States; David Ward - USGS, Alaska Science Center, Anchorage, AK, United States; Sean Boyd - Environment Canada, Delta, BC, Canada

When faced with declining environmental conditions, organisms have three options: move, persist, or die. We use a model organism, the Pacific black brant (*Branta bernicla nigricans*), to examine how individuals and populations of long-lived birds choose among these three options. The black brant is a small, sub-arctic and arctic nesting goose, occurring in coastal estuaries and wetlands along the Pacific coast. Brant primarily breed on the Yukon-Kuskokwim River Delta (YKD), Alaska, where populations have declined substantially since the 1980’s, and remain significantly below historic levels. Concurrently, the brant population on the Arctic Coastal Plain has increased, where gosling growth and post-fledging survival rates on the ACP are greater than those of brant fledged on the YKD. Pre-breeding, non-breeding, and failed breeders from the YKD use the ACP as molting habitat during summer, indicating knowledge of alternate habitats. Moreover, brant wintering distributions have shifted northward, potentially in response to environmental changes. A study of brant population ecology was initiated in 1984 at the Tutakoke River Brant Colony on the YKD. Since the project’s inception, > 45,000 individual brant have been uniquely marked with tarsal bands. Given the observed latitudinal relationships, we used the Barker Robust Design in Program MARK to test for temporal trends in site fidelity and natal philopatry, which would potentially be indicative of an individual-choice based range shift. We did not detect temporal trends in site fidelity, which for adult females was constant, and essentially equivalent to 1. These findings have important implications for the conservation of long-lived birds in the face of climate change, where life-history strategies may effect response plasticity to environmental change.

### **Senescence, heterogeneity, and population age distributions effect population viability in long-lived birds**

Thomas Riecke - University of Nevada, Reno, NV; Alan Leach - University of Nevada, Reno, NV, United States; Jim Sedinger - University of Nevada, Reno, NV, United States

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 the population remains significantly below historic levels. A study of brant population ecology was initiated in 1984 at the Tutakoke River Brant Colony (hereafter TRC), to better understand the causes of this decline. Since the project's inception, >45,000 individual brant have been marked with unique tarsal bands. We used Bayesian CJS models with individual survival probabilities to examine heterogeneity in survival probability. We subsequently used linear mixed-effects model to analyze nesting data collected at TRC from 1994-2013. We included 2,321 nests containing 8,746 eggs laid by 1,137 known-age females in reproductive investment analyses. To better understand age and individual effects on reproductive success, we included 1,959 nests laid by 983 unique, known-age females, in analyses. Reproductive investment and success varied quadratically with female age, and individual random effects and survival intercepts were significant predictors of reproductive investment. These findings are congruent with previous research, which indicated individual and age-related effects on black brant breeding propensity and survival.

#### **Songbird demographic consequences of herbicide application to an early-seral forest**

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Birds that require early-seral forest for breeding have undergone marked declines in many parts of North America. Herbicides are often used to control vegetation that competes with commercial trees in early-seral forests, yet they typically reduce cover of vegetation used by breeding birds for foraging. Past studies that have evaluated the response of forest birds to herbicides have been limited to mostly descriptive studies that quantify bird abundance without assessing critical demographic measures. We used a large-scale manipulative experiment to evaluate the influence of herbicide application on the breeding productivity of the White-crowned Sparrow (*Zonotrichia leucophrys*) in the Coast Range Mountains of western Oregon. We experimentally applied four herbicide treatments (i.e., light, moderate, and intensive herbicide levels plus a no-spray control) to recently harvested Douglas-fir (*Pseudotsuga menziesii*) stands to create a continuum of management intensity along which we evaluated nest survival. On a subset of treatments (i.e., control and moderate), we also evaluated the survival of juvenile birds immediately after fledging. Contrary to our predictions, nest survival was not inversely linked to the degree of management intensity. Instead, annual variation in nest survival within treatments was in some cases greater than treatment differences. Juvenile survival was greater for individuals in moderately treated stands relative to control stands, although this effect was not statistically significant. Our findings suggest that nest survival may be influenced more strongly by factors other than management intensity, and that quantifying the effects of

factors that change as early-seral forests age (e.g., predator populations) may be fruitful for understanding the mechanisms underlying variation in breeding productivity.

#### **National strategy for monitoring and conservation of the Golden Eagle in Mexico**

Ricardo Rodríguez-Estrella - Centro de Investigaciones Biológicas del Noroeste, La Paz, Baja California, Mexico

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 in Chihuahua, Coahuila, Nuevo León, Zacatecas, Jalisco, San Luis Potosí, Guanajuato, Sonora and the Baja California peninsula and some conservation proposals.

#### **Wintering Dark-eyed Juncos carry recognized plant pathogens and beneficial bacteria on their feathers**

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Migratory birds can disperse pathogenic microbes and establish novel disease foci along extensive migratory routes. Previous studies of feather microbial communities focused on keratin degradation, finding little bacterial diversity. We dislodged microbes from ventral feather samples of overwintering Dark-eyed Juncos after mist net capture in south-central Kansas. Microbial isolates (>300) were characterized via biochemical and physiological tests and identified by 16S rRNA gene sequencing and phylogenetic analysis. Individual bacterial loads from eight juncos varied significantly within a range of 105-106 colony-forming units g<sup>-1</sup> feather. Gram-positive bacteria dominated cultures. *Bacillus* spp. were abundant. *Lysinibacillus*, *Paenibacillus*, and *Staphylococcus* were also isolated. Remarkably, substantial numbers of Actinomycetes were isolated, including *Clavibacter*, *Curtobacterium*, *Microbacterium*, and *Rathayibacter*, genera recognized as crop plant pathogens. In addition we found *Frigoribacterium* and *Kitasatospora*, implicated as being beneficial to host plants, acting as antagonists to pathogens or as growth promoters. Proteobacteria dominated the Gram-negative bacteria, with Alphaproteobacteria most abundant, including recognized plant pathogens, *Agrobacterium* and *Sphingomonas*. This is the first report of diverse plant pathogens and beneficial bacteria on wild bird feathers. The clear implication is that migratory birds act as vectors of both bacterial plant diseases and beneficial bacteria. Dark-eyed Juncos may be beneficial, neutral or harmful to crop species with respect to pathogen and antagonist dispersal. Recent food-supplementation experiments suggest low-quality winter habitat, forcing juncos into marginal habitats, e.g. crop fields, where plumage bacterial diversity may be altered. Supported by NIH NIGMS IDeA KINBRE, NSF and NSF GK-12.

#### **Combining multiple data sources to determine drought and land-use impacts on Lesser Prairie-Chicken**

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The lesser prairie-chicken (*Tympanuchus pallidicinctus*) was recently listed as “threatened” under the Endangered Species Act, yet studies quantifying factors affecting population abundance over broad spatial and long temporal scales are lacking, making conservation decisions difficult. We used 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. Our results indicate a decreasing trend in the population growth rate from 1997 to 2012, though the population growth rate was not significantly different between 1997 and 2012. The population growth rate in 2011 and 2002 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 agricultural land and the influence of Conservation Reserve Program grasslands) had a significant effect on lesser prairie-chicken survival, nest success, and population growth rates at a state-level scale. Our study was the first to assess the relative importance of drought and land-use change on lesser prairie-chickens with results informing future conservation plans. Additionally, we illustrate how integrated population models can provide inference on parameters with missing data (e.g., survival data from 2003 to 2012 in this study) to help guide management actions with limited data sources.

#### **Quantifying drivers of avian population dynamics**

Beth Ross - Kansas State University, Manhattan, KS, United States

Because environmental conditions are predicted to change and become more variable within the current century and beyond, forecasting the effects of projected climate variability on future wildlife populations is critical for managing species of conservation concern. Managing species while assuming current environmental conditions fails to incorporate the uncertainty associated with future climatic conditions. Without incorporating projected climate variability into conservation strategies and management, efforts may fall short or waste valuable resources. Understanding ecological drivers of populations necessitates long-term, broad-scale population data, yet often such data are messy, requiring advanced statistical methods to best address ecological and management-based questions. I combine statistics, modeling, ecological questions, and long-term datasets to provide robust estimates of population parameters while quantifying the effects of climate and landscape change on Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*), scaup, and waterfowl community composition. Additionally, I use advanced statistical tools (e.g., Bayesian state-space models, INLA, integrated population models) to translate ecological information into a management context for lesser prairie-chickens and scaup.

#### **Global patterns of avian extinction risk attributable to severe hailstorms**

Jeremy D. Ross - Sutton Avian Research Center, Bartlesville, OK, United States; Eli S. Bridge, Oklahoma Biological Survey, University of Oklahoma, Norman, OK, United States

Hailstones are often lethal to birds and can have devastating effects on populations throughout the annual cycle. This phenomenon is regularly viewed as a stochastic cause of population regulation or extinction, however there has been little done to parameterize such threats for declining or imperiled avian species. We have used a global map of hailstorm occurrence previously estimated from satellite weather data to calculate statistics on the hailstorm exposure experienced by imperiled avian species listed as near-threatened through critically endangered in the 2014 Bird species distribution map database produced by BirdLife International and NatureServe. Our results indicated that there is a suite of 67 imperiled bird species that are likely to experience 2+ hail days (i.e.,  $\text{meanHD} \geq 2$ ) across their entire range in a typical year. Furthermore, when we constructed a hail risk index (i.e.,  $\text{meanHD4}/\text{stdevHD}$ ) and standardized the results, we found 52 species exceeded the all-species mean risk, while 10 species showed hail risks exceeding the all-species mean by more than two standard deviations. Many of these top 10 species were characterized by having restricted geographic ranges ( $< 10,000\text{km}^2$ ), and with only one exception every  $100\text{km}^2$  portion of these species' ranges was exposed to a minimum of 3.7 hailstorms per annum. Though our analyses are relatively simple, such an approach can shed light on species that may be particularly vulnerable to extinction by hailstorm and is a starting point for ground-truthing more precise hailstorm risks facing imperiled bird species.

#### **Influence of Wilson's Warbler summer body condition on winter territory selection**

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For migratory birds, there is evidence that the wintering habitat quality influences birds' body condition and fitness. Birds wintering in higher quality habitats have higher body condition scores, arrive earlier to breeding grounds, and improve their breeding opportunities. However, little is known on how breeding conditions influence winter-site selection. We studied Wilson's Warblers (*Cardellina pusilla*) to explore relationships among breeding body condition and wintering vegetation structure, food abundance, territory size and winter body condition. We colored banded 68 birds during the winters of 2011 to 2014 in the cloud forest of central Veracruz and measured body condition (body mass vs. wing length) as well as territory size, which we obtained by following birds' movements and corroborating territory limits by birds response to play-back of the species song and call. The habitat evaluation included: habitat structure (11 variables e.g. shrub abundance and tree height) and food abundance (arthropods within Wilson's Warbler diet). Breeding body condition was determined by the yellow percentage on tail feathers grown in the breeding grounds, since carotenoids in yellow in feathers reflect body condition. We obtained the color information using Photoshop on standardized digital photos. We found that individuals with better breeding condition indices were associated with wintering territories with higher shrub abundance. Moreover, the wintering territory size was influenced by territory shrub and food abundance; smaller territories were registered where the shrub and food



abundance was higher. Breeding body condition was not directly related to wintering body condition, however, birds' wintering body condition was positively related to herbaceous cover, suggesting that overall condition in Wilson's Warblers is positively related to vegetation density in the wintering habitat. Our study highlights the importance of preserving high quality habitats for migratory birds, both in breeding and wintering grounds, given the influence of both habitats on birds' body condition and subsequent breeding opportunities.

#### **Breeding ecology of the Arizona Grasshopper Sparrow (*Ammodramus savannarum ammodramus*)**

Janet Ruth - U.S. Geological Survey, Albuquerque, NM, United States

We studied the breeding ecology of Arizona Grasshopper Sparrow (*Ammodramus savannarum ammodramus*) on two sites in southeast Arizona from 2009-2013. We documented measurements and life history of this poorly-studied subspecies through targeted mist-netting and color-banding of territorial males, territory mapping, location and monitoring of nests, and vegetation measurements on territories and at nests. Male mass averaged  $16.0 \pm 0.8$  g ( $n=106$ ), wing length  $62.7 \pm 1.5$  mm ( $n=106$ ), and exposed culmen  $11.6 \pm 0.5$  mm ( $n=105$ ). Average nest measurements included inside diameter  $65.2 \pm 4.6$  mm ( $n=115$ ), inside depth  $28.4 \pm 6.1$  mm ( $n=115$ ), height of rim above ground  $25.4 \pm 10.4$  mm ( $n=114$ ); and nest concealment  $87.7 \pm 8.1$  % ( $n=79$ ). Clutch size averaged 4.0 eggs (range 3-6,  $n=74$ ). Incubation lasted 11-12 days, and the nestling period 8-9 days. Mean territory size, using flush mapping protocol, averaged across sites and years, was  $0.75 \pm 0.39$  hectares ( $n=230$ ). Raw return rates of color-banded males ( $n=97$ ) across sites and years averaged 39.2% (range among years and sites 31.8 – 47.6%). Overall apparent nest success was 55% of 128 nests, with 32% of nests predated, 2% abandoned, 2% trampled by cattle, and 9% of unknown fate, with variation among sites and years. Additional information about daily nest survival associated with site, year, nest age, and nest concealment will be modeled using Program Mark). This information will allow comparisons with the other North American Grasshopper Sparrow subspecies (*A.s. perpallidus*, *pratensis*, and *floridanus*). This information is preliminary and is subject to revision.

#### **A sassy soap opera: An examination of family flocking dynamics of the Black-crested Titmouse**

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The black-crested titmouse (*Baeolophus atricristatus*, hereafter BCTI) is a small, non-migratory passerine that has a tendency to form family flocking groups due to delayed juvenile dispersal each summer. Because of a relatively recent split as a separate species from its sister-taxa, the tufted titmouse (*Baeolophus bicolor*), the BCTI has holes in its life history, making it a solid candidate in which to study family flocking dynamics. The goal of our study was two-fold: 1) To observe if intrinsic factors, such as weight or sex, or extrinsic factors, such as territory size or habitat homogeneity, affect BCTI juvenile natal dispersal, 2) Investigate if BCTI territory size or flock size varied annually. To accomplish these objectives, we captured and color-banded over 150 individual BCTI, representing over 20 complete family groups, during the spring of 2013 and 2014. GPS coordinates were taken at regular increments throughout the year to gather territory data from banded families, and a GIS layer from the Texas Parks and Wildlife Department was obtained to analyze

habitat homogeneity of each territory. The program ArcGIS was utilized for GPS and GIS data analysis. Before fledging, hatchling BCTI were weighed and sexed (via feather DNA extraction). Our preliminary results suggest that intrinsic factors are influencing which juveniles fail to disperse, with heavier males being more likely to remain with their parents throughout the year. Preliminary analyses on territory size and flock composition data have revealed larger territories and flock size during the fall/winter months. For 2015, we are continuing our examination of spatial patterns regarding BCTI and the role of delayed juvenile dispersal in the formation of family flocks.

#### **Unusual patterns of nestling loss in House Sparrows: Infanticide or neglect?**

Katherine Sasser - University of Kentucky, Lexington, KY, United States

Unusual patterns of nestling loss in house sparrows: Infanticide or neglect? In altricial birds, hatchlings are vulnerable to many sources of mortality before they leave the nest. The primary causes of nestling mortality are predation, starvation (which in many cases may be adaptive brood reduction), and in some species infanticide by conspecifics. Little evidence has been presented to suggest that the causes of nestling mortality might be linked. We use a long term data-set on breeding in house sparrows to assess patterns of nestling loss across a time span of nearly two-decades. We found evidence for predation, classic brood reduction, and infanticide, but we also uncovered an unusual form of whole brood loss in which nestlings die one by one within the first 3 days post-hatch until the whole brood has failed. In some years, this phenomenon, which we have called "dwindling" is comparable in frequency to that of all other nest failures combined. Preliminary analyses indicate dwindling is especially common at locations with high densities of sparrows and higher rates of infanticide as well. To better understand this phenomenon we intensively sampled weight changes over the course of the first few days of life and we found that deaths are preceded by zero or negative weight changes. The deaths appear to be due to starvation or disease. Our main hypothesis is that parents at high-density locations are at risk of losing the brood and nest-site to aggressive takeovers by other sparrows. As a result, parents neglect their current broods, leading to starvation. We present the evidence we have collected to date, and, discuss alternative hypotheses such as disease, and evaluate the evidence for or against this hypothesis. If our hypothesis is correct, this would constitute an unusual form of negative density-dependence acting on levels of parental care.

#### **Choosing geographic scales for analyses of North American Breeding Bird Survey data**

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The North American Breeding Bird Survey's putative sample unit is the survey route, a cluster of 50 counting locations grouped along a roadside transect and surveyed over a single morning by a single observer. The generally small sample sizes of individual birds of any species encountered on the route, and the consistency of counting imposed by counting on a single day for a single observer, largely imposed the route as a sample unit on BBS analyses for the first 3 decades of the survey. However, the inherently hierarchical nature of the BBS sampling clearly extends to stops; stops are the natural sample

unit of the BBS. Critical ecological and sampling factors, such as habitat associations and detectability, can only be reasonably explored at the stop level. Stops, however, are vaguely located and observed; BBS observers count an unknown proportion of birds in an unknown area. Recent analyses highlight the potentials and limitations of stop data from roadside surveys; we provide examples from detectability estimation and environmental covariate analyses. A distance sampling study of Mourning Dove Call-count Surveys document the relative importance of stop and route-level factors; route-level analyses control for observer-related detectability effects, but habitat and other factors are influential at the stop level. Analysis of disturbance related to energy development documents the potentials and difficulties associated with use of roadside stop locations in association analyses of effects of habitat disturbance on BBS counts at stops. Limited development occurred adjacent to stop locations, and alternative modeling approaches that assess potential habitat effects of development at the route level may be more effective in predicting consequences of development-related habitat change.

### **Response of forest birds to inputs of emergent aquatic insects across a regional scale**

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Aquatic insects that emerge from lakes and streams provide energy and nutrients to terrestrial systems, however the potential impact of emergent insects on spatial distributions of terrestrial vertebrate consumers over a regional scale has rarely been considered. We asked whether two avian foraging guilds, aerial insectivores--a guild of conservation interest--and foliage gleaners, responded numerically to estimated emergent aquatic insect inputs from lakes and streams into surrounding forests in northern Wisconsin. We used annual bird species abundance estimates (1989-2011) and modeled estimates of insect inputs from aquatic to terrestrial systems to determine whether guild abundance and richness were associated with magnitude of estimated insect inputs. Aerial insectivore abundance and richness were positively associated with aquatic insect inputs from lakes ( $R^2 = 0.13$ ,  $R^2 = 0.19$ ,  $P < 0.01$  for both) and richness, but not abundance, was correlated with insect inputs from streams ( $R^2 = 0.08$ ,  $P = 0.006$ ;  $R^2 = 0.03$ ,  $P = 0.07$ , respectively). Foliage gleaner abundance and richness were not significantly associated with emergent insect inputs from lakes or streams. We also explored the influence, at the landscape-level, of lakes, streams, and forest cover on each foraging guild. Aerial insectivore abundance was best explained by combined lake and stream insect inputs and percent forest cover in the 12.6 ha area centered on the bird survey station ( $R^2 = 0.35$ ,  $P < 0.001$ ). Gleaner abundance was best explained by percent forest in the 12.6 ha surrounding area ( $R^2 = 0.27$ ,  $P < 0.001$ ). Our results suggest that aerial insectivore abundance and species richness are associated with areas of higher aquatic insect inputs and relatively low forest cover, and that gleaners are positively associated with forest cover but not aquatic insect inputs. The importance of emergent aquatic insect inputs from lakes and streams to forests as a food resource for aerial insectivores should be considered when managing habitat for this declining guild.

### **When is the best time to sample migrating birds in the air with weather surveillance radar to determine their stopover density at the ground?**

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Weather surveillance radar is a useful tool for mapping stopover distributions of migratory landbirds as it detects birds low to the ground as they begin nocturnal migratory flight. This approach is sensitive to the time flight exodus is sampled since the number of birds in the air during this time changes rapidly. Thus, an empirical determination is needed to identify the optimal time to sample migrant density in the air for mapping their ground densities. We estimated mean daily landbird migrant ground densities via repeated line-transect surveys during autumn 2013 and 2014 at 28 sites in Delaware, Maryland, and Virginia and analyzed radar data from the Dover, DE (KDOX) and Wakefield, VA (KAKQ) WSR-88D stations. We assessed the relationship between seasonal mean ground densities of migrants and seasonal mean radar reflectivity, an estimate of emigrant bird density aloft, sampled at a series of sun elevation angles ranging from  $1.5^\circ$  to  $10^\circ$  below the horizon. We fit a logistic growth curve to the change in mean reflectivity through time during the onset of nocturnal flight to determine the sun angle at the inflection point of the curve (i.e., at the maximum growth rate) for each sampling night by radar. We computed correlations between ground bird densities and mean reflectivity among the series of radar sampling times and among a series of times relative to the inflection point of daily exodus curves. The radar sampling times of strongest correlation among absolute sun angles were close to the end of evening civil twilight (sun  $6^\circ$  below horizon), but differed between years. Sampling radar at the inflection point of daily exodus curves provided a consistent correlation and this approach is likely robust to broad spatio-temporal changes in the timing of exodus that would not be accounted for by using an absolute sun angle.

### **Genetic distinctiveness of the Galápagos Short-eared Owl and implications for its conservation**

Sarah Schulwitz - University of North Texas, Denton, TX, United States; Paula Castaño - Island Conservation, Puerto Ayora, Santa Cruz Island, Galapagos Islands, Ecuador; Karl Campbell - Island Conservation, Puerto Ayora, Santa Cruz Island, Galápagos Islands, Ecuador; Jeff Johnson - University of North Texas, Denton, TX, United States

The Galápagos Islands are known for their unique biodiversity including Darwin's Finches, Galápagos Mockingbirds, and Galápagos Tortoises. However, limited research has been conducted on more elusive species, such as the Galápagos Short-eared Owl (*Asio flammeus galapagoensis*). Here, we investigate the phylogenetic history and population structure among Galápagos Short-eared Owl populations. To determine if genetic distinctiveness existed among islands, we analyzed 433bp of the mitochondrial control region domain I obtained from museum specimens and live-trapped birds, including specimens from mainland Ecuador (*A. f. bogotensis*) and the U.S.A. (*A. f. flammeus*). Results indicated that the Galápagos Short-eared Owl was distinct relative to mainland subspecies;

however, haplotype diversity was insufficient to conclusively determine if island populations represent evolutionarily distinct lineages. Therefore, our current work is focused on using microsatellite genotypes to determine if population structure or gene flow exists among island populations, particularly with the island of Floreana. The results of this research have important implications for informing island restoration efforts. Rodenticides will be used throughout the island of Floreana starting next year to eliminate invasive rodents, which may negatively impact the Galápagos Short-eared Owl due to indirect poisoning. If we find that the Floreana Short-eared Owl population is isolated, for example, then additional efforts should be made to establish a captive population of Short-eared Owls until non-target poisoning is no longer an issue.

#### **Not all ducks are created equal: Heterogeneity in adult and duckling survival rates of wood ducks in Nevada**

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Population growth is regulated by adult female survival and recruitment of individuals into the breeding population. In cavity nesting ducks, recruitment should be most sensitive to duckling survival. Heterogeneity in vital rates means individual ducks survive and recruit into the breeding population at different rates. Heterogeneity can be explained by measurable variables or can be latent and known to exist but not explained by measurable variables. From intensive mark-recapture data we estimated seasonal adult female survival and monthly duckling survival. These 2 parameters likely induce the most variation in the population growth rate for wood ducks in Churchill CO, NV. We captured, banded and released 2,361 female wood ducks from January 2007 to December 2014. These data were analyzed using the Cormack-Jolly-Seber model with Pledger mixtures module available in program MARK. Including Pledger mixtures in the analysis allowed us to parse the population into 2 groups based on latent heterogeneity, a high survival group and a low survival group. Survival during the non-breeding season (October-February) varied from  $0.875 \pm 0.045$  for the low quality group to  $0.975 \pm 0.01$  for the high quality group. Survival during the breeding season varied from  $0.24 \pm 0.08$  for the low quality group to  $0.76 \pm 0.08$  for the high quality group. We webtagged 2,289 ducklings in the nest from April 2008 to July 2014 and recaptured these webtagged ducklings from 1 to 27 months following initial marking. These data were analyzed using multistate approaches available in program MARK. Duckling survival ranged from  $0.25 \pm 0.18$  to  $0.41 \pm 0.12$ . Duckling survival was positively affected by duckling age, egg volume and attending hen age. Duckling survival was negatively affected by local duckling density. Overall, we observed substantial latent heterogeneity in adult female survival rates and substantial explained heterogeneity in duckling survival rates for wood ducks in Churchill CO, NV.

#### **Rapid speciation in the late Miocene marked the evolutionary history of *Lipaugus* and *Tijuca* (Cotingidae) across lowland and montane Neotropical forests**

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Rapid diversifications are prevalent throughout the tree of life, and have often limited our ability to resolve the taxonomic relationships of lineages derived from these events. However, rapid diversifications provide the opportunity to consider the biological mechanisms responsible for such rapid generation of biodiversity. The putative Cotingid genera, *Lipaugus* and *Tijuca*, are an example of a clade whose interspecific relationships have been blurred by seemingly rapid diversification and incomplete taxon sampling. Here we present the first complete phylogenetic hypothesis for *Lipaugus* and *Tijuca* using species tree methods and a robust multi-locus dataset, consisting of 8 loci sampled from 34 individuals including all 9 currently described species. We confirm the monophyly of these two genera and furthermore, that the two species of *Tijuca* are embedded within *Lipaugus*. In addition we elucidate the occurrence of intraspecific variation within these widely distributed, lowland occurring species. Overall, our findings indicate that the evolutionary history of this clade is characterized by a burst of speciation in the late Miocene, likely resulting from the creation of novel habitats following an intense period of mountain building during Andean orogeny. We also find that in addition to the rarity associated with the range-restricted, sub-montane and montane occurring species that make up the majority of diversity within *Lipaugus*, all species represent very old, evolutionary distinct lineages.

#### **Flaring of eyespots in the American Kestrel**

Steve K. Sherrod - Sutton Avian Research Center, Bartlesville, OK, United States; Dianne Moller - Hoo's Woods Raptor Center, Milton, WI, United States

The feathered eyespots or ocelli on the back of the head of the American Kestrel are photographically shown to "flare" during instances of high stress associated with attacks by enemies. This behavior greatly emphasizes the kestrel's "rear head, owl face" pattern to any mobbing songbirds that might attack from the rear when the kestrel is vulnerable or otherwise preoccupied in defense. This display, however, is not thought to be directed toward raptorial predators of kestrels. Multiple explanations selecting for the presence of these "rear head, owl face" markings in the American Kestrel are considered. To our knowledge this behavior has never before been recorded or reported.

#### **Factors influencing avian habitat selection between oak-hickory and mesic forests**

Kevin Sierzega - Southern Illinois University Carbondale, Carbondale, IL, United States; Michael Eichholz - Southern Illinois University Carbondale, Carbondale, IL, United States

Oak regeneration has declined over the past century due to decreased fire disturbance and mesophication. Oaks are a keystone species and provide abundant resources for forest birds; the ability of mesic tree species to provide similar resources is untested. To determine whether mesic stands offer comparable resources to oak-hickory stands, we examined two non-exclusive habitat selection hypotheses that influence avian abundance and distribution: (1) Habitat heterogeneity and (2) Availability and distribution of food resources. We predicted oak dominated stands would provide greater heterogeneity and more food resources than mesic stands. We conducted spring migration and breeding bird surveys from 15-April to 15-July 2013-2014 along an oak-hickory to mesic tree-species dominance gradient at oak (n=12), mixed oak-mesic (n=4), and mesic (n=6) sites in the Shawnee National Forest, Illinois. At each site, we collected microhabitat data and used the branch

clipping method to sample arthropods. We estimated detection probabilities for PIF-concern, breeding species and compared densities among oak, mixed oak-mesic, and mesic stands. We used mixed models to examine density as a response to stand habitat variables. Oak-hickory stands yielded higher densities of Neotropical migrants (e.g., Acadian flycatcher and Worm-eating Warbler). Neotropical migrant densities responded positively to habitat characteristics associated with oak-hickory stands (e.g., dense leaf litter and high canopy tree H'). We used mixed models to examine differences in arthropod biomass among dominant tree groups and found higher biomass in oak-hickory, mid-successional species than mesic, late-successional species. Our results suggest that oak-hickory stands provide more heterogeneity and arthropod food resources than mesic stands and may be preferred habitat by Neotropical migrants.

#### **Vulnerability of shortgrass prairie birds to climate change**

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The habitats and resources needed to support grassland birds endemic to North American prairie ecosystems are seriously threatened by impending climate change. Although prairie bird populations have persisted through millennia of both climate stasis and extreme variability, their future is uncertain. Climate projections for the Great Plains prairie region predict a future of hotter and drier summers with strong multiyear droughts and more frequent and severe precipitation events. Here we address components of vulnerability, including exposure, sensitivity, and adaptive capacity. Fluctuations in weather conditions in eastern Colorado, 1997-2014, influenced breeding performance of a suite of avian species endemic to the shortgrass prairie, many of which have experienced recent population declines. Dry conditions favored nest survival of Mountain Plovers and Burrowing Owls but resulted in smaller clutch sizes and lower nest survival for passerines. Intense rain events and high temperatures also corresponded with lower nest survival for most species. Declining summer precipitation may reduce the likelihood that some passerine species can maintain stable breeding populations in this region of the shortgrass prairie. The interplay of climate change and land use practices within prairie ecosystems will likely lead to changes in local abundances and shifts in distributions. Knowledge of climate throughout the evolutionary history of birds provides long-term perspective on modern day conservation issues. Although many modern birds have coped with changing climates during their evolutionary pasts, primarily by broadening niches or redistributing on the landscape, land use change and human perturbations of grassland systems may yield limited opportunities for such redistributions. Management for heterogeneity in grassland structure may help provide a buffer against climate change by allowing birds to shift into suitable areas as needed.

#### **Vital rates and population dynamics of Spotted Towhees (*Pipilo maculatus*) in an urban environment**

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Studies of urban birds have focused mostly on descriptions of communities, or compared reproductive success between rural and urban settings or along urbanization gradients. Few studies have measured vital rates to ask whether urban populations of birds are self-sustaining. We report results of a 3-yr demographic study of Spotted Towhees (*Pipilo maculatus*) in four forested parks in Portland, Oregon (USA) conducted between 2004 and 2006. Annual adult survival (SA) varied little among parks (0.505-0.567). Females raised between 0 and 3 broods/season (mean = 1.4), and total seasonal production of young (F) did not differ among parks (range: 1.39-1.85 female offspring/female). We calculated growth rate ( $\lambda = SA + F \cdot SJ$ ) for each park using a stochastic population model and park-specific SA and F, and an estimate of juvenile survival (SJ). SJ was the product of our empirically derived estimate of fledgling survival to independence (30 days post-fledging) and survival through the remainder of the year (SR) at a rate equal to 100%, 90%, 80% or 70% of SA. All parks were self-sustaining (i.e.,  $\lambda > 1.0$ ) if we assumed SR = 100% of SA, but as SR dropped to 90%, 80%, and 70% of SA the number of self-sustaining parks dropped to 3, 2, and 1, respectively. Realistic estimates of SJ (based on literature comparisons) were obtained when we estimated SR to be between 80% (0.298) and 90% (0.335) of SA, suggesting that 2 to 3 of the parks were likely self-sustaining. Removal of fledgling losses to domestic cats during the first 30-days out of the nest converted the park with the lowest  $\lambda$  into a self-sustaining park, while allowing immigration of single birds annually into parks that were sinks converted them into stable populations. Towhee populations thus have the capacity to maintain themselves in urban settings without immigration from outside.

#### **Avian species loss and persistence in Amazonian slash-and-burn mosaics**

Jacob Socolar - Princeton University, Princeton, NJ, United States

Although slash-and-burn agriculture is the most pervasive driver of deforestation in western Amazonia, we know essentially nothing about the biological communities of the resulting forest mosaics. This knowledge gap is particularly troublesome because slash-and-burn agriculture is legal and commonplace inside protected areas. I address this issue with a study of bird distribution and human impacts in Loreto department, Peru. To accurately quantify biodiversity loss across a range of natural forest types, I use a dataset of nearly 1000 avian point counts, conducted in primary forest and slash-and-burn mosaics across three habitats: seasonally-flooded varzea forest, mesic upland terra firme, and dystrophic upland white-sands. These data afford an opportunity to understand the responses of whole bird communities, including rare species and habitat specialists, to slash-and-burn agriculture. I report three findings. First, slash-and-burn mosaics support extraordinary species diversity that is nevertheless lower than primary habitats in aggregate; however, the difference becomes apparent only after substantial survey effort across multiple habitat types. Second, relatively small changes in avian diversity belie larger changes in species composition, and numerous primary forest denizens are rare or absent in secondary habitats. Third, on the nutrient-poor white sands, a diverse community of endemic specialist birds vanishes from slash-and-burn areas. These results paint a mixed picture for the fate of biodiversity in slash-and-burn mosaics, but suggest that disincentivizing agriculture on unproductive soils represents a win-win for farming and conservation.

### **Full-service hotels, convenience stores, or fire-escapes: Evaluating fall stopover sites for Neotropical migrants in the northern Yucatan Peninsula**

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Recent declines of Neotropical migratory songbirds are disconcerting; 70% of migrants have exhibited population declines over the past three decades. In prioritizing stopover sites for conservation and management, identifying the functional value of each site is essential. We assessed capture rates and physical condition of common migratory species and used automated radio-telemetry to estimate stopover behavior for two focal species, Swainson's Thrush (*Catharus ustulatus*) and Red-eyed Vireo (*Vireo olivaceus*), to evaluate the function and quality of two stopover sites for migrants after crossing the 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 captured 1,481 migrants during fall 2014 (1,352 at Contoy, 119 at Eden). Capture rates and species richness varied by site: 0.53 birds/net hour at Contoy and 0.26 birds/net hour at Eden; and 65 species at Contoy and 20 at Eden. The distribution of fat classes was significantly different between sites ( $\chi^2 = 118.65$ ,  $df=3$ ,  $N=1,251$ ,  $p < .001$ ) with more birds with lower fat scores at Contoy. We estimated minimum stopover duration for 18 individuals; mean stopover duration was longer at Eden (6.8 days,  $N=5$ ) than Contoy (2.7 days,  $N=13$ ). Departure from Contoy Island was clear: nine individuals (69%) departed westward towards mainland Mexico and four departed towards South America. Departure from Eden was ambiguous, but birds appeared to move southward. Based on our data Eden appears to function as a higher quality stopover site, while Contoy is a lower quality site, demonstrated by the higher proportion of lean birds captured, shorter stopovers, and higher proportion of birds departing in a seasonally inappropriate direction. Our results will inform conservation and management activities in the Yucatan Peninsula, while also contributing to the development of full-life-cycle conservation plans for Neotropical migratory songbirds.

### **Constraints on egg production in Monteiro's Hornbills**

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Hornbills have evolved a number of unique breeding adaptations that follow from the female's habit of sealing herself inside the nesting cavity. For example, because eggs are laid at intervals of multiple days (and incubated as they are laid), hatching asynchrony is extreme. Moreover, the often-lengthy interval between the laying of the first and last egg also requires that females engage in long-term sperm storage. The duration of sperm storage is further increased due to the fact that after sealing themselves into the nest cavity, females may delay the laying of the first egg by as much as 12 days. Here we analyze the relationship between the length of this pre-laying interval, clutch size, egg size, and inter-egg intervals in Monteiro's hornbills (*Tockus monteiri*) using nest boxes in Namibia. Longer pre-laying intervals were associated with

smaller clutches. Egg size decreased and inter-egg intervals increased as the clutch progressed. We hypothesize that females in poorer condition use the pre-laying period to amass male-delivered resources for egg production.

### **Changes in the Bahamas bird communities since the last Ice Age**

David Steadman - University of Florida, Gainesville, FL, United States; Janet Franklin - Arizona State University, Tempe, AZ, United States

Using fossils from Abaco, Bahamas, we establish a chronology for long-term change in an insular bird community. We classify each species of bird identified on Abaco as extinct (lost globally), extirpated (gone from Abaco but persists elsewhere), or extant (still resides on Abaco). The fossils reveal two main times of extinction and extirpation in the Bahamas. The first was during the Pleistocene-Holocene Transition (PHT; 15-9 ka), when the warming climate caused sea level to rise, island areas to shrink, and grasslands to disappear. Of 45 bird species identified among the Pleistocene fossils, 25 (56%) no longer occur on Abaco (21 extirpated, 4 extinct), including at least 11 species characteristic of open pine woodlands or grasslands, such as Swainson's Hawk, Burrowing Owl, Short-eared Owl, Brown-headed Nuthatch, a solitary, Eastern Bluebird, Eastern Meadowlark, Hispaniolan Crossbill, and Chipping, Savannah, and Grasshopper Sparrows. While recorded commonly as Pleistocene fossils, most of these species apparently did not persist through the PHT. The second series of losses involved a taxonomically and ecologically diverse set of birds (various hawks, falcons, owls, pigeons, many passerines) as well as reptiles (lizards, tortoises, crocodiles) and mammals (bats, rodents) that persisted through the PHT but did not survive the past millennium of human activities. Of 37 species of birds recorded in the Holocene deposits, 15 (14 extirpated, 1 extinct; total 41%) no longer exist on Abaco. From the standpoint of causing faunal change, 1000 years of human presence is comparable to the radical climatic shifts that took place when the continental ice sheets melted at the end of the last Ice Age.

### **Modeled impacts of climate and land-use change to waterbirds in the Prairie Pothole Region**

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The Prairie Pothole Region (PPR) of the north-central U.S. and south-central Canada contains millions of small prairie wetlands that provide critical habitat to many migrating and breeding waterbirds. Due to their small size and the relatively dry climate of the region, these wetlands are considered to be at high risk for negative climate change effects as temperatures increase. Climate change will also alter land-use decisions, particularly the probability of grassland conversion to cropland and impact the availability of upland nesting habitats. We assessed the vulnerability of breeding waterbirds to climate and land-use change using species distribution models (SDMs) and inferred change in populations by estimating future relative to current habitat extent. This effort built on a previous assessment using 1971-2011 Breeding Bird Survey occurrence records and future projections of temperature and precipitation in a single SDM. To improve predictions, we explored the use of multiple SDMs and recently available climate covariates such as evapotranspiration. To address

multiple threats, we additionally incorporated the impacts of land-use change anticipated for mid-century. We found that multiple SDMs improved predictions, and that climate covariate choice affected the modelled vulnerability of waterbirds. Grassland loss exacerbated the impacts of climate change for a number of species.

#### **Evacuation migration: Tornadoic storm avoidance behavior in breeding warblers**

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Migration is a common behavior used by animals of many taxa to exploit temporally differential quality of disparate environments. Migrant birds are often categorized as either facultative (i.e., those that are forced to migrate by some proximal cue, often weather) or obligate (i.e., those that migrate on a regular cycle). During migration, obligate migrants can curtail or delay flights in response to inclement weather or until favorable winds prevail, and they can temporarily reorient or reverse direction when ecological or meteorological obstacles are encountered. However, it is not known whether obligate migrants undertake facultative migrations and make large-scale movements in response to proximal cues outside of their regular migration activities. Here we present the first documentation of obligate migrant songbirds undertaking a facultative migration, wherein they retreated from their breeding grounds, apparently to avoid a severe weather system, and returned after the storm passed. Five golden-winged warblers (*Vermivora chrysoptera*) equipped with light-level geolocators left their breeding territories in eastern Tennessee 26 – 27 April 2014 as a severe tornadoic storm system developed several hundred kilometers to the west. As the system moved toward the study area, spawning 84 confirmed tornadoes, the birds took various routes ~700 km to the coast of the Gulf of Mexico, and one bird apparently continued along the west coast of Florida to Cuba, ~1500 km from our study area. The severe storm system and atmospheric variation associated with it arrived at the study area one to two days after the birds evacuated. We hypothesize the probable cue, radiating >1000 km from severe tornadoic storm systems, and sensed by birds, was infrasound (i.e., sound below the range of human hearing) which is uniquely powerful from tornadoic storm systems and can influence bird behavior.

#### **American Woodcock migratory connectivity as indicated by hydrogen isotopes**

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American Woodcock (*Scolopax minor*) use of dense mesic habitats throughout the annual cycle presents challenges to population monitoring and describing continental-scale migratory connectivity. Identification of key regional sources of

recruitment into the annual harvest would be invaluable for validating existing monitoring programs. Stable hydrogen isotope analyses of feathers (d2Hf) are often used to assign origins to birds based on hydrogen isotopic distribution patterns that vary predictably in tissues across North America. The objective of this study was to apply d2Hf measurements to estimate population sources and connectivity among natal and winter ranges of hunter-harvested juvenile American Woodcock. We conducted d2Hf analyses on P1 feathers from 494 hunter-harvested juvenile woodcock wings retrieved from hunters during 2010–2011 and 2011–2012 seasons. We used P1 feathers from prefledged woodcock (n = 43) to create a d2Hf isoscape by regressing d2Hf and expected growing-season precipitation values (d2Hp); this isoscape was then used to assign probabilistic origins of harvested woodcock. Modeled d2Hp values explained 79 % ( $R^2 = 0.79$ ,  $F_{1,41} = 156.8$ ,  $P < 0.001$ ) of the variance for prefledged P1 d2Hf values ( $d2Hf = 0.98 d2Hp + 11.6$ ), indicating a well-supported model to estimate woodcock natal origins. Overall, 64 % of the 2010–2011 and 2011–2012 harvest sample were assigned to the northernmost (>44° N) portion of both the Central and Eastern Management Regions. Future management of American woodcock should consider the potential for population mixing on the wintering grounds, the large derivation of harvest from the northernmost portions of the breeding range, and the difference in breeding distributions within each Management Region.

#### **Population demographic sensitivity for the threatened Lesser Prairie-chicken**

Daniel Sullins - Kansas State University, Manhattan, KS; David Haukos - U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, Division of Biology, Kansas State University, Manhattan, KS, United States; Brett Sandercock - Division of Biology, Kansas State University, Manhattan, KS, United States

Loss of habitat and concurrent long and short-term population declines have led to the recent listing of the Lesser Prairie-chicken (*Tympanuchus pallidicinctus*, LPC) as a threatened species under the Endangered Species Act. Recovering LPC to population goals will require a solid understanding of the underlying processes contributing to the LPC boom and bust population fluctuations and identification of life stages exercising the greatest influence on demographic rates. Therefore, we captured, marked, and estimated vital rates (e.g., nest survival, brood survival, adult survival) from 182 female LPC and their offspring at 4 study sites in Kansas and Colorado. We estimated the finite rate of population growth ( $\lambda$ ) for each site using a deterministic matrix model and examined vital rate contributions to differences in growth rates between sites using a fixed-effects life-table response experiment. We assessed variables for which the population rate of change may be sensitive, or elastic, and used life-stage simulation analysis to identify vital rates explaining the most influence on the finite rate of population change, given their estimated variance. Finite rate of population growth estimates for each site ranged from  $0.49 \pm 0.06$  to  $0.55 \pm 0.07$  and adult survival contributed the most to differences among sites. The LPC population, when pooled among sites, was projected to decline ( $\lambda = 0.53 \pm 0.06$ ) and juvenile survival (August to March of first year), nonbreeding survival, and chick survival exerted the greatest influence on  $\lambda$ . Conservation of the species by managing brood habitat in landscapes where suitable nesting cover is present may increase chick and juvenile survival.

### **Experimental tests of the function and flexibility of song consistency in a wild bird**

Conor Taff - Cornell Lab of Ornithology, Davis, CA, United States; Corey Freeman-Gallant - Skidmore College, Saratoga Springs, NY, United States

Measures of bird song that capture aspects of vocal performance, such as consistency, have become a major focus in understanding sexual selection on song. Despite accumulating evidence that consistency is related to reproductive success in many species, it is still unclear whether this pattern is driven through male-male or female-male interactions. We studied the function and flexibility of song consistency in common yellowthroat warblers (*Geothlypis trichas*). A previous study of this population found that song consistency—measured as the amount of variability within a bout of songs—was positively correlated with the likelihood of siring extrapair young. In this study, we conducted two experiments aimed at determining whether consistency is a male-directed or female-directed signal and whether song effort is flexibly adjusted to changes in social context. In the first experiment, we simulated a male territorial intrusion with song playbacks that varied in consistency and rate; focal males responded aggressively to playbacks, but their response did not differ with playback consistency or rate and the focal male's song consistency did not change after the encounter. In the second experiment, we presented focal males with a taxidermic female mount and female vocalizations; focal males approached the speaker, but continued to sing and did not perform the aggressive rattle vocalization observed during male encounters. Immediately after the simulated female encounter, focal males increased in song consistency. Taken together, our results suggest that song consistency in common yellowthroats is a female-directed signal that is actively adjusted in response to rapidly changing social conditions.

### **Spatial ecology, migration, and zoonotic disease transmission in crows across an urban to rural landscape**

Conor Taff - Cornell Lab of Ornithology, Davis, CA, United States; Andrea Townsend - Hamilton College, Clinton, NY, United States

There is growing interest in understanding the role that wildlife populations play in acting as reservoirs and vectors of zoonotic disease transmission to domestic animals and humans. *Campylobacter jejuni* is one major food pathogen whose transmission dynamics are thought to be linked to the behavior of wild birds. However, ecological studies to date have typically only tested for prevalence of *C. jejuni* in wildlife without integrating information about strain sharing, movement, or contact between domestic animals and potentially infectious wild birds. We studied the role of American Crows in *C. jejuni* transmission on local and regional scales across an urban to rural landscape in central California. We found high rates of *C. jejuni* prevalence in crows (>55% infected) and full genome sequencing of isolates suggests that a subset of strains carried by crows are potential human pathogens. Using a combination of satellite and GPS backpacks deployed on 19 crows, we collected >6,000 locations from winter foraging, migratory routes, and summer breeding locations. We combine these extensive movement data with isotopic analysis of >1,000 crow feathers to characterize local and regional space use and the degree of population mixing during the winter when a large roost of 10,000 crows forms in Davis, CA. We paired these movement data with our sequencing

data to evaluate the potential for pathogenic disease transmission from crows to other species.

### **Host associations and diversity of two suborders of avian chewing lice from South Africa**

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Previous studies on avian chewing lice (Insecta: Phthiraptera) from South Africa have focused on a limited number of taxa or small geographic areas. We investigated host associations and genetic diversity of two suborders (Amblycera and Ischnocera) of avian chewing lice collected from five provinces in South Africa. Lice were obtained from previously prepared museum skin specimens representing a diversity of passerine families. Lice were identified by morphology to genus and species, when possible. Phylogenetic analyses were based on louse mitochondrial COI sequences, including closely related louse lineages represented on GenBank. Host specificity of the two suborders and potential host-parasite coevolution also will be discussed.

### **A comparative transcriptomic approach for understanding hybrid breakdown in three closely related North American parids**

Scott Taylor - Cornell University, Ithaca, NY, United States; Matt Carling - University of Wyoming, Laramie, WY, United States; Irby J. Lovette - Cornell Lab of Ornithology, Ithaca, NY, United States; Zac Cheviron - University of Illinois, Champaign-Urbana, IL, United States

When locally adapted species meet and interbreed along an environmental gradient, their hybrid offspring often exhibit reduced fitness. Although this is a common pattern, we still lack a multi-level understanding of how genomic and physiological mechanisms may underlie this 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 thermoregulatory performance and basal metabolism, and preliminary data indicate that selection against hybrids may be related to genetic incompatibilities in core metabolic pathways (e.g., oxidative phosphorylation, lipid metabolism). We sequenced RNA from five individuals of each species and assembled species-specific transcriptomes. Across species, the transcriptomes are of similar size and contain approximately the same number of expressed transcripts and Zebra Finch (*Taeniopygia guttata*) gene orthologs. Molecular evolutionary rates of individual transcripts vary among the three species as do candidate pathways involved in hybrid breakdown. Our ongoing work includes RNA sequencing of hybrid individuals to determine the structure of co-regulated gene networks in comparison to the parental species.

### **Assessing Black Rail occupancy and habitat along the Texas Gulf Coast**

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The Black Rail (*Laterallus jamaicensis*) is one of the most secretive birds in North America, and little is known about the

habitat requirements of this species along the Gulf Coast. Anecdotal observations suggest that this species' population has declined during the last century, and wetland surveys document a substantial loss of breeding habitat. Our project sought to quantify detection probability and occupancy and to identify habitat covariates that influence occupancy for Black Rails. We conducted breeding bird surveys to estimate occupancy and detection probability for the Black Rail in estuarine wetlands. We surveyed 90 points at Brazoria and San Bernard National Wildlife Refuges along the Texas Gulf Coast from March to May of 2014. Survey periods occurred at dawn, dusk, and night. We also measured vegetation structure variables such as vegetation height, stem density, canopy height, and species composition. We recorded 57 occurrences at 31 points. Overall occupancy was ~68%, and detection probability was ~10%. Of our habitat variables, only the number of stems between 10-20 cm was significant ( $p = 0.045$ ), although the number of stems between 20-30 cm also approached significance ( $p = 0.052$ ). Our study indicates that Black Rails are widespread but difficult to detect, and occupancy is affected by the presence of a vegetation canopy at heights between 10-30 cm.

#### **Extensive biogeographic introgression and weak genomic divergence between phenotypically distinct wood warblers**

David Toews - Cornell Lab of Ornithology, Ithaca, NY, United States; Scott Taylor - Cornell Lab of Ornithology, Ithaca, NY, United States; Rachel Vallender - Environment Canada, Montreal, Quebec, Canada; Bronwyn Butcher - Cornell Lab of Ornithology, Ithaca, NY, United States; Irby Lovette - Cornell Lab of Ornithology, Ithaca, NY, United States

Many aspects of the hybridization dynamics between Golden-winged (*Vermivora chrysoptera*) and Blue-winged Warblers (*V. prinus*) are well studied, and this system also draws substantial conservation attention as expanding Blue-winged Warbler populations displace Golden-winged Warblers. To date, however, genetic tools have had little power to distinguish between these phenotypically distinct wood warblers. Here we use a reduced representation ddRAD genomic approach to generate thousands of polymorphic genetic markers and quantify the extent of admixture among these warblers. Even with extensive genome-wide sampling, we find only subtle differentiation; compared to similar data from other pairs of hybridizing wood warblers, this extremely low level of divergence between Blue-winged and Golden-Winged Warblers suggests that they have a long history of substantial genomic admixture. Levels of admixture also vary with geography and these latitudinal patterns confirm some previous biogeographic scenarios of a northward expansion of Blue-winged Warblers. However, we also find phenotypic Golden-winged Warblers that appear genomically to be more aligned with Blue-winged Warblers. We discuss these new data in the general context of the genomic consequences of avian hybridization as well as for their possible conservation implications.

#### **The genomic consequences of avian hybridization**

David Toews - Cornell Lab of Ornithology, Ithaca, NY, United States

Contact zones between previously isolated taxa provide natural systems for studying the processes involved in avian divergence, adaptation, and reproductive isolation. I study these contact zones by combining field-based research with integrative laboratory techniques, using genomic tools, stable isotopes, behaviour, and physiology. My current research is

focused on the hybridization dynamics of recently diverged wood warblers. In particular, my work on hybridizing Myrtle and Audubon's Warblers asks: what are the important characteristics between these distinct taxa that are involved in reproductive isolation and how are these manifested in hybrids? I also discuss how genomic data are helping to resolve these questions in this and other avian systems.

#### **Elucidating the diet of the riparian-obligate Louisiana Waterthrush (*Parkesia motacilla*) in impacted aquatic systems**

Brian Trevelline - Duquesne University, Pittsburgh, PA, United States; Steven Latta - National Aviary, Pittsburgh, PA, United States; Brady Porter - Duquesne University, Pittsburgh, PA, United States; Timothy Nuttle - Civil & Environmental Consultants, Inc., Pittsburgh, PA, United States

Riparian songbird communities are ecologically delicate systems that are vulnerable to water pollution due to their dependence on aquatic insects. These songbird communities are specialized for breeding in the forested habitat surrounding a freshwater stream and are primarily comprised of forest-obligate migrants. The long-term decline of these migrants has been well documented for over 40 years and is believed to be primarily due to anthropogenic impacts such as abandoned mine drainage, acid precipitation, and agricultural run-off. These impacts indirectly affect breeding riparian songbirds by reducing the abundance and diversity of aquatic insects, which disrupts the aquatic-terrestrial trophic subsidy on which they depend. Nevertheless, the riparian specialist Louisiana Waterthrush (*Parkesia motacilla*) have been documented breeding and successfully fledging young along impacted streams. We hypothesized that waterthrush compensate for low aquatic insect availability by diversifying their diet and targeting terrestrial prey. We utilized DNA barcoding and Next-Generation Sequencing to identify residual prey DNA from the fecal sacs of Waterthrush nestlings. Our preliminary data suggests that waterthrush diet is primarily composed of mayflies (Order Ephemeroptera), flies (Order Diptera), and moths (Order Lepidoptera). In fecal sacs collected from 32 Pennsylvania and Arkansas nests, mayflies were present in 94% of fecal samples despite several streams exhibiting low %EPT, which is a reliable predictor of waterthrush territory size. Our preliminary data further supports that mayflies are a particularly important component of waterthrush diet. Our data also suggests that increased territory size among waterthrush nesting on acidified streams may serve as a compensatory mechanism to obtain preferred prey items.

#### **Polarimetric radar observations of bioscatter transport by tropical cyclones**

Matthew Van Den Broeke - University of Nebraska, Lincoln, NE, United States

Birds and other biological scatterers (bioscatterers) may become trapped near the circulation center of well-developed tropical cyclones. These severe weather phenomena may transport tropical bird species well into the extratropics, and may move pelagic species well inland. While the presence of such scatterers may be mistaken for light precipitation using conventional weather radar, polarimetric weather radar observations offer a unique opportunity to distinguish and monitor bioscatterers. An overview of the polarimetric variables will be provided with examples of how they are applied to bioscatterers, including birds. Then, polarimetric radar observations of bioscatterers will be summarized for



Hurricanes Irene (2011), Sandy (2012), and Arthur (2014). Ground-based evidence will be presented which suggests that some of the biological transport signature is due to birds.

#### **Polarimetric radar observations of spring migration in Nebraska and Oklahoma**

Matthew Van Den Broeke - University of Nebraska-Lincoln, Lincoln, NE, United States

Polarimetric radar observations offer a unique opportunity to observe migrating biological scatterers, including birds. Polarimetric characteristics of birds may vary by which grouping of species is dominant. During migration, many birds are present at the altitude of the radar beam, allowing frequent radar observations. Changing species composition through the migration season also allows an opportunity to assess polarimetric differences as dominant species groups change. Ground-based observations of birds will be related to polarimetric radar data during the spring 2015 migration season for Nebraska and Oklahoma. Of special focus will be large movements of geese during the early migration season, observations of migration along the central Platte, avian interactions with a cold front, and observations of nocturnal passerine movements.

#### **Effects of habitat heterogeneity on grassland songbird fecundity in an experimental landscape**

Bram Verheijen - Kansas State University, Manhattan, KS, United States; Brett Sandercock - Kansas State University, Manhattan, KS, United States

In North America, tallgrass prairie was historically maintained as a mosaic of heterogeneous habitats by an interaction between fire and grazing. In recent decades, intensification of agricultural practices in managed grasslands has led to more homogeneous landscapes, which caused widespread declines in songbird populations. Patch-burn grazing management increases heterogeneity in vegetative structure, as only a third of the pasture is burned each year in a three-year rotational scheme, and movements of cattle are not restricted. Patch-burn grazing management increases bird diversity, and has species-specific effects on bird abundance. However, the consequences on bird reproductive output are unknown. We assessed how patch-burn grazing affected the reproductive output of three species of declining grassland songbirds in tallgrass prairie. Our study was conducted at Konza Prairie Biological Station, a tallgrass prairie reserve in northeast Kansas. Between 2011 and 2015, we monitored nests of Dickcissels (*Spiza americana*), Eastern Meadowlarks (*Sturnella magna*) and Grasshopper Sparrows (*Ammodramus savannarum*), and in 2015 we attached radio-transmitters to Dickcissel fledglings. We compared nest survival, brood parasitism rates by Brown-headed Cowbirds (*Molothrus ater*), and fledgling survival and movements among three pastures managed with a patch-burn grazing regime. A fourth pasture with annual burns and season-long stocking of cattle served as a negative control, and a fifth pasture with annual burns, but no grazing, served as a positive control. We found that nest survival of Dickcissels was highest on the patch-burn grazing treatment, but found no treatment effect for the other two species. Rates of cowbird parasitism were high on all treatments, but highest on pastures that were grazed by cattle, and parasitized nests faced a 50% reduction in the number of host eggs. Bird abundance alone did not reflect the effects of management on reproductive output and might not be sufficient to determine the effects of grassland management regimes on wildlife.

#### **Changes in population genetics of Red-cockaded Woodpeckers over time**

Julia Vilstrup - USGS and Oregon State, Corvallis, OR, United States; Mark Miller - USGS, Corvallis, OR, United States; Thomas Mullins - USGS, Corvallis, OR, United States; Jeff Walters - Virginia Tech, Blacksburg, VA, United States; Susan Haig - USGS, Corvallis, OR, United States

Molecular tools provide quick, detailed and quantitative information regarding the status and change in status of a species or population. Thus, it is a useful measuring stick as to the success of management efforts over time. The Red-cockaded Woodpecker (*Picoides borealis*) was one of the first species listed under the U.S. Endangered Species Act due to habitat loss from forest fragmentation and degradation from fire suppression in their long-leaf pine (*Pinus palustris*) ecosystem. However, there have been no range-wide surveys of genetic diversity since the 1990s. Thus, we sequenced 605 bp of the mitochondrial control region for 628 birds from 73 breeding areas across its range. Samples included blood samples from 1969-2006 ( $n = 147$ ) and buccal swabs from 2014 ( $n = 481$ ). We identified 48 mtDNA haplotypes in birds from both time periods. One haplotype occurred in 48.9% of all samples regardless of time period. South central Florida was the most haplotype rich and diverse region ( $Hd = 0.8282$ ) with 19 haplotypes, of which eight are unique to the region. Across the species, a recent population expansion is implied from overall high haplotype and nucleotide diversity ( $Hd = 0.737$ ;  $Nd = 0.00216$ ) and a negative Tajima's D ( $-2.05447$ ,  $p < 0.05$ ). However, haplotype and nucleotide diversity has declined since 1969-2006 (from  $Hd = 0.787$  and  $Nd = 0.00254$ , to  $Hd = 0.723$  and  $Nd = 0.00050$ ). There is some evidence of current geographical population differentiation ( $F_{ST} = 0.1687$ ) which, despite translocation efforts, has become more prominent in the last 45 years (from  $F_{ST} = 0.1317$ ). Overall our results highlight the importance of taking a historical perspective when evaluating and changing the status of a species of concern.

#### **Eeny, meeny, miny, moe: What will my model show?**

Cassandra Walker - Oklahoma State University, Stillwater, OK, United States; Mona Papes - Oklahoma State University, Stillwater, OK, United States

The use of species distribution models (SDM) in scientific literature has greatly increased over the last twenty years, largely due to increased modelling software accessibility and applications of SDMs to ecological investigations. With increased SDM use, a reflection on environmental variable selection is needed to understand how selection techniques may influence model output. Benchmark studies have advised the removal of multicollinearity from variables prior to construction of models, whereas other authors advocate the use of ecologically relevant variables in building SDMs. The aim of this study is to investigate spatial and temporal aspects of variable selection methods across spatial extents and occurrence years to understand the role that variable selection plays in model output and interpretation. Four methods for choosing predictor variables were used to SDMs for Bell's Vireo (*Vireo bellii*) in Maxent algorithm across three spatial extents defined by different EPA ecoregion levels. Variable selection methods included in the modeling process ranged from the inclusion of all available variables to using separate methods of removing correlated variables and finally choosing ecologically relevant variables for the study species. The forty-eight models constructed were then evaluated using the Receiving Operator

Characteristic Area Under the Curve (ROC AUC), calculated omission error, and analysis of spatial distribution predictions. Results show that the method of variable selection influenced model performance (AUC and model omission error) to varying degrees across decreasing spatial extent as well as year. Potential distributions for each spatial extent were highly affected by the variable selection method, with considerable amounts of non-overlapping regions of suitable area. These results show that the choice of variable selection for species distribution modelling in Maxent greatly influences the output and therefore interpretation of the model predictions. Much consideration should be given to variable selection choice and interpretation of model predictions should be interpreted with scrutiny.

#### **Comparative population genomics in three *Setophaga* species: A reevaluation of ice-age speciation hypothesis**

Silu Wang - University of British Columbia, Vancouver, BC, Canada; Haley Kenyon - Queens University, Ontario, Canada; Darren Irwin - University of British Columbia, Vancouver, BC, Canada

The Ice-age Speciation Hypothesis predicts speciation in many of the youngest avian species occurred due to boreal forest fragmentation during late Pleistocene glaciation, which imposed selection that caused accelerated ecological differentiation among isolated populations. The palaeotemperature record suggests cooling phases in Pleistocene that might have led to sequential fragmentation of North American boreal forests. Under this scenario, it is likely that a major ice sheet separated eastern and western boreal zones around 1.8-0.8 millions of years ago and that a glacial advancement that divided the western boreal forest into Pacific coast and Rocky mountain fragments around 0.7 millions of years ago. One of the empirical supports for this prediction was observed in a *Setophaga* clade, where *S. townsendi* (a Rocky mountain species) and *S. occidentalis* (a Pacific coast species) diverged around 0.5 million years ago, and their common ancestor diverged from *S. virens* (a Taiga species) around 1.3 million years ago. However, this previous observation was based on one mitochondrial marker, which could be incongruent with neutral nuclear DNA markers, and whether population patterns support this hypothesis is unknown. Here we generate tens of thousands of SNPs in the nuclear genomes of multiple individuals for each species with the Genotyping-by-Sequencing technique. We find that the phylogenomic pattern in this species cluster supported the Ice-age Speciation Hypothesis, where *S. townsendi* is more closely related to *S. occidentalis*, and *S. virens* is basal. In addition, we model population genetic parameters such as locus-specific  $F_{st}$ , Tajima's  $D$ , and  $D_{xy}$  to test whether there was an accelerated rate of population differentiation associated with the ice-age glaciation. Integrating population genomics information and phylogenetic context broadens our understanding for the impact of ice-age glaciation on avian diversity.

#### **Flower-eating behavior in Cedar Waxwings: A chemical analysis**

Emily Webb - Ohio Wesleyan University, Delaware, OH, United States

Flower-eating behavior is understudied even in tropical locations where the consumption of flower parts is more common. Cedar Waxwings (*Bombycilla cedrorum*) are the only species of North American frugivores that are known to consume flower petals, specifically apple blossoms. This study

analyzed the nutritional value of flower petals from apple trees (*Malus domestica*) by examining the relative content of biologically important macromolecules including protein, sugar, phenolic compounds, and active antioxidants. In addition, Cedar Waxwings were observed at an apple orchard during May and June for patterns in flower-eating behavior such as selectivity by flowering stage or degree of pigmentation and proportion of other flower parts consumed as well as their sequence of consumption. The results were compared to what is known about the nutritional ecology and behavior of Cedar Waxwings in an effort to support current or generate new hypotheses with respect to flower petals as a seasonal dietary component.

#### **Drivers of adult survival in arctic-breeding shorebirds: Insights from coordinated research**

Emily Weiser - Kansas State University, Manhattan, KS, United States; Brett K. Sandercock - Kansas State University, Manhattan, KS, United States; Stephen C. Brown - Manomet Center for Conservation Sciences, Manomet, MA, United States; Richard B. Lanctot - US Fish and Wildlife Service, Anchorage, AK, United States

Arctic-breeding shorebirds are one of the most rapidly declining groups of birds worldwide. These long-distance migrants are vulnerable to a range of threats, including climate change, habitat loss, contaminants, and increasing predator numbers, in breeding areas, migratory stopover sites, and wintering areas. However, conservation planning is challenging because causes of decline are not well known for most of these species. The Arctic Shorebird Demographics Network coordinated standardized data collection across 16 shorebird breeding sites in Alaska, Canada, and Russia over a five-year period (2010-2014). We used data from individually marked birds to estimate adult annual survival rates for six species with large sample sizes. Estimates of annual apparent survival ranged from ~0.30-0.80 across species, with some variation among breeding sites. Apparent survival was highest for site-faithful birds (Dunlin, Semipalmated Sandpipers, Western Sandpipers) but we were also able to obtain good estimates for species thought to be more transient (Red and Red-necked Phalaropes). Individual characteristics (e.g. sex, nest success) and ecological covariates (e.g. weather, predator abundance at breeding sites) partially explained variation in survival for some species. This is the first broad-scale assessment of survival in these species, and our findings will inform future work to help focus research on the most sensitive stages of the annual cycle for each species.

#### **Improving avian conservation and ecological research with quantitative tools**

Emily Weiser - Kansas State University, Manhattan, KS, United States

In a changing world, observing the current state of a system is not sufficient to fully understand and manage it. Quantitative tools such as demographic analyses and simulation models are crucial for predicting the future state of a population and its response to changing conditions. My work focuses on using these tools to define the current state of a population, identify the environmental and ecological variables that affect it, project its future state, and evaluate options for management of threatened species. I use mark-recapture methods with Bayesian hierarchical models to estimate vital rates, and individual-based simulation models to predict population viability and compare scenarios under different management

regimes. With these tools, I have provided detailed advice for conservation management for several threatened birds, including options for genetic management, metapopulation connectivity, and reintroduction of endangered species. I am currently working with the Arctic Shorebird Demographics Network to synthesize demographic data for 18 species across 16 field sites in Alaska, Canada, and Russia to delineate factors affecting population trends and abundance. Our findings will direct future research towards options to conserve this declining group of birds.

**Varying levels of individual foraging specialization among populations of the endangered Hawaiian Petrel (*Pterodroma sandwichensis*): Gauging sensitivity to changes in prey availability**

Anne Wiley - University of Akron, Akron, OH, United States; Peggy Ostrom - Michigan State University, East Lansing, MI, United States; Christine France - Museum Conservation Institute, Smithsonian Institution, Washington, D.C., United States; Jay Penniman - University of Hawaii, Haiku, HI, United States; Helen James - National Museum of Natural History, Washington, DC, United States

In the face of ongoing climate change, ocean acidification, and industrialized fishing, it is critical to understand and predict the response of seabirds to shifts in prey availability. Theory suggests populations composed of specialists can be slower to change resources due to behavioral constraints, and populations can be vulnerable to reductions in resources on which they are specialized. Here, we examine the relative degree of foraging specialization present in two populations of the endangered Hawaiian Petrel (*Pterodroma sandwichensis*). This species has undergone an apparent shift in diet during the past ca. 100 years and is clearly vulnerable to changing conditions in its marine environment. To determine the consistency of trophic position and foraging location throughout the period of molt, we analyzed the stable carbon and nitrogen isotope composition of sequentially grown flight feathers. Our results show marked differences between populations. Petrels from Haleakala, Maui, were much more likely to be generalists with regard to  $\delta^{15}\text{N}$  than petrels from Lanai (e.g. they had a larger variance in  $\delta^{15}\text{N}$  values among feathers; std dev of 1.6 vs. 1.0 ‰, on average). Additionally, the Maui population had a larger total (isotopic) niche width, implying that they rely on a broader range of foraging resources. Populations also showed distinct average  $\delta^{15}\text{N}$  values throughout the period of molt (12-13.5 ‰ for Maui and 15.2-16.4 ‰ for Lanai), suggesting they maintain separate foraging locations, despite the close proximity of their breeding colonies (80 km). Because they show clear differences in foraging location and degree of individual specialization, we recommend prioritizing the conservation of multiple Hawaiian Petrel populations in order to preserve intraspecific foraging diversity and promote adaptability. We predict that the Lanai and Maui populations will respond differently to future changes in prey availability given the higher degree of foraging specialization present among Lanai individuals.

**Grasshopper Sparrows on the move: What explains variation in within-season breeding dispersal in a declining grassland songbird?**

Emily Williams - Kansas State University, Manhattan, KS, United States; Alice Boyle - Kansas State University, Manhattan, KS, United States

Within-season breeding dispersal is an intriguing behavior that is uncommon among birds. Recent evidence from a population of Grasshopper Sparrows (*Ammodramus savannarum*) breeding in tallgrass prairie of Kansas has revealed that on local plots, density and identity of individuals changes dramatically over the season. Furthermore, re-sighting of marked birds indicated that some sparrows engage in within-season dispersal of 1–4 km, presumably between nesting attempts. We hypothesized that these dispersal decisions may be shaped by spatial and/or temporal variation in predation or nest parasitism risk, food availability, or nest microhabitat quality. Here we present the results from predictions stemming from the predation/parasitism avoidance and food availability hypotheses. We monitored 116 nests and captured and blood-sampled 237 male Grasshopper Sparrows between May-July 2014 at the Konza Prairie Biological Station on 18 watersheds experimentally managed with grazing and burning regimes. To assess the effects of predation and nest parasitism on dispersal, we monitored nests every two days to determine nest fate, and estimated daily nest survival in Program MARK. We estimated food intake rates by measuring triglyceride concentrations in plasma, and estimated prey availability using three 80 m sweep-net transects within each watershed 3x/season. We found strong support for predation but not nest parasitism driving within-season emigration decisions. Nest survival over the 24-day nesting period was substantially greater in sparrows that remained on initial territories than those that subsequently dispersed. Contrary to prediction, arthropod abundance and food intake rates were unrelated to sparrow densities, suggesting that settlement decisions following dispersal may not be driven by simple spatial and temporal changes in food availability. These results suggest that emigration decisions are partly driven by predation, but further study is needed to determine what factors shape habitat settlement decisions following dispersal movements and the fitness consequences of within-season dispersal.

**Drought impacts on nesting ecology of early-successional breeding bird species in a bottomland hardwood forest of east Texas**

Meredith Wilson - Stephen F. Austin State University, Nacogdoches, TX, United States; Christopher Comer - Stephen F. Austin State University, Nacogdoches, TX, United States; Warren Conway - Texas Tech University, Lubbock, TX, United States; Christopher Farrell - Texas Parks and Wildlife, Lindale, TX, United States; Scott Bosworth - Texas Parks and Wildlife, Lindale, TX, United States

Bottomland hardwood forest successional stage can impact both fitness and survival of breeding birds by influencing forest resource availability, microclimate suitability, nest predation and brood parasitism rates. Due to extensive logging in southeastern bottomland hardwood forests, much of what remains is secondary-growth, characterized by closed canopy, and sparse understory. We assessed impacts of a one-in-100-year drought event on habitat factors affecting nesting success of three early-successional bird species: Northern Cardinals (*Cardinalis cardinalis*), Indigo Buntings (*Passerina cyanea*), and White-eyed Vireos (*Vireo griseus*) in a bottomland hardwood forest of east Texas. Nest searches and monitoring were confined to nine, 25 ha plots from April – July, 2013 and 2014 at the Old Sabine Bottom Wildlife Management Area (OSBWMA) in east Texas. To assess impacts of the 2011 drought, we compared Mayfield nest-survival estimates from OSBWMA in 2008-2009 to those of 2013-2014. Nest success estimates increased for Northern Cardinals (20% to 43%) and

for Indigo Buntings (16% to 38%) after the 2011 drought; but declined for White-eyed Vireos (51% to 38%). Indigo Bunting nest sites were more likely to be located within vines, as compared to random locations, although Indigo Bunting nest success was positively influenced by being located in structures with fewer supporting branches, greater percent vine ground cover, and more forest-interior locations. White-eyed Vireo nest success was positively associated with greater percent understory regeneration, while Northern Cardinal nest success was associated with greater percent vine ground cover. The drought disturbance seemed to provide habitat that tended to increase nesting success of two early-successional species, the exception being White-eyed Vireos for which relationships may be tenuous due to few nests monitored. Identifying key habitat variables provides insight for developing specific forest management prescriptions that mimic natural disturbances and sustain breeding bird populations.

#### **A new population and a new migratory route: Evidence for rapid change in migratory biology in Argentinean Barn Swallows (*Hirundo rustica*)**

David Winkler - Cornell University, Ithaca, NY, United States; Facundo Gandoy - Universidad Nacional de Salta, Salta, Argentina; Ignacio Areta - Universidad Nacional de Salta, Salta, Argentina; Marshall Iliff - Cornell Laboratory of Ornithology, Ithaca, NY, United States; Eldar Rakhimberdiev - Dept Ecology & Evol Biol, Cornell, Ithaca, NY, United States; Kevin Kardynal - University of Saskatchewan, Saskatoon, Canada; Keith Hobson - University of Saskatchewan, Saskatoon, Canada

The view that migratory paths are ruled by inherited cue-responses would suggest that it takes many generations for selection to effect large-scale changes in migratory behavior. The Barn Swallow (*Hirundo rustica*) is a common breeder throughout much of North America, and the vast majority of this population migrates to Central and South America for the northern winter. This species began breeding in Argentina in the 1980's in an area that had formerly been near the edge of the bird's common wintering range, and the population continues to grow and spread from there. Population genetic data, as well as observations in breeding colonies, indicate that individuals of North American origin are still recruiting to the Argentinean breeding population. The long-distance migration patterns of the North American birds raise a very interesting question: Do the swallows breeding in Argentina have a migratory route and destination like their North American ancestors, migrating to North America (and potentially even breeding there?) in the southern winter, or do they instead migrate like most southern hemisphere temperate-tropical migrants to northern South America for the winter? Earlier analyses of stable isotope profiles suggested the latter, but those analyses could not rule out a North American migratory destination. Data from geolocation loggers now conclusively demonstrate that the birds have a migratory pattern like most austral migrants: they spend the southern winter in northern South America. We will discuss the possible mechanisms that may have produced this rapid change and its implications for the evolution of migratory patterns in general.

#### **Aggregation of Grasshopper Sparrow (*Ammodramus savannarum*) territories: A test of the extra pair mating and cooperative care hypotheses**

Sarah Winnicki - Denison University, Granville, OH, United States; Alice Boyle - Kansas State University, Manhattan, KS, United States

In highly territorial species, spatial aggregation of competitors presents a conundrum. Territorial male Grasshopper Sparrows (*Ammodramus savannarum*) in NE Kansas exemplify such aggregations, showing great variability in their proximity to neighboring territories, but no link between territory aggregation and increased protection from predators and/or nest parasites. Alternative hypotheses for these patterns of territory aggregation include (1) facilitation of extra-pair matings or (2) cooperative care of offspring noted anecdotally in the literature. We predicted that the (i) proportion of extra-pair offspring and/or (ii) incidence of cooperative care at nests should increase as territories become more aggregated, and (iii) nest success should be related to the degree of territory aggregation and incidence of extra-pair young and/or cooperative care. To test these predictions, we located nests, quantified the territory locations, and observed parental care. We extracted DNA from blood of adults and nestlings and using microsatellites, calculated the proportion of each brood likely sired by extra-pair males. Although half of the nests contained at least one extra-pair nestling, the proportion of extra-pair nestlings and nest fate were unrelated to aggregation. We observed no extra-pair nest helpers feeding nestlings. However, nests were less likely to fail when other adult birds assisted in nest site defense. Extra-pair mating opportunities, incidence of cooperative care and nest success do not appear to explain the distribution of Grasshopper Sparrow territories on Konza Prairie, although data from more nests is needed to support these conclusions and to explain the relationship between increased nest success and shared defense. Further research will include the exploration of the hypothesis that male sparrows are aggregating with their male kin to facilitate nest site defense and to mitigate the genetic costs of extra-pair mating.

#### **Sensitivity to heat stress varies widely across avian orders**

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Sensitivity to heat stress varies widely across avian orders. 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 (T<sub>b</sub>) 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 upper critical thermal max (CTM) for each species by tracking T<sub>b</sub>, 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 CTMs and were able to effectively thermoregulate at air temperatures as high as 60°C. Passerine birds, in contrast, showed a much more limited capacity for thermoregulation at high air temperatures and exhibited CTMs near 50°C. We found that thermal tolerance is primarily driven by the primary

pathway of evaporative heat loss, where birds that evaporate water from the skin or have a well-developed gular apparatus were most effective at heat dissipation at high air temperatures. Body size was also a critical factor in determining heat tolerance at high temperatures. This work greatly expands our knowledge of avian tolerance to heat and provides insights into how more intense heat waves may change avian distributions and community structure.

#### **Geographic structure of population dynamics in Mountain Plover**

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A large portion of the Mountain Plover population winters in the agricultural landscape of Imperial County, CA, but little is known about where those wintering birds go to breed. The breeding range extends generally along the western edge of the North American Great Plains from southern Alberta into northern Mexico. We used color band relocations across 12 years from 948 banding locations aggregated into roughly 30 sites to describe the generally weak migratory connectivity structure between summer and winter subpopulations. To infer connectivity patterns beyond banding locations and banded birds, we measured stable hydrogen isotopes in feathers of wintering birds across four years. We found evidence for widespread breeding population mixing during winter and for rapid geographic turnover in the compositional structure of the wintering adult population that strongly reflects recruitment of young from the previous year. Recruitment patterns were geographically distinct across years, and are likely related to patterns of drought across the western edge of the Great Plains.

#### **Effects of tropical cyclones on bird populations and their habitats**

Joseph M. Wunderle, Jr. - Intl. Inst. of Tropical Forestry, USDA Forest Service, Luquillo, Puerto Rico, United States

A growing body of literature documents the effects of tropical cyclones (hurricanes and typhoons) on bird populations and their habitats and reveals some common patterns of response by birds and their resources. These studies implicate both direct and indirect storm impacts on birds and their habitats in population declines. Direct effects on bird populations include mortality due to exposure to high winds, rains, and storm surges. Indirect effects, however, may have the longest lasting impact on bird populations and include loss of food resources or foraging substrates, increased risk of predation, loss of nests and nest or roost sites, and microclimate changes. The short-term responses of birds to hurricane damage, at least for terrestrial species, include shifts in diet, habitats, and foraging locations. Reproduction may be curtailed or nest success decline in the immediate storm aftermath and reproductive success may be changed due to mortality, which shifts population age structure. As vegetation recovers, terrestrial birds may respond to outbreaks of herbivorous insects as defoliated plants leaf out and to increases in flowering and fruiting. This food resource bloom can increase avian reproductive success as pairs produce multiple clutches extending normal breeding periods. Birds most vulnerable to hurricane impacts have a diet of nectar, fruit or seeds; roost or forage on large old trees, require closed forest canopy; have special microclimate requirements and/or live in a habitat in

which vegetation recovers slowly. These vulnerability traits are exacerbated in small populations isolated in habitat fragments. Despite increasing knowledge of hurricane effects more research is needed to understand storm effects on avian demography and the role of source-sink dynamics in post-hurricane recovery, especially given predicted increases in the frequency of the most powerful hurricanes with global climate change.

#### **Genetics illuminates reproductive patterns in a cooperatively breeding precocial species, Kalij Pheasants (*Lophura leucomelanos*) in Hawai'i**

Lijin Zeng - University of California, Riverside, CA, United States; John Rotenberry - University of Minnesota, Saint Paul, MN, United States; Marlene Zuk - University of Minnesota, St. Paul, MN, United States; Thane Pratt - USGS Pacific Islands Ecosystem Research Center, Volcano, HI, United States

We have recently reported cooperative breeding in Kalij Pheasants (*Lophura leucomelanos*) in Hawai'i, where social groups often include one female with multiple males, with one male dominant over the other(s). Cooperative breeding in precocial species is rare, but appears to be promoted by reduced recruitment of females, and high density with subsequent habitat saturation in this introduced species. In cooperatively breeding species, unbiased characterization of the genetic mating system and relationships among social unit members can help illuminate the benefits and costs of social behaviors. Using 12 autosomal microsatellites from 88 adult samples and 82 egg samples, we determined relatedness patterns within groups and the genetic consequences of the mating system in this population. We analyzed relatedness for 32 within-group dominant-subordinate male dyads from 17 groups, using CERVUS 2.0. We found that 34.4% of the dyads were related, indicating that helpers may gain indirect fitness benefits by helping kin. We analyzed parentage for 82 offspring from 13 broods using ML-RELATE. Three offspring were likely products of conspecific brood parasites. 68.4% of the remaining 79 offspring were fathered by the dominant male of the social group, while 16.5% were fathered by subordinate males of the group, suggesting that helpers gained direct benefits as well. Thus, the mating system of pheasants appears flexible and adaptable to ecological constraints imposed by a new environment.

#### **Age and sex dependent stopover biology of Ruby-throated Hummingbirds (*Archilochus colubris*) during autumn migration**

Theodore Zenal - University of Southern Mississippi, Hattiesburg, MS, United States; Frank Moore - University of Southern Mississippi, Hattiesburg, MS, United States

This study focuses on age and sex related differences exhibited during stopover by Ruby-throated Hummingbirds (*Archilochus colubris*) on autumn migration along the northern coast of the Gulf of Mexico. Sex-dependent migration is expected because of sexually dimorphic characteristics in wing morphology and body size. Age-dependent migration is expected since young birds engaging in their first migration lack the experience of older individuals. Information on arrival condition, phenology, fuel deposition rates (FDR), stopover duration, and estimated flight ranges are obtained through banding data, passive integrated transponder tags, radio telemetry, and color marking. All variables except FDR had significant differences between age as well as sex; however we detected no interactions between age and sex. Males arrived in better

condition than females, while older birds arrived in better condition than younger birds. Females arrived earlier in the season compared to males, while older birds arrived earlier than younger birds. Males had longer stopover durations compared to females, while younger birds stayed at our study site longer than older birds. Males were estimated to fly farther than females, while older birds were able to fly farther than younger birds. We also tested for correlations between arrival condition and FDR as well as stopover duration finding that only young males had significant correlations of FDR and stopover duration with arrival condition. Differences in FDR among age and sex classes as well as relationships between FDR and stopover duration with arrival condition are minimized when migrants face an ecological barrier. Ultimately, this study provides novel information on the poorly understood migration of Ruby-throated Hummingbirds by detecting differences in their stopover biology by age and sex.

### **Challenges with curating BBS stop-level data: Can historical data meet modern analytical needs?**

David Ziolkowski Jr. - USGS Patuxent Wildlife Research Center, Laurel, MD, United States; Keith Pardieck - USGS Patuxent Wildlife Research Center, Laurel, MD, United States

The North American Breeding Bird Survey (BBS) is about to celebrate its 50th year of providing estimates of population trends for varying scales ranging from the local sampling unit (the route) up to the continental scale. Each BBS route is comprised of 50 individual point counts but digital storage and computing limitations in the early decades necessitated that the program's operational structure be oriented around the route as the most basic unit for management and analysis. With the rapid evolution and integration of more powerful computing and spatial technologies (such as GPS, GIS, and remote sensing), BBS data users in the 21st century are now eager to improve the resolution of the BBS by taking advantage of the structure that lies below the route, at the stop level. The BBS program made first inroads in this direction in 1997 when it reconfigured its database to accept 50-stop data and it has since continued in that vein as it now nears the completion of a project that will make available the 50-stop data from all years of the survey. However, concurrent pilot projects aimed at collecting stop-coordinate data from routes elucidated fundamental issues, both methodological and analytical in nature, that need to be addressed before further progress can be made towards stop-level work. These issues raise questions and challenge many commonly held assumptions about the degree of resolution that can be expected from data below the route-level. It is essential that BBS data users who attempt to work with stop-level data be both aware of these caveats and cautious about assumptions related to them. The BBS office is in the process of developing a new prospective approach that will advance the survey's functional scale to the stop-level and in so doing greatly enhance the utility of the Survey – but this represents an operational paradigm shift for the program and will require further time and resources to implement.

## POSTERS

### **To bond or not to bond: Impact of social structure on pair bonding in avian species**

Justin Agan - Oklahoma State University, Stillwater, OK;  
Madeleine Naylor - Oklahoma State University, Stillwater, OK,  
United States; Ashley Love - Oklahoma State University,  
Stillwater, OK, United States

Different mating strategies (e.g., monogamy and polygamy) have arisen over time depending on the costs and benefits to overall reproductive fitness. One way species can increase fitness within their mating strategy is by pair bonding. Pair bonding is a relationship where one or more parties invest in pair cooperation to increase fitness. The environment can influence pairing in different ways; some environments may be conducive to individuals, while others may select for groups. As populations increase in density and social complexity, we expect that there will be more opportunities for extra-pair copulations and a reduced likelihood of long-term pair bonding, due to increased access to potential mates. This study addresses if sociality and density provide a potential evolutionary explanation to explain why pair formation occurs in some species but not in others, and why there is variation in the duration of pair bonds among species. We hypothesized that solitary species are more likely to pair bond and pair for longer durations because they are limited in their interactions with other individuals and will, therefore, have higher reproductive output if they stay with one familiar individual. To determine what factors influence the presence and duration of pair bonding in birds we extracted data from The Birds of North America online database. We compiled data on pair bonding, mating strategy, parental care, sociality and density, and reproductive output. Our results showed that pair bonding and the pair bond duration are significantly correlated with a number of life history traits (parental care, group size, territory size and body size) but that reproductive output (clutch size and broods per season) is not significantly different between groups. Our results add to a growing body of research that suggests that sociality and density influence mating behavior within and among species.

### **Influences of community structure on behavioral plasticity across geographic regions in eastern bluebirds**

Alexandra Albers - Appalachian State University, Boone, NC, United States; John A. Jones - Appalachian State University, Boone, NC, United States; Lynn Siefferman - Appalachian State University, Boone, NC, United States

Because ecological systems are constantly undergoing stress and fluctuation, animals are often faced with the challenge of adapting to altering environments. For many bird populations, competitive pressures can be variable and individuals should show plastic behavior (e.g. aggressive, passive, etc) in response to ecological stress, even in species where individuals have predictable personality types. Indeed, interspecific competition is often a significant ecological stressor, especially for obligate secondary cavity nesters competing for limited nestboxes. In this study, we investigated the behavioral differences between an Eastern Bluebird, *Sialia sialis*, population in North Carolina that is currently experiencing interspecific competition with Tree Swallows, *Tachycineta bicolor*, versus a bluebird population in Alabama that is not experiencing intensive

interspecific competition. In both populations, past research demonstrates that individuals show repeatable personality types. We quantified behavioral phenotypes early in the breeding season by measuring behavior in response to simulated territorial intrusions (i.e. conspecific playback). Although males in both populations were more aggressive than were females, the populations did not differ in overall aggression. Furthermore, males in the North Carolina population were more aggressive when Tree Swallows were in close proximity to the nest cavity during the behavioral trial ( $t_{27} = 2.13$ ,  $P=0.043$ ). This research demonstrates that overall aggression does not necessarily vary with geography but suggests that individual bluebirds change their behavior in response to harassment by interspecific competitors. Understanding how individuals respond to competition is important because the behavior of mated bluebird pair predicts their reproductive success. A better understanding of how the environment shapes behavior in species with distinct personalities will aid our understanding of how personality evolves.

### **Carduelini new systematics: New groups and splits showed by mitochondrial DNA and Bayesian phylogeny**

Antonio Arnaiz-Villena - University Complutense, Madrid, Spain; Valentin Ruiz-del-Valle - University Complutense, Madrid, Spain; Pablo Gomez-Prieto - University Complutense, Madrid, Spain; Cristina Areces - University Complutense, Madrid, Spain; Diego Rey - University Complutense, Madrid, Spain; Mercedes Enriquez-de-Salamanca - University Complutense, Madrid, Spain; Lucian Basile - University Complutense, Madrid, Spain; Manuel Martin-Villa - University Complutense, Madrid, Spain; Narcisa Martinez-Quiles - University Complutense, Madrid, Spain; Ester Muñiz - University Complutense, Madrid, Spain

A molecular phylogeny for a group of Carduelini finches has been analyzed "de novo". Compared Carduelini finch groups include: Greenfinches, "Arid-Zone" finches and the genera *Rhodopechys* and *Pyrrhula*. The mitochondrial cyt b molecule was used for species comparison and maximum likelihood and Bayesian methods were employed in order to obtain a solid phylogeny. Our results show that a new systematics should be considered for the studied species and provide new insight into the group's origin and phylogeography. Our main conclusions are as follows. (1) Genus *Pyrrhula* should be regarded as sharing its extinct (or non-analyzed) ancestor with "Arid-Zone" finches. Further analyses using other genetic markers could be required to verify these phylogenetic findings, and a taxonomical revision of these Genera (*Rhodopechys*, *Pyrrhula* and "Arid-Zone" finches) and Carduelini tribe is needed to maintain monophyletic clades. (2) The polytomies found in our Carduelini finch phylogenetic dendrograms indicate that a systematic revision of these groups is required. (3) The Desert Finch (*Rhodopechys obsoleta*) is a Greenfinch ancestor of the other extant species. In other works, this bird is a pale colour Greenfinch. (4) The "Arid-Zone" finches include *Leucosticte arctoa tephrocotis*, *Leucosticte arctoa arctoa*, *Carpodacus nipalensis*, *Rhodopechys githaginea*, *Rhodopechys mongolica* and *Rhodopechys sanguineus*. (5) *Carpodacus erythrurus* and *Haematospiza sipahi* form a single phylogenetic clade. (6) Two Grosbeak genera, *Mycerobas* and *Eophona*, should also be reclassified. (7) Genus *Loxia* (Crossbills) is monophyletic and placed close to *Carduelis flammea* and *C. hornemanni*. (8) *Pinicola enucleator* should be classified together with

Bullfinches (*Pyrrhula* species). *Pinicola* seems the most ancient extant species within this monophyletic group.

#### **Effects of prescribed burning on brood parasitism and predation rates for two vireo species**

Karen Bagne - Kenyon College, Gambier, OH, United States;  
Kathryn Purcell - Pacific Southwest Research Station, Fresno, CA, United States

Brown-headed Cowbirds (*Molothrus ater*), a brood parasite, arrived in the Sierra Nevada of California relatively recently, but have found numerous songbird hosts to raise their young. We monitored songbird nests in ponderosa pine forests that were part of a prescribed burning program. Hutton's Vireo (*Vireo huttoni*) and Cassin's Vireo (*Vireo cassinii*) were common cowbird hosts. After burning, cowbird parasitism increased and remained higher up to 6 years post-burn. Although well concealed visually, Hutton's Vireo nests were the most heavily parasitized at a rate of 60% following burning, which was almost double the rate on fire-suppressed plots. Concealment was lower on burned sites where, in addition to brood parasitism, there was higher nest loss due to predation. Burning also increased parasitism rates for Cassin's Vireo, although overall predation rates were mostly unaffected.

#### **Annual survival and breeding dispersal in Scissor-tailed Flycatchers: Associations with sex and reproductive success?**

Adam Becker - Portland State University, Portland, OR, United States; Diane Landoll - University of Oklahoma, Norman, OK, United States

Breeding dispersal (i.e., movement among breeding locations in successive years) in birds exhibits considerable interspecific variability but is typically sex-biased with females dispersing farther and more frequently than males. We used banding data collected over a 7-yr period to describe annual survival and breeding dispersal of male and female Scissor-tailed Flycatchers (*Tyrannus forficatus*; STFL). We banded 103 adult male and 102 adult female STFLs between 2008 and 2014 at two sites near Lawton, OK (Fort Sill Military Reservation and Wichita Mountain Wildlife Refuge). Adults were captured at nests during the nestling period by mist net and color-banded for individual recognition. Return rates in successive years were established through recaptures and resightings, and breeding dispersal distance (BDD) was measured as the distance between nests in successive years. Return rates were low (31.2%) and did not differ between the sexes. Detectability was also low, however, and estimates of annual survival based on MARK analyses were higher than observed return rates, although still equivalent for males and females. Birds that returned were significantly more likely to have successfully raised young in the previous year, but among the returnees, the frequency of dispersal did not differ between successful and failed breeders, nor between the sexes. BDD of males ( $704 \pm 174$  SE,  $n = 30$ ) and females ( $734 \pm 279$  SE,  $n = 27$ ) did not differ, and BDD of failed ( $706 \pm 234$  SE,  $n = 16$ ) and successful ( $723 \pm 204$  SE,  $n = 41$ ) breeders did not differ. Although BDD of sexes did not differ, males were marginally more likely to disperse to a distant territory ( $> 600$  m) than females ( $P = 0.079$ ). Thus, unlike most birds, only modest evidence suggested that prior nest success influenced dispersal

probability, and little to no evidence suggested a sexual difference in dispersal behavior.

#### **The effects of early incubation on eggshell microbial loads in Eastern Bluebirds**

Patricia Bollinger - Indiana State University, Charleston, IL, United States; Eric Bollinger - Eastern Illinois University, Charleston, IL, United States; Steven Daniel - Eastern Illinois University, Charleston, IL, United States; Rusty Gonser - Indiana State University, Terre Haute, IN, United States; Elaina Tuttle - Indiana State University, Terre Haute, IN, United States

We examined whether incubation before completion of the clutch reduced eggshell microbial load in Eastern Bluebirds (*Sialia sialis*) nesting in Illinois. We sampled shell microbes on eggs exposed to different levels of incubation: partial incubation (first-laid eggs;  $n = 47$ ), full incubation (last-laid/fifth eggs;  $n = 37$ ) and no incubation (manipulated first-laid eggs held with their nests in empty nest boxes and exposed to ambient temperatures;  $n = 36$ ). We swabbed one half of the shell surface on the day of laying and the other half four days later. Microbes from swab samples were cultured on MacConkey agar, which selects for gram-negative enteric bacteria (common pathogens of avian embryos) and on Tryptic Soy Agar (TSA), which supports growth of a wide variety of microorganisms. We counted colony-forming units (CFUs) of bacteria and fungi and identified the most common gram-negative bacterial colony types using the Enterotube II system. We recorded nest-cup temperature using iButton thermochrons placed under the nest cup lining. Initial microbial loads averaged 147 CFUs per egg (TSA samples), lower than that reported in studies from tropical environments but higher than in an arid temperate environment. Samples from MacConkey plates averaged 14 CFUs per egg. Bacteria identified included *Pantoea*, *Acinetobacter*, *Klebsiella*, *Escherichia*, *Pseudomonas* and *Citrobacter*. Fungi were detected on 63% of eggshells. Eggs in all treatment groups had reduced numbers of CFUs on MacConkey agar after four days' exposure to either incubation or ambient temperatures, but this effect was statistically significant only for first-laid eggs experiencing partial incubation during egg-laying. Earlier data from experimental clutches indicated that prolonged lack of incubation resulted in significantly reduced hatching success. The pattern of change in microbe numbers reported here suggests that partial incubation during egg-laying may enhance egg viability by reducing eggshell microbial loads.

#### **Local and regional patterns of breeding dispersal and habitat selection in a declining grassland bird**

Alice Boyle - Kansas State University, Manhattan, KS, United States

Dispersal is a critical behavior influencing meta-population dynamics, potential for local adaptation, and extinction risk under changing climates. Although less common than natal dispersal, some mobile animals engage in breeding dispersal between successive reproductive attempts. Such behavior confounds both accurate estimates of survival and our ability to devise effective management strategies. Breeding dispersal appears to be particularly prevalent in grassland birds, yet the basic patterns of variation in dispersal behavior (within and among years) at local, regional, and continental scales, and the causes of that variation remain unknown. I report here on



preliminary results from studies of individual variation in return rates and dispersal of >600 color banded Grasshopper Sparrows (*Ammodramus savannarum*) at the Konza Prairie in NE Kansas, as well as a regional study of dispersal distances of the same species in the central Great Plains. Sparrows at Konza are remarkably transient with near complete turn-over of territory holders on local plots within the breeding season. Additionally, they exhibit habitat-specific seasonal shifts in territory density, and movements between breeding attempts of >4 km. Territory densities on plots exhibited management-specific temporal changes within years, and densities varied between years within the same management regime, perhaps due to the varying effect of fire under different precipitation conditions. However, there were few direct links between patterns of movement, density, and metrics of individual condition. Return rates were ~20% for adults and ~8% for first year birds, and many returning individuals settled on territories within 50 m of their last observed location the previous year. At regional scales, isotope data suggest that non-site-faithful birds often make large-scale dispersal movements. This result implies that factors influencing habitat quality regionally (such as inter-annual variation in rainfall) rather than local management practices or landscape-scale availability of grassland habitat may explain the high mobility of grassland birds.

#### **Identifying migration and wintering locations of Common Terns (*Sterna hirundo*) breeding in the Laurentian Great Lakes using light level geolocation**

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Six U.S. states bordering the Great Lakes have listed the Common Tern (*Sterna hirundo*) as threatened or endangered. Declines in colonies in the Canadian Great Lakes Region were recently estimated at 41%. Factors that negatively impact Common Terns on their breeding grounds have largely been identified, but increased understanding of migration and wintering habitat selection, and migration chronology, are priorities for this species. Sightings from wing-tagged birds provide only limited information and may be biased by the location of observers or access points; banding data also supply limited information about movement patterns. We used data provided by light level geolocators to track adults through their annual cycle and isolate important non-breeding locations. With the identification of these locations, we will better understand conservation needs for the Great Lakes population of Common Terns. In June 2013, we deployed 20 leg-mounted geolocators (mass=0.75g) on adults nesting on Interstate Island in the Duluth-Superior harbor, Lake Superior, and 30 units on birds nesting on Elm Island, North Channel of Lake Huron. In June 2014, we retrieved seven geolocators from the Interstate Island colony and 15 units from Elm Island. Of the 22 units

recovered, only seven were still recording data; others failed at various times. We used the R package GeoLight to estimate movement patterns at stopover and wintering locations. With a few exceptions, birds showed similar migration routes and wintering distributions. Three major staging periods were identified during migration (1-lower Great Lakes, 2-Atlantic Coast, 3- Gulf of Mexico). Wintering locations included Central America and the north and west coasts of South America. These results provide support for segregation of eastern and central North American breeding populations and have important implications for management and focus of future research.

#### **Remote population estimation of a migratory aerial insectivore through the use of weather radar**

Kyle Broadfoot - University of Oklahoma, Norman, OK, United States; Jeffrey Kelly - Oklahoma Biological Survey, Norman, OK, United States

Archived weather radar data is a repository for large-scale observations of aerial organisms at a high temporal resolution, and has in recent decades become a valuable tool for ornithological studies. Post-breeding, pre-migratory roost sites of Purple Martins (*Progne subis*) may host several hundred-thousand birds, whose morning exodus is substantial enough to appear regularly on weather radar. Previous work has shown the correlation between radar observations of martin emergences and on-the-ground abundance estimates. Here we provide a direct estimate of the number of martins at an urban roost using radar by converting reflectivity measurements (dBZ) into a biologically meaningful density product ( $\eta$ ). This method has the potential to provide population estimates across the Purple Martin roosting distribution and illuminate the spatio-temporal dynamics of these populations with respect to landscape-level changes.

#### **Comparative Transcriptomics Of Avian Migration: Gene Expression In The Brains Of Tree Swallows (*Tachycineta Bicolor*) Staging For Migration**

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Avian migration has been a subject of scientific inquiry for over two hundred years, and ornithologists have amassed a substantial body of knowledge on the ecology, physiology, geography, and evolution of the seasonal movements of birds. There is still little known, however, about which genes and genomic regions are involved in migration. We used a comparative transcriptomic approach to search for candidate genes for migratory behavior in Tree Swallows (*Tachycineta bicolor*), a long distance migrant that breeds across North America and winters along the Gulf Coast, and in Florida, Central America, and the Caribbean. In late fall, enormous roosts of Tree Swallows form in agricultural fields in the southeastern United States. These roosts are believed to be

migratory stopover sites for swallows on their way from breeding sites further north to wintering sites elsewhere. There is substantial variation in physical condition (e.g. furcular fat) of birds captured in these roosts, suggesting corresponding variation in migratory schedule. This variation in migratory timing enabled us to compare brain gene expression among thirty individual swallows captured at the same time, under the same environmental conditions, at a roost near Vacherie, Louisiana, in November of 2012. The captured individuals fell into three furcular-fat classes, suggesting that these birds can be grouped into three categories of readiness to migrate. We extracted RNA from the brains and livers of these birds, and sequenced their whole-brain and liver transcriptomes with Illumina HiSeq. We developed a novel, reference transcriptome-free method to identify differentially expressed transcripts among the three fat classes. These differentially expressed transcripts can be considered as candidate genes for involvement in migratory behavior.

### **Nesting associations of orioles and becardards in Yucatan, Mexico**

Timothy Brush - University of Texas-Pan American, Edinburg, TX; John Brush - University of Texas-Pan American, Edinburg, TX, United States

Several bird species build hanging nests together, probably to protect against nest depredation and possibly brood parasitism. During 2011 and 2013, we did short-term studies of nesting associations of Altamira Orioles (*Icterus gularis*), Rose-throated Becardards (*Pachyrhamphus aglaiae*), and Orange Orioles (*I. auratus*) in Yucatan state, Mexico. 47% of the 263 Altamira Oriole nests had at least one other species nesting within 10 m, but many Altamira nests were in habitat less suitable for other species. In semi-open forests around Mayan ruins, 60% of Altamira nests had nesting associates, compared to only 38% of Altamira nests in areas partially cleared for agriculture. Of all Altamira Oriole nesting associations, 83% included Rose-throated Becardards, while 26% included Orange Orioles. 56% of all 185 Rose-throated Becard nests were associated with Altamira Orioles, with a high of 72% in semi-open forest. 71% of all 69 Orange Oriole nests were associated with Altamira Oriole nests, with a high of 76% along edges of dense forests. Only 4 of the 69 Orange Oriole nests, which sometimes nests colonially, were within 10 m of conspecifics. Tree species chosen most frequently by most species (such as *Piscidia piscipula*) had an open growth form, possibly further reducing the chances of nest depredation. These nesting associations and locations may especially help smaller species such as Orange Oriole, in habitats not suitable for single-species nesting colonies.

### **House Sparrow declines in north central Florida**

Jessica Burnett - University of Florida, Gainesville, FL; Michael Moulton - University of Florida, Gainesville, FL, United States

Although many studies have documented House Sparrow (*Passer domesticus*) declines in urban areas in the U. K., few have documented such population trends in North American cities. Methods: We conducted a comparative study in commercial and residential areas in Gainesville, Florida to (i) quantify the rarity of House Sparrows in this area, (ii) assess whether different land use patterns predicted House Sparrow presence or absence and (iii) determine whether the presence

of other synanthropic species were associated with House Sparrow presence. We conducted 119 repeated point counts (total N = 238 counts) in two habitat types, commercial and residential, using a stratified random sampling technique from May to September 2014. We used the Florida Natural Areas Inventory's Cooperative Land Cover Map v. 3.0 and Program R to determine what, if any, land use characteristics affected House Sparrow occupancy rates. We also built co-occurrence models. Results: Despite repeated efforts we detected no House Sparrows in residential sampling areas. We detected House Sparrows at only 14 of 119 (18 %) of sampling points and at only 22 % of commercial sampling points. Amount of land devoted to commercial uses best-predicted House Sparrow occupancy. Our model-averaged estimate of  $\phi$  (Pr | occupancy of a sampling point) and  $p$  (Pr | detection) were  $0.16 \pm 0.00$  SE and  $0.811 \pm 0.0764$  SE, respectively. House Sparrow occupancy was not significantly associated with any synanthropic species' occupancy and was negatively correlated with Red-bellied Woodpeckers (*Melanerpes carolinus*). Conclusions: We confirmed the rarity or, more likely, the absence of House Sparrows in residential areas of Gainesville, Florida. Although House Sparrow presence can best be predicted by the amount of high intensity urban areas (e.g. particularly near grocery stores) their occupancy of these sites was much lower than one might expect of a once-ubiquitous and successful invader.

### **Nocturnal singing in diurnal birds: Finding mates and repelling intruders?**

Antonio Celis-Murillo - University of Illinois at Urbana-Champaign, Champaign, IL, United States; Michael Ward - University of Illinois at Urbana-Champaign, Urbana, IL, United States; Roberto Sosa Lopez - CIIDIR unidad Oaxaca, Instituto Politécnico Nacional, Oaxaca, Mexico; Thomas Benson - University of Illinois at Urbana-Champaign, Champaign, IL, United States

Nocturnal singing in diurnal birds is poorly described and not well understood. Despite limited investigations, nocturnal singing behavior is known to vary by species and individuals, some showing high vocal activity while others vocalize infrequently or not at all. Studies have suggested that nocturnal singing serves similar functions as during the day, attracting mates and repel intruders. Although these two explanations seem reasonable, they are only based on data from species that regularly sing at night and not from species that rarely sing at night. Empirical data on these species are even more limited, partly because of the logistical challenges associated with studying rare individual behaviors throughout the night. We used manual and autonomous acoustic recording, automated detection and classification algorithms and individual acoustic identification to investigate the role of nocturnal singing in the reproductive activities of the diurnal Field Sparrow (*Spizella pusilla*). We monitored six grassland patches via soundscape recordings to quantify the signal effort of resident territory-holders (individuals living near recorders), neighboring territory-holders and intruders (individuals detected singing near resident territory-holders but known to be established in a different grassland patch). We used general linear mixed models to examine if social (fertility stages, the presence of neighbors and intruders singing) and ecological factors (moon illumination) influence nocturnal signaling effort in mated male Field Sparrows. We found that resident males sing more during the fertile and post-fertile periods and when conspecifics (neighbors and intruders) are also singing. We also found that

neighbors and intruders sing more near resident males when their mates are fertile. Our data demonstrates that nocturnal song in diurnal birds is influenced by the social environment (mate's fertility stages, neighbors, intruders) and that it plays a role in the reproductive activities.

### Molecular systematics of swifts of the genus *Chaetura*

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The genus *Chaetura*, which formerly included species now placed in several genera, is currently considered to consist of 9-12 species of swifts endemic to the New World. However, species limits and relationships within this morphologically conservative genus are controversial. We used mitochondrial and nuclear sequence data of all species and many subspecies of *Chaetura* to address the following questions: (1) does *Chaetura*, as currently constituted, form a monophyletic group?, (2) what are the evolutionary relationships of species within *Chaetura*, and do molecular data support the most recent morphological assessments?, (3) are species of *Chaetura* monophyletic, and what are the relationships of several controversial taxa (e.g., *C. andrei andrei*, *C. spinicaudus fumosa*, *C. chapmani viridipennis*, and *C. vauxi richmondi*)?, and (4) do the genetic data reveal previously unrecognized (i.e., cryptic) evolutionary lineages? Our results indicate that *Chaetura* likely forms a monophyletic group and that broad-scale molecular divisions within the genus largely follow the morphological results. However, the genetic data are at odds with some recent proposals regarding species relationships.

### Thermoregulatory use of heat increment of feeding in Northern Saw-whet Owls

Sheldon Cooper - University of Wisconsin, Oshkosh, WI, United States

The heat increment of feeding (HIF) is the transient increase in metabolic rate following ingestion of a meal. HIF has been viewed as an unavoidable loss of ingested energy. However, several authors have suggested that HIF may be used to substitute for shivering heat production in birds that are exposed to cold ambient temperatures. I measured HIF in Northern Saw-whet Owls (*Aegolius acadicus*) in Wisconsin during fall migration. Mean minimum nightly temperature during fall migration is approximately 5°C which is below the lower critical temperature of Northern Saw-whet Owls. HIF was measured as the increase in resting metabolic rate (measured as oxygen consumption) after feeding the owls with laboratory mice at thermoneutral conditions (25°C) and during cold exposure (5°C). Nighttime resting metabolic rate (RMR) under thermoneutral conditions was  $2.30 \pm 0.60$  mL O<sub>2</sub> min<sup>-1</sup> in fasted owls and increased significantly (12%) while feeding. Nighttime RMR at 5°C was  $4.65 \pm 0.53$  mL O<sub>2</sub> min<sup>-1</sup> in fasted owls and did not change significantly while feeding. Thus, HIF substitutes for thermoregulatory heat production during cold exposure in Northern Saw-whet Owls.

### Combined effect of abrasion and bacterial degradation on feathers

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Bacterial degradation of feathers (Burt and Ichida. Auk 116:364-372.1999) and abrasive damage to the plumage by airborne particles (Burt, Ornithol. Monogr. 38. 1976) have been described in general terms, but the contribution of each to feather damage is unknown. We studied the relative effects on central tail feathers from 40 House Sparrows (*Passer domesticus*). Fifteen feathers were exposed for 6 sec. to abrasion by particles of iron oxide carried in a high pressure airstream. The distal most one centimeter from each of 15 feathers was degraded in a suspension of feather-degrading bacilli at an optical density of 0.5 McFarland standards incubated at 37°C for 24 hours. Following treatment each feather was photographed in a scanning electron microscope at 119 times its normal size. The damage to the feathers was dramatically different. Abraded feathers remained substantially intact, but had significantly fewer barbules/barb after abrasion. Such damage would reduce the ability of barbs to lock onto each other. Following bacterial degradation the keratin of the feathers had separated into separate strands, which strongly suggests a complete loss of rigidity and, therefore, function. Both forms of wear seriously threaten the function of the plumage (e.g., insulation, aerodynamics) and therefore provide strong selection for evolution of adaptations that limit damage, for example hardening the feather with particulate pigments (e.g., melanin) and preening (e.g., removes bacilli from the plumage).

### Aerodynamic asymmetry Sources, costs, and (dis)advantages

Horacio de la Cueva - Centro de Investigación Científica y de Educación Superior de Ensenada, Ensenada, Mexico; Mónica Jaramillo González - El Colegio de la Frontera Sur, Campeche, Mexico; Adriana Cáceres - Centro de Investigación Científica y de Educación Superior de Ensenada, Ensenada, Mexico

Aerodynamically asymmetric characters affect survival and reproduction through flight costs. *Fregata magnificens*, and the Hydrobatidae *Oceanodroma melania*, *O. leucorhoa*, and *O. microsoma*, from the Mexican Pacific were measured and modelled to analyse asymmetry effects on their aerodynamics. *F. magnificens* engage in passive and acrobatic flight, are sexually dimorphic, and males have a deeply forked tail. Hydrobatidae are active fliers, monomorphic, and sustain themselves with their wings over water whilst feeding. We captured 35 male and 30 female *F. magnificens* at Isla Isabel, (21° 52' N, 105° 54' W), and 68 Hydrobatidae (25 *O. melania*, 21 *O. microsoma*, and 22 *O. leucorhoa*), at San Benito Is. (28° 18' N, 115° 33' W). For *F. magnificens* we measured wing length (l), wing and tail areas (S, St), mass; and we calculated aspect ratio (AR), wing loading (Q), glide speed (Vx), and gliding polars [WHAT ARE GLIDING POLARS]. We also measured gliding speeds with a Doppler radar for 326 (183 males). For Hydrobatids we measured l, S, St, mass; calculated Q, AR, and adjusted wing loading moments (MQ, MQa). We found that asymmetric *F. magnificens* spend more energy flying and that L/D is 2.2 [UNITS] higher in males and 2.1 [UNITS] in females. The lowest lift to drag ratio (L/D) for asymmetric males was 10 m/s, and for females it was 12 m/s [VELOCITY OR LIFT/DRAG].

The tail asymmetry effect is higher in males [WAS ASYMMETRY HIGHER OR THE EFFECT OF ASYMMETRY]. Hydrobatidae had no statistically significant differences ( $p > 0.05$ ) in wing asymmetry, MQ, and MQa, *O. melania* Left wings had lower variance ( $4.40\text{cm}^2$ ) than Right wings, ( $5.87\text{cm}^2$ ); *O. leucorhoa* ( $L = 1.85$ ,  $R = 1.67$ ), *O. microsoma* ( $L = 1.55$ ,  $R = 1.40$ ); MQa wings difference *O. melania*  $0.008\text{ N}\cdot\text{m}^3$ , *O. leucorhoa*  $0.007$ ; *O. microsoma*  $0.011$ . General conclusions from this work are re limited due to the need for a larger, more taxonomically diverse sample. However, we offer several hypotheses testable against our results.

### **Does captivity influence immune responses, stress endocrinology, and organ size in House Sparrows (*Passer domesticus*)?**

Sarah DuRant - Oklahoma State University, Stillwater, OK, United States; Ashley Love - Oklahoma State University, Stillwater, OK, United States; Matthew Lovern - Oklahoma State University, Stillwater, OK, United States

Many studies use wild caught animals for laboratory studies. Individuals captured in wild populations have much higher genetic diversity than laboratory bred species, and thus may be more indicative of individual differences in responses to various stimuli. However, wild-caught individuals must adapt to a novel environment, which can have long-lasting effects on behavior and physiological processes. In this study we examined the influence of captivity on immune responses, stress endocrinology, and body and organ mass in wild-caught House Sparrows, a species commonly used in laboratory studies. We also tested whether corticosterone, the primary stress hormone in birds, correlated with immune responses or organ atrophy. We found that brain, liver, and spleen size was 30-75% lower in birds held in captivity for 3, 6 or 9 weeks relative to wild caught birds. Despite the decrease in size of liver and spleen, which are important for immune function, we found that birds that were wounded immediately upon capture healed wounds 2 days slower than birds that were wounded after 6 weeks of captivity. We did not detect an effect of captivity on bacteria killing ability of birds. Although we did not detect strong effects of captivity on the immune parameters we measured, reductions in liver and spleen mass suggest that captivity could have long term implications for avian immune function. Alternatively, these organs may atrophy in response to reduced pathogen diversity or abundance and metabolic demands of life under laboratory conditions.

### **Is Lake Erie a coastal ecological barrier to migratory songbirds?**

David Gesicki - Bowling Green State University, Bowling Green, OH, United States

The Great Lakes are an important stopover area and migratory pathway for millions of nocturnally migrating songbirds. Large expanses of open water can act as geographic barriers to migrating songbirds resulting in flight detours and increased mortality. Identifying migratory pathways is critical to understanding the potential risks affecting migratory birds. We recorded nocturnal flight calls (NFCs) of migratory warblers and sparrows at four sites along the Ohio coastline of Lake Erie during spring migration. Patterns in the number of recorded NFCs revealed that fewer birds were recorded aloft over open water sites compared to coastal sites. Furthermore, sparrows

appeared more likely to cross the lake at the western basin compared to warblers. In summary, although many warbler and sparrow migrants cross Lake Erie, the lake appears to be a barrier for at least some members of the studied species groups. However, consistent with previous studies, the western basin appears amenable to a lake crossing, particularly for sparrows. Our findings provide useful insight into the differential effects of Lake Erie on the passage of different species of nocturnal songbird migrants.

### **Adaptive significance of aberrant song in chickadees in Illinois**

Evan Glynn - Eastern Illinois University, Charleston, IL, United States; Patrick Enstrom - Eastern Illinois University, Charleston, IL, United States; Eric K. Bollinger - Eastern Illinois University, Charleston, IL, United States

We studied the behavioral responses of Black-capped (*Poecile atricapillus*) and Carolina (*P. carolinensis*) chickadees to playback of black-capped, Carolina, and aberrant chickadee songs throughout the state of Illinois. These two species are parapatrically distributed throughout the eastern United States, including Illinois. Some areas (contact zones) exist where the ranges of the two species overlap. Individuals in these regions may sing aberrant vocalizations. We focused on the two parental vocalizations, and two of the most common aberrant vocalizations, in an attempt to understand the adaptive significance of these songs, and their role in the stability of this contact zone. Playback experiments were conducted from March to June in 2011 and 2012 in 28 counties throughout Illinois. During playback trials, behavioral response data were compared among four different chickadee playback vocalizations; Black-capped, Carolina, and two aberrant dialects. In contact zones, the behavioral responses of aberrant individuals to aberrant playback were similar to the responses of parental individuals to their respective parental songs. In addition, contact zone birds responded aggressively to both parental songs. In parental areas, each parental species showed the most aggressive response to its respective conspecific song playback, intermediate response to aberrant songs, and the least aggressive response to heterospecific song. Thus, aberrant vocalizations were highly effective within the contact zone, and somewhat less effective outside of the zones. We found no differences in behavioral responses to playback when comparing responses of parental populations within 50 km and farther than 50 km from the contact zone.

### **Olive-sided flycatcher occurrence in relation to habitat in British Columbia, Canada**

Elizabeth A. Gow - University of British Columbia, BC, Canada; Richard Schuster - University of British Columbia, BC, Canada; Michael Laforge - University of Saskatchewan, SK, Canada; Peter Arcese - University of British Columbia, BC, Canada

Olive-sided flycatchers (*Contopus cooperi*) are a species of conservation concern in Canada, due to their rapid population declines, but the reasons for their declines are unknown. They are generally associated with sparse canopy cover and forest gaps, but what is puzzling is that populations are declining despite the increased potential habitat created from logging, suggesting low nest success or wintering ground effects are contributing to their declines. As a baseline study to prioritize conservation efforts we use existing point count data from two

regions of British Columbia, Canada, the Gulf Coast and the Central Interior, in combination with aerial photography to determine species occupancy and probability of occurrence in relation to key olive-sided flycatcher habitat variables (edges, open forest and marshy areas). These models and maps provide the initial framework to identify key habitat variables that predict occupancy of olive-sided flycatchers that can be used to target conservation efforts.

### **Are the large bills of Asian canopy birds an adaptation to high solar heat loading?**

Eric Gulson - Cornell University, Ithaca, NY, United States;  
David Winkler - Cornell University, Ithaca, NY, United States

When regulating their internal body temperature, birds use their unfeathered bills and legs to exchange heat with the environment and save on more costly ways of maintaining homeostasis. Previous studies have found that larger bills help birds dispense of excess heat. I tested this idea using the various canopy and understory levels of the Bornean lowland forest as a hot/cool environmental gradient created by differences in solar loading and focused on a range of mid-sized birds, particularly Old World suboscines, in this gradient. I used a climate-controlled chamber with a thermal imaging camera to record surface temperatures on birds exposed to a temperature range spanning 20 to 40 °C, analyzed the temperatures of each body part with custom software, and used equations for radiative and convective heat exchange to calculate heat lost from the body and the bill. All birds actively used their bills and legs to thermoregulate by warming them rapidly in relation to their body as ambient temperature approached internal body temperature, meaning they all had control over blood flow to these areas to more efficiently lose heat. Birds that lived in the canopy had proportionately larger bills and lost a significantly higher proportion of heat, relative to the body, than did birds from the middle and lower strata. These data indicate that the bill is indeed an important component in the thermoregulation of mid-sized canopy birds. Selection for larger bills in some of these taxa may have come from thermoregulatory pressures at least as much as those associated with prey capture and processing.

### **Phylogeography of the Velvet-browed Brilliant (*Heliodoxa xanthonys*), a Hummingbird endemic to the Pantepui Region**

Michael Hanson - Yale University, New Haven, Connecticut, United States; Kristof Zyskowski - Yale Peabody Museum, New Haven, CT, United States

The Velvet-browed Brilliant (*Heliodoxa xanthonys*) is a member of a clade of nine species of predominantly Andean hummingbirds, and is the only representative of the genus in the Guianan Pantepui highlands. The tepuis (table mountains) ranging from Venezuela to Suriname have been considered analogues to islands in their biogeography, exhibiting unique assemblages of endemic species isolated by tall cliffs and surrounding expanses of lowland habitats. We studied the intraspecific phylogeography of *H. xanthonys* following the discovery of a new population from the easternmost and most isolated tepui, Tafelberg and the adjacent Wilhelmina Mountains in Suriname. The Tafelberg-Wilhelmina population exhibits differences in body size and bill length and potential differences in coloration that are distinct from other

populations. Additionally, in 2001 a population from the southern limit of the species range (Cerro de la Neblina, Venezuela) was found morphologically distinct enough from other populations to be considered a new subspecies, *H. x. willardi*, and the Tafelberg-Wilhelmina population is even more isolated. In this study, we sequenced multiple mitochondrial and nuclear DNA loci from tissue samples and conducted morphometric analysis on linear measurements of skins collected throughout the species range. Our findings indicate that the Surinamese population may represent a new evolutionarily significant unit identifiable morphologically and genetically, whereas the Cerro de la Neblina subspecies does not appear to be distinguishable at the molecular level from other Venezuelan *H. xanthonys* populations.

### **How to make an egg shine: A nanostructural basis for gloss of avian eggshells**

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Bird eggs are characterized by diverse colors that are thought to be produced by just two pigmentary compounds. Contrary to expectations, we discovered a structural mechanism of color production in avian eggs. The eggs of tinamous (distant relatives of ostriches and kiwis) are famous for their vivid coloration and glossy appearance, but the underlying mechanism for these optical effects has remained unclear. Using mechanical manipulations in conjunction with angle-resolved spectrophotometry, scanning electron microscopy, and chemical analyses we show that the glossy appearance of tinamou eggs is produced by a smooth cuticle, composed of calcite, calcium phosphates and proteins. Furthermore, we demonstrate that this cuticle produces weak iridescence, an optical effect never previously documented for bird eggs. Gloss and iridescence are likely not solely the result of surface smoothness, but may also be influenced by the cuticle's unique chemical composition. Our discoveries provide a foundation for further exploration of structural coloration and its behavioral effects across avian eggshells.

### **Assessing habitat change as a driver of psittacid population trends**

David Hille - University of Oklahoma, Norman, OK, United States; Donald Brightsmith - Texas A&M University, College Station, TX, United States; Michael Patten - University of Oklahoma, Norman, OK, United States

Members of the family Psittacidae face conservation challenges worldwide. The Neotropics are home to a large diversity of psittacids that experience these grave conservation issues. Of the some 159 species in the Neotropics, half are threatened while the plight of 9 have already led to extinction. Although habitat loss and trade pressure are both generally attributed to the cause of these conservation issues, there is very little delineation between the magnitudes at which these causes

affect specific species. The sixteen Psittacidae species occurring in Nicaragua are not exempt from the threats that confront the majority of Neotropical psittacids. However, individual species respond at different levels to the aforementioned threats. A twenty-year, countrywide monitoring study of Nicaraguan psittacids shows varied population changes. Using these population trends as a response variable, I will test the magnitude of habitat change as a driver of change. Habitat change metrics will be measured by calculating vegetation indices from Landsat 5 TM and Landsat 7 ETM+ images collected in conjunction with the established survey years of 1995, 1999, 2004, and 2013 and measured in relation to the 70 point count transects involved in the surveys. This study will help to delineate species-specific causes of population trends in Nicaraguan psittacids and provide invaluable information for conservation efforts throughout the Neotropics.

#### **Effects of habitat fragmentation on habitat use in an endangered grassland bird**

Emily Hjalmarson - University of Oklahoma, Norman, OK, United States; Don Wolfe - Sutton Avian Research Center, Bartlesville, OK, United States; Michael Patten - University of Oklahoma, Norman, OK, United States

In addition to habitat loss, anthropogenic influence has increased the degree of patch discontinuity, edges, and isolation within many species' ranges; the effect is collectively known as habitat fragmentation. Organisms vary in their response to fragmentation, often according to the metrics used for gauging its effect, but there have been many cases in which fragmentation negatively affects aspects of their ecology. One example is the negative relationship found between degree of fragmentation and size of home ranges: organisms will hold larger home ranges in areas of high discontinuity to sustain habitat requirements that are no longer satisfied due to patchiness of resources. However, this finding has not yet been explicitly tested using specific home range size across individuals versus quantified fragmentation within their particular range. The Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*), an endangered prairie grouse with severe habitat loss and fragmentation throughout its range, is an ideal species for examining how habitat use in the form of home range is affected by fragmentation. Using data from radio-telemetry tracking efforts in Oklahoma from 1999-2013, we quantified individual home range sizes using Brownian bridge movement models, generating an overall shape along with a distribution showing frequency of use within the range. Using GIS, we estimated fragmentation levels within the ranges in terms of edge to area ratio of suitable land cover. We found that size, shape, and patterns of use within home ranges were correlated with increased degree of fragmentation. We suspect that birds forced to hold large ranges, therefore requiring increased movement, are at higher risk for mortality and suffer increased energetic costs. Our findings support the importance of ensuring connectivity between habitat areas in addition to preventing overall habitat loss.

#### **Resolving an avian enigma; natural history and ecology of the Sapayoa**

Johnathan Hruska - Cornell University, Ithaca, NY; Sarah Dzielski - Cornell University, Ithaca, NY, United States; Benjamin Van Doren - Cornell University, Ithaca, NY, United States

The Sapayoa (*Sapayoa enigma*), as implied in its scientific name, has long befuddled ornithologists. Originally considered to be part of the Pipridae (manakins), and then shuffled to *incertae sedis* within the New World Suboscines (Tyrannides) based on morphological characters, its systematic placement has only become recently unambiguous, with molecular evidence unequivocally nesting it within the Old World Suboscines (Eurylaimides). This placement has inspired discussion regarding the evolutionary timing of the origin of Old World Suboscines, with some claiming a Gondwanan origin and others arguing for a Laurasian origin. In addition, due to its restriction to the largely inaccessible Chocó Bioregion, the Sapayoa has been poorly studied in the field. Its natural history has long overlooked and understudied, with only a single nest description and few notes on its foraging ecology comprising all that was historically known. Here, we present detailed and novel insights into its natural history and ecology, all compiled from field observations of several individuals during a five-week study of the Sapayoa in the Darien National Park, Panama during June 2014. We present the first detailed and comprehensive description of parental effort (brooding, feeding) during the entire nesting period; first morphological descriptions of nestlings; detailed notes on territory size and habitat preference; comprehensive and species specific descriptions of mixed-foraging flocks they frequented; and novel vocalizations, including a non-vocal "sonation". Finally we present preliminary evidence that Sapayoa are a social species, particularly during the nesting period, which suggests that they engage in cooperative breeding. We aim to use this information in conjunction with other natural history information of Old World Suboscines to conduct a more comprehensive comparative phylogenetic study of this poorly understood avian group.

#### **Altitudinal Migration of Long-tailed Manakins (*Chiroxiphia linearis*) in an agricultural landscape in Costa Rica**

Angela Hsiung - University of Georgia, Athens, GA, United States; Richard Chandler - University of Georgia Warnell School of Forestry and Natural Resources, Athens, GA, United States

Numerous Neotropical resident bird species are believed to make altitudinal migrations, but little is known about the timing and extent of these migratory events. In addition, most studies of altitudinal migration in Neotropical areas have been conducted in relatively pristine forests. Tropical forests have been cleared at a rapid rate, yet the effects of deforestation on altitudinal migration are unknown. The objective of this study was to document the migratory pattern of a Neotropical resident species in an agricultural landscape to understand their year-round habitat requirements. The Long-tailed Manakin (*Chiroxiphia linearis*) is a Neotropical resident species whose range extends from southern Mexico to northern Costa Rica. They are a forest-dependent species who use montane forest patches for nesting and foraging. Much research has been done on the mating behavior of the Long-tailed Manakins. However, little is known about the degree to which this species makes altitudinal migrations. Between January and February of 2015, we captured Long-tailed Manakins with mist-nets within agricultural areas of the Puntarenas Province in Costa Rica and fitted them with radio transmitters (n=18). After being released, the manakins were tracked and located every 3-5 days until early April to document their movement before and during the breeding season. Preliminary telemetry data revealed that some of the manakins with radio transmitters

stayed at lower elevations during the non-breeding season and moved to higher elevations during the breeding season to establish leks. We will compare the telemetry data with point-count and mist-net data to better understand the altitudinal movement of Long-tailed Manakins. Our results highlight the importance of preserving remaining forest patches within tropical agricultural landscapes at both low and high elevations in order to meet the habitat needs of Neotropical resident species year-round.

#### **Modeling the current and potential future distribution of Henslow's Sparrow (*Ammodramus henslowii*) by the 2050s and 2070s**

Katrina Hucks - University of Louisiana at Lafayette, Lafayette, LA, United States; Chris Butler - University of Central Oklahoma, Edmond, OK, United States

Henslow's Sparrow is a declining North American grassland bird. Henslow's Sparrow utilizes different geographic areas for breeding and wintering, so it is important to explore how these areas may be affected by a warming climate. We used Maxent, a maximum entropy approach, to predict the potential future distribution of Henslow's Sparrow under various representative concentration pathways (RCPs). We also collected Christmas Bird Count (CBC) data to determine if there was already a range shift on the winter grounds. An initial model was used to identify the most important ecogeographical variables for the species' distribution. We then used four IPCC 5 RCPs to project the range into the 2050s and 2070s. We found that a combination of mean diurnal range, temperature seasonality, minimum temperature of the coldest month, mean temperature of the warmest quarter, annual precipitation, and elevation were the most important variables for the distribution of Henslow's Sparrow across North America. The potential future distribution models showed little change in both the breeding and wintering grounds. CBC data showed a range shift to the upper Gulf Coast regions of Mississippi and Alabama, concentrated since the 1970s. The combination of CBC data and the potential distribution models suggest that climate change will not strongly affect Henslow's Sparrow through the 2070s and we suggest that management efforts should focus on maintaining suitable habitat in both the breeding and wintering ranges.

#### **Nesting home ranges of Scissor-tailed Flycatchers in Oklahoma: Preliminary analysis of factors affecting size**

Michael Husak - Cameron University, Lawton, OK; Diane Landoll - University of Oklahoma, Norman, OK, United States; Jessica Roy - Cameron University, Lawton, OK, United States

While previous studies have estimated nesting density and radius of territory defense around a nest site for breeding Scissor-tailed Flycatchers (*Tyrannus forficatus*), none have addressed breeding home range sizes or dynamics. We estimated home range sizes of nesting Scissor-tailed Flycatchers in native oak/elm (*Quercus/Ulmus*) savannahs and invasive mesquite (*Prosopis glandulosa*) savannahs in southwestern Oklahoma. Color-banded adults were followed during the breeding season and their perch locations recorded on a Garmin 62Csx handheld gps unit. 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. Mean home range size (6.02 ha) was larger than has been implied previously in the literature. Variation in home range size between nesting stages (eggs vs nestlings) and years will be discussed, as will effects of within home range vegetation structure on home range size.

#### **A Taxonomy of vagrancy: Causes, mechanisms, and terminology**

Marshall Iliff - Cornell Lab of Ornithology, Ithaca, NY, United States

The occurrence of birds far outside their home range, commonly known as "vagrancy", has been a subject of interest to ornithologists and birdwatchers for centuries. These occurrences were formerly termed "accidental," but as well-documented observations have continued to accrue it has become clear that these occurrences often follow well-defined, predictable patterns and in many cases involve intentional movements. In some cases, not only are these movements intentional, but essential drivers of range expansion and colonization. Although many vagrants die or fail to reproduce as a consequence of their movements, those that do have the potential to play very important roles in expansions, colonizations, and even speciation. However, popular and scientific terminology remains somewhat muddled and to date there has been no comprehensive synopsis of the phenomenon of avian vagrancy. Some authors have addressed specific mechanisms of vagrancy in depth (e.g., Rabøl 1969, Gilroy and Lees 2003, Thorup 2004), but the body of literature on each of these has not been comprehensively summarized. Regional summaries of rare bird occurrence patterns in Europe (Vinicombe and Cottridge 1996, Slack and Wallace 2009) and North America (Howell, Lewington et al. 2013) have provided the best overviews to date, but a global perspective and clarification of mechanisms and terminology is badly needed. I attempt to summarize what is known or suspected about avian vagrancy, provide meaningful categories and consistent terminology, provide a phylogenetic perspective of apparent vagrancy mechanisms, and suggest additional areas for future study.

#### **Phenotypic diversification of New World oscine passerines**

Tyler Imfeld - University of Minnesota Twin Cities, St Paul, MN, United States

Although clear in specific cases, the broad-scale role of adaptive radiation in the history of life remains uncertain. If adaptive radiation is the dominant mode of diversification, then species and phenotypic diversification rates should be correlated. However, recent studies of birds and other organisms suggest the gradual accumulation of both species and phenotypic diversity. We estimated species and phenotypic diversification rates of multiple independently-dispersing lineages of New World oscines in order to assess the relationship between these rates. Most lineages arriving in the New World have diversified on a trajectory consistent with a constant-rates birth-death process with a relatively high extinction fraction. By contrast, several relatively old North American lineages have not diversified at all, and one widely-distributed lineage--the Emberizoidea--has diversified at a rate far exceeding comparably-aged New World lineages. Rates of phenotypic evolution in emberizoids exceed those in all other groups,

regardless of age and diversity. Thus, we find support for the idea that adaptive radiation contributed to the extraordinary diversity of this lineage relative to other New World groups. This suggests that adaptive radiation can play a key--if not pervasive--role not only in limited island systems but also in continental contexts.

#### **Analysis of parasite transmission between summer and wintering grounds in a common migratory songbird**

Kim Jackuchan - Mary Baldwin College, Staunton, VA, United States

Host-parasite relationships associated with avian malaria have been widely considered and researched due to their detrimental effects on avian communities. However, the location of where primary transmission is occurring is not fully understood. Long distance migrants in particular are of interest as many have migratory routes that extend from the Northeastern United States and Canada (the breeding grounds) all the way down to South America (the wintering grounds). In order to determine where parasitic transmission is occurring we assessed the prevalence and genetic diversity of avian malaria in Red-eyed Vireos (*Vireo olivaceus*) from sampling locations across their breeding range (Pennsylvania, Maryland and Virginia). It was hypothesized that a high degree of similarity in parasite lineage assemblages between breeding location would be indicative of wintering ground transmission while regional differences in lineage assemblages would be indicative of transmission on the wintering grounds. To test this hypothesis, Polymerase Chain Reaction (PCR), DNA sequencing and phylogenetic testing was conducted. Results showed three lineages that were common across multiple sampling locations. This supports the hypothesis that parasitic transmission is occurring on the wintering grounds.

#### **Evaluating effects of nest parasitism on postfledging *Seiurus aurocapilla* in central Missouri**

Juliana Jenkins - University of Missouri, Columbia, MO; John Faaborg - University of Missouri, Columbia, MO, United States

Nest parasitism by Brown-headed Cowbirds (*Molothrus ater*) negatively affects host nest production and nest success for the majority of their hosts. Nest parasitism is routinely cited as one of the main causes for nest failure in North American migrant songbirds, with parasitism rates approaching 100% in highly fragmented landscapes. It is unclear what effects, if any, cowbird fledglings have on host broods after leaving the nest. We monitored 66 Ovenbird (*Seiurus aurocapilla*) nests from 2012-2014 in Central Missouri, 48% of which were parasitized. We used radio-telemetry to track daily movements, survival and parental care for 13 Ovenbird fledglings from parasitized nests and 21 Ovenbird fledglings from non-parasitized nests in order to test if cowbird presence increased mortality rates, reduced the proportion of adult attendance and altered dispersal patterns. Clutch size and productivity were lower in parasitized nests, but mean fledgling mass and total brood size (host and parasite young) did not differ between parasitized and non-parasitized nests. All mortalities occurred within the first ten days postfledging. Estimated postfledging cumulative survival and proportion of adult care were not significantly different between parasitism groups. There was no difference in Ovenbird movement patterns during the first two weeks postfledging, however non-parasitized Ovenbirds moved

farther from the nest than parasitized Ovenbirds after 15 days. Our observations do not support the hypothesis that Brown-headed Cowbirds negatively affect survival of postfledging Ovenbirds.

#### **Determinants of reliance upon heterospecific alarm calls in a winter bird community**

Harrison Jones - University of Florida, Gainesville, FL, United States; Kathryn Sieving - University of Florida, Gainesville, FL, United States

Animal species must constantly acquire information about their surroundings, either through personal interaction with the environment (personal information) or social information acquired from other individuals. Asymmetries in information production capabilities between species lead to community-level information networks in which certain species act as information producers for an audience of heterospecific eavesdroppers. The role of information-producing species as large-scale facilitators has been well studied; however, the degree to which eavesdropping species rely on this social information is poorly understood. Foraging guild (aerial vs. substrate-based foraging) has been hypothesized to determine reliance on social information because it determines access to personal information about predation. We conducted a community-wide comparative study on a winter bird community in North-central Florida to test how foraging behavior correlates with frequency of response to the alarm calls of the local information-producing species (Eastern Tufted Titmouse, *Baeolophus bicolor*). We performed field observations of foraging behavior, and used hierarchical clustering to determine foraging guilds. Species segregated into seven guilds based on foraging maneuvers and microhabitat characteristics of the foraging site. We then performed playbacks of known-context, high-risk titmouse alarm calls to species in the same community (N= 109 playbacks). Our data reveal community-wide high frequency of response to the titmouse alarm call, with a notable exception being a sit-and-wait aerial forager. Foraging guild did not significantly predict percentage response by a species ( $F=0.22$ ,  $p=0.647$ ), yet a significant negative correlation was detected between percentage of aerial foraging maneuvers and proportion of response ( $R^2= 0.53$ ,  $p< 0.01$ ). These data support the hypothesis that aerial foragers benefit from increased personal information and are less reliant on community informants such as the titmouse. Percentage of aerial maneuvers, rather than foraging guild alone, may represent a better measure of access to personal information about predation.

#### **What is a shrubland bird?: A review of regional variation in habitat use of shrub-breeding birds in the eastern US**

Cara Joos - Central Hardwoods Joint Venture and American Bird Conservancy, Columbia, MT, United States

Bird species associated with shrubland habitats are declining throughout eastern North America. Previous research identified regional differences in habitat-selection, reflecting regional differences in bird communities. These differences argue for a review that synthesizes the habitat use of shrub-breeding birds in eastern North America. This review required a list of shrub-breeding birds; however existing lists either conflicted or were not comprehensive. Here we present an objective and repeatable approach for generating a species list



useful for summary and syntheses. We searched for reviews and syntheses of shrubland birds and habitats within the 22 states in USFW regions 3 & 5 to generate a comprehensive shrubland habitat list. We then built a list of shrub-dependent breeding species by comparing our habitat list to the habitats described in AOU and BNA species accounts for each species detected on BBS routes in our region. For each species we conducted a literature search for studies reporting abundances within different habitat types and recorded abundance data for any shrub or non-shrub habitat reported. Finally, using ranks of abundances by habitat types we conducted a meta-analysis to confirm species as shrubland specialist based on ranked abundances in shrub and non-shrub habitats. This 2 step literature search yielded 18 shrubland habitat categories and 81 shrub dependent breeding species. We found studies for 64 species in 17 states. Preliminary results show species and their associated habitats varied between regions. Reported habitats included shrub, grassland and forest in both regions, and agricultural and urban habitats in regions 3 and 5 respectively. Ranked abundances identified variation in shrubland dependence among species and eliminated species where studies reported them in higher abundances in non-shrub habitats. This review reveals knowledge gaps, including lack of research on high priority conservation species, and presents a repeatable method for reviews in other regions and habitat guilds.

#### **After a century of human population growth in a sub-tropical lowland**

Chie-Jen Ko - National Taiwan University, Xindian District, Taiwan, China; Pei-Fen Lee - Taipei, Taiwan, China

Biodiversity change in response to human-induced environmental alteration is rarely assessed in sub-tropical terrestrial regions. We assessed the population status change of 112 terrestrial breeding birds in Taiwan between the agricultural era (1863–1945) and industrial era (1990–present). We acquired population status from historical and current literatures. Traits reflecting species' body size, preference of habitats, specialization of habitat and diet, and range width were used as explaining factors to infer the driver of population change. 27% of species declined after industrialization, which doubles the number of species that increased, but the loss was offset by an equal amount of introduced species. Species with narrow range width and are habitat specialists have a higher chance to decrease, but forest and farmland species do not seem to be vulnerable. Overall, considerable loss of species richness is not observed. The trend towards more generalists in the terrestrial breeding avifauna reflects a process towards biotic homogenization. Effect of community structure change to ecosystem function may be a more important environmental issue than species loss in sub-tropical regions. Increasing usage of historical literature is expected to bring significant insight for understanding biodiversity response to anthropogenic effects when long-term quantitative data is rare.

#### **The role of domestication in genotypic divergence of the two subspecies of Zebra Finch (*Taeniopygia guttata*)**

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University, New York, NY, United States; Christopher Balakrishnan - East Carolina University, Greenville, NC, United States

The selective and demographic influences of domestication result in dramatic phenotypic and genetic changes in the species we choose to domesticate. These changes have been well-studied in many of the classic model systems, like the domesticated chicken, *Gallus gallus domesticus*. Little is known, however, about other domesticated avian species like the Zebra Finch, *Taeniopygia guttata*. As a representative of the Oscine Passerines, Zebra Finches have been the subject of extensive neurological and behavioral research. The majority of research done on these birds relies on domesticated populations, yet little is known about patterns of genomic divergence between domesticated and wild populations. Zebra Finches are found on the mainland of Australia and have been bred in captivity for around 150 years. 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. Domesticated Zebra Finches were sampled from four laboratory populations in the United States that conduct active research on these birds. Following quality filtering, we mapped the remaining reads to the Zebra Finch reference genome for single nucleotide polymorphism (SNP) calling. Because we cannot unambiguously assign genotypes to individuals with medium coverage genomes, we are using a genotype likelihood method employed in ANGSD to estimate allele frequencies in the two populations. Though data analyses are still in progress, our findings will highlight patterns of diversity, divergence and selection in the Zebra Finch genome, with implications for future research in this important model system.

#### **Are males in a hurry? Differential migration in songbirds**

Laura Leggett - University of Southern Mississippi, Hattiesburg, Mississippi; Kristen Covino - University of Southern Mississippi, Hattiesburg, MS, United States; Theodore J. Zenzal - University of Southern Mississippi, Hattiesburg, MS, United States; Frank Moore - University of Southern Mississippi, Hattiesburg, MS, United States

The majority of songbirds breeding in eastern North America migrate between northern breeding locations and southern wintering locations. Species that differentially migrate arrive at breeding grounds and migratory stopover habitats at different times according to sex, age, or other factors. By differentially migrating these groups may receive a number of benefits, such as reduced competition for territory and food sources, and may spend less time waiting for mates. Long-distance migrants were captured in Cameron Parish, Louisiana during spring migration 2005-2014. We analyzed passage data of 4,917 migrants across four species: Black-and-white Warblers (*Mniotilta varia*), Hooded Warblers (*Setophaga citrina*), Indigo Buntings (*Passerina cyanea*), and Orchard Orioles (*Icterus spurius*). Passage date for Black-and-white Warblers and Orchard Orioles were not different between the sexes. Male Hooded Warblers migrated through more than six days earlier than females on average. Indigo Bunting males showed a similar pattern, migrating through more than seven days earlier than females. Details of their breeding destinations may explain why we did not see differential migration in Black-and-white Warblers and Orchard Orioles. Hooded Warbler and Indigo Bunting males may be migrating earlier due to pressure to arrive on the breeding grounds early and establish a territory.

### **Patterns of dawn singing by Western Wood-Pewees (*Contopus sordidulus*)**

Scott Lovell - St. Mary's University, Calgary, AB, Canada; M. Ross Lein - University of Calgary, Calgary, AB, United States

The “dawn chorus”, an intense bout of song activity before dawn, is demonstrated by many passerines, but is especially pronounced in suboscines. The function of this phenomenon has been the subject of much speculation, with no less than 12 hypotheses put forth. However, until recently, little empirical evidence in relation to any of these hypotheses has been available. We documented dawn chorus behaviour of Western Wood-Pewees (*Contopus sordidulus*) in southern Alberta during the breeding season of 2014. Five males were recorded multiple times over the course of the breeding season. Dawn song began 30 - 35 min before local civil twilight and continued for 35 - 60 min. The intensity and length of a dawn song bout varied within an individual bout and across the stages of the breeding cycle. Each male had two song types delivered at a high rate during a dawn singing bout, increasing to 42 songs / min at mid-bout, then declining to the end of the bout. At the beginning of a dawn song bout, the “pee-er” song was used exclusively. During the middle part of a song bout, the “pee-pip-pip” song was alternated with the “pee-er” song, and decreased significantly during the final 15 min of the song bout. The two song types were sung in a non-random fashion. Males sang at locations near a territorial boundary and pairs of neighbouring males engaged in strong countersinging from the same location each morning. A number of dawn singing bouts ended with an attempted copulation. These observations are consistent with the social dynamics hypothesis for the function of dawn singing in this species.

### **Review and meta-analysis of species traits as predictors of variation in range shifts under climate change**

Sarah MacLean - University of California, Berkeley, CA, United States; Steven Beissinger - University of California, Berkeley, CA, United States

Global climate change is expected to cause many species ranges to shifts toward higher latitudes or elevations, but documented range shifts have been highly idiosyncratic across species, some of which show no detectable range shifts. A growing body of literature seeks to explain variation in observed range shifts using species-specific life history and ecological traits, resulting in the leading hypotheses that range shifts will be greater in species with greater dispersal ability, reproductive potential, and ecological generalization. Here we (1) present the first comprehensive review of how range shifts relate to species' traits in eleven studies of birds, (2) assess leading hypotheses relating range shifts to species' traits using meta-analytical methods that account for differences in effect size, and (3) compare responses of birds to 42 studies of other taxa. We show that range shifts in birds have almost exclusively contradicted a priori expectations related to a diversity of traits including migratory behavior, body size, fecundity, diet guild, territory type, and brain mass. The results of our meta-analysis indicate that body size is inversely related to extent of range shifts in birds, but positively related to range shifts of mammals, fish, and invertebrates. Fecundity and diet generalism have generally been poor predictors of range shifts. We conclude that species' traits possess considerable potential for predicting variation in range shifts of birds and other taxa,

but propose a new framework for future studies that includes updated working hypotheses and standardized methods for quantifying species' traits that will allow for more powerful comparisons across systems.

### **The influence of watershed condition on avian use of dry playa wetlands**

Willow E. A. Malone - Kansas Cooperative Fish and Wildlife Research Unit, KS, State University, Manhattan, KS; David A. Haukos - Kansas Cooperative Fish and Wildlife Research Unit, iKansas State University, Manhattan, KS, United States

Playa wetlands are keystone ecosystems of High Plains region of the Great Plains supporting large numbers of migratory and resident avian species. Previous research focused on the influence of habitats created during the unstable, wet phase ecological state playa condition, with little available information on the stable, dry phase ecological state. Our objective was to determine the relationship of surrounding land use (native grassland, cropland, Conservation Reserve Program) on avian use of playa wetlands in the dry ecological state. We conducted breeding bird surveys in >20 playa wetlands with differing watersheds to record occupancy, relative abundance, and species richness. Species diversity was derived using Simpson's index. Similar surveys were conducted in paired, non-playa habitats. Preliminary findings indicate that watershed condition influences species occurrence, abundance, and diversity in dry playa wetlands. Further, playas support a greater avian diversity than non-playa habitats, even in a dry ecological state.

### **Feather mite and Parulid associations**

Alix Matthews - Arkansas State University, Jonesboro, AR, United States; Than Boves - Arkansas State University, Jonesboro, AR, United States; Ashley Dowling - University of Arkansas, Fayetteville, AR, United States

Birds are hosts to a wide variety of ectosymbionts, including feather mites, but very little is known about the details of these intimate relationships. There are likely thousands of feather mite species yet to be identified, the nature of the symbiotic relationship (parasitic, mutualistic, or commensal) between hosts and feather mites is ambiguous and inconclusive, and the level of phylogenetic concordance between hosts and feather mites is poorly understood. To begin to address these knowledge gaps, we are attempting to construct the co-evolutionary history between feather mites and New World Warblers (Parulidae). Here, we present preliminary results describing associations between feather mites and a number of parulid hosts. We extracted feather mites from 54 individuals representing 26 parulid species by washing bird specimens in ethanol, water, and dish soap. We separated morphologically distinct groups of feather mites using a dissecting microscope and made slides of 2 to 3 representative individuals from each group. We identified mites using a compound light microscope and morphological keys. We have constructed a complex and informative association web of the feather mites and hosts we have sampled so far. The most common families of feather mites discovered on hosts are Proctophyllodidae and Trouessartiidae. Host species have a richness of 1 to 4 feather mite subfamilies. As we continue to collect parulids and feather mites, we will be able to construct a more robust association web. We will ultimately construct phylogenies for a few of

these feather mite lineages and then compare these to the Parulidae phylogeny to test for phylogenetic concordance and patterns of host switching.

### **Sexual ornaments as indicators of foraging propensity in a socially monogamous seabird, the Brown Booby (*Sula leucogaster*)**

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Sexual selection is an often powerful force that can shape the evolution of many bird species typically through selection on sexual ornaments. In the coastal seabird, the Brown booby (*Sula leucogaster*), male gular color is likely a sexual ornament, with increased green coloration being associated with higher chick quality and increased parental care. Here, we tested the hypothesis that the gular ornament of the Brown booby is able to communicate information about parental care because it reflects foraging habits and ability. We conducted stable carbon and nitrogen isotope (d13C and d15N) analysis on Brown booby breast contours (male and female, with and without clutches) from Islas Marietas, Mexico to investigate the feeding behaviors of these birds. Brown boobies with and without clutches differed significantly in d13C (t-test,  $p=0.0028$ ), suggesting more inshore foraging in breeding birds. In breeding males, carbon and nitrogen isotope values covaried with gular color. Among breeding birds, greener skin was associated with decreasing d13C (linear regression,  $R^2=0.77$ ,  $p=0.0019$ ), signifying more offshore foraging in more attractive, greener-skinned males. Breeding male skin color was also correlated with increasing d15N ( $R^2=0.62$ ,  $p=0.0107$ ), implying greener birds forage either at higher trophic levels or in regions with distinct nitrogen cycling (e.g. increased relative nitrate utilization). The d13C and d15N values of breeding females echoed the same trends when regressed with their mates' color values ( $R^2=0.58$ ,  $p=0.0169$  and  $R^2=0.43$ ,  $p=0.0521$  for d13C and d15N, respectively), showing that females foraging farther offshore tend to have mates with more attractive ornaments. In contrast, there was no relationship between isotope data and gular coloration in non-breeding birds. Our results indicate that male skin color ornaments in the Brown booby convey information on individual foraging habits, such as near-shore or offshore utilization, and that females' foraging habits are linked with the quality of their mates.

### **Host associations of avian chewing lice (Phthiraptera: Amblycera) from South Africa**

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Despite a well-known avian host fauna, parasitic chewing lice (Phthiraptera: Amblycera) remain relatively unknown in South Africa. Here we present a study on prevalence and diversity of amblyceran chewing lice from birds collected in South Africa, to complement information on host associations from recent

surveys on amblyceran lice from the area. We obtained lice from previously prepared museum skin specimens representing a diversity of avian families. Lice were identified by morphology to genus and species, when possible. The mitochondrial cytochrome c oxidase subunit I gene was used to conduct phylogenetic analyses of louse taxa. Phylogenetic analyses also were conducted including African louse lineages represented on GenBank. Host associations new to science will be based on morphological identifications and genetic characterizations.

### **Causes and consequence of multiple breeding in Japanese tits *Parus minor* focusing on individual quality**

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Tradeoffs between current and future fecundity produce a variety of life history strategies. Multiple breeding (breeding more than once per season) is a typical reproductive strategy in short-lived species which is considered to be effective to gain fitness. Despite apparent fitness benefits, not all individuals are multiple breeders. If the reproductive trade-off exist, single breeders will have some benefit such as higher survival than multiple breeders. However, many previous studies have not detected cost of reproduction partly because of the difference in individual quality. Understanding cause and consequence of multiple breeding is significant not only from life history point of view but also conservation perspective because multiple breeding is significant for population growth rate. Although many studies examined factors affecting multiple breeding such as timing of breeding or food availability, effect of individual quality, especially male quality on multiple breeding have not been assessed fully. We investigated causes and consequence of multiple breeding focusing on individual quality (wing length as age indicator and body condition) in Japanese tits (*Parus minor*) from 2009 to 2014 breeding season. We found that timing of breeding (hatching date) in the first clutch significantly negatively correlated to the multiple breeding. Individual quality had only slight effect for multiple breeding. However, male quality (wing length) not female quality significantly negatively affected the timing of breeding. We did not detect costs of multiple breeding even in the low quality individuals. Rather, multiple breeding even had a positive effect for female survival. We conclude that multiple breeding itself may not be so much costs of reproduction in the multi-brooded species and male quality is more important factor for annual reproductive success than females.

### **Response of grassland passerine communities to tallgrass prairie restoration with summer fire and sheep grazing**

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The lack of effective management techniques for invasive sericea lespedeza (*Lespedeza cuneata*) is increasingly problematic for wildlife species and the ranching communities

of the Great Plains that rely on native grassland habitat. The noxious weed is highly competitive, drastically reducing the density of native grasses and forbs. Additionally, the plant has a high tannin content, making it unpalatable to cattle. These factors translate to reduced nesting cover for grassland birds and reduced forage for cattle. Traditional management techniques (i.e., herbicide application, spring prescribed fire, cattle grazing) are ineffective at controlling the invasion of the forb. We demonstrated that summer prescribed fires and targeted sheep grazing are effective at reducing sericea lespedeza biomass and seed production by the plants that persist. We measured the response of grassland passerine and pollinator communities to these methods in terms of relative abundance, species diversity, and reproductive success. Our findings suggest that applying summer prescribed fire or targeted sheep grazing to sericea lespedeza-invaded rangeland results in a shift to a plant community composed of higher abundance of native plants, which benefits the grassland bird communities, as well as domestic grazers.

### **Tracking of males and females: Investigating protandry throughout the annual cycle in a small migratory songbird**

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Protandry, the phenomenon of males arriving earlier at the breeding grounds than females, has been demonstrated in several migratory bird species. The pattern is linked to reproductive success and often ascribed to selection for securing the highest quality territories or mates. Protandry can be achieved by males wintering closer to the breeding area or migrating earlier or faster than females; none of these options being mutually exclusive. Constraints in following the birds throughout the annual cycle have so far limited our understanding of the proximate causes of protandry. Furthermore, protandry may not occur exclusively at the breeding grounds, but could potentially act at all stages during the annual cycle. Recent technological advances are currently enabling us to track yet smaller songbirds throughout their migration, giving us the opportunity to study the causes of protandry in further detail. Here, we use data derived from geolocator tracking of red-backed shrikes, *Lanius collurio*, from a Scandinavian breeding population over a five year period (2009-2014) to assess whether males precede females throughout the annual cycle by comparing differences in the migration speed and timing at each of the migration stages.

### **Movement, life history and wing shape in the pittas (Aves: Pittidae)**

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The pittas are understory birds distributed throughout the old world tropics. Though they generally get around by hopping through the undergrowth, there appears to be a surprising amount of diversity in the movement ecology of these reclusive birds. Some species are sedentary, some seem to engage in seasonal local movements, and some are obligate long-distance migrants. We measured hand-wing index (HWI), a measure of wing shape used to evaluate aerodynamic properties of the

wing, of specimens representing every taxon of Pittidae (down to the level of subspecies, following taxonomy of Erritzoe and Erritzoe 1998) available at the American Museum of Natural History (representing 88% of total taxa). We then examined the relationship between HWI and other life history traits with character mapping and phylogenetic generalized least squares analyses. Most detectable movements in this family are concentrated in two clades: two members of the *Erythropitta erythrogaster* complex, and seven species in the genus *Pitta*. We also investigated the relationship between movement tendency and diversification. Movement patterns are correlated with variation in HWI, and clutch size and range size are significantly correlated with HWI as well.

### **Historical demography of European green woodpecker: An evidence of extra-Mediterranean refugia**

Utku Perktas - Hacettepe University, Ankara, Turkey;

In this study, we re-evaluated historical demography of European green woodpecker (*Picus viridis*) based on previously published multi-locus DNA data and ecological niche modeling analysis including landscape genetics. We tested whether multiple refugia existed for European green woodpecker during the Last Glacial Maximum or the species survived in a big refugium along the southern Europe, including Caucasus, Anatolia, Balkan, Italy and southern France. To test this hypothesis, an ecological niche model was developed to predict the geographic distribution of European green woodpecker under reconstructed past (the Last Glacial Maximum) and present bioclimatic conditions. In addition, robust coalescent-based analyses (e.g. the Bayesian-based coalescent simulations) were used to assess demographic events over the history of European green woodpecker. Results based on genetic and ecological niche modeling analyses showed that European green woodpecker survived the Last Glacial Maximum in a big continuous refugium along southern Europe including southern France and southern United Kingdom. Therefore, this study includes evidence of an extra-Mediterranean glacial refugia located in southern France for this woodpecker species.

### **Effects of geolocators on annual return rates, nestling provisioning, and reproductive success of Cerulean Warblers**

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The Cerulean Warbler (*Setophaga cerulea*) is a declining Nearctic-Neotropical migrant that is a species of concern. Cerulean Warblers breed in the canopy of eastern North American hardwood forests and winter in the canopy of montane forests of northern South America. Little is known about migration routes, stopover sites, or migratory connectivity between breeding and wintering populations of this species. Recently, the use of geolocators has made it possible to study migration patterns of individual birds as small as the Cerulean Warbler in order to more fully understand their full annual cycle, which will improve conservation efforts for the species. In order to improve recapture rates and to

minimize negative effects on birds outfitted with these devices, a description of harness materials and attachment methods used, as well as documentation of any observed negative effects caused by outfitting these birds with geolocators, should be made available to other researchers. In this study, we are comparing not only return rates, but also survival during the breeding season, nestling provisioning rates, and reproductive success of 30 geolocator-tagged male Cerulean Warblers along with their color-banded control counterparts. Preliminary data from the first ten geolocator-tagged birds has shown no negative effects on these estimates, and we will have more breeding season data for the other 20 tagged birds after the 2015 breeding season to include in this poster presentation as well as the return rates for the first 10 geolocator-tagged and 2014 color-banded control birds.

### **Post-fledging movements of Oklahoma Bald Eagles**

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From 2010 through 2013, GPS satellite transmitters were placed on 12 Bald Eagle nestlings in northeastern Oklahoma. As of May 2015, 9 transmitters are still actively recording eagle movements three times per day. Two eagles tracked in 2010 initially moved >300 km south to Texas during the first months after leaving the nest. One eagle tracked in 2011 initially remained within about 300 km of the nest moving in several directions. The remaining nine eagles moved north as far as Nebraska, Montana, North Dakota, Minnesota, Iowa, Wisconsin, and Ontario during the first several months post-fledging, with maximum linear distances traveled from nest sites ranging from about 575 km to over 1500 km. Most eagles established relatively consistent annual movement patterns in terms of seasonality and destination of travel. Two mortality events were confirmed by recovering carcasses in Oklahoma approximately 4 years and 2.5 years post-fledging, but causes of death were uncertain. Transmissions from a third eagle ceased for unknown reasons in Missouri about 1.75 years post-fledging. We report on one female eagle that has been tracked since 2010 through its first nesting season as an adult in 2015 when it established a nest about 100 km from its own natal territory.

### **Importance of woodpeckers and snags for secondary cavity-nesting birds in cloud forest fragments in central Veracruz**

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In tropical forests, natural cavities are the major nesting substrate for secondary cavity-nesters. Contrastingly, in temperate forests, excavated cavities are the preferred nesting substrate for cavity adopters, and standing dead trees the selected substrate for cavity excavators. However, in tropical montane forests, cavity nesters remain poorly studied and this lack of knowledge hinders the establishment of conservation

policies. We determined the availability and characteristics of tree-cavities and standing dead trees in three cloud forest fragments in central Veracruz. We used non-metric dimensional scaling to evaluate differences among sites in avian primary and secondary cavity-nesting community composition. We found 58 cavities and 11 standing dead trees, but only 14 cavities were suitable for secondary cavity-nesters. Almost all of the suitable cavities (n=13) and all standing dead trees were found in the largest forest fragment. Lack of depth accounted for most cavities not being suitable for nesting. Cavity suitability for birds was significantly associated with cavity origin, almost half of which were excavated by woodpeckers, and were mostly located in standing dead trees. Excavated cavities occurred in smaller trees, were located higher from the ground, and were of greater depth than natural cavities. Cavity occupancy by birds was extremely low, with only one natural cavity used as a nest-site by a Collared Forest-Falcon (*Micrastur semitorquatus*). The non-metric dimensional scaling analyses showed that while primary cavity-nesters were present in the three study sites, secondary cavity-nesters were present only in the larger forest fragment, which contained most cavities suitable for nesting by birds. Our results show the importance of standing dead trees for woodpeckers and consequently for secondary cavity-nesters. Although protection actions have been implemented, we believe that illegal wood extraction remains to be the main cause of nesting substrate loss for primary nesters, therefore restricting suitable cavity availability for cavity adopters.

### **Woodpecker nest survival and densities in relation to a mountain pine beetle epidemic**

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Mountain pine beetle (*Dendroctonus ponderosae*; MPB) epidemics in pine (*Pinus* spp.) forests of western North America are increasing in size and severity with important implications for disturbance-associated woodpecker species. We studied nest survival and densities of 5 woodpecker species (American three-toed woodpecker [*Picoides dorsalis*], hairy woodpecker [*P. villosus*], downy woodpecker [*P. pubescens*], northern flicker [*Colaptes auratus*], and red-naped sapsucker [*Sphyrapicus nuchalis*]) in western Montana for 4 years pre-epidemic (2003-2006) and 5 years post-epidemic (2009-2013). We monitored 355 nests of the 5 woodpecker species. We investigated the relationships between daily survival rate (DSR) and metrics of MPB severity (annual and cumulative estimates of tree-mortality), and timing (pre- vs. post-epidemic) while accounting for other potentially important covariates identified in previous studies (temperature, precipitation, timing within the breeding season, nest height, diameter at breast height (dbh) of the nest tree, and nest-tree species). Additionally, we examined trends in densities of hatched nests over the same period. Generally, we found little support for relationships between DSR and variables that described MPB epidemic timing and severity. Instead, we found support for nest survival relationships with only a few covariates unrelated to the MPB epidemic (temperature, nest height, dbh of the nest tree). Few significant relationships were likely attributable to high nest survival rates with little variation, which is characteristic of cavity-nesting birds. In contrast, densities of hatched nests for *Picoides* spp. significantly increased following the epidemic

(pre-mean = 9.5 nests/year  $\pm$  2.5 [1 SD] vs. post-mean = 30.2 nests/year  $\pm$  12.1 [1 SD];  $t_{4.4} = -3.73$ ,  $p = 0.02$ ), while densities changed little for red-naped sapsucker and northern flicker. Our findings suggest that woodpecker populations tend to relate positively with MPB epidemics, although these relationships may be the result of numerical increases in nest densities rather than functional increases in nest survival rates.

#### **A balancing act: Zebra Finches may trade-off between behavioral and immunological strategies to avoid infection**

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Disease exposure is a universal threat to all living organisms, and self-defense can occur in a variety of ways. Individuals can proactively prevent disease through avoidance behaviors. However, if they become infected, individuals can activate the immune response to control the infection. It is hypothesized that a trade-off occurs between avoidance behaviors and activation of the immune response to provide optimal protection against infection. This behavioral-immunological trade-off may occur because of the associated costs of each strategy. Avoiding areas of disease is costly for social animals that depend on large groups to find food, mates, or protection. Likewise, strong immune responses require energetic investment and may lead to autoimmune diseases. Support for a trade-off in defenses comes from a study in which wild-caught House Finches with weaker immune responses utilized strong avoidance strategies and birds with stronger immune responses relied less on behavioral strategies. I studied this behavioral-immunological trade-off in a captive population of Zebra Finches (*Taeniopygia guttata*). I ran a series of association trials, inoculated focal birds with lipopolysaccharide, and collected blood samples to measure multiple aspects of the innate immune response. I expect that birds that avoid a sick stimulus bird will have lower levels of natural antibodies, complement, and acute phase proteins than birds that are non-avoiders. This would indicate that it is optimal for birds to balance investment between using behavioral or immunological defenses against infection, instead of using avoidance and strong immune responses concurrently. Linking these two defense strategies and how they may influence the social network of a natural avian population could shed light on persistence in individual variation in disease susceptibility. This could ultimately lead to modifications to wildlife disease studies or even public health studies.

#### **Testing for year-round territoriality in a tropical oriole: Quantifying territorial behavior of male and female troupials (*Icterus icterus*)**

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We investigated year-round territoriality in a tropical resident oriole, the Venezuelan Troupial (*Icterus icterus*), in Puerto Rico. Troupials are a sexually monochromatic tropical oriole in which both sexes sing and perform vocal duets. We quantified territoriality in the breeding and non-breeding seasons for both

males and females. Using radio telemetry, we collected GPS coordinates for each bird during hour-long observations. We followed individuals recording every landing location throughout the observation. Mated pairs tended to fly around the territories together. We collected data on 23 birds in 14 territories. Data were collected for multiple years and also multiple seasons: May-July for the breeding season and Nov-Dec for non-breeding season. Preliminary results show no significant difference in territory size between the sexes or between the breeding and non-breeding seasons. Also, preliminary results show no significant difference in territory overlap with neighbors between the sexes and seasons. This suggests that males and females are equally territorial and that the territories of troupials are still strongly maintained in the non-breeding season. Thus, we have documented a system of clear year-round territoriality, which could in part explain elaborate female coloration and vocalizations in this tropical resident species.

#### **Assumed density dependence proved absent in Prothonotary Warblers (*Protonotaria citrea*) breeding in east central Arkansas**

Morgan Slevin - Arkansas State University, Jonesboro, AR, United States; Than Boves - Arkansas State University, Jonesboro, AR, United States

Continuing population declines and a relatively low population size for such a widespread species make the Prothonotary Warbler (*Protonotaria citrea*) a species of conservation concern. Full life cycle modeling is a current goal of the range-wide team studying the Prothonotary Warbler. Density dependence, a critical component of a full life cycle model, is often assumed, but rarely tested, to exist in most bird populations. Density dependence is classically associated with negative impacts on population growth rates. High density can lower clutch size, the number of fledglings per breeding female, and fledging success, among other effects. It is therefore important to assess the presence or absence (and strength) of density dependence in a population when constructing full life cycle models. I performed Spearman correlation tests between Prothonotary Warbler density (average number of birds across a breeding season at a point count within at least 50 m of a nest) and each nest's clutch size and between density and the number fledged from each nest. Then I performed a Mann-Whitney test between mean densities in the area around successful nests and around failed nests. I did not find density to be correlated with either clutch size ( $U = -0.039$ ,  $P = 0.846$ ) or number fledged ( $U = 0.186$ ,  $P = 0.352$ ). Additionally, there was no significant difference between mean surrounding densities of successful nests ( $n = 17$  nests,  $\mu = 0.970$  birds) and failed nests ( $n = 10$  nests,  $\mu = 0.683$  birds;  $W = 110$ ,  $P = 0.208$ ). These metrics that I compared to density are critical to population growth rates and their lack of association with the density surrounding each nest suggests that this population of Prothonotary Warblers is not subject to density dependence relative to these metrics, thus filling in a critical knowledge gap in the species' full life cycle model.

#### **Modularity in the evolution of avian plumage patterns**

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Complex phenotypic traits are often comprised of distinct developmental and functional components, but pleiotropic linkages among components of unrelated traits may create severe evolutionary constraints. In principle, these constraints can be overcome through the evolution of modularity – grouping trait components into tightly-correlated sets of integrated modules, and reducing their linkages with other such modules. Increasing trait modularity allows each individual module to evolve independently, thereby increasing the evolvability of the overall trait. Bird plumage can be modeled as a modular complex trait, where each feather is composed of multiple developmental modules that combine to produce variation in coloration and morphology. Although this modular system has been proposed to facilitate the evolution of avian plumage diversity, it has not been tested in a rigorous phylogenetic framework. Through comparative phylogenetic analysis I test whether, at an evolutionary scale, plumage functions as a modular system. For 107 species of wood-warblers (Parulidae), I scored 42 male plumage patches for the presence/absence of four phenotypic characters theoretically produced by four separate developmental modules – melanin pigments, carotenoid pigments, structural coloration, and feather patterning. Using a multilocus phylogeny and a threshold model of discrete trait evolution, I tested for evolutionary correlation between each pairwise combination of traits. My results confirm that different components of bird plumage behave in a modular fashion – for each character type, trait evolution is highly correlated across most plumage patches. However, a character type within a given plumage patch is more often uncorrelated with the evolution of other character types within that patch and across other plumage patches. This suggests that each developmental source of plumage coloration is evolving independently on an evolutionary scale. Future research will investigate whether the level of integration in this modular system can facilitate diversification in plumage.

#### **Exploring temporal sound-space partitioning in bird communities emerging from inter- and intra-specific variations in behavioral plasticity using a microphone array**

Reiji Suzuki - Nagoya University, Furo-cho, Chikusa-ku, Nagoya, Japan; Richard Hedley - University of California, Los Angeles, CA, United States; Martin L. Cody - University of California, Los Angeles, CA, United States

Birds do not always vocalize at random, but may rather divide up sound-space in such a manner that they avoid overlap with the songs of other birds. Such a behavior can be interpreted as an adaptive behavioral plasticity in that an individual modifies its resource exploiting strategy actively in response to the current state of resource use by others on a short time scale. Our purpose is to understand temporal sound-space partitioning in bird communities as a self-organizing phenomenon emerging from inter- and intra-specific variations in behavioral plasticity. So far, we conducted pilot analyses on the degree of avoidance and the information flow from one species to another in singing behaviors at our primary field site, in a mixed conifer-oak forest near Volcano, CA. We found that asymmetric information flows between species might exist, and our coevolutionary simulations implied the evolutionary significance of such an inter-specific diversity. For further analyses, it is important to annotate many or long recorded tracks in which multiple individuals and species are singing at

the same time. However, it is costly or even impossible to do this manually. Thus, it will be significantly beneficial if we can extract songs of multiple individuals from tracks automatically. Currently, we are developing and using a portable system composed of a laptop PC with an open source software for robot audition HARK (Honda Research Institute Japan Audition for Robots with Kyoto University) and a commercially available microphone array. We introduce the current state of our project and show that our system can successfully estimate the DOA and separated sounds of songs even when individuals of the same species are singing. We will also discuss the existence of variations in behavioral plasticity in preliminary results.

#### **Latitudinal geographical variation in sexual dimorphism in an Andean forest bird (Furnariidae: *Pseudocolaptes boissonneautii*)**

Kalli Trahan - Louisiana State University, Youngsville, LA, United States

Sexual dimorphism is often thought to be caused by sexual selection, but may also be due to ecological forces such as resource partitioning and behavioral differences between sexes. We evaluated the extent of geographical variation in bill size and sexual size dimorphism across the range of an Andean montane bird, *Pseudocolaptes boissonneautii*. We also examined whether geographic variation in this species follows Bergman's Rule and Rensch's Rule. We measured bill shape in 182 specimens and we analyzed wing length for another set of 153 specimens. We found sexual dimorphism in both bill morphology and wing length, but males had longer wings, whereas females had longer bills. Bill length was more strongly correlated with body size in females than in males. Both sexes showed a negative correlation between bill length and bill curvature, i.e. longer bills were straighter. The degree of sexual dimorphism varies geographically in wing length and especially bill length. However, females displayed a greater geographic variation in bill morphology. Body size increased towards the Equator, the opposite of the prediction of Bergmann's Rule. The species also did not conform to Rensch's Rule since females showed a greater variance in bill length and body size than did males, although males were the larger sex. The unusual pattern of geographic variation in sexual dimorphism in bill length within this species provides a rare opportunity for understanding the causes underlying sexual dimorphism, but further studies are needed on the foraging behavior and breeding habits of this species.

#### **Flamingos and climate change: A tale of two species**

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From 1850 to 2010, the average temperature globally rose by approximately 1°C. This change in temperature has modified the distribution, phenology, and interactions of numerous organisms. However, the potential effects of climate change on many species are not well understood. We investigated how climate change may affect the future distribution of American Flamingoes (*Phoenicopterus ruber*) and Chilean Flamingoes (*P. chilensis*). American Flamingoes breed in the Caribbean and northern South America. Chilean Flamingoes breed from central Peru to Chile and Uruguay. We downloaded location data for these two species from ORNIS and eBird. We used Maxent to determine which ecogeographical variables most

affected their distribution and to project how their ranges may shift by the 2070s under four different climate change scenarios. The Maxent models showed good agreement with the current ranges of the Chilean and American Flamingoes. It is predicted that habitats of the American Flamingoes will significantly decline in the future. The habitat area of the Chilean Flamingo is predicted to slightly increase. These models show that tropical species may vary in their response to climate change.

#### **Avian haemosporidian prevalence and its relationship to host life history**

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Parasites can influence the dynamics of ecological communities through their effects on 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 295 individuals of 36 bird species sampled from five habitats at Ames Plantation in west Tennessee to understand the relationship between the local bird community and their blood parasites. We aim to examine 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 126 individuals of 27 species to be infected with haemosporidian parasites (overall prevalence of 43%). We identified 20 genetic lineages including 12 in the genus *Haemoproteus* and 8 in *Plasmodium*. Fifteen percent of infected individuals harbored more than one parasite lineage. Infection status did not vary with habitat or with any individual-level trait (age; sex; or body condition, a measure of health). Across species, total infection prevalence increased with abundance and was also lower in species that forage only on the ground. Total prevalence and prevalence of *Plasmodium* decreased with annual survival. Prevalence was unrelated to species mass and nest height. Statistical models did not converge for nest type, indicating insufficient sample size. 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 prevalence varies across species in relation to certain host traits. We plan to sample birds again in 2015 to increase sample sizes and to examine temporal variation in this system.

#### **The influences of human structures on occupancy dynamics of Russet Sparrow in Zengwen region, Taiwan**

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Understanding occupancy patterns and the mechanisms that underlie occupancy dynamics is fundamental for successful conservation planning. We conducted surveys within an

occupancy-modeling framework for an endangered species, the Russet Sparrow (*Passer rutilans*), in the Zengwen Reservoir region of Taiwan. Because the Russet Sparrow is known to be associated with human structures and we applied stratified random sampling to a 1x1 km grid to select 60 plots based on whether or not there are human structures (e.g., houses and dams). Within each plot, we conducted two 250m transect surveys along the road system and recorded both detections of Russet Sparrows and its potential competitor, the Eurasian Tree Sparrow (*Passer montana*). In April 2014 and April 2015, we conducted three repeated surveys in each plot within a 3-week period. In each transect, we used playbacks of male territorial song to increase the survey detection. We used a single-species multi-season model in Program Presence to model the occupancy dynamics, and we selected the best fit models using Akaike Information Criteria. The occupancy rates between two years were similar (0.34 in 2014 and 0.30 in 2015). The models that incorporated Markovian process showed higher weights, indicating that the changes in occupancy are not random. Estimated local extinction rate was 0.49 and was not associated with human structures. Although human structures did not seem to affect occupancy, the colonization rate was higher in plots with human structures (0.27) than plots without human structures (0.03). Future analyses will focus on how land-use patterns and the quality and quantity of potential nest cavities influence on occupancy dynamics.

#### **Population history of an insular, island species: *Aphelocoma insularis***

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As the human population on Earth rises, it is important to understand how people shape biodiversity and the environment. The Channel Islands provide an opportunity to assess the effects of anthropogenic processes on flora and fauna over hundreds of years. In particular we study the Island Scrub-Jay (*Aphelocoma insularis*), a passerine bird endemic to the Channel Islands. Changing human land use provides the possibility of studying the genetic footprint of the evolutionary processes that have influenced the survival of this insular, island species. By analyzing DNA samples obtained from current Island Scrub-Jays and from historical specimens I address questions about the insular population of Island Scrub-Jays on Santa Cruz Island-specifically, how genetic diversity has changed over time with respect to human settlement and practices and the evolutionary relationships between the Island Scrub-Jays and other *Aphelocoma* jays. Understanding the population history of the Island Scrub-Jays will guide future decisions regarding the conservation of this species and the Channel Islands as a whole.

#### **Survival of hen Eastern Wild Turkey in the Ouachita National Forest**

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A collaborative study between Arkansas State University, The United States Forest Service, The Arkansas Game and Fish Commission and the National Wild Turkey Federation was initiated in 2011 to look at the effects of prescribed burning on the habitat use and demography of the Eastern Wild Turkey



(*Meleagris gallopavo silvestris*) in a shortleaf pine-bluestem grass ecosystem. One method employed by the United States Forest Service to promote historic forest conditions is to apply prescribed burning on a three year interval. Current prescribed-burning protocol allows for large scale (> 200 ha.) burns to take place year-round which corresponds to the growing season as well as the dormant season of the forest. The study goals are to see how the current prescribed burning protocol is influencing the female Eastern Wild Turkey in Management Area 22 of the Ouachita National Forest. Eastern Wild Turkey hens were captured using rocket netting techniques and a 122 gram Platform Terminal Transmitter (PTT) equipped with GPS and VHS options were secured to the birds utilizing backpack style attachment techniques. Four GPS locations were remotely downloaded each day for three consecutive years on all hens that were equipped with the PTT's. Nesting data, brood rearing data, habitat utilization and survival of the study population are currently being analyzed. For the purposes of this presentation, I will present survival data of Eastern Wild Turkey hens in a shortleaf pine-bluestem grass ecosystem. Results of year round data that was collected will be presented and yearly variation will be discussed.

#### **Territorial aspects of the Painted Bunting (*Passerina ciris*) in the Texas cross timbers**

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Over the past few decades migratory songbird populations have been declining due to many factors, including predation and brood parasitism. In turn, both of these factors are either directly or indirectly related to habitat fragmentation. Although an increase in fragmentation might appear to benefit edge specialists such as the painted bunting (*Passerina ciris*), these birds also appear to be suffering a population decline. Understanding the defining territorial aspects of this edge species could elucidate factors contributing to declines in other songbird populations and improves the paucity of information on the ecology of this species in its western range. We used an avian spot-mapping survey to investigate variation in the aspects of territory choice by painted buntings within the fragmented landscape of the Cross Timbers ecoregion in Texas. We used a kernel density estimation to delineate core area and territories. We investigated relationships between territory size and edge distance, canopy coverage, ground coverage, and vegetative community type between used and available sample points. Preliminary results from a previous field season using Pearson correlations in SPSS suggest that the presence or absence of unusable ground cover is a defining factor in the territory size of painted buntings, while previous studies on the eastern population have suggested a connection with edge distance. These results, as well as the presence of a highly mosaic landscape, suggest a disparity in the ecology of these two populations.

#### **The importance of time when measuring habitat characteristics: Implications for avian nest survival studies**

Jennifer Wilcox - Arkansas State University, Jonesboro, AR, United States; Than Boves - Arkansas State University, Jonesboro, AR, United States

Vegetation structure is an important predictor of avian nest survival, specifically those habitat features that contribute to nest concealment. Numerous studies document changes in floristic characteristics from year to year; however, little is known about whether habitat characteristics potentially important to nest survival can change significantly within a few weeks. Based on a literature search of scientific articles pertaining to avian nest survival, we found that researchers either measured vegetation characteristics as soon as a nest fledged or failed ( $n = 20$ ), provided a date range ( $n = 10$ ), or waited until the end of the breeding season ( $n = 2$ ), while others offered no timing information at all ( $n = 15$ ). Measuring habitat variables at the end of the breeding season could have important implications for perceived relationships between vegetation structure and nest survival. We tested the prediction that habitat variables leading to nest concealment change significantly over the course of a single breeding season (May through July). In 2014 and 2015, we measured habitat parameters thought to be important in predicting nest success following a modified Breeding Biology Research and Monitoring Database Protocol (BBIRD, Martin et al. 1997). The same nest sites ( $n = 40$ ) were sampled early in the breeding season (May) and again late in the breeding season (July) in two bottomland hardwood forest stands in east-central Arkansas. We found no significant difference between habitat parameters measured early and again 8 weeks later (Wilk's  $W = 0.83$ ,  $F_{8,31} = 1.09$ ,  $P = 0.39$ ). Conducting vegetation surveys at the end of the breeding season probably does not affect conclusions regarding avian nest survival. However, researchers should be mindful of the potential for short-term changes in vegetation structure.

#### **Habitat use by secretive marsh birds in moist-soil managed wetlands in eastern Kansas**

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Moist-soil management is a common form of wetland management for waterfowl, where wetlands are dewatered in spring to enhance summer vegetative production, and then flooded in the fall to accommodate migrating waterfowl. The use of moist-soil managed wetlands by other marsh birds (e.g., rails) has received little study. Our objective was to determine variation in abundance of the American Bittern (*Botaurus lentiginosus*), Least Bittern (*Ixobrychus exilis*), King Rail (*Rallus elegans*), Virginia Rail (*Rallus limicola*), and Sora (*Porzana carolina*) in relation to habitat structure within and among moist soil managed wetlands in Eastern Kansas. We used call-playback surveys (spring, summer) and flush counts (fall) to survey marsh bird abundance. Study sites included the Flint Hills National Wildlife Refuge, the Marais des Cygnes National Wildlife Refuge and State Wildlife Area, and McPherson Valley Wetlands State Wildlife Area. Surveys were performed during the spring and fall migration and summer breeding seasons of marsh birds in Kansas. Only 6 birds of three species (American Bittern, Least Bittern, and Sora) were detected in three of 31 wetland units across all sites during the spring and summer in 2014. During the fall of 2014, a total of 24 American Bittern, 4 Least Bittern, and 57 Sora were detected in 16 out of 24

wetlands surveyed. There were no significant patterns in abundance of these species with marsh-wide habitat characteristics during fall. However, in fall surveys Sora were detected in areas within marshes with lower coverage of vegetation (e.g., *Eleocharis*) than American Bittern locations or systematic sampling points. American Bitterns were detected in areas with higher cattail (*Typha*) coverage than Sora locations or systematic sampling points. Surveys in 2015 are ongoing.

#### **Sexual differences and female reproductive status in spring migration of American Woodcocks**

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David E. Willard - The Field Museum, Chicago, IL, United States

As a game bird of management interest, American Woodcocks (*Scolopax minor*) have been studied extensively as breeding birds and fall migrants. Here, we report a previously undocumented facet of woodcock migratory biology. In a sample of 820 specimens salvaged as window-strikes on spring migration in Chicago over 35 years, we found approximately three times as many females as males. While this could be explained by a skewed sex ratio, the fact that the ratio in fall migrant woodcocks (N=450) is 1:1 suggests an alternative explanation. Most spring female woodcocks examined in this study were migrating with extremely well developed ovaries and oviducts (unlike virtually all other migrants). We suggest that one possibility for the disparity in numbers between the sexes is that some males remain in the south in the spring, mating with females as they migrate north, while the females store sperm for fertilization as the ova mature, allowing them to begin laying immediately on arrival on northern breeding grounds.

#### **Saturation surveys for Lesser Prairie-Chickens in Oklahoma, USA**

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The Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) has experienced considerable declines in both population size and range over the past several decades, leading to a decision by the U. S. Fish and Wildlife Service to list the species as “threatened” under the Endangered Species Act in 2014. Although these declines have been evident, precise population estimates have been difficult, and even within their present-day range, portions are unsuitable or the species has been extirpated for various, sometimes unknown, reasons. To gain a better understanding of the current population size and occupied range of the species in Oklahoma, we conducted “saturation surveys” in 2010 and 2011 along accessible roads, composed of 214 survey routes. At each designated stopping point, habitat was assessed as being “suitable”, “marginal”, or “unsuitable”, and listening for leks was conducted at those stops that were assessed as suitable or marginal. A total of 73 leks was located in 2010-2011. We estimate that 75-80% of the occupied range in Oklahoma was sampled. These surveys are being repeated in 2015 and 2016, with minor modifications, including photo-points that can be compared to future surveys, and will be repeated again every 5 years in accordance to the Lesser Prairie-Lesser Range-Wide Management Plan. This will provide long-term population comparisons as well as

document habitat changes. We will compare survey and habitat assessment results from 2010-2011 to the portions surveyed in 2015.

#### **Successful interspecific nesting between a Scissor-tailed Flycatcher and Western Kingbird and evidence of a unique sympatric peripheral hybrid zone**

Alexander Worm - Arkansas State University, Jonesboro, AR, United States; Than Boves - Arkansas State University, Jonesboro, AR, United States

Scissor-tailed Flycatchers (*Tyrannus forficatus*) and Western Kingbirds (*T. verticalis*) are sympatric species that have been simultaneously expanding their ranges eastward over the past few decades and, at the same time, have anecdotally increased their rate of hybridization. Here we describe observations of a male Scissor-tailed Flycatcher and female Western Kingbird pair successfully raising a brood at a nest in Memphis, TN, USA. This observation is the first documented case of an interspecific pair of these species successfully raising young. Despite a lack of attention in the scientific literature, citizen science efforts have documented relatively extensive hybridization at the periphery of these species' expanding ranges. Based on our initial observations and previous amateur efforts, we believe that this type of hybrid zone (termed here a “sympatric peripheral hybrid zone”) deserves more attention by biologists to better understand the effects of hybridization on future range expansion.

#### **Population trends of the endangered Mariana Common Moorhen in the Northern Mariana Islands**

Lainie Zarones - Saipan, Northern Mariana Islands

The Mariana Common Moorhen (*Gallinula chloropus guami*) is a federally endangered species that is endemic to the Mariana Islands. It is currently found only on the islands of Saipan, Tinian, Rota and Guam. The species occupies a variety of wetland types, including natural marshes, golf course ponds, ponding basins, and constructed lakes. The most recent archipelago-wide survey in 2001 estimated the population was less than 300 individuals. Mariana Common Moorhens in Saipan have been surveyed continuously at 18 wetland sites monthly from Oct 1999 to Nov 2005, and then quarterly to 2014. I present the results from this 15-year dataset across a variety of wetland types. The average number counted was 83 individuals. There was no overall positive or negative trend in numbers over this period, though some of the more populated wetlands exhibited large cycles in numbers. The highest total was 149 in August 2003, and the lowest was 27, one month later. The Mariana Common Moorhen appears to be a year-round breeder, as nesting activity was documented during all months.

#### **Assessing changes in species composition and phylogenetic structure of Florida bird communities using historical species lists**

Zoe Zelazny - University of Florida, Gainesville, FL, United States; Gordon Burleigh - University of Florida, Gainesville, FL, United States; Judit Ungvari-Martin - University of Florida, Gainesville, FL, United States

Florida contains some of the highest levels of avian biodiversity in North America and is at high risk for biodiversity loss. Once covering three-fourths of the landscape, the Florida wetlands have been greatly reduced, and the percentage of long-leaf pine forests has dropped significantly due to logging and fire suppression. Although sometimes viewed as inconsistent and incomplete, it is possible to assess changes in species distributions since the widespread human population growth in Florida in the early 1900s. We assembled 100 bird species lists containing 406 total species from the legacy natural history literature from 1874 to 1932. To estimate major changes in the avian species composition in Florida since the 1930s, we used a new approach to compare the species lists to the species composition from contemporary observations from the Avian Knowledge Network. In addition, we estimated the difference in phylogenetic structure between the historic and the modern species communities. Most of the species increasing in abundance are nonindigenous species that were introduced after the 1930s. Increases also may reflect the decline of the millinery trade and the ability of some species to adapt to urban environments. We also found a general trend of higher phylogenetic conservation in older communities than contemporary communities.