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### **Contact Info:**

Jay Sheppard *jmsheppar@aol.com*  
Managing Editor

Please feel free to pass this information on to others.

**Adams, E. M.**, University of Maine, USA, [evan.adams@briloon.org](mailto:evan.adams@briloon.org)  
 Olsen, B. J., University of Maine

#### EFFECTS OF CHANGING GLOBAL CLIMATE, LOCAL WEATHER, AND HABITAT ON SONGBIRD MIGRATORY PHENOLOGY AND ABUNDANCE

Global climate, local weather, and stopover habitat conditions interact to affect migratory timing and abundance in songbird species. Large-scale climate patterns affect the vital rates of populations during breeding and wintering, thus changing the abundance of species available for stopover during migration (the total migratory population size). Whereas, local weather and stopover habitat characteristics influence where and how long birds land and refuel (the daily stopover population size). Using hierarchical N-mixture modeling ("unmarked" in Program R), we quantified the effects of the summer North Atlantic Oscillation (NAO), winter El Niño Southern Oscillation (ENSO) and winter Madden-Julian Oscillation (MJO) on fall migratory timing and population size for fifteen songbird species on Key Biscayne, FL, while controlling for changes in daily detection probability, local weather and habitat. Overall, we found a negative trend in detection-corrected stopover population size in six of the fifteen species from 2002-2011. Local weather and habitat influenced stopover population size of all species. Most species arrived at and departed from the site on favorable tailwinds, though some species showed alternative stopover arrival and departure decisions. Further, we found that a positive NAO advanced migration timing across almost all species, and positive phases of the ENSO and MJO were associated with a lower annual migratory population size in most species. Given the predicted changes in global climate and local South Florida weather over the next century, this analysis suggests that many Caribbean-wintering songbirds will be migrating earlier and using Key Biscayne more for stopover in the future. Despite these changes, anticipated reductions in tropical rainfall is likely to decrease total migratory population sizes for many Caribbean migrants and may lead to stopover population declines overall for many species. (ID 15957)

**Adelman, J. S.**, Virginia Tech, USA, [adelmanj@vt.edu](mailto:adelmanj@vt.edu)  
 Moyers, S. C., Virginia Tech, USA, [sahnzi@vt.edu](mailto:sahnzi@vt.edu)  
 Hawley, D. M., Virginia Tech, USA, [hawleyd@vt.edu](mailto:hawleyd@vt.edu)

#### BEHAVIORAL RISK FACTORS OF MYCOPLASMAL CONJUNCTIVITIS IN HOUSE FINCHES<sup>†</sup>

Anthropogenic feeding of birds can influence pathogen transmission both by bringing high densities of birds into close proximity and by providing discrete fomites, or environmental sources of pathogen transmission. Although it has been shown experimentally that bird feeders can serve as fomites for *Mycoplasma gallisepticum*, the causative agent of Mycoplasmal conjunctivitis in House Finches (*Haemorrhous mexicanus*), the role of feeders in driving transmission in free-living House Finch populations has not yet been elucidated. We examined behavioral risk factors of disease by asking whether time spent on bird feeders, exploratory behavior in a novel environment, or social network metrics predicted the likelihood of acquiring Mycoplasmal conjunctivitis for House Finches in Blackburg, Virginia. We found that the amount of time spent on a bird feeder was a strong predictor of the likelihood of acquiring Mycoplasmal conjunctivitis. The extent of exploration in a novel environment was a strong predictor of social network degree at bird feeders, but neither exploration nor network degree predicted the probability of acquiring conjunctivitis. Finally, we will discuss results of an ongoing captive experiment testing whether time on bird feeders is also associated with the probability of spreading *Mycoplasma gallisepticum* to flockmates (e.g., superspreading). Overall our results indicate that anthropogenic feeding is likely a strong driver of disease dynamics in this system and potentially for songbirds more broadly. (ID 15902)

**Aguillon, S. M.**, University of Arizona, USA, [aguillon@email.arizona.edu](mailto:aguillon@email.arizona.edu)  
 Duckworth, R. A., University of Arizona, USA, [rad3@email.arizona.edu](mailto:rad3@email.arizona.edu)

#### RESOURCE-MEDIATED BEHAVIORAL DYNAMICS AMONG KIN DRIVE DISPERSAL IN FIRST-YEAR WESTERN BLUEBIRDS (*SIALIA MEXICANA*)\*

Dispersal is a fundamental component of life history and strongly influences population demographics and evolution. However, context-dependency of dispersal decisions, such as effects of social interactions and resource availability, are rarely disentangled from intrinsic factors, such as personality traits. Here, we examine how interactions between individual personality, relatedness, and resource availability influence dispersal decisions in Western Bluebirds (*Sialia mexicana*). A long-term dataset on family dynamics and behavior was used to determine how distinct combinations of personality traits and cavity resources affected dispersal decisions of first-year breeding males. We found that males dispersed non-randomly and settled significantly closer to their natal nest than expected by chance. The distance a male dispersed from his kin was driven by an interaction between father and son aggressive personalities, such that both aggressive sons and the sons of aggressive fathers dispersed longer distances. Furthermore, the presence of kin and the availability of cavity resources on the natal territory influenced natal dispersal. Sons born on territories with few cavity resources and those with kin present in their first year of breeding dispersed longer distances. Resource acquisition and personality type are interdependent in this species, so these proximate influences on dispersal likely mediate changes in population density, behavior, and resource availability across years. Thus, the frequency of behavioral types in a population can have important, but previously unappreciated, consequences for population dynamics. (ID 15887)

**Akresh, M. E.**, University of Massachusetts Amherst, USA, [makresh@eco.umass.edu](mailto:makresh@eco.umass.edu)

King, D. I., U.S. Forest Service, Northern Research Station, USA, [dking@fs.fed.us](mailto:dking@fs.fed.us)

#### CLIMATE, PLANT LEAFING PHENOLOGY, AND OTHER FACTORS AFFECT NEST-SITE SELECTION AND NEST SURVIVAL OF PRAIRIE WARBLERS IN A MIXED-OAK SHRUBLAND

Many studies have examined the ways in which birds are adapted to select nest sites that increase nest survival, yet few studies have empirically taken into account interactions with plant leafing phenology and climate. We examined nest-site selection and nest survival for a conservation-priority shrubland bird, the prairie warbler (*Setophaga discolor*), in a managed pitch pine-scrub oak barren in Montague, Massachusetts during 2008-2011. We found prairie warblers selected more dense vegetation at the preferred nest heights between 0.5-1.5 m and selected nest sites close to roads and fire breaks. Frost tolerant plant species were selected as nest substrates early in the season, as late frosts in the study site delayed oak species leaf-out dates. After oak species leaf-out, there was a predominant switch to using oaks as nest substrate in habitats in which oaks were a major component. Nest survival rates differed among years, decreased with nest age and distance to road or fire break, increased with nest concealment, and in a delayed leaf-out year, survival rates were lower before leaf-out of the dominant nest vegetation. Few variables significantly affected cowbird parasitism rates. Overall, we found that nest-site selection was adaptive in the sense that it increased nest survival. Plant phenology influenced nest-site selection and nest survival in this system; its effects on birds should be considered as a potential mechanism by which bird communities can be affected by global climate change. (ID 15742)

**Albrecht-Mallinger, D.**, Virginia Commonwealth University, USA, [albrechtmald@vcu.edu](mailto:albrechtmald@vcu.edu)

#### CONSPECIFIC ATTRACTION IN A LOW-DENSITY POPULATION OF A DECLINING SONGBIRD\*

Many organisms use both vegetation structure and social cues in selecting habitats. Many species of songbirds use the presence of breeding



conspecifics as a social cue and sign of habitat quality, and can be induced to settle in unoccupied habitats by artificially broadcasting breeding song, a process referred to as “conspecific attraction”. Conspecific attraction by male song has been proposed as a conservation tool for attracting species of concern to managed habitats. In our study, we tested response to conspecific attraction in a low-density population of the threatened Golden-winged Warbler (*Vermivora chrysoptera*) in Virginia Appalachia. In the summer of 2012, occupancy surveys were conducted in areas of suitable habitat at 171 survey points across 60 distinct habitat patches. Male song was broadcast at 14 under-occupied sites in late summer of 2012 and additional 14 sites in early spring of 2013. Response to broadcast song was observed, with a modest increase in mean male abundance at survey points within 250 meters of treatments, and mean abundance decreasing outside of this range throughout the study area. Recruitment to conspecific playback was lower in our study than observed in previous research on high-density systems. Males recruited to sites of conspecific attraction were younger than males at control sites, and proportionally fewer instances of confirmed breeding were observed on treatment sites compared to controls. Our results suggest more research is needed of the effectiveness of conspecific attraction in low-density species and that its use should be tailored to the spatial and demographic conditions of the managed population (ID 16403 | Poster 11)

Alcaide, M., University of British Columbia, Canada, malcaidetor@gmail.com  
Scordato, E. S., University of Chicago, USA, liz.scordato@gmail.com  
Price, T. D., University of Chicago, USA, pricet@uchicago.edu  
**Irwin, D. E.**, University of British Columbia, Canada, irwin@zoology.ubc.ca  
GENOMICS IN A RING: SPECIATION IN GREENISH WARBLERS

The greenish warbler has been regarded as a prime example of the phenomenon referred to as “ring speciation,” in which two reproductively isolated forms co-occur in one region (in this case, central Siberia) while being connected by a long chain of populations through which traits change gradually (in this case, encircling Tibet). Our analysis of thousands of single-nucleotide polymorphisms (SNPs) shows that spatial patterns of genomic variation are mostly consistent with the ring species model, but reveals two surprising findings. First, long-term breaks in gene flow have occurred not just in central Siberia but also in the western Himalayas, where we find an extensive hybrid zone between genetically divergent forms. This suggests that geographic separation has played an important role in diversification. Second, reproductive isolation between the terminal forms of the ring is not complete; rather, we observe limited introgression of blocks of linked markers from one form into the other. Despite this introgression, the two Siberian forms are highly distinct genomically, suggesting selection against introgressed portions of the genome. The contrasting pattern in the Siberian and western Himalayan contact zones is consistent with phenotypic variation in traits such as song, plumage, and migratory behavior, each of which changes little across the Himalayan zone but sharply across the Siberian contact zone. While these results cast doubt on the view that the greenish warbler is an example of speciation by distance, they do show that greenish warblers display a phenotypic and genomic continuum from slightly divergent populations to almost fully reproductively isolated species. (ID 15836)

Alexander, J. D., Klamath Bird Observatory, USA, jda@klamathbird.org  
Ralph, C. J., USDA Forest Service, Pacific Southwest Research Station, USA, cjralf@humboldt1.com

**Rockwell, S. M.**, Klamath Bird Observatory, USA, smr@klamathbird.org  
Frey, R. I., Klamath Bird Observatory, USA, bif@klamathbird.org  
Stephens, J. L., Klamath Bird Observatory, USA, jlh@klamathbird.org

TRENDS IN ABUNDANCE AND PRODUCTIVITY FROM 12 YEARS OF  
CONSTANT EFFORT MIST NETTING IN THE KLAMATH-SISKIYOU  
BIOREGION OF SOUTHERN OREGON AND NORTHERN CALIFORNIA

Much attention has been recently given to declines observed in North American landbird populations, spurring new research into the possible sources of these declines. Constant effort mist netting provides one tool to aid our understanding of demographic factors that may drive population trends in bird species, such as survival rates and productivity. Using data from ten constant effort mist netting stations in the Klamath-Siskiyou Bioregion of southern Oregon and northern California, we analyzed population trends for common breeding birds from 2002-2013. We studied 12 species breeding in our study area, including six that have been identified as conservation focal species in the Oregon-Washington and/or continental Partners in Flight plans. We examined changes in the relative abundance of different age classes of these species over the last 12 years, and compared these to Breeding Bird Survey (BBS) trends over a larger region during the same time period. We also used the capture rate of hatch-year birds as an index to assess trends in productivity over time, and then evaluated the influence of reproductive success on adult abundance in the following year. We used correlation matrices to determine whether any banding stations in our network tended to follow the same trends in population dynamics (i.e., form a “functional population”), or whether they trended independently of each other. These long-term monitoring efforts allowed us to identify declines occurring in breeding populations of study species, compare those with regional trends, and complete a first step towards understanding potential demographic causes of trends in abundance. Further research into the potential drivers of observed population trends and their proximate demographic mechanisms in all phases of the annual cycle are needed to understand and address causes of declines. (ID 16353)

**Alexander, J. D.**

SUMMARY OF SYMPOSIUM. THE NEXT STEPS IN VALUE- ADDED  
METRICS FROM CAPTURE AND MARKING OF BIRDS

The bird conservation community is sharpening focus on factors that limit populations within the full life cycle context. Such focus requires information about the basic demographic factors that make up the rate of population growth  $\lambda$ —such as, reproductive rates, survival, and recruitment. However, more subtle value-added metrics that describe demographic and life history factors influencing population viability will also be needed from state of the art monitoring programs. In the social sciences, demographic studies, such as the U.S. Census, measure factors about age, income, health, migration, ethnicity, and education. Similarly, well designed and coordinated bird monitoring programs can also result in finer resolution bird demographic measures such as the age of breeding adults, body condition of migrants, timing and extent of molt and overwintering success that may be influential in driving the basic components of  $\lambda$ . With a better understanding of these value-added demographic metrics, our conservation efforts will be better informed and targeted. Here, we consider the latest breakthroughs from an array demographic monitoring efforts to begin discussions regarding priorities and objectives that will drive the future of monitoring efforts coordinated across the hemisphere and designed to meet the information needs required by a full life cycle conservation approach. (ID 16402)

**Andersen, M. J.**, American Museum of Natural History, USA, mandersen@amnh.org  
Oliveros, C. H., University of Kansas Biodiversity Institute, USA, oliveros@ku.edu  
Benz, B. W., American Museum of Natural History, USA, bbenez@amnh.org  
Moyle, R. G., University of Kansas Biodiversity Institute, USA, moyle@ku.edu  
HIGHER-LEVEL PHYLOGENY OF CROWS AND ALLIES INFERRED FROM  
ULTRA-CONSERVED ELEMENTS

The core-Corvoidea is a diverse clade of oscine passerines with >700 species. It has a global distribution and is hypothesized to have originated in the Papuan region. Higher-level systematics of this group has yet to resolve numerous relationships at the base of the tree. Indeed, at least nine major

corvid lineages root to a basal polytomy when traditional molecular datasets of few nuclear loci are analyzed. The group including crows and their allies (jays, monarch flycatchers, fantails, drongos, and birds-of-paradise), is of particular interest. This species-rich clade appears to have radiated rapidly based on a pattern of short basal internodes with equivocal relationships among constituent lineages. Here, we use target capture and massively parallel sequencing of ultraconserved elements (UCEs) to infer a robust phylogeny of the crows and allies, and we place this clade in phylogenetic context of the core-corvoidea ( $n=60$  taxa sampled). We sequenced 1,600 UCE loci on the Illumina platform, which resulted in a concatenated dataset >1 Mbp. We compare results from concatenated maximum likelihood (RAxML) and Bayesian (MrBayes) methods, as well as coalescent species tree analyses in STEAC. Overall, the tree is remarkably well-resolved. We found support that the crows and allies radiated rapidly, as evidenced by the short-internodes at the base of the phylogeny. Systematic relationships of this group are discussed and compared to existing phylogenetic hypotheses. (ID 16242)

**Anderson, A. M.**, Boise State University, USA, alexandraanderson@u.boisestate.edu  
 Heath, J. A., Boise State University, USA, julieheath@boisestate.edu  
 Novak, S. J., Boise State University, USA, snovak@boisestate.edu  
 Smith, J. F., Boise State University, USA, jfsmith@boisestate.edu  
 Steenhof, K., Owyhee Desert Studies, USA, steenhof@hughes.net  
 DO WINTERING STRATEGY CARRY-OVER EFFECTS ON NEST INITIATION AND MATE CHOICE FACILITATE POPULATION RESPONSE TO CLIMATE CHANGE IN A PARTIAL MIGRANT, THE AMERICAN KESTREL?\*

Earlier breeding is a widespread response to climate change, but the mechanisms driving shifts in nesting phenology remain poorly understood. Rapid shifts in nesting phenology (~28 days over 27 years) of partially migratory American kestrels (*Falco sparverius*) in southwestern Idaho is associated with warming winters, suggesting that conditions in the non-breeding season have carry-over effects on reproduction. We tested the hypothesis that wintering strategy (resident or non-resident) creates temporal divides between sympatrically breeding kestrels, leading to assortative mating, and genetic divergence between early and late breeding kestrels. We intensively trapped and marked kestrels in the winters of 2010, 2011, and 2012, and recaptured birds in nest boxes the subsequent springs. Resident kestrels nested earlier than non-resident kestrels but the difference depended on year. Resident females were more likely to mate with resident males than non-resident males, providing evidence of assortative mating. Analysis of 6 polymorphic microsatellite loci, however, showed no evidence of genetic differentiation or structure between early and late breeding kestrels. Lack of genetic differences may be the result of condition-dependent changes in wintering strategies or re-nesting after failed attempts. Results support the hypothesis that environmental conditions (i.e., warmer winters) that favor an increased proportion of birds remaining on (or near) breeding areas may lead to earlier nesting, but phenological shifts were not the result of genetic divergence between early and late breeders. (ID 16073)

**Apa, A. D.**, Colorado Parks and Wildlife, USA, tony.apa@state.co.us  
 Wiechman, L. A., Colorado State University, USA, lawiechman@gmail.com  
 Phillips, M. L., Colorado Parks and Wildlife, USA, mike.phillips@state.co.us  
 GUNNISON SAGE-GROUSE CONSERVATION: SUCCESSFUL DEVELOPMENT OF CAPTIVE-REARING TECHNIQUES FOR THE COLLECTION, STORAGE AND HATCH OF WILD AND CAPTIVE-SOURCE EGGS

Gunnison sage-grouse (*Centrocercus minimus*) are distributed across southwestern Colorado and southeastern Utah, United States. Their distribution has decreased over the past century and may receive protection from the Endangered Species Act. Reduced genetic diversity, small

population size, and isolation can affect Gunnison sage-grouse population persistence. Population augmentation is used to counteract these issues, but translocation efforts have yielded mixed, and mostly unsuccessful, results. Captive-rearing is a viable, although debatable, conservation approach to bolster wild populations. Although there have been captive-rearing efforts with greater sage-grouse (*C. urophasianus*), to date, no information exists about captive-rearing for Gunnison sage-grouse. Therefore, we investigated egg collection, artificial incubation, and hatching techniques for Gunnison sage-grouse. From 2009-2011, we collected and artificially incubated 206 Gunnison sage-grouse eggs from 23 wild and 14 captive females. Our hatch success was 74% and hatchability was 90%. Eggs collected during laying were stored successfully without impacting hatchability. Wild-produced eggs were heavier than captive-produced eggs, and lost mass during incubation similarly. Mass loss during incubation should be 11% and rarely exceed 12%. We have developed artificial incubation techniques to incubate and hatch Gunnison sage-grouse eggs and conservationists and managers need to evaluate the utility in developing a captive-rearing program or creating a captive population that could assist in Gunnison sage-grouse conservation. (ID 16014)

**Arcese, P.**, University of British Columbia, Canada, peter.arcese@ubc.ca  
 Norris, R., University of Guelph, Canada, rnorris@uoguelph.ca  
 Blight, L., University of British Columbia, Canada, lkblight@interchange.ubc.ca  
 Wilson, S., Environment Canada, Canada, ScottD.Wilson@EC.GC.CA  
 Krebs, E., Environment Canada, Canada, Elsie.Krebs@ec.gc.ca  
 Anderson, E., British Columbia Institute of Technology, Canada, eric.anderson@sfu.ca  
 Bertram, D., Environment Canada, Canada, Douglas.Bertram@dfo-mpo.gc.ca  
 Hobson, K., Environment Canada, Canada, Keith.Hobson@EC.GC.CA

A CENTURY OF CHANGE IN TROPHIC FEEDING LEVEL IN DIET SPECIALIST AND GENERALIST MARINE BIRDS OF THE SALISH SEA  
 Despite a lack of long-term data on the population dynamics and abundance of most of the world's birds, stable isotope analyses of feathers collected over a century provided us with a novel opportunity to 1) compare centennial patterns of change in trophic feeding level in specialist and generalist marine birds in the Salish Sea, 2) test if diet specialization and change in trophic feeding level are linked, and 3) identify mechanistic links between diet specialization and regional abundance and potential historic baselines. Specifically, we used isotopic values ( $\delta^{13}C$ ,  $\delta^{15}N$ ) from western grebe (*Aechmophorus occidentalis*), marbled murrelet (*Brachyramphus marmoratus*) and glaucous-winged (*Larus glaucescens*) gull feathers to test how each species responded to documented and presumed changes in forage fish abundance in the Salish Sea from the 1880s to present. Isotopic signatures indicated  $\geq 60\%$  declines in trophic feeding level in murrelets and gulls, which exhibit moderately and very broad diets, respectively. In contrast, we observed no change in trophic feeding level in grebes, which specialize on 40-60cm pelagic forage fish in winter and have declined  $\geq 95\%$  in the Salish Sea since 1970, but increased by  $\geq 300\%$  in coastal California. We suggest that each of these marine predators have responded strongly to human and climate-related changes in forage fish abundance in the last century, but that diet specialization affects how those changes are reflected as long-term trends in abundance or distribution. (ID 16374)

**Ardia, D. R.**, Franklin & Marshall College, USA, daniel.ardia@fandm.edu  
 TEMPERATURE AND IMMUNITY: TEMPERATURE MANIPULATION DURING EMBRYONIC DEVELOPMENT AND ITS EFFECT ON THE IMMUNE SYSTEM AND THERMOREGULATORY PERFORMANCE<sup>†</sup>  
 Developmental conditions during early life can have effects on physiology in later life history stages. Using temperature modifications during development I have studied how developmental temperature affects

organismal performance, including multiple measures of immune response. Temperature can drive physiological development through tradeoffs or can adjust developmental programming, such as through perinatal programming. The effect of temperature on performance is particularly critical in a period of rapid global warming. I present results from field and laboratory manipulations of embryonic temperatures on immunity and thermoregulation. Experimental cooling of tree swallow embryos led to long-term lower innate immunity measured as bacteria killing ability. Field temperature manipulation during embryonic development also affected thermoregulatory ability, with moderate cooling leading to improved thermoregulatory performance. In captive studies using artificial incubation, quail and zebra finches show effects of temperature manipulation on cell-mediated immunity, bacteria killing ability, white blood cell counts, metabolic rate and thermoregulation. In general, deviation from optimal embryonic development conditions leads to reduced immune activity in juveniles, but potential acclimatory performance in metabolic rate and thermoregulation. These results suggest that embryonic development conditions in birds can have complex developmental effects on immunity, thermoregulatory performance, and metabolic rate. (ID 16124)

**Arnold, T. W.**, University of Minnesota, USA, arnol065@umn.edu  
ESTIMATING ANNUAL SURVIVAL FROM BAND RECOVERY DATA<sup>†</sup>

Band recovery data have been the primary means of estimating annual survival for hunted species of birds, whereas live encounters are more typically used for non-game species. Provided band recovery data come from throughout a population's potential range, they can provide estimates of true annual survival that are not confounded by emigration. However, non-game species typically lack adequate sample sizes of dead recoveries. Working with four species of game birds that are nevertheless lightly banded and harvested (Sandhill Crane, Wilson's Snipe, American Coot, Clapper Rail), I examine the effects of different inclusion criteria on estimated survival rates of hatch-year and after-hatch-year birds using Seber band-recovery models. Although survival rates can typically be obtained from sparse data sets typical of many non-game birds, there was pronounced heterogeneity in survival estimates based on timing of banding and method of recovery (i.e., shot vs. other dead vs. live encounters). I explore data management practices and analytical methods for obtaining the most reliable survival estimates possible from sparsely banded species. (ID 16389)

**Atuo, F. A.**, Oklahoma State University, USA, fidelis.atuo@okstate.edu  
O'Connell, T. J., Oklahoma State University, USA, tim.oconnell@okstate.edu  
QUANTIFYING THE SPATIO-TEMPORAL DISTRIBUTION OF MULTIPLE RAPTORS IN MIXED-GRASS PRAIRIE LANDSCAPES

The North American Great Plains supports multiple species of diurnal raptors that potentially rely on similar sources of food (e.g., small mammals) and nesting substrates (e.g., isolated large trees). At broad scales, these species co-occur. In this study, we endeavored to determine the scales at which multiple raptor species partition habitat in mixed-grass prairie landscapes. From December 2012–April 2014, we conducted monthly surveys of raptors at two state wildlife management areas (separated by ~ 100 km) in western Oklahoma. Using distance sampling on line transects, we recorded 1421 sightings of 15 diurnal and 2 nocturnal species and estimated spatially explicit habitat use for all raptors. Overall, mixed grasses, relatively sparse ground cover, and more abundant canopy trees were important vegetation variables in predicting raptor abundance with broad overlap among species. Red-tailed Hawk was the most abundant raptor at both sites (0.046/ha annual density), both as a breeding species and in reaching its highest densities during autumn and winter. Red-tailed Hawk habitat use overlapped broadly with that of Swainson's Hawk (breeding season) and Northern Harrier (wintering season) but fine-scale habitat use indicated greater reliance on

riparian trees for Red-tailed Hawk. Our analysis provides evidence for fine-scale niche partitioning among the most abundant raptors at the study sites. (ID 15977)

**Augustine, D. J.**, USDA-ARS, USA, David.Augustine@ars.usda.gov  
Derner, J. D., USDA-ARS, USA, justin.derner@ars.usda.gov

PATCH BURN GRAZING MANAGEMENT AND GRASSLAND BIRD HABITAT IN THE WESTERN GREAT PLAINS

Combining prescribed fire and grazing management has been recommended as a tool to generate a heterogeneous vegetation mosaic for grassland birds. Past studies have focused on tallgrass prairies of the eastern Great Plains; less is known about fire-grazing interactions in semiarid grasslands of the western Great Plains. We conducted a patch burning experiment in shortgrass steppe (northeastern Colorado) comparing 3 unburned pastures with 3 pastures in which 25% of the area is burned each year. Burns were implemented in October or November of 2007 - 2010, and vegetation, cattle, pronghorn antelope, and grassland bird responses were monitored during 2008 - 2011. Herbaceous plant production on burns (mean + 1 SE = 498 + 82 kg ha<sup>-1</sup>) was similar to unburned sites (462 + 53 kg ha<sup>-1</sup>; P = 0.73) during the first post-burn growing season. Burns removed >95% of standing dead biomass, and reduced vertical vegetation density in mid-June by 53% (1.8 + 0.2 cm on burns vs. 3.8 + 0.3 cm in unburned sites). Cattle preferentially grazed on the patch burns during the growing season, and pronghorn preferentially grazed on patch burns during the fall and winter. Grassland birds showed strong responses to the heterogeneous vegetation mosaic produced by patch burn grazing management. At a 16-ha spatial resolution (i.e. the size of the patch burns), Horned Lark abundance was significantly negatively correlated with vegetation visual obstruction readings (VOR) in multiple years ( $r^2 = 0.25 - 0.55$ ). In contrast, Lark Buntins were positively correlated with VOR in a wet year ( $r^2 = 0.63$ ), and were less common and only found on unburned sites with high VOR in dry years. In all four years of the study, Mountain Plovers only occurred on current-year burns. Findings suggest patch burn grazing management can be an effective management tool to assist in sustaining disturbance-dependent grassland birds in the western Great Plains. (ID 15923)

**Baker, A. J.**, Royal Ontario Museum, Canada, allanb@rom.on.ca  
Weir, J., University of Toronto, Canada, jason.weir@utoronto.ca  
Tavares, E., Royal Ontario Museum, Canada

RELEVANCE OF NEWLY DISCOVERED GENETIC DIVERSITY TO SPECIATION AND CONSERVATION OF ENDANGERED BIRDS<sup>†</sup>

Genotype by sequencing of kiwi populations produces results that correspond to recently recognized species limits, and is supported by ecological and behavioural data. Additional genetic structure suggests that gene flow is restricted within brown kiwi populations. This raises the thorny problem of whether they warrant recognition as valid subspecies that can garner resources for protection, or alternatively listed as evolutionary significant units (ESUs) or management units (MU) of lower conservation priority. In contrast, the subspecies of red knot (*Calidris canutus rufa*) in the Americas is one of six subspecies worldwide that have been recognised mostly on the basis of small morphological differences, but amplified fragment length polymorphisms detect genetic differentiation among the three wintering populations of *C. rufa*. The taxonomic issue in either kiwi or red knot is whether or not to classify differentiated intraspecific units early or late in the process of genetic differentiation, just as it is with incipient species. High throughput multilocus genetic studies have detected unsuspected genetic lineages within species, and help taxonomists to make better informed decisions on rank. (ID 15917)



**Balakrishnan, C. N.**, East Carolina University, USA, balakrishnanc@ecu.edu  
 Bergland, A. O., Stanford University, USA, bergland@stanford.edu  
 Gonser, R. A., Indiana State University, USA, Rusty.Gonser@indstate.edu  
 Warren, W. C., Washington University School of Medicine, USA, wwarren@genome.wustl.edu

Tuttle, E. M., Indiana State University, USA, Elaina.Tuttle@indstate.edu

#### THE GENOMICS OF NONSPECIATION IN THE BEHAVIORALLY POLYMORPHIC WHITE-THROATED SPARROW

Chromosomal inversions are thought to contribute to adaptation and speciation as they reduce recombination, protecting favorable combinations of alleles. White-throated sparrows are a remarkable species in which a large inversion in the genome is perfectly associated with a suite of behavioral and morphological characteristics. This polymorphism, in combination with disassortative mating, leads to the stable maintenance of two “morphs” within the species. Among the behavioral traits that vary predictably by morph are key aspects of behavior including levels of aggression and parental care in both sexes. The unique features of this system have made white-throated sparrows a model system for the study of social behavior. With this in mind, we sequenced and assembled the complete genome of the white-throated sparrow *Zonotrichia albicollis*. Doing so, in combination with pooled whole genome resequencing data (pool-seq), enabled us to resolve the evolutionary and demographic history of the inversion. As expected, we find a bimodal distribution of *Fst* across the genome, with regions encompassing the inversion displaying high *Fst* (0.3) between morphs. We also find that the white morphs show high linkage disequilibrium across the inversion. Analyses of allele frequency spectra suggest that both the “tan” and “white” forms of the chromosome have experienced recurrent selective sweeps with little recombination between the derived and ancestral chromosomes. Comparison with transcriptomic data from two songbird outgroups indicates that within the inversion, that the tan morph more closely resembles the ancestral form, suggesting a transition from a more highly parental, less aggressive form to a more territorial form represented by the white morph. (ID 15953)

**Balasubramaniam, P.**, University of California, Riverside, USA, pbala001@ucr.edu  
 Rotenberry, J. T., University of Minnesota, USA, john.rotenberry@ucr.edu

#### A TEST OF THE FECUNDITY/OFFSPRING QUALITY TRADE-OFF AT HIGH ELEVATIONS: PATTERNS OF LIFE HISTORY VARIATION IN GALLIFORMES ACROSS ELEVATIONAL GRADIENTS\*

Elevational gradients are an excellent system to explore how environmental variation influences life history evolution. Patterns from altricial species show that species breeding at high elevations trade off between reduced fecundity and higher offspring quality and/or adult survival. At high elevations birds have smaller clutches and fewer broods, but longer incubation, nestling periods and post fledging care. It is hypothesized that the fecundity/offspring quality trade-off is achieved through increased parental investment via extended parental care. Using phylogenetically controlled methods I test the generality of the fecundity/offspring quality trade-off by analyzing patterns of life history variation in a clade of precocial species, Galliformes, across elevational gradients after also controlling for allometry and breeding latitude. Parental care of nestlings constrains clutch size in altricial species; hence precocial species that lack such care should not vary in clutch size across elevations, and reduction in fecundity should result from fewer broods. Investment in offspring quality should be via increase in egg mass, a form of parental investment analogous to parental care of nestlings. I found partial support for this hypothesis; clutch size did not vary across elevations and egg mass increased with elevation. Incubation periods were longer at high elevations. Colder temperatures and shorter breeding seasons at high elevations may select for higher offspring quality over offspring number. This study shows that selection pressures across elevational gradients drive the evolution of similar strategies despite intrinsic differences across taxa. (ID 15838)

**Baldassarre, D. T.**, Cornell Lab of Ornithology, USA, dtbaldas@syr.edu  
 White, T. A., Cornell University, USA, tawhite201@gmail.com  
 Karubian, J., Tulane University, USA, jk@tulane.edu  
 Webster, M. S., Cornell Lab of Ornithology, USA, msw244@cornell.edu

#### GENOMIC AND MORPHOLOGICAL ANALYSIS OF A SEMI-PERMEABLE AVIAN HYBRID ZONE SUGGESTS ASYMMETRICAL INTROGRESSION OF A SEXUAL SIGNAL

Hybrid zones are geographic regions where differentiated taxa meet and potentially exchange genes. Increasingly, genomic analyses have demonstrated that many hybrid zones are semi-permeable boundaries across which introgression is highly variable. In some cases, certain alleles penetrate across the hybrid zone in only one direction, recombining into the alternate genome. We investigated this phenomenon using genomic (genotyping-by-sequencing) and morphological (plumage reflectance spectrophotometry) analyses of the hybrid zone between two subspecies of the red-backed fairy-wren (*Malurus melanocephalus*) that differ conspicuously in a sexual signal, male back plumage color. We used a classic geographic cline approach to compare cline centers and widths among the genetic loci, and compare these to the plumage color cline. These analyses revealed a highly variable pattern of differential introgression, with many narrow coincident clines combined with several significantly wider clines, suggesting that the hybrid zone is a semi-permeable tension zone. The plumage cline was shifted significantly into the genomic background of the orange subspecies, consistent with sexual selection driving asymmetrical introgression of red plumage alleles across the hybrid zone. This interpretation is supported by previous experimental work demonstrating an extra-pair mating advantage for red males, but the role of genetic dominance in driving this pattern remains unclear. This study highlights the potential for sexual selection to erode taxonomic boundaries and promote gene flow, particularly at an intermediate stage of divergence. Additionally, it demonstrates the utility of combining a next generation genomic dataset with a classic hybrid zone analytical technique. (ID 15949)

**Barker, F. K.**, University of Minnesota, USA, barke042@umn.edu

#### TAXONOMIC VARIATION IN CRYPISIS: A SURVEY WITH EXAMPLES FROM WRENS AND BLACKBIRDS\*

Until the advent of molecular techniques, the recognized diversity of taxonomic groups was a function of the number of genetically differentiated units and human ability to recognize them through the expression of phenotypic traits. Since lineages vary in the basis of diversification, especially with regard to the importance of sexual selection, we might expect lineage-specific variation in the degree to which current species designations reflect actual historically isolated units. I survey genetic and taxonomic differentiation in Neotropical passerine species with regard to family-level taxonomy. This survey suggests substantial variation among groups in both recognized taxonomic variation and in the frequency of unrecognized differentiation. This pattern is explored using examples from wrens (Troglodytidae) and blackbirds (Icteridae). (ID 16347)

**Barrowclough, G. F.**, American Museum Natural History, USA, gfb@amnh.org  
 EFFECTIVE POPULATION SIZE, COALESCENCE, AND EPHEMERAL DIVERSITY: A TAXONOMIC CHALLENGE\*

DNA sequencing has enabled systematists to perform detailed geographical surveys that have resulted in the discovery of unanticipated variation in a variety of avian taxa. This has enabled them to describe patterns of geographical variation at previously unavailable spatial and temporal scales. One salient observation has been that coalescence in small populations leads to diagnosable taxa on time scales of a few thousands to tens of thousands

of years. Although the resulting geographic structure certainly represents important biogeographical signal, it also presents challenges because some of it is probably ephemeral and may be eliminated by gene flow or climatic and vegetational change. Its formal taxonomic recognition leads to significant conservation and management problems. Examples of this phenomenon in several North American taxa (grouse, hawks, owls), and in some African turacos, suggest that the problem may be particularly prevalent in relatively sedentary species. (ID 15764)

**Bartuszevige, A. M.**, Playa Lakes Joint Venture, USA, [anne.bartuszevige@pljv.org](mailto:anne.bartuszevige@pljv.org)  
Vazquez, M., Playa Lakes Joint Venture, USA, [misti.vazquez@pljv.org](mailto:misti.vazquez@pljv.org)  
Carter, M., Playa Lakes Joint Venture, USA, [mike.carter@pljv.org](mailto:mike.carter@pljv.org)

#### INTEGRATING HUMAN DIMENSIONS INTO BIOLOGICAL PLANNING FOR BIRD CONSERVATION IN THE WESTERN GREAT PLAINS

Increasingly, conservation organizations are acknowledging that conservation delivery is reliant not just on understanding ecological processes but social processes as well. The Playa Lakes Joint Venture (PLJV) is using human dimensions to better understand how to engage private landowners in playa conservation. The science of human dimensions addresses that suite of issues related to how people value natural resources, how they want those resources to be managed, and how they affect and are affected by those resources and related decisions. Playas are ephemeral wetlands found throughout the shortgrass prairie region. When wet, they are highly productive and provide food waterbirds during migration through the Central Flyway thus; playa conservation is a high priority. Since 97% of the landscape in this region is privately owned and half of the land area is in rowcrop agriculture, successful conservation delivery depends on public participation. In 2013, PLJV conducted landowner focus groups to understand their knowledge, attitudes and willingness to engage in conservation of playas on their property. Landowners were asked about their knowledge of playas and relationship to the High Plains Aquifer, their willingness to engage in conservation activities and impediments to participation. According to the results, many landowners do not understand playa functions and benefits, nor the connection between playas and the Aquifer. Many do not know about the playa restoration and conservation programs that are currently available. PLJV will include these results in their biological planning through a landscape design process which builds on the foundations of landscape ecology to bridge the gap between science and conservation. In addition, the landscape design process is designed to meet science-based bird conservation goals and meet needs of private landowners to deliver practical conservation solutions. (ID 16197)

**Batthey, C. J.**, University of Washington, USA, [cjbatthey@uw.edu](mailto:cjbatthey@uw.edu)  
Slager, D. L., University of Washington, USA, [slager@uw.edu](mailto:slager@uw.edu)  
Bryson, R. W., University of Washington, USA, [brysonjr@uw.edu](mailto:brysonjr@uw.edu)  
Klicka, J., University of Washington, USA, [klicka@uw.edu](mailto:klicka@uw.edu)  
PARAPHYLY AND MIGRATION IN THE RED-EYED VIREO SUPERSPECIES\*

The red-eyed vireo (*V. olivaceus*) presents an intriguing case study in the evolution of migration and range in the new world. The species is composed of at least three populations – northern migrants breeding as far north as the Yukon Territory, austral migrants ranging south to central Argentina and nonmigratory residents which breed across the species' "wintering" range in northern South America. In order to study the effect of migratory divide on gene flow within the species and to resolve its placement within the larger red-eyed vireo superspecies (including *V. altiloquus* of the Caribbean, *V. flavoviridis* of Mexico and Central America, and the microendemics *V. magister* and *V. gracilirostris*), we sequenced a genome-wide sampling of single-nucleotide polymorphisms (SNP's) from vireo tissues via a ddRADseq protocol and used this data to infer the phylogeny and patterns of historic

gene flow within the group. Preliminary results show that the red-eyed vireo is paraphyletic, with North- and South American breeders split by *V. altiloquus*. Resident and migrant South American breeders form a monophyletic group and ABBA/BABA tests found significant introgression between these lineages. No introgression was detected between northern- and southern-hemisphere red-eyed vireos, or between any other species as currently recognized. Our results support the recognition of South American breeders of the red-eyed vireo as a distinct species under the phylogenetic species concept, and suggest that use of the term "superspecies" to describe the red-eyed vireo and its close relatives should be discontinued given the lack of detectable gene flow. (ID 16086)

**Beason, J. P.**, Rocky Mountain Bird Observatory, USA, [jason.beason@rmbo.org](mailto:jason.beason@rmbo.org)  
Levandoski, G. J., Rocky Mountain Bird Observatory, USA, [greg.levandoski@rmbo.org](mailto:greg.levandoski@rmbo.org)  
Sparks, R. A., Rocky Mountain Bird Observatory, USA, [rob.sparks@rmbo.org](mailto:rob.sparks@rmbo.org)  
WESTERN Tanager MIGRATION RESEARCH AT ROCKY MOUNTAIN NATIONAL PARK IN COLORADO

Rocky Mountain Bird Observatory and the National Park Service initiated a project to investigate the migration patterns, fall stop-over sites, and winter distribution of Western Tanager (*Piranga ludoviciana*) at Rocky Mountain National Park in 2012. Field work in 2012 resulted in ten Western Tanagers being captured and out-fitted with light-level geolocators. In 2013, four tagged tanagers returned to territories occupied in 2012 and two geolocators were recovered. Southeast New Mexico and western Texas were identified as stopover locations and wintering areas were southern Mexico and Guatemala. This information represents the only complete documentation of Western Tanager migration throughout its range and may be representative of the population occupying the southern Rocky Mountain region. (ID 16271 | Poster 55)

Beck, M., Virginia Tech, USA, [beckmic@vt.edu](mailto:beckmic@vt.edu)  
**Hopkins, W. A.**, Virginia Tech, USA, [hopkinsw@vt.edu](mailto:hopkinsw@vt.edu)  
Jackson, B. P., Dartmouth College, USA, [Brian.P.Jackson@Dartmouth.edu](mailto:Brian.P.Jackson@Dartmouth.edu)  
Hawley, D. M., Virginia Tech, USA, [hawleyd@vt.edu](mailto:hawleyd@vt.edu)

#### THE EFFECTS OF A REMEDIATED FLY ASH SPILL AND WEATHER CONDITIONS ON REPRODUCTIVE SUCCESS, PHYSIOLOGY, AND OFFSPRING DEVELOPMENT IN TREE SWALLOWS

Birds are exposed to a number of natural and anthropogenic stressors during reproduction that can individually or interactively influence reproductive success and offspring development. We examined the effects of weather conditions, exposure to element contamination from the recently remediated fly ash spill in Kingston, TN, and the interaction between these factors on Tree Swallows (*Tachycineta bicolor*). Over the course of two breeding seasons beginning 2.5 yrs after the spill and 10 mo after completion of remediation, we monitored reproductive, physiological, dietary, and developmental characteristics of adults and nestlings at 1,122 active nests. We found that females breeding in impacted areas transferred greater concentrations of Hg, Se, Sr, and Tl to their eggs than females in reference colonies. After hatching, parental provisioning of emerging aquatic insects resulted in greater blood concentrations of Se in nestlings reared in colonies impacted by the spill compared to reference colonies, and these elevated concentrations remained stable across both years of study. However, egg and blood element concentrations were unrelated to any adverse effects on reproductive success, physiological parameters, or nestling condition. We found no strong effects of "normal" weather conditions on Tree Swallow growth or reproductive success. However, unseasonably cold weather was associated with reduced nestling wing growth and reproductive success among all colonies. There was no evidence of a negative interactive effect between contamination and severe weather. Given that blood Se



concentrations in nestlings near the remediated site exceeded the lower threshold of concern for birds and concentrations of Se in blood and Hg in eggs are not yet declining following remediation, future studies should continue to monitor emerging aquatic insects, resultant low-level exposure, and potential effects on insectivorous wildlife in the area. (ID 15875 | Poster 122)

**Beckman, E. J.**, University of New Mexico, USA, lbeckman@unm.edu  
Witt, C. C., University of New Mexico, cwitt@unm.edu

#### INTROGRESSION AMONG HIGH ANDEAN SISKINS\*

Genetic introgression among closely related taxa may have a significant evolutionary impact by challenging reproductive isolation and facilitating the local adaptation of one species by the introduction of favorable alleles from a second species. To understand its consequences on recently diverged lineages, we assessed introgression among three young siskin species that are sympatric in the high Andes. Previous work showed that between one widespread species, *Sporagra magellanica*, and its two high-altitude restricted relatives, there was extensive haplotype sharing in mitochondrial DNA, a known selective target at high elevations. The observed mtDNA pattern could indicate introgression and, potentially, selection for the introgressed allele resulting in local adaptation in *S. magellanica*. Alternatively, the pattern could reflect incomplete lineage sorting. To elucidate the hybridization history of the Andean siskins, we evaluated introgression in mtDNA and nDNA, then assessed concordance between the characters. First, we sequenced mtDNA from *S. magellanica* across the central Andes and found a latitudinal cline in allele frequency as predicted by introgression if hybridization is rare. Second, we generated two nDNA datasets using next-generation sequencing: a genotype-by-sequencing dataset of ~5,000 loci and an anchored phylogenomics dataset of ~300 loci. We constructed species trees from these data and found no evidence for introgression using the ABBA/BABA method. mtDNA and nDNA introgression patterns were not concordant. The most likely scenario is that mtDNA of a high-altitude specialist was introduced into *S. magellanica* via a rare hybridization event; a future study of divergence times estimated by mtDNA and nDNA will explicitly test this hypothesis. (ID 16280)

**Beckmann, C.**, Deakin University, Australia, c.beckmann@deakin.edu.au  
Martin, K., University of British Columbia, Canada, kathy.martin@ubc.ca

#### HIGH AND LOW ELEVATION BREEDING CONDITIONS IN THE AUSTRALIAN MOUNTAINS: THE TABLES TURN FOR SONGBIRDS WHEN THE HEAT WAVES BEGIN

On the Australian continent high elevation habitats are naturally rare, with just 12 % of Australia's land mass between 500-999 m in elevation, and only 1 % above 1000 m, with most located in temperate regions of Australia. High elevation habitat often gives rise to higher seasonality and thus short reproductive seasons, frequent storms, extreme weather, and wider daily temperature ranges compared to low elevations at the same latitude, with high elevation habitat thought to be inherently more stressful. Over the past 35 years alpine temperatures in Australia have been increasing, with the greatest increases occurring in south-eastern Australia, where most temperate high elevation habitat on the continent is found. Climate change is recognized as having a diverse range of possible impacts on Australian high elevation habitats. We studied the breeding phenology, fecundity and breeding behaviour of an elevational generalist songbird, the grey fantail, (a monomorphic, socially monogamous species with biparental care) across an elevational gradient (378 to 1331 m, field sites situated 3.6 km apart). Although the onset of egg laying was delayed by 21 days at HE in contrast to LE, unlike many temperate elevation gradients in the Americas, the breeding season duration was 13 % longer at HE than LE. Clutch size, adult morphometrics and nest dimensions did not vary with elevation. Early in the

breeding season birds at high elevation faced more frequent and extreme cold weather, however severe heat waves late in the breeding season were a source of nesting mortality for low elevation breeders. With heat waves predicted to increase in frequency and severity, low elevation habitat will become more stressful, thus increasing the relative conservation value of high elevation areas. (ID 16116)

**Beckmann, C.**, Deakin University, Australia, c.beckmann@deakin.edu.au  
Biro, P., Deakin University, Australia, pete.biro@deakin.edu.au  
Martin, K., University of British Columbia, Canada, kathy.martin@ubc.ca

#### HIERARCHICAL ASSESSMENT OF AVIAN RE-NESTING BEHAVIOR UNDER RISK OF PREDATION: POPULATION-LEVEL, ACROSS- AND INTRA-INDIVIDUAL RESPONSES

Animal behavior is most often studied at the mean- and across-individual levels. However, individuals can also differ in their intra-individual (residual) variation, but this has been virtually un-studied in non-human animals and has never been studied in the field. Here, we statistically decompose behavioral variation into all three levels to gain a better understanding of avian re-nesting behavior under risk of predation in the wild. We followed 62 marked pairs of grey fantails (*Rhipidura albiscapa*) across an entire breeding season and quantified re-nesting behavior under risk of nest predation (194 nesting attempts). On average, individual female fantails increased distances moved, and decreased height of nests, with each successive nest failure, suggesting attempts to move away from risky areas/habitats. In addition, re-nests were placed closer to the previous one if it was successfully fledged than if it was abandoned during building or was predated. Females did not consistently differ in re-nesting behavior (i.e. no across-individual variation in intercepts and slopes). However, females differed in the predictability of distances moved between nests, and predictability of the heights of these nests, suggesting perhaps that relatively unpredictable females (with higher residual variance) are more risk averse. Importantly, none of the mean-level trends described above were evident if we did not account for these individual differences in the re-nesting predictability (by fitting a unique individual-specific residual variance parameter). These results highlight the need to consider variation at mean-, across-individual, and intra-individual levels whenever possible when studying labile traits such as behavior. (ID 16117)

**Behney, A. C.**, Cooperative Wildlife Research Laboratory, Center for Ecology, Southern Illinois University, USA, abehney@siu.edu  
O'Shaughnessy, R., Cooperative Wildlife Research Laboratory, Center for Ecology, Southern Illinois University, USA  
Eichholz, M. W., Cooperative Wildlife Research Laboratory, Center for Ecology, Southern Illinois University, USA  
Stafford, J. D., U.S. Geological Survey, South Dakota Cooperative Fish & Wildlife Research Unit, USA

#### AN ASSESSMENT OF FORAGING RISK-TAKING BEHAVIOR USING FIELD-LEVEL FOOD MANIPULATIONS

Foraging animals face a fundamental tradeoff between food consumption and predation risk. Factors that influence foragers' perceived predation risk or valuation of energy may affect how animals approach this tradeoff. We manipulated food abundance in wetlands differing in vegetation structure to assess how risk-taking in 5 duck species during spring migration was influenced by food abundance, vegetation structure, and ultimately, life history characteristics. Ducks make an interesting focal group because they regularly feed with their head under the water surface, effectively eliminating vigilance while feeding. Based on traditional life history theory, we predicted that shorter lived, more fecund species (r-selected) should be willing to take more risks (devote more time to feeding) than longer lived, less fecund species (k-selected). We quantified life history using survival,

mass, and reproductive output; the gradient from more r-selected to more k-selected was wood duck, blue-winged teal, ring-necked duck, lesser scaup, and mallard. Consistent with our predictions, wood ducks exhibited the most pronounced increase in risk for a greater food reward (12.6% more feeding while in food treatment plots vs. control plots) and showed a very clear pattern of females increasing their value of energy prior to nesting. Ring-necked duck, and lesser scaup also devoted an average of 15.3% more time to feeding while in treatment plots than control plots but with much more variability. Contrary to our predictions, blue-winged teal actually reduced their risk while in treatment plots by feeding 14.0% less than in control plots. Overall, food abundance influenced risk-taking in all species but mallards. Traditional life history characteristics were poor predictors of risk-taking behavior among duck species. Our results highlight the importance of food availability and factors other than traditional life history characteristics in risk-taking behavior. (ID 16015)

**Beissinger, S. R.**, University of California at Berkeley, USA, [beis@berkeley.edu](mailto:beis@berkeley.edu)  
**Tingley, M. W.**, Princeton University, USA, [mtingley@princeton.edu](mailto:mtingley@princeton.edu)

#### THE UPS AND DOWNS OF CLIMATE CHANGE: HETEROGENEOUS ELEVATIONAL SHIFTS OF SIERRA NEVADA BIRDS AND OTHER TAXA OVER THE PAST CENTURY

Studies of observed biogeographic responses to 20th century climate change have principally examined effects based on increases in mean temperature, which is collectively termed a “warming fingerprint”. The importance of change in other aspects of climate is widely acknowledged, but how these changes drive biogeographic responses is poorly understood. Montane species provide an excellent system to study biogeographic responses through changes in upper and lower elevation limits, and mean elevation. We describe how various climatic characteristics have changed regionally in the Sierra Nevada during the 20th century and compare to changes in other biotic realms in California. We then review empirical evidence of biogeographic responses to climatic changes in montane birds, and compare directions and rates of elevational shifts of birds to invertebrates, plants and mammals in the Sierra Nevada. Range limit shifts of montane birds exhibited strong spatial heterogeneity. Moreover, shifts were inconsistent with a warming fingerprint; downslope shifts were as common as upslope shifts, and community turnover was greatest at highest and lowest elevations. We identify potential mechanisms for these responses, and consider how they are filtered through: (1) exposure – how much local climate change has occurred relative to a species’ climatic niche; (2) sensitivity – the degree to which species persistence and demographic performance depend on climate; (3) adaptive capacity – how a population responds to changes in climate by either persisting in situ or moving to more suitable regions; and (4) indirect effects – the influence of climate change on species interactions. (ID 15820)

**Belisle, M.**, Université de Sherbrooke, Canada, [Marc.M.Belisle@USherbrooke.ca](mailto:Marc.M.Belisle@USherbrooke.ca)

#### INFLUENCE OF AGRICULTURAL INTENSIFICATION ON THE BREEDING ECOLOGY OF TREE SWALLOWS\*

One of the main hypotheses put forward to explain the decline of aerial insectivores involves the widespread use of insecticides, particularly in agriculture. Insecticides may harm birds directly by poisoning them, and indirectly, by reducing the abundance of their prey. To assess the evidence supporting this hypothesis using the Tree Swallow (*Tachycineta bicolor*) as a model species, we monitor the breeding ecology of this aerial insectivore within a network of 400 nest boxes distributed equally among 40 farms located along a gradient of agricultural intensification, and thus in pesticide use, in southern Quebec, Canada, since 2004. So far, we found that nest box occupancy by Tree Swallows decreases with agricultural intensification, but likely through competitive interactions with House Sparrows (*Passer*

*domesticus*), which abundance is higher in intensively cultivated areas. Indeed, the main prey of Tree Swallows, Diptera, is generally equally abundant throughout the study area during nest building and laying and is thus likely to play a negligible role at this period. On the other hand, during the nestling and fledgling stages, Diptera abundance is lower and decreases more rapidly as the summer progresses in intensively cultivated areas compared to landscapes characterized by hayfields and pastures. This likely result in the lower survival and slower growth of nestlings we observe in intensively cultivated areas. Adults also appear to sustain a cost when breeding in intensively cultivated areas as they, for example, spend more time away from the nest (likely foraging) and show a lower immunological response to phytohemagglutinin. (ID 16192)

**Benedict, L.**, University of Northern Colorado, USA, [lauryn.benedict@unco.edu](mailto:lauryn.benedict@unco.edu)  
**Warning, N.**, University of Northern Colorado, USA, [natwarning@gmail.com](mailto:natwarning@gmail.com)  
**SPATIAL AND BEHAVIORAL RESPONSES OF ROCK WRENS TO CANYON WRENS**

Migratory species may make annual territory settlement decisions based on the presence of sedentary species in the same habitats. These decisions set the stage for competitive ecological interactions between species and are mediated by behavioral interactions. We studied how migratory rock wrens (*Salpinctes obsoletus*) interact with sedentary canyon wrens (*Catherpes mexicanus*) in Northern Colorado, where both species are crevice-nesting insectivores that live exclusively in rocky habitats. We examined where rock wrens established home ranges in relation to canyon wren home ranges and we conducted song playback experiments to assess rock wren behavioral responses to simulated territorial intrusion by rock wrens, canyon wrens, and spotted towhees (*Pipilo maculatus*), a species with which rock wrens do not compete for food or nest sites. Results indicated that rock wrens recognized the songs of canyon wrens and responded similarly to territorial threats from rock wrens and canyon wrens. Rock wrens did not, however, avoid establishing home ranges that overlapped substantially with the home ranges of canyon wrens. Space use patterns provided no evidence of interference competition between the two species, but behavioral responses to song playback did suggest that rock wrens treated canyon wrens as competitors once home ranges were established. (ID 15784)

**Benham, P. M.**, University of Illinois, Urbana-Champaign, USA, [benham2@illinois.edu](mailto:benham2@illinois.edu)

**Cheviron, Z. A.**, University of Illinois, Urbana-Champaign, USA, [cheviron@illinois.edu](mailto:cheviron@illinois.edu)

#### HISTORICAL AND ECOLOGICAL CORRELATES OF POPULATION STRUCTURE IN THE SAVANNAH SPARROW (*PASSERCULUS SANDWICHENSIS*)

Investigating phylogeographic patterns in widespread species can provide important insights into the landscape features and historical processes initiating divergence between populations. The Savannah Sparrow breeds throughout much of North America with 18 subspecies occupying arid grasslands, desert islands, humid meadows, tundra, and saltmarshes. In the present study we gather representative samples from across the breeding distribution of the Savannah Sparrow and employ next-generation sequencing techniques to determine patterns of historical expansion and divergence between distinct environments. DNA was extracted from 126 tissue samples representing 15 subspecies. These individuals were sequenced using a genotyping-by-sequencing approach on an Illumina HiSeq platform, which yielded over 200 million reads. We genotyped each individual at nearly 3000 unlinked single nucleotide polymorphisms (SNPs) and then used these data to examine population structure and historical demography. Our SNP data set revealed greater population structure than a previous mtDNA phylogeography with an early division apparent between

eastern/northern and western populations. This initial split was followed by divergence between western birds and populations occupying saltmarshes in northwestern Mexico. Saltmarsh populations subsequently diversified into six genetically distinct populations in isolated estuaries largely corresponding to previously described subspecies. Within the eastern clade we find three populations diverging stepwise from the eastern United States to Alaska, a pattern that we interpret as expansion into habitats made available by receding glaciers. (ID 16003)

**Benites, P.**, Museo Argentino de Ciencias Naturales, Argentina, pilarbenites@gmail.com

Gabelli, F., Facultad de Psicología, Universidad de Buenos Aires, Argentina, fabiangabelli@gmail.com

Tubaro, P. L., Museo Argentino de Ciencias Naturales, Argentina, pltubaro@gmail.com

#### SONG DIFFERENCES IN RED-BREASTED MEADOWLARKS

Song is one of the most important signals in communication in birds, and the song of a given species is the result of a combination of characteristics of elements with given temporal structures and frequency parameters. Red-breasted Meadowlarks are a group of five species within the *Stunella* clade that inhabit open areas in South America, three of which can be found in sympatry in the south of Buenos Aires, Argentina. They exhibit in their song repertoires two types of song, the perching song (PS) and the flight song (FS), which differ both in structure and in the behavioral context in which they are emitted. We evaluated in this study the interspecific song differences of Red-breasted Meadowlarks, analyzing structural, temporal and frequency parameters of 141 songs of all five species of the group through a PCA followed by ANOVAs on the PC factors. We found a varied degree of interspecific differences in both types of song in species of the group in the three categories of song parameter. Particularly, we found that song differences in the group are marked among species that are sympatric, and even more in sympatric sister species, while a greater overlap in the structure of the song is found when comparing allopatric and more distantly related species. These results suggest divergence in reproductive characters, and agree with the prediction that signals in closely related species that live in sympatry should be more divergent than those signals in species that live in allopatry (Dobzhansky 1937, Lack 1968). (ID 16338 | Poster 101)

**Benkman, C. W.**, University of Wyoming, USA, cbenkman@uwyo.edu

#### SURVIVAL AND POPULATION SIZE OF A RESIDENT BIRD SPECIES ARE DECLINING WITH INCREASES IN HOT SUMMER DAYS

Few studies have identified plausible biological mechanisms by which increasing temperatures affect populations. We hypothesize that the South Hills Crossbill (*Loxia curvirostra* complex), endemic to south-central Idaho, has declined because the serotinous lodgepole pine (*Pinus contorta*) cones, which crossbills rely almost exclusively on as their source of food, are opening and releasing their seed because of an increase in hot summer days. We use distance sampling to confirm an 80% decline in crossbill abundance between 2003 and 2011, and mark-recapture-resighting techniques and a life-table analysis to show that temporal variations in apparent adult survival are sufficient to cause the observed population decline. We modeled climate covariates with apparent annual survival to test competing hypotheses of climate impacts and find that warmer temperatures correlate with lower survival. We also show that changes in cone productivity and forest cover are unlikely to account for the crossbill decline. The implications are that warmer temperatures will lead to additional declines in survival and population size, potentially causing the extinction of this unique crossbill. (ID 16026)

Bergeon Burns, C. M., Louisiana State University and AgCenter, USA, cbburns@agcenter.lsu.edu

Woltmann, S., Austin Peay State University, USA, woltmanns@apsu.edu

Stouffer, P. C., Louisiana State University and AgCenter, pstouffer@lsu.edu

**Taylor, S. S.**, Louisiana State University and AgCenter, USA, staylor@agcenter.lsu.edu

#### PHYSIOLOGICAL AND ECOLOGICAL EFFECTS OF THE DEEPWATER HORIZON OIL SPILL ON SEASIDE SPARROWS

The 2011 Deepwater Horizon (DWH) oil spill released vast amounts of crude oil into the Gulf of Mexico, much of which reached shorelines including the coastal marshes. Polycyclic aromatic hydrocarbons (PAHs) contained in oil can persist in this environment for many years, creating potential for chronic effects in resident species. As a top consumer and year-round resident, the Seaside Sparrow (*Ammodramus maritimus*) plays an important role in salt marsh ecosystems and is vulnerable to long-term consequences of marsh oiling. Our group has been studying the effects of the DWH spill on Seaside Sparrows breeding in coastal marshes of southeastern Louisiana for the last three years. We established replicate study areas to compare animals nesting in unoiled marsh with those found at sites that experienced moderate-to-heavy oiling. Radiotelemetry and mark-recapture data indicate that individuals generally have restricted movements (within a few hundred meters of their nest) during the breeding season, suggesting potential for differences among study areas. We are examining hepatic cytochrome P450 (CYP1A) enzyme as a biomarker of PAH exposure, with upregulation predicted in individuals living in oiled environments. We are also examining reproductive success and abundance. Preliminary nesting data combined from 2012 and 2013 indicate that nests on unoiled sites are significantly more likely to fledge young than those on oiled sites. Point count data indicate a tremendous decrease in abundance between years that obscure differences among plot types. The decrease in abundance may be attributable to Hurricane Isaac inundating our study sites between the two breeding seasons. (ID 16224)

**Berzins, L. L.**, University of Northern BC, Canada, berzins@unbc.ca

Shrimpton, J. M., University of Northern BC, Canada, Mark.Shrimpton@unbc.ca

Dawson, R. D., University of Northern BC, Canada, Russ.Dawson@unbc.ca

#### EXPERIMENTAL ALTERATION OF PRE-BREEDING HORMONES IN FEMALE TREE SWALLOWS INFLUENCES EXTRA-PAIR COPULATIONS AND REPRODUCTIVE SUCCESS\*

Extra-pair paternity (EPP) occurs commonly among many socially monogamous species; however, the mechanisms underlying why females engage in extra-pair copulations (e.g. direct and indirect benefits) are unclear. Several hypotheses currently exist to explain variation in the rate of EPP among females including food availability, parental care, and breeding density as examples. Recently, it has also been demonstrated that behavioral traits, such as aggression, may influence rates of EPP. To test the hypothesis that female behavior may influence extra-pair mating decisions, we treated female tree swallows (*Tachycineta bicolor*) with hormones during pre-breeding to experimentally alter female behavior. Females were treated with implants containing either 1-4-6 androstatrien-3, 17 dione (ATD) combined with flutamide (FLU) to reduce aggressive behavior and testosterone (T) to increase aggressive behavior, or received sham implants to serve as controls. We found that females treated with ATD/FLU implants had significantly less extra-pair offspring in their nests than control females. In addition, nestlings raised in the nests of females treated with ATD/FLU were lighter at 16 days of age compared to controls. Similar to previous studies, we found negative effects of increased T on female reproductive success as females treated with T implants during pre-laying laid clutches later and did not incubate their eggs. Overall, our results demonstrate that experimentally altering pre-breeding hormones in female tree swallows influence whether females



engage in extra-pair copulations, and suggest that female mating strategies may be influenced by aggressive behavior. (ID 15791)

**Best, H. E.**, University of Northern Colorado, USA, best0432@bears.unco.edu  
Benedict, L., University of Northern Colorado, USA, lauryn.benedict@unco.edu

#### NORTH AMERICAN BIRDS AND THEIR PRIVATE CONVERSATIONS: QUANTIFYING THE PREVALENCE AND CONTEXTS OF OSCINE PASSERINE SOFT SONGS

Some avian species sing soft song (also known as a whisper or quiet song) which has low amplitude and therefore can only be heard in close proximity to the singer. Soft song may be used when a bird wants to avoid detection by undesired listeners. Soft song is used by various species in multiple contexts including courtship, copulation, and territorial disputes. Individual studies have shown that the function of soft song varies among species, but to date no studies have provided an overview of the prevalence and most common functions of soft song. We used the Birds of North America Online reports to find information on the communication sounds of North American Oscine Passerines. We noted all references to soft song, as well as mechanical sounds and calls that could be used for quiet communication. The data were characterized by both the form of the sound (song, call, mechanical) and the context of the sound. Our preliminary data show that the majority of species use some form of low amplitude communication, and that song is the most prevalent form. Communication between mates and territorial disputes are both common contexts for soft song. Results indicate that soft song is common among North American Oscine Passerines, and that it can confer a range of advantages. Soft song may be an essential behavior for birds that rely heavily on private conversations with a limited set of receivers. Soft song can be difficult to document, but deserves more study as a widely-used multifunctional signal type. (ID 16113 | Poster 98)

**Betts, M. G.**, Oregon State University, USA, matt.betts@oregonstate.edu  
Hadley, A. S., Oregon State University, USA, adam.hadley@oregonstate.edu

#### HUMMINGBIRD FOREPLAY: EXPERIMENTAL EVIDENCE THAT A TROPICAL PLANT DISTINGUISHES AMONG HUMMINGBIRD SPECIES

Pollination by birds can provide directed pollen flow under environmental conditions that may be challenging for insects. However, if bird home ranges are small, as for territorial hummingbirds, plants still face the problem of inbreeding which may negate many of the benefits of sexual reproduction. We provide evidence for a previously undescribed plant "behavior" that appears to maximize outcrossing. Using an aviary to experimentally control pollen quality, we demonstrate that a tropical plant, *Heliconia tortuosa*, invests in reproduction differentially across 6 species of hummingbirds. The growth of pollen tubes, the first critical step in reproduction, occurred frequently when plants were visited by specialized traplining species with long bills (e.g., *Phaethornis guy*, *Campylopterus hemileucurus*), but was reduced 4x when visited by straight-billed territorial birds (e.g., *Amazilia tzacatl*). Further, we demonstrate experimentally that hand-pollination only leads to fertilization when nectar is extracted. Plants therefore appear to use nectar extraction capacity of hummingbirds as an indicator of degree of hummingbird specialization, which in turn reflects pollinator movement capacity and potential for long-distance pollen flow. Our findings have implications for plant-pollinator coevolution, as well as the stability of plant-pollinator networks threatened by anthropogenic change. (ID 15892)

**Billerman, S. M.**, University of Wyoming, USA, sbillerm@uwyo.edu  
Carling, M. D., University of Wyoming, USA, mcarling@uwyo.edu

#### GENOMIC ANALYSIS OF A SAPSUCKER HYBRID ZONE\*

Biodiversity is created through population divergence and speciation. 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 (*S. ruber*) Sapsuckers hybridize along a narrow contact zone that stretches from northern California to British Columbia and are excellent models for investigations of the evolution of reproductive isolation. To study reproductive isolation in the sapsucker hybrid zone, I will use an integrative approach that combines ecological niche modeling with recent advances in sequencing technology to assess not only how different species are distributed across the landscape, but also how gene flow may be affected by climate change. Robust climate models will be combined with genetic data from a genotyping-by-sequencing approach to address how ecological differences may impact differences in genotype distribution, genetic diversity, and gene flow across an avian hybrid zone. Using genetic data, I will determine the genetic ancestry of individuals using Bayesian genomic cline analysis, which will help form the basis of testing basic predictions of hybrid zone movement. Further in a moving hybrid zone, there will likely be a mismatch between phenotype and genotype, with genes of one species expanding beyond the phenotypic hybrid zone. Taken together with climate data, the genetic data will also allow me to test how climate change may impact genetic diversity in a potentially important area for diversification. (ID 16145)

**Bled, F.**, Mississippi State University - Carnivore Ecology Laboratory, USA, florent.bled@gmail.com  
Sauer, J. R., USGS-PWRC, USA, jrsauer@usgs.gov  
Pardieck, K. L., USGS-PWRC, USA, kpardieck@usgs.gov  
Doherty, P. F., Colorado State University - Department of Fishery and Wildlife Biology, USA, doherty@warnercn.colostate.edu  
Royle, J. A., USGS-PWRC, USA, aroyle@usgs.gov

#### MODELING TRENDS FROM NORTH AMERICAN BREEDING BIRD SURVEY DATA: A SPATIALLY EXPLICIT APPROACH

Population trends, defined as interval-specific proportional changes in population size, are often used to help identify species of conservation interest. Efficient modeling of such trends depends on the consideration of the correlation of population changes with key spatial and environmental covariates. This can provide insights into causal mechanisms and allow spatially explicit summaries at scales that are of interest to management agencies. We expand the hierarchical modeling framework used in the North American Breeding Bird Survey (BBS) by developing a spatially explicit model of temporal trend using a conditional autoregressive (CAR) model. By adopting a formal spatial model for abundance, we produce spatially explicit abundance and trend estimates. Analyses based on large-scale geographic strata such as Bird Conservation Regions (BCR) can suffer from basic imbalances in spatial sampling. Our approach addresses this issue by providing an explicit weighting based on the fundamental sample allocation unit of the BBS. We applied the spatial model to three species from the BBS. Species have been chosen based upon their well-known population change patterns, which allows us to evaluate the quality of our model and the biological meaning of our estimates. We also compare our results with the ones obtained for BCRs using a nonspatial hierarchical model. Globally, estimates for mean trends are consistent between the two approaches but spatial estimates provide much more precise trend estimates in regions on the edges of species ranges that were poorly estimated in non-spatial analyses. Incorporating a spatial component in the analysis not only allows us to obtain relevant and biologically meaningful estimates for population trends, but also enables us to provide a flexible framework in order to obtain trend estimates for any area. (ID 15966)

**Blockstein, D. E.**, National Council for Science and the Environment, USA, David@NCSEonline.org

#### OVERVIEW: THE ECOLOGY AND EXTINCTION OF THE PASSENGER PIGEON (ECTOPISTES MIGRATORIUS)<sup>†</sup>

The Passenger Pigeon was once the most abundant bird in the world. They became superabundant because their ecological characteristics – highly mobile and colonial – allowed them to exploit superabundant food resources (especially oak and beech mast). The immense numbers protected birds from predators. But the large numbers and the coloniality made market killing possible. Despite the horrendous numbers that were slaughtered, killing alone could not have accounted for the extremely rapid decline following the Civil War. Extinction was a result of the interplay between biological and human factors – including vulnerability resulting from specialization, the rise of technology (railroads and telegraphs), economics and values. If the nesting grounds had been left alone, it is very unlikely that enough birds would have been killed to drive the population to extinction. Deforestation – especially in the east – added to the problem. The population apparently reached a point at which recovery was impossible. This number may have been surprisingly high. Once the population went from billions to tens of thousands, the species was apparently doomed, due to failure to raise enough young to replace those that had been killed. The story of the Passenger Pigeon holds many lessons for today. These range from the obvious that abundance is not a predictor of resilience to the subtle that new forms of technology that may appear unrelated can be significant causes of extinction. (ID 15748)

**Bolus, R. T.**, U.S.G.S. Rocky Mountain Science Center, University of Illinois at Urbana-Champaign, USA, rbolus@usgs.gov

Diehl, R. H., U.S.G.S. Northern Rocky Mountain Science Center, USA, rhdiehl@usgs.gov

Deppe, J. L., Eastern Illinois University, USA, jldeppe@eiu.edu

Ward, M. P., University of Illinois at Urbana-Champaign, USA, mpward@illinois.edu

Moore, F. R., The University of Southern Mississippi, USA, frank.moore@usm.edu

Bohrer, G., The Ohio State University, USA, bohrer.17@osu.edu

Schofield, L. N., Eastern Illinois University, USA, schofield.lynn@gmail.com

Zenzal, T. J., The University of Southern Mississippi, USA, tjzenzal@gmail.com

#### AVAILABILITY AND USE OF SUPPORTIVE WINDS BY MIGRATING LANDBIRDS THAT CROSS THE GULF OF MEXICO<sup>†</sup>

Migrating birds time their movements and change their routes and altitudes to capitalize on supportive winds, strategies to minimize energy expenditure and/or total migration time. Ideally a migrant would have full information about the present and future locations of supportive winds, but there are likely perceptual and physical constraints on what information is available and can be used. We hypothesized that migrating passerines respond to variation in winds, but that their response is limited by their ability to sample or forecast winds. We captured and radio-tagged Swainson's Thrushes, Indigo Buntings, Wood Thrushes, Gray Catbirds, and Red-eyed Vireos on the northern coast of the Gulf of Mexico (n = 376). We used an automated radio telemetry system to detect individuals' departures from Ft. Morgan, Alabama, USA and arrivals at the Yucatan Peninsula, Mexico (n = 69 detections in Mexico, or 18%) following successful crossings of the Gulf of Mexico. Using each individual's departure time, departure direction, arrival time, and flight duration we built individual-based models to create predicted tracks based on wind conditions and varying altitude selection strategies. We found evidence that birds are limited in their ability to search altitudinal differences in winds en route, perhaps due to the costs of climbing. We also tested the interacting effects of winds, morphology, and physiological condition on individuals' decisions to cross the Gulf of Mexico. Individuals in better physiological condition and individuals of species that had more efficient wings for flight were more likely to cross the Gulf, sometimes even when winds were not ideal. (ID 16388)

**Bombaci, S. P.**, Colorado State University, USA, sara.bombaci@colostate.edu

Pejchar, L., Colorado State University, USA, Liba.Pejchar@colostate.edu

Gallo, T., Colorado State University, USA, travis.gallo@colostate.edu

#### BIRDS LOSING GROUND TO HABITAT MITIGATION IN A REGION UNDERGOING RAPID ENERGY DEVELOPMENT

Habitat manipulation intended to mitigate the impact of energy development on game animals is well underway in the western U.S. Yet, the consequences of these actions for other species are not well understood. A series of large-scale experimental plots have been established in the Piceance Basin, a region of Colorado undergoing rapid energy development, to evaluate alternative methods for promoting mule deer habitat. We use this experimental design to additionally test the effects of these mitigation strategies on songbird populations. We found lower bird occupancy and species richness values in all treatment plots compared to control plots; however the strength of this response varied by habitat guild. Our approach and research findings can be used to inform multiple-species conservation objectives in pinyon-juniper ecosystems undergoing energy development. (ID 15727)

**Bonier, F.**, Queen's University, Canada, bonierf@queensu.ca

Rendell, W. B., Loyalist College, Canada

Robertson, R. J., Queen's University, Canada

#### LONG-TERM DECLINE OF A BREEDING POPULATION OF TREE SWALLOWS (TACHYCINETA BICOLOR)<sup>†</sup>

Many aerial insectivore species are in decline, particularly in Northeastern North America, but the causes of these declines are largely unknown. The box-nesting population of Tree Swallows at the Queen's University Biological Station in Ontario has been continuously studied since 1975, and has been in decline for the past two decades. This extraordinary dataset offers a unique opportunity to test hypotheses for the causes and correlates of decline in this population, with possible implications for our understanding of aerial insectivore declines in general. I will present patterns of correlations between population dynamics and breeding success, recruitment, return rates, adult condition, disease, weather patterns, and climate. Overall, most evidence points to a cause for the decline away from the breeding grounds. (ID 16017)

**Bonisoli-Alquati, A.**, University of South Carolina, USA, alquati@mailbox.sc.edu

Møller, A. P., Université Paris-Sud, France, anders.moller@u-psud.fr

Jenkinson, S., University of South Carolina, USA, shannajenkinson@gmail.com

Milinevsky, G., National Taras Shevchenko University of Kyiv, Ukraine, genmilinevsky@gmail.com

Mousseau, T. A., University of South Carolina, USA, mousseau@sc.edu

#### ECOLOGICAL CORRELATES OF SPECIES SENSITIVITY TO IONIZING RADIATION IN CHERNOBYL

Finding the life history correlates of sensitivity to toxicants is important for predicting species' response to environmental contamination. Here, we analyzed how species-specific sensitivity to low-dose ionizing radiation is predicted by morphological and life history traits in a set of 18 passerine species. During the course of two field seasons, we sampled the understory avifauna across forest plots that varied in radioactive contamination over four orders of magnitude (range: 0.01 – 117.5 µSv/h) in the Chernobyl region. As a measure of sensitivity to radiation exposure we used the slope and effect size of the relationship between radiation and DNA damage, as measured by the comet assay on peripheral erythrocytes. On a final sample of 561 birds (range: 7 – 196 birds per species), we investigated whether variation in species-specific reproductive effort, migratory behavior and the intensity of sexual selection predicted the likelihood of increased DNA damage when exposed to ionizing radiation. DNA damage increased with increasing radiation exposure in species with pheomelanin-based plumage and in

species migrating longer distances. Species with relatively large clutch size, higher sexual size dimorphism and carotenoid-based plumage were more strongly affected by exposure to ionizing radiation, as indicated by larger effect sizes. These results are in line with previous findings on population trends and adaptation of bird species to ionizing radiation in Chernobyl. They suggest that life history traits can covary with biomarkers of exposure, and their investigation can inform the selection of sensitive biomarkers for ecological risk assessment. (ID 16301)

**Bonter, D. N.**, Cornell University, USA, dnb23@cornell.edu  
Greig, E. I., Cornell University, USA, eig9@cornell.edu

#### WINTER RANGE EXPANSION IN ANNA'S HUMMINGBIRDS: THE INTERPLAY OF CLIMATE, HABITAT, AND SUPPLEMENTAL FEEDING

Anna's Hummingbirds (*Calypte anna*) have undergone a dramatic expansion in winter range limits over the past two decades with birds now successfully overwintering as far north as British Columbia. The dynamics of this range expansion have not been formally studied, nor has significant attention focused on the mechanisms underpinning the range expansion. Anthropogenic drivers including habitat change, climate change and the provisioning of supplemental food all potentially contribute to the successful overwintering of this species at northern latitudes. We analyzed data from Project FeederWatch, a citizen science initiative designed to track changes in the distribution and abundance of birds over time and space, in order to examine potential drivers of the change in Anna's Hummingbird winter ranges. We combine data from 2,956 FeederWatch locations collected over 17 years with indices of land cover, climate, human population density, and the availability of supplemental food. We 1) document the range expansion of Anna's Hummingbirds within an occupancy modeling framework 2) test the hypothesis that the hummingbird range expansion is facilitated by increased availability of supplemental food sources and 3) contrast the relative impact of warming winter temperatures and increased urban development on the hummingbird range expansion. This work is one of the first to use a nectar-dependent species within an occupancy modeling framework to assess the impacts of climate change, urbanization and supplemental feeding on range dynamics. (ID 15847)

**Borchert, S. M.**, Louisiana State University, USA, sborch2@lsu.edu  
Stouffer, P. C., Louisiana State University, USA, pstouffer@lsu.edu

#### SITE-SPECIFIC HABITAT AND LANDSCAPE ASSOCIATIONS OF RUSTY BLACKBIRDS WINTERING IN LOUISIANA

The Rusty Blackbird (*Euphagus carolinus*) has gained notoriety 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 68 sites in Louisiana where Rusty Blackbirds had been known to occur to address occupancy, transience, ground cover habitat, and invertebrate biomass. At a site-specific scale of 100 m, modeled occupancy was  $0.29 \pm 0.131$  with a detection probability of  $0.54 \pm 0.066$ . Our data suggest that invertebrate biomass may be higher at sites with shallow water, wet leaf litter, and grass ground cover types previously found to be associated with Rusty Blackbird occupancy. Rusty Blackbirds use a large area (5 – 7 km) while foraging on the wintering grounds, therefore management may need to be targeted to larger spatial scales. Using a combination of locations provided by citizen scientists in Louisiana and our own survey sites, we developed spatial models at the landscape scale using datasets on land cover, cropland cover, soil type, and rainfall. Preliminary analyses show that Rusty Blackbirds are positively associated with floodplain forest, poorly drained soil types, and rainfall. Our results indicate that Rusty Blackbirds would likely benefit from management for areas that are able to retain shallow water with a requisite amount of floodplain forest. (ID 16090)

**Borgman, C. C.**, University of New Mexico, USA, borgman@unm.edu  
Wolf, B. O., University of New Mexico, USA, wolf@unm.edu

#### REPRODUCTIVE DYNAMICS OF LOGGERHEAD SHRIKES IN THE ARID SOUTHWEST; EFFECTS OF PRECIPITATION AND TEMPERATURE

The Loggerhead Shrike is a medium-sized predatory passerine that occupies open habitats across a large range from southern Canada through Mexico. Despite its' extensive distribution, this species has declined dramatically over the last 40 years. The Southwestern United States is a region characterized by a rapidly changing climate with increasing air temperatures and increasingly severe droughts associated with decreased winter precipitation. Many studies have examined the breeding biology of Loggerhead Shrikes, but few have focused on the arid southwestern United States and none of these have examined the potential effects of climate change or variability on reproduction and population dynamics. We examined the breeding biology of Shrikes over six years on a semi-arid site in New Mexico where land uses have been relatively static, but climatic conditions are highly variable. We measured total number of breeding pairs, clutch size, number of young fledged, nest success, and nest initiation dates annually and examined the effects of environmental factors such as precipitation and temperature on these variables. We found a dramatic 20-day advancement in mean and 28-day advancement in earliest nest initiation dates in conjunction with temperature. Nest success was below average in all years, and varied between 11% and 45%. Shrikes experienced lowest nest success in years with diminished precipitation, particularly winter precipitation. In an area where winter precipitation is expected to decrease, Shrikes may experience further population declines as result of reduced fecundity. (ID 15842)

**Borowske, A. C.**, University of Connecticut, USA, a.c.borowske@gmail.com  
Elphick, C. S., University of Connecticut, USA, chris.elphick@uconn.edu  
Kern, R., University of Delaware, USA, kern.ra@gmail.com  
Shriver, W. G., University of Delaware, USA, gshriver@udel.edu

#### IMPLICATIONS OF FEATHER WEAR AND FAULT BARS: A COMPARISON OF SPECIES, SEXES, AND AGES\*

Feather wear may be caused by both mechanical strain and poor feather quality. Structurally weak fault bars occur during feather growth and, as a sign of low feather quality, may indicate past stress and future wear. Breeding-related activities may cause extreme feather wear, and may carry-over to influence feather quality during molt. Feather quality may also be influenced by stressful events experienced during feather growth. We examined flight feather wear and fault bars in adult and juvenile saltmarsh (Ammodramus caudacutus) and seaside (A. maritimus) sparrows to investigate the relationships between feather condition and quality and reproductive investment in adults, and between feather quality and early stress in juveniles. Based on differences in reproductive involvement, with male saltmarsh sparrows investing the least in their offspring, followed by male seaside, female seaside, and female saltmarsh sparrows, and nesting that often subjects chicks to flooding, we predicted that feather wear would be greater in birds with higher reproductive involvement and those in poorer condition (as measured by scaled mass index). Also, that fault bars would be more frequent and more severe in birds with higher reproductive involvement, in juveniles compared to adults, and in juvenile saltmarsh sparrows compared to seaside sparrows. As predicted, the number of broken feathers was greater in females than in males. Contrary to prediction, seaside sparrows of both sexes had more average wear than saltmarsh sparrows of either sex, and neither sex nor species were strong predictors of fault bars in adults. We also found no relationship between scaled mass index and wear or fault bars in adults. As predicted, however, juveniles of both species had more and more severe fault bars than adults of either species. (ID 16029)



**Bowie, R. C.**, University of California, Berkeley, USA, bowie@berkeley.edu  
 SUBSPECIES AS TAXONOMIC ENTITIES OR AS EARLY INDICATORS OF  
 ADAPTIVE DIVERGENCE: AN AFRICAN PERSPECTIVE<sup>T</sup>

Recent analyses of global diversification rates suggest that lineage divergence may be elevated at higher latitudes relative to the tropics - particularly in the New World. In support of this, meta-analyses have indicated a greater preponderance of subspecies at higher latitudes, either indicative of greater taxonomic effort or that the combined influence of landscape and climatic dynamics provides the required selective regime to facilitate rapid morphological divergence reflected in taxonomy as subspecies. Here, I review the above hypotheses in the context of African tropical forest and temperate arid scrubland passerine bird faunas. Results suggest that many subspecies of tropical taxa warrant species recognition, but despite elevation of these taxa, lineage diversity remains greatly underestimated. In contrast, subspecies described from the arid scrublands of southern Africa are rarely monophyletic and are not generally diagnosable. Instead these taxa are more often clinal, reflecting interesting evolutionary phenomena underlying adaptation across environmental gradients. In conclusion, the processes underlying morphological divergence may differ in tropical versus temperate biomes, with drift being the primary driver of morphological divergence in the tropics, whereas in temperate environments subspecies may prove to be a better indicator of the early stages of adaptive divergence across a landscape than as a unit of taxonomy. (ID 16270)

**Bowlin, M. S.**, University of Michigan-Dearborn, USA, mbowlin@umich.edu  
 Enstrom, D. A., Illinois Natural History Survey, USA  
 Murphy, B. J., University of Michigan-Dearborn, USA  
 Plaza, E., University of Michigan-Dearborn, USA  
 Jurich, P., University of Michigan-Dearborn  
 Cochran, W. W., Illinois Natural History Survey, USA  
 Cochran, J., JDJC Corp, USA

THRUSHES USE AN ENERGETICALLY INEFFICIENT STRATEGY WHILE  
 MIGRATING<sup>T</sup>

The altitude at which migratory birds fly can have far-reaching consequences; however, no fine-scale full-flight altitude data are available for small migratory birds. We tracked 7 Swainson's Thrushes (*Catharus ustulatus*) carrying altimeters from takeoff until landing or near-landing during 9 migratory flights. Contrary to expectations, these birds made numerous ( $9.33 \pm 4.42$ ), significant ( $>100$  m) altitude alterations during their flights (1.44 per hour), not including initial ascent and final descent. The average recorded flight altitude of the nine flights was  $673.0 \pm 523.2$  m; average maximum flight altitude was  $1199.5 \pm 862.7$  m (range  $319.2$ - $2744.5$  m). Initial ascent rates ( $0.42 \pm 0.15$  ms<sup>-1</sup>, N=8) matched predictions; final descent rates were  $0.55 \pm 0.30$  ms<sup>-1</sup> (N=5). The significant, repeated changes in flight altitude we observed should cause the thrushes to use more energy than they would if they flew at or near a single altitude for several hours at a time. We speculate that these altitude modifications may be due to birds flying over cities or may be responses to small-scale atmospheric changes during the flights. (ID 16134)

**Bowman, J. R.**, Archbold Biological Station, USA, rbowman@archbold-station.org

Moldoff, D., University of Kentucky, USA, dmoldoff@gmail.com  
 Shipley, A., Kauai Endangered Seabird Recovery Project, USA

HETEROSPECIFIC EAVESDROPPING BY EASTERN TOWHEES

Many species give alarm calls recognized by other species, but whether eavesdroppers respond appropriately is not well known. Florida Scrub-Jays (FSJ), a cooperative breeder, give distinct alarm calls to the presence of both aerial and terrestrial predators. We tested if Eastern Towhees, a terrestrial-forager sympatric with FSJs responded appropriately to jay alarm calls and

modified their vigilance behavior when near jays. We conducted a series of point counts, behavioral observations, and alarm call playbacks to evaluate their response and to gain insights into the information towhees obtain from jays. Towhees responded to FSJ terrestrial predator calls, but not aerial predator calls, by increasing vigilance. However, they also responded to alarm calls of Northern Mockingbirds and Stellar's Jays, but not to those of Brown Jays or California Thrashers. When towhees were foraging near FSJs in the absence of alarm calls, they reduced their rate of vigilance and increased foraging. In addition, towhees were more abundant near FSJs than apart from them and their abundance increased following playback of FSJ calls, suggesting that towhees move to forage in the presence of jays. Our results suggest that towhees understand the context of calls and can discriminate among specific call types. They appear to be able to learn alarms of other local species, but might respond to non-resident species that have alarm calls similar to local residents. Towhees are not just responding to alarm calls, but altering their behavior to increase eavesdropping opportunities and behaviors, such as foraging, that could potentially influence fitness. (ID 15772)

**Boyce, A. J.**, University of Montana, USA, andyboyce@gmail.com  
 Martin, T. E., USGS, USA, tom.martin@umontana.edu  
 Wolf, B. O., University of New Mexico, USA, wolf@unm.edu

DIVERGENT PHYSIOLOGICAL TOLERANCE IN TWO ALLOPATRIC  
 SPECIES OF WHITE-EYE (ZOSTEROPIDAE) ON A TROPICAL  
 ELEVATIONAL GRADIENT\*

The mechanisms that limit elevational distributions of parapatric species in the tropics are poorly understood. Physiological tolerance and interspecific competition are both thought to play a role in limiting elevational ranges; however, little experimental evidence exists to support either of these hypotheses. Using respirometry, we experimentally tested a major assumption of the hypothesis that physiological tolerance can limit species elevational distributions by measuring multiple components of temperature tolerance in two parapatrically distributed species of White-eye (Zosteropidae) using a field respirometry system at Kinabalu Park in Sabah, MY. Both lower critical temperature and conductance were lower in the high elevation species. Interestingly, upper critical temperature did not differ between the two species, suggesting that while temperature tolerance may limit the upper (cold) edge of a species elevational range, it is unlikely to be the limiting factor on the low (hot) end. Our results support the assumption that species with differing elevational ranges may evolve divergent physiological tolerances, particularly in the presence of the stable climatic conditions of the humid tropics. It also suggests the possibility that energetic savings due to adaptive differences in physiological tolerance could partially underlie the parapatric distributions often observed along elevational gradients in tropical species. (ID 15982)

**Boyle, W. A.**, Kansas State University, USA, aboyle@ksu.edu  
 ALTITUDINAL BIRD MIGRATION IN THE AMERICAS<sup>T</sup>

Altitudinal migration involves annual seasonal movements up and down elevational gradients. Despite the fact that birds living in every major mountain range worldwide engages in altitudinal migration, the patterns and causes of these short-distance movements are poorly understood compared to long-distance latitudinal migrations. Unlike many aspects of ornithology, we know more about altitudinal migration in tropical systems than in temperate ones. I review the prevalence and taxonomic patterns of altitudinal migrations based on existing community-level studies. For the few taxa that have been studied in detail, I describe the conclusions regarding causes of individual-level variation in altitudinal migration. I then present new quantitative analyses of the prevalence, spatial patterns, taxonomic and geographic correlates of altitudinal migration among North America's land birds. Although much of the evidence is based upon few

observations,  $\geq 10\text{-}15\%$  of North America's land birds appear to engage in some type of altitudinal migrations. As in tropical systems, almost all North America's altitudinal migrant species are partial migrants, with some individuals or populations being resident, and most movements involve movements between higher-elevation breeding areas and lower elevation non-breeding areas. However, these generalizations obscure tremendous species-specific variation in spatial and temporal patterns, and in the ubiquity and predictability of migration at the individual and population level. I outline priorities for future research on North American altitudinal migrants in light of emerging environmental threats to montane systems. (ID 16105)

**Bradley, D. W.**, University of Guelph, Canada, bradleyd@uoguelph.ca  
Clark, R. G., Environment Canada, Canada, Bob.Clark@ec.gc.ca  
Dawson, R. D., University of Northern British Columbia, Canada, dawsonr@unbc.ca

Taylor, C. M., Tulane University, USA, caz@tulane.edu  
Winkler, D. W., Cornell University, USA, dww4@cornell.edu  
Norris, D. R., University of Guelph, Canada, mnorris@uoguelph.ca  
PRIMARY PRODUCTIVITY AND VARIABLE MOLT STRATEGIES IN AN AERIAL INSECTIVORE

Migratory animals make critical decisions concerning timing of departure and subsequent destination at the end of the breeding season. In birds, this decision may be made based on local resource availability prior to departure as they balance the energetic cost of growing feathers necessary for long-distance flight with the demands of provisioning nestlings. This migration versus molt dilemma has led to the evolution of interspecific variation in molt timing and, in some species, variation even exists among populations. We explored how variation in habitat quality could influence molt-migration strategies in an aerial insectivore by combining two emerging tools in migration research: light logging tracking devices (geolocators) and satellite-derived vegetation indices (NDVI). We tested the hypothesis that a reduction in primary productivity at the breeding sites relative to subsequent fall migration stopover sites shapes molt timing strategy in nine populations of Tree Swallow (*Tachycineta bicolor*) from across North America. Swallows from breeding sites to the west of the Great Lakes, or along the Atlantic coast, departed shortly after reproduction, in synchrony with the onset of vegetation de-greening (i.e. decline in insect abundance), and staged at sites  $>600$  km away for up to 3 months, presumably to molt flight feathers. In contrast, swallows breeding at sites between Atlantic and western locations either remained at the breeding site, or moved only a short ( $<300$  km) distance. These sites had consistently higher primary productivity during the molting period compared to breeding site where birds departed before molting. Our results provide evidence of how temporal and spatial variation in habitat quality at breeding and stopover sites can drive differences in molt-migration strategies of Tree swallows across North America and we suggest that these patterns may apply to a wide range of migratory songbirds whose migration period may overlap with molting. (ID 16122)

**Brady, M. L.**, LSU Museum of Natural Science, USA, mbrady3@tigers.lsu.edu  
TEMPORAL VARIATION IN DIVERSITY AT THE EDGE OF THE TROPICS  
Latitudinal diversity gradients are a well-studied phenomenon, yet the fine-scale patterns and the mechanisms that produce them remain obscure due to a lack of spatially dense and precise distributional data. A striking example occurs in the summer in temperate eastern North America's breeding passerines, where diversity peaks in the Great Lakes region and declines southward to a continent-wide low along the Gulf Coast. The inflection point where higher winter diversity and higher summer diversity shift occurs in a band that crosses central Louisiana. This band represents a shift in the temporal peak of diversity from summer to winter, which corresponds to the temporal diversity peaks in the temperate and tropical zones, respectively.

Given that in the northern tropical zone, where wintering species from the temperate zone increase the diversity of a resident breeding community, this line corresponds to the transition from temperate diversity patterns to the beginning of subtropical diversity patterns. Use of this transition zone may be a strategy that wintering species use to exploit resources made available by a relatively more depauperate breeding bird community, while freeing them from many of the rigors of long-distance migration. I used fine-scale survey data from the Louisiana summer and winter bird atlas projects and Chao's measure of diversity in the program EstimateS to test for spatial differences in temporal diversity shifts. Paradoxically, this diversity shift occurs against a shift in diversity in vascular plant species and in the absence of gradients in rainfall, temperature, or elevation. (ID 16238)

**Brauch, J.**, Colorado State University, USA, jbrauch@rams.colostate.edu  
EVALUATION OF POPULATION MONITORING STRATEGIES FOR GREATER SAGE-GROUSE: GENETIC MARK-RECAPTURE AS AN ALTERNATIVE TO TRADITIONAL LEK COUNTS.

Monitoring programs that provide accurate and defensible estimates of population size and trend are essential for the proper management of wildlife species. This is particularly important for monitoring cryptic or rare species, or those that face a federal listing under the Endangered Species Act, such as the Greater Sage-Grouse (*Centrocercus urophasianus*). We conducted a two-year study to evaluate the use of genetic mark-recapture as an alternative monitoring strategy for a small, low-density population of Greater Sage-Grouse in Colorado. Non-invasive sampling of fecal pellets and feathers was conducted from Nov.-Mar. during two consecutive winter seasons. Field crews collected approximately 1,050 genetic samples during the 2012-2013 winter season and 1,200 samples during the 2013-2014 season. Genetic samples are currently being processed at the USGS Molecular Ecology Lab in Fort Collins, CO to identify the unique genetic fingerprint (or mark) of the source individual. Preliminary mark-recapture data and analysis are expected to be available in August, 2014. The evaluation of this method is part of a collaborative study between Colorado State University and Colorado Parks and Wildlife to evaluate monitoring strategies for Greater Sage-Grouse. (ID 16038)

**Braun, E. L.**, University of Florida, USA, ebraun68@ufl.edu  
Kimball, R. T., University of Florida, USA, rkimball@ufl.edu  
Meiklejohn, K. A., University of Florida, USA, kmeiklej@gmail.com  
Hosner, P. A., University of Florida, USA, idiopitlon@gmail.com  
Kumar, A., University of Florida, USA, ambuj@ufl.edu  
Glenn, T. C., University of Georgia, USA, travis.glenn@gmail.com  
Faircloth, B. C., University of California, Los Angeles, USA, brant@faircloth-lab.org

SMALL GENOMES IN THE ERA OF BIG DATA: PHYLOGENY AND PATTERNS OF MOLECULAR EVOLUTION FOR MITOGENOMES IN GALLIFORMES

Mitochondrial DNA sequences have long been used to examine phylogenetic relationships among vertebrates and explore patterns of molecular evolution. Because of the key role for mitogenomes in encoding components of the mitochondrial electron transport chain and ATP synthesis, they might be expected to exhibit different patterns of evolution from the nuclear genome. As part of a larger sequence capture study we have expanded our sampling of mitogenomes from galliforms (and anseriform outgroups) to more than 70 species with members of all families included. Analyses of complete mitogenomes recovered a well supported topology that was congruent with expectations from multi-locus studies, as might be expected based upon the rapid coalescent of the mitochondrial gene tree. However, we also found that estimates of the topology and rates of evolution for mitochondrial data were especially sensitive to the details of the models used for analyses. Our

analyses also indicated differences in the estimates of evolutionary rate for mitochondrial and nuclear sequence data, such that relative branch lengths differed between the two data types. We explored methods to obtain the best estimates of branch lengths and used these to explore correlations of mitochondrial rates of evolution with whole organism traits, such as body size and longevity. Although we have now entered a “big data” era for phylogenetics and molecular evolution where it is possible to collect large amounts of sequence data very rapidly, analyses of mitogenomes continue to provide information about patterns of organismal and sequence evolution. (ID 16325)

**Brautigam, K. J.**, University of Arkansas at Monticello, USA, brautigam@uamont.edu  
Osborne, D. C., University of Arkansas at Monticello, USA, osborne@uamont.edu  
White, D., University of Arkansas at Monticello, USA, whited@uamont.edu  
Honey, J. P., Arkansas Game and Fish Commission, jphoney@agfc.state.ar.us

#### EFFECTS OF SUPPLEMENTAL WILDLIFE FEEDERS ON SURVIVAL OF ARTIFICIAL GROUND NESTS IN SOUTHEAST ARKANSAS\*

Supplemental feeding of white-tailed deer is a popular management tool for alleviating real and perceived nutrient deficiencies. Year-round deer-feeding has become common practice in the southeastern US. Turkey populations in Arkansas have experienced 10 consecutive years of below-average recruitment. Nest success is the primary factor of turkey population dynamics, predation is the top cause of turkey nest loss, and mesopredators are the top nest predators. Our objectives were to determine if feeders in use during nesting season effect survival of ground nests, and determine if distance to feeders influences nest survival. We hypothesized that artificial ground nests near active deer feeders would have lower survival rates than nests near inactive feeders. We predicted nest survival to increase with distance to feeder. We expected mesopredators to be the dominate nest predators. We conducted a two-year field experiment using artificial ground nests. We designated one plot for each of the 2 treatment levels in 5 forested lands in southeast Arkansas. Treatment plots each contained a corn-filled feeder at plot center while control plots each contained an empty feeder. We randomly placed 320 nests across the ten plots. During the nest trial, cameras captured wildlife activity at feeders and half of nests. Apparent survival for treatment nests was significantly greater at 4.40% than for control nests at 0%. Kaplan-Meier survival curve analysis indicated that survival rates of treatment nests were lower than control nests early during the nesting period as a result of increased predator activity around feeders. We found no trend between distance from feeder and the timing of nest predation. Raccoons accounted for 57.3% of all failed nests and the top non-target feeder visitor. Our results indicate that mesopredator densities in southeast Arkansas may be too high for deer feeders to have a significant effect on their foraging activities. (ID 16059)

**Bravo, G. A.**, University of São Paulo Museum of Zoology, Brazil, gbravo1@usp.br  
Remsen, J. V., Louisiana State University Museum of Natural Science, USA, najames@lsu.edu  
Brumfield, R. T., Louisiana State University Museum of Natural Science, USA, robb@lsu.edu

#### ADAPTIVE PROCESSES DRIVE ECOMORPHOLOGICAL CONVERGENT EVOLUTION IN ANTWERNS (THAMNOPHILIDAE)

Phylogenetic niche conservatism and convergence are contrasting evolutionary patterns that describe phenotypic similarity across independent lineages. Assessing whether and how adaptive processes give origin to these patterns represent a fundamental step toward understanding phenotypic evolution. Phylogenetic model-based approaches offer the opportunity not only to distinguish between phylogenetic niche conservatism and convergence, but also to determine the extent that adaptive processes explain phenotypic similarity. The *Myrmotherula* complex in the Neotropical family Thamnophilidae is a polyphyletic group of sexually dimorphic small insectivorous forest birds

that are relatively homogeneous in size and shape. Here, we integrate a comprehensive species-level molecular phylogeny of the *Myrmotherula* complex with morphometric and ecological data within a comparative framework to test whether phenotypic similarity is described by a pattern of phylogenetic niche conservatism or convergence, and to identify evolutionary mechanisms underlying body size and shape evolution. We show that antwerens in the *Myrmotherula* complex represent distantly related clades that exhibit adaptive convergent evolution in body size and divergent evolution in body shape. Phenotypic similarity in the group is primarily driven by their tendency to converge toward smaller body sizes. Differences in body size and shape across lineages are associated to ecological and behavioral factors. (ID 16157)

**Bridge, E. S.**, University of Oklahoma, USA, ebridge@ou.edu  
Ross, J. D., University of Oklahoma, USA, lakeeriebirds@gmail.com  
Contina, A., University of Oklahoma, USA  
Kelly, J. F., University of Oklahoma, USA, jkelly@ou.edu

#### HOW WELL DOES PRIMARY PRODUCTIVITY EXPLAIN MOLT-MIGRATION IN WESTERN SONGBIRDS?

Within western North America, spring snowmelt, arid summer conditions, and dramatic monsoonal rains in the Southwestern United States and Northwestern Mexico, give rise to a complicated and dynamic pattern of primary productivity. A majority (~54%) of migratory songbird species in this region are so-called molt migrants that replace their feathers during an extended stopover period in monsoonal areas during fall migration. One explanation for molt migration is the push-pull hypothesis, which posits that arid conditions in the late summer, “push” western migrants out of their breeding locations, while at the same time, high productivity associated with late summer monsoonal rains, “pull” these birds into their molting areas. As a test of the push pull hypothesis, we constructed a series of agent-based models to determine whether primary productivity (represented as the Enhanced Vegetation Index or EVI) was a primary determinant of western molt migration. We used a simplistic set of movement models meant to simulate seasonal movements of Painted Buntings that breed in Oklahoma. As birds moved across the landscape they received a cumulative EVI score that corresponded to their exposure to different levels of primary productivity. After millions of simulations we selected individuals with the highest EVI scores and compared them to actual migration tracks from Painted Buntings equipped with geolocators. Preliminary results give some support for the push-pull hypothesis, however, factors other than EVI (e.g. density dependence) may influence the migration routes in addition to primary productivity. (ID 15883)

**Bridge, E. S.**, University of Oklahoma, USA, ebridge@ou.edu  
EMERGING TECHNOLOGIES FOR MONITORING SMALL BIRDS IN THE AEROSPHERE\*

A fundamental challenge in the emerging field of aeroecology is finding ways to monitor the location and behavior of small animals (birds, bats, and insects) that are capable of making continental scale movements. Extreme miniaturization of electronic components along with rapidly decreasing power requirements has led to several exciting possibilities with regard to remote monitoring of small birds. We have already realized the potential to estimate migration tracks for small species using geolocators and to obtain location data locally using sub-gram radio transmitters. Devices that record altitude, activity levels (i.e., movement), flight calls, and magnetic fields may soon be available as well. This presentation will briefly summarize some of the important technological developments that can help advance the field of aeroecology and will relate the limitations and future prospects of each. In addition, I will discuss several newly developed analysis tools that will soon be available to improve our inferences from geolocators and other sources of location and distribution information. (ID 16386)



**Brittingham, M. C.**, The Pennsylvania State University, USA, mxb21@psu.edu  
 Barton, E. P., The Pennsylvania State University, USA, epb5026@psu.edu  
 Fronk, N. R., The Pennsylvania State University, USA, nrf5017@psu.edu  
 Langlois, L. A., The Pennsylvania State University, USA, la276@psu.edu  
 Pabian, S. E., Colorado State University, USA, Sarah.Pabian@colostate.edu  
**BIRD COMMUNITY RESPONSE TO SHALE GAS DEVELOPMENT IN CORE FOREST**

North-central Pennsylvania contains one of the largest blocks of core forest within the mid-Atlantic region and is an important breeding area for Neotropical migrants. These core forests overlay the Marcellus shale where resource extraction has increased exponentially in recent years and is projected to continue for at least the next 40 years. Shale gas development includes a pad and associated infrastructure which fragments core forest habitat. We quantified the response of the bird community to shale gas development at a local scale around 30 well pads within core forest habitat and at a larger landscape scale using roadside surveys and a before-after-control-impact (BACI) design. At the local scale, the bird community differed between reference sites and areas near wells with synanthropic or human-associated species more abundant near well pads ( $F=11.17, P<0.001$ ) and forest interior species more abundant with increasing distance from well pads ( $F=53.90, P<0.001$ ). Abundance of early successional species did not differ with distance to pads ( $F=2.25, P=0.09$ ). Results from the BACI roadside survey did not show changes in guild abundance for any of the 3 guilds although abundance of selected species differed. Within the first 3 years of gas development, there has been an increase in synanthropic species and a decline in forest interior species in proximity to well pads. We did not detect changes at the larger landscape scale must likely due to the short time frame and localized pattern of the disturbance, and the pervasive edge effects inherent in roadside surveys. The increase in synanthropic species at the local scale suggests that biotic homogenization may be a long-term consequence of shale gas development within core forest. (ID 16055)

**Broberg, A. R.**, Colorado State University, USA, abroberg@rams.colostate.edu  
 Wann, G. T., Colorado State University, USA, greg.wann@colostate.edu  
 Aldridge, C. L., Colorado State University, USA, cameron.aldrige@colostate.edu  
 Braun, C. E., Grouse Inc, USA

#### LONG-TERM SEASONAL DISTRIBUTION CHANGES OF TWO COLORADO WHITE-TAILED PTARMIGAN POPULATIONS

There is a wealth of evidence that global climate change is having biological effects. Here, we analyze 47 years of data on a Colorado resident bird species, the white-tailed ptarmigan, to determine if climate change has had an effect on its distribution. Location data were collected by surveying two study sites from 1966 to 2013, and are used to determine the average elevation of ptarmigan at the sites. We show that these two ptarmigan populations have been shifting in elevation over the study period, and those shifts can at least in part be attributed to climate change. (ID 16058 | Poster 14)

**Broms, K. M.**, Colorado State University, USA, kristin.broms@colostate.edu  
 Johnson, D. S., Alaska Fisheries Science Center/NOAA, USA, Devin.Johnson@noaa.gov  
 Altwegg, R., University of Cape Town, South Africa, Res.Altwegg@gmail.com  
 Conquest, L. L., University of Washington, USA, conquest@u.washington.edu  
**INTRODUCTION TO BAYESIAN METHODS FOR AN OCCUPANCY MODEL<sup>†</sup>**

This presentation will give an overview for understanding and implementing Bayesian models. Combined with modern computational power, these methods help solve previously intractable problems; a basic awareness of these models has become essential to data analysis. The model that I will use as the context in which to learn about Bayesian models is an

occupancy model with a spatial component. I will review the details of what an occupancy model is and provide motivation on why the spatial model was needed and hence, why Bayesian methods were crucial to analyze the data. The data come from the Southern African Bird Atlas Project, which is a database of bird lists submitted by citizen scientists following a specific protocol. While the model was built specifically for this bird atlas project, it is applicable to many other data sets from around the world. To increase your familiarity with Bayesian models, we will compare the Bayesian version with a likelihood-based occupancy model, and I will describe general circumstances and specific examples related to bird atlas data of when Bayesian methods are desired and when they are superfluous. In addition, I will provide simple definitions for terms that are commonly used when discussing Bayesian methods to help you effectively communicate with other scientists regarding these methods. Finally, we will examine the model output. Primarily, I will use the freely available JAGS software in combination with the R programming language, but there will be a discussion of the other software options, such as WINBUGS. (ID 16252)

**Brown, C. E.**, Louisiana State University, USA, cbro117@lsu.edu  
 Winkler, D. W., Cornell University, USA, dww4@cornell.edu  
 Sheldon, F. H., Louisiana State University, USA, fsheld@lsu.edu

#### COMPARATIVE TRANSCRIPTOMICS OF AVIAN MIGRATION: GENE EXPRESSION IN THE BRAINS OF TREE SWALLOWS (TACHYCINETA BICOLOR) STAGING FOR MIGRATION

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 virtually nothing known, however, about which genes and genomic regions are involved in migration. We used a comparative transcriptomic approach to identify 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 of these birds, and sequenced their whole-brain transcriptomes with Illumina HiSeq. Transcripts that are differentially expressed among birds from different fat classes can be considered as candidate genes for involvement in migratory behavior, and were aligned to the Zebra Finch (*Taeniopygia guttata*) genome to identify genomic regions that are rich in differentially expressed genes relative to the rest of the genome. (ID 16152)

**Brunton, D. H.**, Massey University, New Zealand, d.h.brunton@massey.ac.nz  
 Baillie, S. M., Dalhousie University, Canada, shauna.baillie@dal.ca  
 Blanchard, W., Australia National University, Australia

#### UNDERSTANDING DISPERSAL, BODY CONDITION AND DISEASE DYNAMICS BY MONITORING BANDED INDIVIDUALS WITHIN AND BETWEEN POPULATIONS: INFORMING SPECIES CONSERVATION.

Without a doubt human impacts have resulted in serious threats to New Zealand's unique biodiversity. These threats have resulted in NZ leading in innovative conservation approaches such as species translocations. However,

not all of our native bird species are suitable for translocation. Most NZ birds do in fact fly and although migration is rare, dispersal can be an integral feature of their life history making translocations problematic and natural recolonisations of protected areas promising. We observed such a dispersal and recolonisation event for NZ bellbirds, *Anthornis melanura*; an event that provided a rare opportunity to compare avian host condition and seasonal patterns of malaria parasites between source and founder populations. We applied banding techniques to document these patterns. Blood samples and measurements were collected year-round from 3 populations ( $N = 457$ ). Four *Plasmodium* lineages (1 endemic, 3 exotic) were detected and diversity decreased by 25% from the source to the founder populations. The endemic parasite species exhibited seasonality at the 2 colonies. However, a winter peak occurred at the source population, indicating likely food stress for bellbirds. Infections were male-biased in autumn and spring with greater sex-bias at the newer colony. Body condition in bellbirds paradoxically varied both positively or negatively with malaria prevalence depending on location. We provide evidence that after dispersal birds are affected through enemy release and food supply. Taken together, our results emphasize the added value of including precise measurements during the banding processing to inform basic science. (ID 15811)

**Bryant, L. C.**, Archbold Biological Station, USA, leebryant@gmail.com  
 Pruett, M. S., Archbold Biological Station, USA, spruett@archbold-station.org  
 Bowman, R., Archbold Biological Station, USA, RBowman@archbold-station.org

#### INTERACTIONS BETWEEN AREA OF OAK SCRUB AND NATAL GROUP SIZE ON POST-FLEDGING PROVISIONING IN FLORIDA SCRUB-JAYS

While the post-fledging period is a critical time in the avian lifecycle, we have a fledgling understanding of it because juveniles are difficult to observe. A variety of factors affect juvenile survival during this period including habitat, juvenile behavior, adult foraging success and provisioning rates, time since fledging (age), and juvenile mass. In the Florida Scrub-Jay (*Aphelocoma coerulescens*), a cooperatively breeding resident species, post-fledging survival is influenced by nestling mass, which is positively correlated with area of oak scrub in the territory and natal group size. Juvenile mass is the best predictor of annual survival, however, juvenile mass is influenced by an interaction between area of oak scrub and natal group size; on territories with less than 8 ha of oak scrub, group size negatively impacts juvenile mass. Resource competition may lead to this negative relationship in territories with large groups but little oak scrub. To determine the interplay between these factors, I conducted hour-long focal observations of adults, both breeders and helpers, during the post-fledging period and recorded foraging time, habitat, number of captures, and the outcome of each capture. I then compared adult foraging success, capture rates, and provisioning rates in territories of various group sizes and area of oak scrub. Preliminary observations suggest no apparent trends in foraging success and provisioning rates among territories with various group sizes and area of oak scrub. Further analysis will provide understanding of these interactions and give insights into the evolution of territoriality and cooperative breeding in the Florida Scrub-Jay and the importance of habitat and helpers in annual demographic patterns. (ID 16273 | Poster 10)

**Buechley, E. R.**, University of Utah, USA, ebuechley@gmail.com  
 ECOLOGICAL AND ANTHROPOGENIC FACTORS CAUSING AVIAN  
 SCAVENGER DECLINES

Scavenging has been overlooked as an integral component of ecosystem ecology. Vultures, the only obligate scavengers, play a central role in the consumption and recycling of carrion. Vulture populations have been declining at a catastrophic rate in recent decades and are regarded as the most threatened avian functional guild in the world. Meanwhile, many facultative avian scavengers—including species of storks, gulls, starlings,

ravens and crows—are among the most abundant bird species in the world that, in many cases, have increasing populations. What ecological and anthropogenic factors are causing the variable extinction risk of avian scavengers? Herein, I: 1) identify all bird species for which scavenging is a major dietary component, 2) analyze differences in intrinsic and extrinsic threats for these species to determine correlates of extinction risk, and 3) discuss implications of changes in abundances of avian scavenger populations. 114 avian scavenger species were identified from 16 families. The minimum adequate model (MAM) using ecological variables to predict extinction risk contains two variables, average mass and scavenger rank, and accounts for 37% of the variance in extinction risk. The most important extrinsic threats to avian scavengers are dietary toxins and decreasing food availability. In the absence of obligate scavengers, populations of facultative scavengers increase, with important top-down effects on ecosystems; they are often predators, competitors, and invasive species. Obligate scavengers efficiently remove carcasses that are disease reservoirs, whereas facultative scavengers are more prone to transmit disease among themselves and to humans. (ID 15985)

**Buehler, D. A.**, University of Tennessee, USA, dbuehler@utk.edu  
 Hockman, E. V., University of Tennessee, USA, ehockman@utk.edu  
 Prevost, S. C., University of Tennessee, USA, sprevo@utk.edu  
 Wilkerson, J. B., University of Tennessee, USA, jwilkers@utk.edu  
 Smith, D. R., University of Tennessee, USA, dsmith23@utk.edu  
 Fischer, R. A., US Army Engineer Research and Development Center, USA, richard.a.fischer@erdc.dren.mil

#### DEMONSTRATION AND IMPLEMENTATION OF AUTONOMOUS AERIAL ACOUSTIC RECORDING SYSTEMS TO MONITOR BIRD POPULATIONS IN INACCESSIBLE AREAS

The need for improvements in avian wildlife monitoring efficiency, accuracy, and scope has led to increased development and use of new technologies, such as autonomous recording devices. Our project introduces a novel autonomous recording system that addresses these issues as well as the specific problem of ground-based land accessibility. Military installations, which host a disproportionately great number of threatened, endangered, and at-risk species (TER-S) bird species compared to other federal lands, pose this problem in the form of sizeable impact areas that are too hazardous to traverse on the ground. The objectives of this project are to demonstrate and validate the use of autonomous aerial acoustic recording systems (AAARS) for monitoring avian TER-S populations across a broad range of military installations. Static and dynamic field tests were implemented in 2011-2013 to directly compare AAARS data with that of human-based techniques in both real bird communities and remotely-controlled simulated communities with known populations. Automatic detection software was used to analyze recordings and derive density estimates for several avian TER-S. Here, we will (1) illustrate the ability of the AAARS to collect data on avian vocalizations, (2) compare conventional survey methods with AAARS in terms of avian population monitoring efficiency, accuracy, and scope, and (3) discuss future use of AAARS beyond its current application into other forms of avian monitoring. (ID 16005)

**Buler, J. J.**, University of Delaware, USA, jbuler@udel.edu  
 WHAT COMES DOWN MUST GO UP: USING WEATHER SURVEILLANCE  
 RADAR TO LINK FLIGHT LIFTOFF OF BIRDS WITH THEIR  
 TERRESTRIAL HABITAT USE<sup>†</sup>

Despite using the air for many facets of their life, birds are still bound to using terrestrial habitats for resting, feeding, and/or breeding. Birds often leave terrestrial habitats en masse to engage in migratory or feeding flights via an abrupt liftoff into the air, which is closely synchronized to sun elevation angle. Additionally, the USA has a comprehensive national network of more

than 150 weather surveillance radars that has been archiving observations of bird flight activity aloft since the mid-1990's. Thus, systematic instantaneous scans by one or more weather radars of birds during liftoffs can be used to comprehensively map the terrestrial distribution of birds at a relatively fine spatial scale across broad extents. I will discuss the recent development and validation of a methodological approach to link flying birds to their ground sources that has provided novel insights into avian ecology and conservation. I will present recent and ongoing studies that 1) elucidate how migrating land birds contend with barrier crossings and extreme weather events, 2) identify important stopover areas and habitat use patterns of birds along their migration routes, and 3) assess waterfowl use of restored and managed wetlands. (ID 15810)

**Bulluck, L. P.**, Virginia Commonwealth University, USA, [lpbulluck@vcu.edu](mailto:lpbulluck@vcu.edu)  
Foster, M. J., Virginia Commonwealth University, USA, [fostermj2@vcu.edu](mailto:fostermj2@vcu.edu)  
Huber, S., Virginia Institute of Marine Sciences, USA

#### CAROTENOID CONTENT IN FEATHERS INDICATES REPRODUCTIVE SUCCESS IN EARLY BREEDING FEMALE PROTHONOTARY WARBLERS

In many avian species, colorful feather ornaments in males are known to often signal individual quality and serve as the basis for mate choice. Fewer studies have assessed if this is true for females who also display plumage ornaments. We investigated whether carotenoid content in female Prothonotary Warblers (*Protonotaria citrea*) feathers, a measure of feather quality, was correlated with annual reproductive success. We collected feathers from 130 box-nesting female warblers over a period of four breeding seasons (2010-2013) in eastern Virginia and measured their reflectance. Because this is a long term study, we know the exact age and annual reproductive success of most individuals in all study years. We found a significant positive relationship between carotenoid content and number of young fledged, after accounting for the effect of nest initiation date, which is known to significantly influence annual reproductive success. We found that early nesters and older females tend to fledge more young, but that all early arriving females are not the same. Among early breeders, the ones that go on to produce the greatest number of young have higher carotenoid content in their feathers. This same relationship was not found in later breeding females. This could indicate that males use female plumage as a signal to select higher quality females during the early portion of the breeding season when selection pressure is highest to choose a high quality mate. (ID 15980)

**Butler, M. W.**, Lafayette College, USA, [butlermw@lafayette.edu](mailto:butlermw@lafayette.edu)  
Homsher, M., Lafayette College, USA  
Ritter, N., Lafayette College, USA  
Waite, H., Lafayette College, USA  
Lubas, E., Lafayette College, USA  
Hines, J. K., Lafayette College, USA

#### QUANTIFICATION OF BILIVERDIN IN AVIAN TISSUES

Avian eggshells exhibit a wide variety of colors and patterns, and it has been suggested that females may use eggshell coloration to signal their reproductive investment to mates. Such a scenario is usually linked to the molecule biliverdin, which contributes to the blue or green hues of many eggs. Because biliverdin can act as an antioxidant, only high-quality females should be able to allocate this valuable molecule to their eggshells. However, this line of reasoning ignores the fact that a high concentration of biliverdin is excreted daily; biliverdin is the predominant bile pigment in many birds, and it is routinely lost to the feces. In order to resolve this paradox, it is critical that we describe the physiological roles that biliverdin plays in vivo. However, methodologies for quantifying biliverdin in avian tissues currently exist only for bile, which is problematic when working with one of the numerous species lacking a gallbladder. Drawing on methodologies for quantifying other bilins, we have developed a spectrophotometric methodology that

can accurately quantify biliverdin in liver tissue, and has the potential for quantifying biliverdin in spleen and brain tissue as well. We are also currently developing a protocol for quantifying biliverdin in plasma samples, although the small concentration of circulating biliverdin presents a challenge. With the establishment of these techniques, behavioral ecologists can develop experiments that investigate the physiological roles of biliverdin, directly testing links between female quality, female investment in eggs, paternal care, eggshell coloration, and offspring quality. (ID 15905 | Poster 103)

**Cabanne, G. S.**, CONICET-MACN, Argentina, [gscabanne@yahoo.com](mailto:gscabanne@yahoo.com)  
Trujillo-Arias, N., CONICET-MACN, Argentina  
Claramunt, S., AMNH, USA  
Vieira Chaves, A., UFMG, Brazil  
Naoki, K., UNSA, Bolivia  
Dantas, G., UFMG, Bolivia  
Santos, F., UFMG, Brazil  
Miyaki, C. Y., USP, Brazil  
Aleixo, A., MPEG, Brazil  
Tubaro, P. L., CONICET-MACN

#### HETEROGENEOUS BIOGEOGRAPHIC HISTORY AND HIGH LEVELS OF CRYPTIC BIRD DIVERSITY BETWEEN THE ATLANTIC AND TROPICAL ANDES FORESTS

The humid forests of the tropical Andes are isolated from the Atlantic forest of southeastern South America by savannas and dry forests (Cerrado and Chaco). Notwithstanding this isolation, both biomes share numerous species, which suggests a direct past connection. In the literature, one possible explanation for this pattern is that the connection occurred during interglacial periods and through gallery forests in the Chaco, while the alternatively hypothesis is that the connection occurred during maximum of glaciations and through the Cerrado. In order to evaluate predictions of the aforementioned hypotheses we performed phylogeographic studies of bird species shared by both regions. Also, we evaluated if the subspecies occurring in each region are full species. We used DNA sequences of cytb, ND2, VLDL, G3PDH and FIB5 to study the phylogenetic relationships among populations of six birds (*Syndactyla rufosuperciliata*, *Thamnophilus caerulescens*, *Poecilotriccus plumbeiceps*, *Arremon flavirostris*, *Cacicus chrysopterus* and *Trichothraupis melanops*). The Andes and Atlantic forest populations of most of the species were reciprocally monophyletic, gene flow was very low and divergence between regions varied from Pliocene to late Pleistocene. These results have low information about the geographic location of the contact; except for *S. rufosuperciliata* and *T. caerulescens*, which supported an early Pleistocene connection through Chaco and southern Atlantic Forest. Our study indicate that the Atlantic and the Andes forests might have been connected, through Chaco, several times during the Pleistocene. Besides, our results detected high levels of cryptic diversity between the Andes and the Atlantic forests, and for *S. rufosuperciliata*, *P. plumbeiceps* and *A. flavirostris* suggest to consider the populations of these regions as full species. (ID 16100)

**Cadieux, P. M.**, Université du Québec à Montréal, Centre for Forest Research, Canada, [cadieuxp@gmail.com](mailto:cadieuxp@gmail.com)  
Drapeau, P., Université du Québec à Montréal, Centre for Forest Research, Canada

#### CHANGES IN THE FUNCTIONAL STRUCTURE OF NEST WEBS FROM MIXEDWOOD TO BLACK SPRUCE-MOSS DOMINATED LANDSCAPES; THE PERSISTENCE OF LARGE CAVITIES DUE TO THE NORTHERN FLICKER

An important shift in forest composition and structure occurs from mixedwood to coniferous boreal forests in Eastern Canada. As opposed to western Canada, large deciduous trees, mostly white birch and trembling



aspen, give way to smaller coniferous trees, primarily black spruce. The decreased size of trees, and the lower availability of senescent or dead trees, poses a real challenge to animals that depend on cavities in large and decayed trees for their reproduction, such as woodpeckers and other cavity nesters. We hypothesized that this shift is associated with a change in the functional structure of the nest web, especially for large cavity nesters. We investigated nest webs along a latitudinal gradient covering 12 000 km<sup>2</sup> spanning from the balsam fir-white birch into the black spruce-moss bioclimatic domain. In 2012 and 2013, we collected data in 48 plots: 12 were old trembling aspen dominated forests, 12 old black spruce forests, 12 deciduous beaver marshes and 12 coniferous beaver marshes. We compared the functional structure and richness (number of species and number of links) of these networks to our control sites in the Lake Duparquet Research Station with 10 years of cavity nesters data. Large cavities excavated by the Pileated woodpecker and associated secondary cavity users were severely limited by the availability of trembling aspen. However, the Northern Flicker was an important provider of medium to large cavities in black spruce and several large cavity secondary users occupied its cavities. In black spruce-moss forests, old aspen patches and beaver marshes were key to maintaining complex cavity nesters networks. (ID 15804)

**Call, E. M.**, Maine Department of Inland Fisheries and Wildlife, USA, [erynn.call@maine.gov](mailto:erynn.call@maine.gov)

Hunter, M. L., University of Maine - Orono, USA, [mhunter@maine.edu](mailto:mhunter@maine.edu)

#### RIVER BIRDS AS RESTORATION BASELINES – TRACKING IMPLICATIONS OF DAM REMOVAL AND RETURN OF DIADROMOUS FISH IN MAINE WATERSHEDS

Restoration of rivers and fish populations through dam removal is being pursued widely, including within Maine's largest watershed, the Penobscot River. This project addresses understanding the linkages among at least three key natural resources—birds, fish, and rivers—in the context of removal of the two lowermost dams on the Penobscot River and return of upriver spawning opportunities for sea-run fish. River-associated birds are indicators of environmental change in watersheds because they are predators of fish, and therefore often top predators in the aquatic food web. To track implications of dam removal and the expected return of abundant diadromous fish prey, we documented, 1) the relationships between river bird abundance and habitat parameters, 2) relative importance of sea-run fish in the diet of four river bird species, bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), belted kingfisher (*Megasceryle alcyon*), and tree swallow (*Tachycineta bicolor*), and 3) nest distribution and brood size of osprey. We expect these measures will reflect changes to the river system post-dam removal as diadromous fish populations recover, proliferate, and integrate into the food web. (ID 16317)

**Callicrate, T. E.**, University of Maryland/Smithsonian National Zoological Park, USA, [tcallicr@umd.edu](mailto:tcallicr@umd.edu)

Conant, S., University of Hawaii at Manoa, USA, [conant@hawaii.edu](mailto:conant@hawaii.edu)

Siewerdt, F., Cobb-Vantress Inc., USA, [frank.siewerdt@cobb-vantress.com](mailto:frank.siewerdt@cobb-vantress.com)

Fleischer, R., Smithsonian National Zoological Park, USA, [fleischerr@si.edu](mailto:fleischerr@si.edu)

#### POPULATION DECLINES AND GENETIC VARIATION: EFFECTS OF SERIAL BOTTLENECKS IN THE LAYSAN FINCH

The Laysan finch (*Telespiza cantans*) is an endangered endemic passerine found in the Northwestern Hawaiian Islands. The population on Laysan island, the only one historically known, experienced a very severe bottleneck in the late 19th – early 20th century, followed by a series of translocations when back-up populations were established on Pearl and Hermes Reef (PHR) approximately 500 km away. PHR populations show divergent bill shape from the Laysan population, which could result from genetic drift due to founder effects or may be evidence of adaption to larger seeds (an important food item) on PHR. To investigate serial bottleneck effects on genetic

diversity and adaptive potential, we genotyped over 40,000 single nucleotide polymorphisms (SNPs) in Laysan finches from all modern populations plus a subset of SNPs in museum samples collected before the 19th century bottleneck. We used SNP genotypes to determine effective size of each population (historical Laysan, modern Laysan, and three PHR populations), migration rates between PHR populations and genetic structure of each population. We tested two hypotheses in this study: 1) genetic diversity is negatively associated with number of bottlenecks experienced by the population; and 2) modern Laysan finch populations show detectable genetic divergence from each other. We evaluated the relative effects of genetic drift and adaptation on Laysan finch genomes by comparing outlier locus genotypes with phenotypic variation and bottleneck history. This information will improve our understanding of how serial bottlenecks affect genetic diversity and adaptability. (ID 16329)

**Camina, A.**, ACRENASL, Spain, [acamia@acrenas.eu](mailto:acamia@acrenas.eu)

CH. López-Hernandez, C., ACRENASL, Spain, [angelachantallopez@acrenas.eu](mailto:angelachantallopez@acrenas.eu)

Ortiz, N., ACRENASL, Spain, [natrioja@gmail.com](mailto:natrioja@gmail.com)

#### THE EFFECT OF WIND FARMS ON GOLDEN EAGLES IN SPAIN<sup>†</sup>

The Golden Eagle (*Aquila chrysaetos*) is a Near Threatened species in Europe according to the IUCN. Spain is one of the leading European countries in wind development. We assessed the impact of wind farms on eagles in terms of fatalities, nest occupancy and breeding success. The study area has 47,856 sq. km (11% of Spain) accounting for 294 breeding pairs, a 20.27% of the Spanish breeding Golden Eagle population. The population density ranges 0.44-0.72 pairs/100 sq. km) and only 9 fatalities have been recorded. Fatality rates ranged 0.000-0.076 eagles/turbines/year. Neither the GLZ and GLM models for nest occupancy and breeding success respectively, did not show differences for distance to the nearest turbine and size of the wind farm or before/after the deployment of turbines (all  $p > 0.05$ ). When analyzing habitat use (birds/ hour) we did not find a relationship between fatality rates and eagle flights. Results revealed that a minimum distance (buffer) between the wind farm and the nest it would not be a feasible method to predict fatalities or disturbance when planning the wind farm. This disagrees with some theoretical studies and guidelines for wind development. Fatalities seem to be related with floating individuals or at hunting areas far from the breeding territories. Reasons of breeding failure seem to be related with other human induced causes than the wind farms like the disturbance with Big Game hunting activity. We finally tested the Collision Risk Modelling (CRM) to compare the predicted collision risk with that real measured in the field, being a weak relationship. As a conclusion, differences on collision rates with those wind farms in the USA could be related with the sedentary/migratory behavior of the two subspecies. (ID 16288)

**Campagna, L.**, Cornell University, USA, [leocampagna@gmail.com](mailto:leocampagna@gmail.com)

Silveira, L. F., Museu de Zoologia da Universidade de São Paulo, Brazil, [lf@usp.br](mailto:lf@usp.br)

Lovette, I. J., Cornell University, USA, [ijl2@cornell.edu](mailto:ijl2@cornell.edu)

#### DIVERGENT PHENOTYPES DESPITE (MOSTLY) HOMOGENEOUS GENOMES: INSIGHTS FROM A RECENT NEOTROPICAL AVIAN RADIATION

In diverging species, reproductive isolation may initially be achieved at key loci involved in generating speciation phenotypes, with differentiation extending throughout the genome only with substantial time. Recent radiations, such as that of seedeaters in the avian genus *Sporophila*, provide an opportunity to explore the genetics of the early stages of speciation. These eight species have extremely low neutral genetic differentiation and lack of species level monophyly, which we interpret as the consequence of recent common ancestry and ongoing hybridization and introgression. These species are predominantly sympatric and differ mainly in adult male

vocalizations and coloration patterns, suggesting an important role for sexual selection in driving their differentiation. We used a reduced representation genomic approach (restriction site-associated DNA tag sequencing) to sample and compare single nucleotide polymorphisms (SNPs) from their genomes. We assess levels of divergence across thousands of unlinked markers using tree based methods, summary statistics and Bayesian assignment tests. Consistent with previous findings, the species show low overall genetic divergence, with  $F_{ST}$  generally  $<0.05$ . Levels of differentiation among species pairs for most SNPs were negligible, but a small proportion of markers represented  $F_{ST}$  outliers and showed signals of divergent selection. Some such SNPs were outliers consistently across independent contrasts involving different species pairs. Highly diverged loci were mapped onto the Zebra Finch genome to obtain a putative chromosomal location and function. Our findings suggest that the genomes of these phenotypically diverse incipient species are mosaics of evolutionary histories, with different loci exhibiting varying degrees of divergence. (ID 15864)

**Campagna, L.**, Cornell University, Ithaca, NY, USA, leocampagna@gmail.com

#### INTRODUCTION TO VARIOUS GENOMIC METHODS

The objective of this talk is to give a general introduction to various genomic methods, most of which will be central to the presentations in this symposium. The data generated using these methods include whole genome sequences, data derived from sequence capture methods and reduced representation libraries (Genotyping by Sequencing – GBS – or double digest restriction site-associated DNA tag – ddRADtag – sequencing), and RNA sequencing experiments. These data vary in the length and number of loci generated, the prevalence of missing data, and the way (and depth) in which the genome is sampled. In turn, these factors influence the suitability of each technique to address different questions in avian evolutionary biology. (ID 16400)

**Carlisle, J. D.**, Wyoming Cooperative Fish & Wildlife Research Unit, Dept. of Zoology & Physiology, U. of Wyoming, USA, jason.d.carlisle@gmail.com  
Chalfoun, A. D., U.S. Geological Survey, Wyoming Cooperative Fish & Wildlife Research Unit, University of Wyoming, USA, achalfou@uwyo.edu

#### DOES GREATER SAGE-GROUSE BREEDING DENSITY PREDICT SAGEBRUSH-ASSOCIATED SONGBIRD ABUNDANCE?

Surrogate species conservation, where conservation action directed at one species also indirectly benefits others, holds promise as a fruitful frontier in wildlife conservation. The well-known Greater Sage-Grouse (*Centrocercus urophasianus*) is often touted as an umbrella species, one form of surrogate, for the enhanced conservation of other sagebrush-associated wildlife species, including three sagebrush-obligate songbird species of conservation interest: Brewer's Sparrow, *Spizella breweri*; Sagebrush Sparrow, *Artemisiospiza nevadensis*; and Sage Thrasher, *Oreoscoptes montanus*. In order to rigorously test the assumption that conserving priority Greater Sage-Grouse habitats will benefit sagebrush-associated songbirds, we set out to describe the relationship between Greater Sage-Grouse breeding density and the presence and abundance of songbirds found in sagebrush steppe. We surveyed 72 randomly sited half-kilometer line transects in 2012 and 2013, stratified across a gradient of previously designated Greater Sage-Grouse breeding density in central Wyoming, USA. We used traditional distance-sampling methods to estimate songbird abundance. Preliminary analysis shows that Greater Sage-Grouse breeding density is only a marginal predictor of songbird abundance, but that responses are species-specific. Final analyses will make use of an on-the-ground index of Greater Sage-Grouse habitat use (abundance of grouse fecal pellets) and vegetation data (remotely sensed and field-collected) to further explore the relationship between this potential umbrella species' habitat preference and that of co-occurring songbirds, including at-risk sagebrush-obligate songbird species. (ID 16076 | Poster 37)

**Carlisle, J. D.**, Intermountain Bird Observatory, Boise State University, USA, jaycarlisle@boisestate.edu

Miller, R. A., Intermountain Bird Observatory, Boise State University, USA, robertmiller7@boisestate.edu

Ware, H. E., Intermountain Bird Observatory, Boise State University, USA, heidiware@u.boisestate.edu

Barber, J. R., Boise State University, USA, jessebarber@boisestate.edu

Heath, J. A., Boise State University, USA, JulieHeath@boisestate.edu

McClure, C. J., The Peregrine Fund, USA, CMcClure@peregrinefund.org

Paprocki, N., Wild Lens Inc, USA, neil@wildlensinc.org

Kaltenecker, G. S., Intermountain Bird Observatory, Boise State University, USA, GregoryKaltenecker@boisestate.edu

#### BEYOND MIGRATION BANDING: UNDERSTANDING FACTORS AFFECTING STOPOVER SUCCESS IN AUTUMN LANDBIRD MIGRANTS.

We have studied the stopover ecology of migratory landbirds in Idaho's Boise Foothills during autumn migration for 17 years using a combination of constant effort banding and other techniques. Building upon a foundation of long-term data on standard stopover metrics such as recapture rates, stopover duration, and mass change exhibited by migrants, we've recently begun exploring additional factors potentially affecting stopover performance of migrants including climate change and anthropogenic noise. We've documented that montane shrub and forest habitats support a high abundance and diversity of migrants during autumn and that the vast majority of individuals and species are able to gain mass – possibly the most important characteristic of suitable stopover habitat. Additionally, we've found that climate variation impacts the migration timing and energetic condition of migrants and that experimental road noise affects the abundance and energetic condition of migrants. Specifically, several species have exhibited delayed autumn migration timing and increased energetic condition in recent years, both changing in concert with temperature and precipitation which we hypothesize are related to food availability. Road noise caused a 25% reduction in bird abundance. While some species left, the species that stayed experienced other impacts, such as reduced energetic condition. These findings demonstrate the critical data that can be collected as part of a bird banding study and their utility in helping to prioritize habitats for migratory bird conservation in a changing world. (ID 16125)

**Carstensen, D. L.**, United States Bureau of Reclamation, USA,

dcarstensen@usbr.gov

Ahlers, D. D., United States Bureau of Reclamation, USA, dahlers@usbr.gov

Moore, S. D., United States Bureau of Reclamation, USA, sdavidmoore@usbr.gov

#### SURVEY RESULTS AND BREEDING PAIR DELINEATION TECHNIQUES OF THE YELLOW-BILLED CUCKOO ON THE MIDDLE RIO GRANDE, NEW MEXICO

The Bureau of Reclamation (Reclamation) began conducting Yellow-billed Cuckoo (*Coccyzus americanus*) surveys on the Middle Rio Grande (MRG), New Mexico in 2006. Current survey protocol (established 2009); have documented a significant population within the MRG basin, and likely the largest population within the western "distinct population segment" (identified by US Fish and Wildlife Service). Based on survey detections, this population has fluctuated in both abundance and spatial distribution during the past six years. The conservation pool of Elephant Butte Reservoir (EBR) has annually contained the largest portion of cuckoo detections within the study area, a phenomenon likely attributed to rapid and continual revegetation of suitable habitat associated with EBR drawdown. Reclamation developed a list of criteria to assist in breeding pair delineation; taking into consideration cuckoo biology, clumping patterns of detections, survey period, habitat, and best biological opinion in order to determine pair locations. Similar to survey detections, pair abundance has fluctuated annually but generally increased since 2009 within the MRG study area. This population

likely acts as an important source for the MRG Basin and a similar pair delineation methodology, if implemented by additional southwestern studies, this could assist in standardization of rangewide abundance comparisons. (ID 16187)

**Carvalho Provinciato, I.,** Universidade Estadual Paulista, Brazil, ivan\_celso@globo.com

Jahn, A. E., Universidade Estadual Paulista, Brazil, ajahn@rc.unesp.br  
Brown, L. M., Tufts University, USA, izzycutty@gmail.com

#### THE RELATIONSHIP BETWEEN WING MORPHOLOGY AND MIGRATION DISTANCE OF FORK-TAILED FLYCATCHERS (TYRANNUS SAVANA) IN SOUTH AMERICA

Recent studies suggest that the wing morphology of birds is correlated with presence or absence of migration, as well as migratory distance. Long distance migrants tend to have longer and more pointed wings than short distance migrants, thereby promoting longer and faster flights. We compared the wing morphology of three populations of the Fork-tailed Flycatcher (*Tyrannus savana*), one of the most widespread birds in South America: (1) a sedentary population in the llanos of the Orinoco Basin in northern South America, (2) a medium-distance migrant population, which migrates ~3500 km between wintering grounds in northern South America and breeding grounds in the middle of the continent (Brazil), and (3) a long-distance migrant population, which migrates >4500 km between wintering grounds in northern South America and breeding grounds in southern South America (Argentina). We found differences in the wing morphology of males among populations, including wing loading and Kipp's distance, suggesting that their wing morphology is shaped in part by migration strategy. We discuss other factors that could affect the wing morphology of Fork-tailed Flycatchers, including age, sex, and variation in life history strategies among populations. (ID 16131 | Poster 54)

**Cauchard, L.,** University of Montreal, Dept. of Biological Sciences, Montreal, Canada, laure.cauchard@umontreal.ca

Doucet, S. M., University of Montreal, Dept. of Biological Sciences, Montreal, Canada  
Bize, P., University of Montreal, Dept. of Biological Sciences, Montreal, Canada  
Doligez, B., University of Montreal, Dept. of Biological Sciences, Montreal, Canada  
Angers, B., University of Montreal, Dept. of Biological Sciences, Montreal

#### INTER-INDIVIDUAL VARIATIONS IN COGNITIVE PERFORMANCES AND SELECTIVE PRESSURES IN A NATURAL GREAT TIT POPULATION\*

Due to the spatio-temporal variation of their environment, animals face situations in which they have to deviate from their normal behavioral repertoire to solve unexpected problems. This behavioral plasticity can be measured via problem-solving or learning tests and these performances have been shown to vary between and within species. However, little is known about the evolution of these inter-individual differences in wild populations, and in particular the fitness consequences. We investigated this question in a wild Great tit (*Parus major*) population in Gotland (Sweden). We first tested the link between problem-solving performance and reproductive success by experimentally manipulating brood sizes and measuring parent's responses to a problem-solving task. Our results showed not only that our brood size manipulation did not affect the problem-solving performance of the breeding pair, but also that solver pairs had more hatched and fledged young, accounting for brood size manipulation. Despite the fact that individuals may benefit from selecting mates with enhanced cognitive abilities, assessing the cognitive performances of potential partners directly could be difficult and the use of indirect cues, such as diet-dependent morphological traits, might be favored. We thus investigated whether individuals' problem-solving and learning performances on a novel non-foraging task correlated with plumage coloration. Higher performing individuals were duller but showed higher UV reflectance than worse performing individuals. These results suggest

that feather coloration, and in particular UV reflectance, are associated with cognitive performances and might be used by higher efficient individuals during mate choice in a complex phenotype- and condition-dependent way. Taking together, these results suggest that natural and sexual selection might play a role in the evolution of cognitive performance in the wild. (ID 16405 | Poster 12)

**Celis Murillo, A.,** University of Illinois at Urbana-Champaign, USA, celismu1@illinois.edu

Benson, T. J., Illinois Natural History Survey, USA, tjbenison@illinois.edu  
Brawn, J., University of Illinois at Urbana-Champaign, USA, jbrawn@illinois.edu  
Schelsky, W., Illinois Natural History Survey, USA, schelsky@illinois.edu  
Ward, M. P., University of Illinois at Urbana-Champaign, USA, mpward@illinois.edu

#### IS CHEATING FOR EVERYONE? PATTERNS OF EXTRATERRITORIAL FORAYS AND EXTRA-PAIR PATERNITY IN FIELD SPARROWS (SPIZELLA PUSILLA)\*

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. Two behavioral mechanisms are available to obtain extra-pair copulations: (1) a passive approach, where individuals mate with others that enter their territories, or (2) an active approach, where individuals search for extra-pair mates using extraterritorial forays, where extraterritorial forays refer to any movement off of one's territory. The relative use of each tactic may depend on numerous factors, such as sex, age, and individual quality. My research is using automated radio-telemetry to examine the behavioral and morphological correlates of male and female Field Sparrows conducting forays and to examine the fitness consequences (paternity) of foraging behavior. My preliminary data demonstrates that both males and females conduct short- and long-distance forays (up to 830 m). Males have been observed conducting forays during the day and night, while females conduct forays only during the day. I also have found individual differences in foray occurrence and effort, where some individuals tend to stay within their territory (mate guarding) while others make frequent forays. Variation in the foray rate (foray/hr) and timing of forays (day vs. night) appear to be linked to male individual quality (and mate quality for females); individual quality assessed by the combination of song performance, body condition and timing of breeding. My study, in addition to provide insights into proximate and ultimate factors behind foray behavior, it also provide insights into why animals seek extra-pair mates, more importantly why females seek extra-pair mates. (ID 16372)

Cerame, B., Louisiana State University, USA, bceram1@tigers.lsu.edu

Cox, J. A., Tall Timbers Research Station, USA, Jim@ttrs.org

Brumfield, R. T., Louisiana State University, USA, robb@lsu.edu

Tucker, J. W., Tall Timbers Research Station, USA, jtucker.sparrow1@gmail.com

**Taylor, S. S.,** Louisiana State University, USA, staylor@lsu.edu

#### LITTLE GENETIC STRUCTURE IN BACHMAN'S SPARROW (PEUCAEA AESTIVALIS) DESPITE NATURAL BARRIERS AND HABITAT FRAGMENTATION: ADAPTATION TO EPHEMERAL HABITAT IN A FIRE-DEPENDENT SPECIES?

We assessed genetic diversity and structure in Bachman's Sparrows (*Peucaea aestivalis*) to determine whether distinct population units exist and whether loss and fragmentation of longleaf pine forest had caused population differentiation and inbreeding. We observed high levels of genetic variation and panmixia across the species' range, which suggests that separate management units/subspecies designations or translocations



to promote gene flow among fragmented populations are not necessary. An historical range expansion and retraction in the early 1900s may account for the lack of genetic structure. Alternatively, high vagility as an adaptation to the ephemeral, fire-mediated habitat that this species prefers may mitigate inbreeding and loss of genetic diversity in highly fragmented habitat. (ID 16020)

Chace, J. F., Salve Regina University, Dept. of Biology and Biomedical Sciences, Newport, RI, USA

Cruz, A., University of Colorado, Boulder, CO, USA

**Vinton, A. C.**, University of Colorado, Boulder, CO, USA, anna.vinton@colorado.edu

Swanson, H. M., City of Boulder Open Space & Mountain Parks, Boulder, CO, USA

#### A CENTURY OF BIRD POPULATION CHANGE IN THE CONIFEROUS FORESTS OF THE COLORADO FRONT RANGE

Knowledge of long-term population trends of birds of western coniferous forests is rudimentary. Here we examine long-term trends of coniferous forest birds in Boulder County, Colorado between 1900 and 2014 as an index of long-term trends along the Colorado Front Range. Bird abundance was determined from Christmas Bird Count data, Indian Peaks Bird Counts, Breeding Bird Atlas, annotated bibliographies (1909, 1913, 1937), and local studies. Notable changes include: woodpeckers have been declining in lower elevation forests but remain stable in higher elevation forests. Blue Jay (*Cyanocitta cristata*) and Common Raven (*Corvus corax*) increasing in lower forests and American Crow (*C. brachyrhynchos*) throughout the county. Black-capped Chickadee (*Parus atricapillus*) abundance in lower elevation ponderosa pine is considerably lower today than in pre-1987 surveys. Brown Creeper (*Certhia americana*), Red-breasted (*Sitta canadensis*) and White-breasted Nuthatch (*S. carolinensis*), and kinglets (*Regulus* sp.) have become more common at higher elevations. Explanations for these changes include fire suppression, reduced logging, and cessation of higher elevation grazing permits, which have led to a more closed canopy and densely forested landscape than a century ago. Urbanization has changed the landscape significantly at lower elevations since 1950. These factors may explain some of the 100-year bird population changes we have detected. (ID 16393 | Poster 89)

**Chalfoun, A. D.**, University of Wyoming, USA, achalfou@uwyo.edu

Mahoney, A. C., University of Wyoming, USA, anikamahoney@gmail.com

#### CONTRASTING INDIRECT EFFECTS OF WIND TURBINE COMPLEXES VERSUS NATURAL GAS DEVELOPMENT ON GRASSLAND AND SHRUBSTEPPE SONGBIRDS<sup>T</sup>

Habitat changes resulting from energy extraction activities can exert both direct (via for example wind turbine strikes causing mortality) and indirect effects on bird species, though the latter has been less studied. During 2011-2012 we investigated the influence of wind energy infrastructure on the reproductive success of grassland songbirds (horned lark and McCown's longspur) within two wind farms in southeastern Wyoming, and in 2012, between wind farms and paired reference sites. We found no significant differences in clutch size, nestling size, or nest survival with distance to the nearest turbine or between wind energy and control sites. In contrast, ongoing work focused on sagebrush songbirds (Brewer's sparrow, sagebrush sparrow, sage thrasher) since 2008 in western Wyoming natural gas fields suggests higher nest predation risk with greater surrounding loss due to energy development. At least one mechanism for this pattern appears to be higher activity of rodent nest predators (deer mice and ground squirrels) with greater surrounding natural gas development. These contrasting patterns suggest intriguing avenues for future research including potential temporal lag effects in the relatively newer wind energy complexes, varying nest predator assemblages and/or different predator responses to various types

of anthropogenic habitat change. Understanding the mechanisms underlying indirect effects of different types of energy extraction activities on breeding birds will be critical, especially in light of the considerable population declines of many co-occurring North American grassland and shrubland songbirds. (ID 16091)

**Chesser, R. T.**, USGS PWRP/National Museum of Natural History, USA, chesser@si.edu

Isler, M. L., Smithsonian Institution, USA, antbird@cox.net

#### ANTBIRDS FROM THE AMAZON TO THE ANDES: HOW MUCH DIVERSITY ARE WE OVERLOOKING?<sup>T</sup>

We have been studying genetic and vocal diversity in several species of South American antbirds of the Amazon and the Andes. Comparisons of our findings with current indicators of diversity reveal that in some cases diversity is reasonably well estimated whereas in others it is grossly underestimated. Morphological diversity in understory antwrens (*Myrmotherula* spp.) of Amazonia, as codified in subspecies designations, is a reasonable proxy for genetic diversity, but the efficacy of current species designations in delineating the actual number of biological species ranges from excellent (equal numbers of currently recognized and actual species) to poor. Our studies of *Myrmotherula brachyura*, an inhabitant of the canopy of Amazonian rainforest, and the *Grallaria rufula/blakei* complex of the understory of the forested Andes, reveal greater disparities regardless of taxonomic category. In these species, morphological diversity is a poor proxy for genetic diversity, and current species designations greatly underestimate the actual number of phylogenetic and biological species. (ID 16218)

**Chevion, Z. A.**, University of Illinois, Urbana-Champaign, USA, chevion@illinois.edu

Jones, M. R., University of Montana, USA, jonesmr9@gmail.com

Carling, M. D., University of Wyoming, USA, mcarling@uwyo.edu

#### POPULATION GENOMICS OF HIGH ALTITUDE ADAPTATION IN RUFOUS-COLLARED SPARROWS (*ZONOTRICHIA CAPENSIS*)

Species with broad elevational distributions experience dramatically different selective pressures at the extremes of their altitudinal ranges. Because there are a number of well-characterized biochemical pathways that may be expected to contribute to adaptive evolution in high-altitude environments, species with large elevational ranges offer exciting opportunities to study both the influences of microevolutionary processes on local adaptation, and the mechanistic basis of adaptive traits. The Rufous-collared Sparrow (*Zonotrichia capensis*) has one of the broadest elevational ranges of any passerine songbird. Along the Pacific slope of the Andes in Peru, *Z. capensis* is continuously distributed from sea-level to over 4600m above sea-level, and populations occurring at the extremes of this range differ in physiological parameters that are likely to be adaptive. In this study, we used a genotyping-by-sequencing (GBS) approach to survey patterns of DNA polymorphism at over 2000 unlinked loci that are distributed across the *Z. capensis* genome. Our results revealed that 1.) elevational gradients play a significant role in the population genetic structuring of *Z. capensis*, and 2.) that levels of genetic differentiation are not randomly distributed among biochemical pathways. Instead, genes that participate in oxygen transport, aerobic metabolism, tissue vascularization and oxidative stress response were over-represented among those exhibiting levels of divergence that exceeded neutral expectations. Taken together, these results suggest that spatially varying selective pressures may serve to limit gene flow between high and low elevation populations, and that local adaptation to highland and lowland environments likely involves coordinated changes in many genes that participate in hierarchical physiological pathways. (ID 16268)

**Chiavacci, S. J.**, University of Illinois; Illinois Natural History Survey, USA, schiavacci@gmail.com

Ward, M. P., University of Illinois; Illinois Natural History Survey, USA, mpward@illinois.edu

Benson, T. J., University of Illinois; Illinois Natural History Survey, USA, tjbenison@illinois.edu

#### WHY DO NESTLINGS FLEDGE EARLY IN THE DAY? EXAMINING THE ROLE OF PREDATION RISK IN SHAPING FLEDGING BEHAVIOR

Predation represents the primary cause of mortality for both nestling and fledgling birds and is often highest in the days immediately before and after nest departure. Due to the selective pressures of such high mortality rates, behaviors have likely evolved that reduce mortality. Among altricial species, fledging often occurs in the morning with the majority of nestlings leaving within several hours of sunrise. However, why nestlings fledge early in the day and whether this strategy is a response to predation risk is unknown. We investigated how the time of day when fledging began and how rapidly siblings within a nest fledged were influenced by day length, nest survival rates, and nest site features that affect nest predation risk. We recorded 477 fledging events at 202 nests of 17 species. Nestlings occupying higher predation risk nests (i.e., nests closer to the ground) initiated fledging earlier in the day than those in safer nests. Similarly, siblings in high risk nests (i.e., nests closer to the ground, surrounded by less vegetation, at sites with higher nest predation rates) fledged over a shorter period of time than siblings in low risk nests. Lastly, nestlings fledged later in the day when day length was longer regardless of predation risk. Our findings that nestlings began fledging earlier in the day and fledged more rapidly when nest predation risk was high lends support to the hypothesis that predation risk influences the process of fledging. By fledging earlier and more quickly, young likely decrease their chances of being depredated in the nest when predation risk is high. In addition, the tendency to fledge later on longer days suggests the timing of nest departure is more strongly influenced by the amount of daylight remaining in the day rather than the time since sunrise; this may be a strategy by which young ensure they depart the nest with enough daylight remaining to reach a safe location prior to nightfall. (ID 16169)

**Chilson, P. B.**, University of Oklahoma, USA, chilson@ou.edu

#### METEOROLOGICAL IMPACTS ON THE ECOLOGY AND BEHAVIOR OF FLYING ANIMALS<sup>†</sup>

The movement of flying animals within the Earth's airspace is largely confined to the atmospheric boundary layer and lower free troposphere – the aerosphere. The airspace has provided those animals, which have adapted to flight, with a host of opportunities regarding foraging, migration, predator evasion, and so forth. Not surprisingly, thermodynamic and kinematic properties of the aerosphere can also dramatically affect the behavior and evolutionary development of volant organisms. For example, the depth and turbulent structure of the atmospheric boundary in a given region is strongly influenced by terrain, vegetation type, thermal forcing, and prevailing winds, which correspondingly directly impact the diurnal and seasonal patterns of behavior among birds and the other organisms with which they interact. Moreover, the behavior of birds are affected at larger spatial-scale meteorological conditions (mesoscale and synoptic scale), such as frontal passages, the formation of low-level jets, localized storms, density currents generated by severe weather events, the development of horizontal convective rolls, and similar phenomena. At even larger spatial scales (planetary scale), long-range migration tracks are heavily influenced by trade winds. A full understanding and appreciation of the interaction between weather and the ecology and behavior of flying animals requires a broad and inter-disciplinary approach. Here we provide examples of how weather radar coupled with other meteorological sensors can be used to i) characterize the

atmospheric conditions; ii) predict the response of birds to these conditions; and iii) observe the actual ornithological response precipitated by the event. (ID 16154)

**Choi, C. Y.**, University of Oklahoma, Center for Spatial Analysis, USA, subbuteo@hanmail.net

Takekawa, J. Y., USGS, USA, john\_takekawa@usgs.gov

Prosser, D. J., USGS, USA, dprosser@usgs.gov

Newman, S. H., FAO, USA, scott.newman@fao.org

Spragens, K. A., USFWS, USA

Palm, E. C., USGS, USA

Xiao, X., University of Oklahoma, USA

#### WATERFOWL MIGRATION AND AVIAN INFLUENZA RISKS<sup>†</sup>

Avian influenza viruses (AIVs), particularly highly pathogenic avian influenza, pose a health concern for wildbirds, poultry and humans. Risk factors influencing the dynamics of AIV are coupled with wild hosts, environments as well as human systems, but the role of waterfowl in the transmission and persistence of AIVs remains unclear. In this context, we initiated a telemetry program in 2006 to study wild bird movements in relation to AIV that has resulted in the marking of more than 600 waterfowl representing 23 species with satellite or GPS transmitters in 12 countries including Asia and Africa. Our spatio-temporal analysis to describe waterfowl flyways probabilistically enables us to better understand waterfowl-poultry interactions (or contact risk), ecological risk factors (such as species-specific traits), correlation between waterfowl movements and AIV distribution, migration routes and timing as well as the habitat preferences, and seasonality of free-ranging waterfowl. We describe a range of analytical approaches used from simple spatial correlations between AIV outbreaks and migration routes (utilization distributions) to Brownian bridge movement models, phylogenetic models, and niche models. Our knowledge of waterfowl movements is currently insufficient to fully integrate their complex role into epidemiological analyses and risk models. However, we discuss recent advances in technologies, including more effective, less costly tracking platforms and interdisciplinary efforts to handle big data analyses that will facilitate adding increased ecological knowledge in future AI risk models. (ID 16383)

**Churchwell, R. T.**, University of Alaska Fairbanks, USA, rchurchw@alaska.edu

Powell, A. N., US Geological Survey and University of Alaska Fairbanks, USA, abby.powell@alaska.edu

Kendall, S., US Fish and Wildlife Service, Hakalau Forest National Wildlife Refuge, USA, steve\_kendall@fws.gov

Brown, S., Manomet Center for Conservation Sciences, USA, sbrown@manomet.org

#### ASSESSING EASTERN BEAUFORT SEA DELTAS AS FALL STOPOVER SITES FOR SEMIPALMATED SANDPIPERS

We assessed habitat quality of post-breeding stopover sites for semipalmated sandpipers at three river deltas on the coast of the Beaufort Sea, Alaska in 2010 and 2011. Over 98% of semipalmated sandpiper migrants are hatch-year at these sites. We surveyed shorebirds every three days to determine abundance throughout migration (20 July – 23 August). We also captured 170 birds early (23 July – 5 August) and late (8 August – 20 August) in migration to collect blood samples and morphometric data. We used blood triglycerides as indices of fattening rates and habitat quality. Food resources were quantified through invertebrate sampling, and an index of predators was created from observational data. We analyzed our data using ANCOVA and mixed models. We originally hypothesized a positive relationship between invertebrate abundance, triglyceride, and shorebird abundance, but we found no difference in triglyceride among deltas even when shorebird abundance differed among deltas. However, shorebirds were positively associated

with invertebrate abundance. We also found a positive association between shorebird weight and river delta that was the result of heavier individuals captured at our most western site. This may indicate we captured a portion of the semipalmated sandpiper population at this delta that then migrated by a different route or without stopping at the other deltas. Fattening rate was not an indicator of habitat quality in our data, but several indirect indicators demonstrated differences in habitat quality of deltas. Also, differences we found in shorebird abundance among deltas indicate even naive hatch year birds can assess habitat quality early in their migration. (ID 15921)

**Cicero, C.,** University of California, Berkeley, USA, ccicero@berkeley.edu  
Benedict, L., University of Northern Colorado, USA, Lauryn.Benedict@unco.edu

King, C., University of Northern Colorado, USA, king4557@bears.unco.edu  
Karin, B., Villanova University, USA, benrkarin@gmail.com

#### CULTURAL EVOLUTION IN BELL'S AND SAGEBRUSH SPARROWS (ARTEMISIOSPIZA BELLI AND A. NEVADENSIS): DOES SONG REFLECT PHYLOGENY AND ECOLOGY?

The Bell's Sparrow (*Artemisiospiza belli*) and Sagebrush Sparrow (*A. nevadensis*) were split recently based on genetic, morphological, and ecological differences. These species meet in a narrow contact zone in eastern California where the Mojave Desert meets the Great Basin. The Bell's Sparrow is smaller than the Sagebrush Sparrow, occupies a different ecological niche, and migrates shorter distances. We add to prior work by examining song differences at two scales: (1) among populations of *A. nevadensis* and three of four subspecies of *A. belli*; and (2) in detail across the contact zone. We studied over 8900 songs from 427 individuals and 27 sites, and measured a number of variables on sound spectrographs to quantify the frequency and temporal characteristics of songs. On a broad scale, songs reflect ecological similarity versus phylogenetic relatedness. Songs of *A. b. belli* are distinctive from a cluster that includes *A. nevadensis*, *A. b. canescens*, and *A. b. clementeae*. Within that cluster, *A. nevadensis* songs are distinctive from the other taxa. The endemic, threatened island subspecies (*A. b. clementeae*) has songs more typical of the ecologically similar *A. b. canescens* than the geographically proximate *A. b. belli*. At both scales, *A. nevadensis* and *A. belli* show marked differences in song frequency and temporal characteristics. Songs across the contact zone generally matched patterns of mtDNA and morphology, with more typical *A. nevadensis* songs at the northern end of the zone, more typical *A. b. canescens* songs at the southern end of the zone, and genetically mixed populations showing song characteristics of both taxa. (ID 15824)

**Cinto Mejia, E.,** Boise State University, USA, elizethcinto@gmail.com  
McClure, C. J., The Peregrine Fund, USA  
Barber, J. R., Boise State University, USA

#### AN EXPERIMENT ON THE EFFECTS OF NATURAL GAS EXTRACTION NOISE ON BIRDS: THE PHANTOM GAS FIELD.

Research has shown that gas extraction activities negatively impact wildlife. We know that bird abundance and diversity are reduced near gas compressor stations, but no work has experimentally parsed out the role that compressor station noise alone plays in these effects. We have recreated the noise component of natural gas compressor stations, a prominent element of gas extraction fields, using speaker arrays at eight sites. At these locations, and eight control sites, we are conducting point counts for birds at 50m and 250m from the center of the site (i.e., the location of the speaker arrays). Here we present a preliminary report from the first year of our experiments on the effects of increased sound levels on the distribution of the bird community. (ID 16362 | Poster 102)

**Clark, A. B.,** Binghamton University, USA, aclark@binghamton.edu  
McGowan, K. J., Cornell Laboratory of Ornithology, USA, kjm2@cornell.edu  
Zajac, M., Binghamton University, USA, mzajac2@binghamton.edu  
Schlosser, J., Binghamton University, USA, jschlos2@binghamton.edu

#### DATE AND RECENT WEATHER AS FACTORS IN NEST INITIATION DECISIONS OF AMERICAN CROWS

Climate change has focused attention on the factors that affect nest initiation dates as well as the overall length of the nesting season in birds. American crows *Corvus brachyrhynchos* are found across North America, suggesting that they use flexible or complex cues that serve them across latitudes. On the other hand, although crows have a wide nesting range, northern populations do migrate and must return to their home territories at an appropriate time for nesting. Analysis of nesting data between 1990 and 2013 from a long term study population of crows in Ithaca, NY shows that clutch initiation has not shifted to earlier dates, but the peak as well as spread in the dates of initiation of first clutches varies dramatically year to year. We present an analysis of clutch initiation patterns in relation to date (daylength), identity of the nesting female and the weather patterns in the week and 2 weeks prior to individual nest starts. Weather variables include precipitation, night and daytime temperatures and cumulative "growing degree days" that would contribute to thawed ground. (ID 16357 | Poster 17)

**Clark, R. G.,** Environment Canada, Canada, bob.clark@ec.gc.ca  
Winkler, D. W., Cornell University, USA, dww4@cornell.edu  
Dawson, R. D., University of Northern British Columbia, Canada, russell.dawson@unbc.ca  
Harriman, V. B., University of Saskatchewan, Canada, vanessa.harriman@usask.ca  
Shutler, D., Acadia University, Canada, dave.shutler@gmail.com  
Hussell, D. J., Ontario Ministry of Natural Resources, Canada, david.hussell@ontario.ca  
Lombardo, M. P., Grand Valley State University, USA, lomardm@gvsu.edu  
Thorpe, P. A., Grand Valley State University, USA  
Dunn, P. O., University of Wisconsin, USA, pdunn@uw.edu  
Whittingham, L. A., University of Wisconsin, USA, whittinga@uw.edu

#### SPATIAL AND TEMPORAL VARIATION IN APPARENT SURVIVAL RATES OF TREE SWALLOWS

Determining demographic rates in wild animal populations and understanding why rates vary are important challenges in population ecology and conservation. Whereas reproductive success is reported frequently for many songbird species, there are relatively few corresponding estimates of annual survival and virtually none for widespread populations of the same migratory species. We incorporated mark-recapture data into Cormack-Jolly-Seber models to estimate annual apparent survival and recapture rates for adult male and female tree swallows (*Tachycineta bicolor*) at seven widely-separated breeding populations across North America for periods of 7-33 years, and for nestlings (first-year survival) in two western populations over 12 years. Across sites, best-approximating models typically indicated strong annual variation in apparent survival rates of adult and juvenile swallows; when sex differences were detected in adults, males tended to have higher survival rates than females. Decreasing or low annual apparent survival rates were evident at two of three sites in northeastern N.A., a region where population declines have been reported in tree swallows and several other species of aerial insectivores. Estimates of apparent annual survival rate generally were uncorrelated among study sites, including some close-neighbouring sites, implying that breeding site-specific conditions or events on nonbreeding areas were important determinants of annual survival rates. Further work is needed to evaluate how survival is related to environmental conditions throughout the annual cycle and how these factors affect population dynamics of swallows and related species of conservation concern. (ID 16022)



**Clatterbuck, C. A.**, San Diego State University, USA, corey.clatterbuck@gmail.com  
 Young, L. C., Pacific Rim Conservation, USA  
 VanderWerf, E. A., Pacific Rim Conservation, USA  
 Naiman, A., Stanford University, USA  
 Bower, G. C., Stanford University, USA  
 Shaffer, S. A., San Jose State University, USA, scott.shaffer@sjsu.edu

#### DO PARENTS ROCK AND ROLL ALL NIGHT: TEMPORAL EGG-TURNING PATTERNS IN LONG-LIVED SEABIRDS

The eggs of most extant avian species must be monitored and tended throughout incubation to maximize hatching success and reproductive fitness. Certain parameters of contact incubation, such as egg temperature, nest humidity and water vapor conductance, and parental attendance, change over the course of incubation, creating variable conditions for the developing embryo. Additionally, avian eggs must be turned during the first few days of incubation to transport vital nutrients to the sub-embryonic fluid, enabling improved growth and gas exchange for the developing embryo. However, few field studies have examined temporal egg turning patterns in wild birds. We used novel, remote logging devices containing a triaxial accelerometer and a magnetometer implanted in artificial eggs to record egg turning behavior of western gulls (*Larus occidentalis*) and Laysan albatrosses (*Phoebastria immutabilis*). The high resolution (1°) and sampling rate (1 sec) of these loggers provided a 3-D visualization of egg turning in wild nests for uninterrupted periods lasting 1-7 days. Resulting data were compared across the incubation period and revealed differences in egg turning rates and angles related to the diurnal activity and life histories of these two surface-nesting, colonial species. This biotechnology and resulting analyses have the capability to examine the conclusions of lab-based avian incubation studies in wild and behavioral contexts, thus linking critical questions surrounding avian breeding ecology, life history, and evolution. (ID 16381)

**Clement, M. J.**, U.S. Geological Survey, Patuxent Wildlife Research Center, USA, mclement@usgs.gov  
 Nichols, J. D., U.S. Geological Survey, Patuxent Wildlife Research Center, USA, jnichols@usgs.gov  
 Pardieck, K. L., U.S. Geological Survey, Patuxent Wildlife Research Center, USA, kpardieck@usgs.gov

#### AVIAN INDICATORS OF CLIMATE CHANGE BASED ON THE NORTH AMERICAN BREEDING BIRD SURVEY

As global climate changes, it is generally expected that ecological systems will respond and adapt. Appropriate indicators of ecological responses can be used to measure concurrent changes in ecological systems, inform management decisions, and potentially to project the consequences of climate change. An ideal indicator should be based on predicted ecological responses to climate change, incorporate data across a large geographic extent and a wide range of climatic conditions, be sensitive to environmental change, and be practical and affordable. For terrestrial animals, predicted ecological responses include an increase in the range of species, a pole-ward movement in the range centroids of species, and an increase in local colonization rates. However, monitoring data typically confound the spatio-temporal processes of interest with an imperfect observation process that includes detection probabilities <1 and spatial dependence among observations. Furthermore, the impact of imperfect observation on monitoring data is likely to differ towards range margins, potentially biasing indicators. Here we present indicators of climate change developed from the North American Breeding Bird Survey using new multi-season occupancy models that account for imperfect detection and spatial dependency among observations. We evaluate three indicators of climate change — range size, centroid position, and colonization rates — for example species. We conclude with a discussion of potential uses of these indicators, as well as other ecological parameters that might be useful as indicators of climate change. (ID 15904)

Coe, B. H., Virginia Tech, USA, bchop@vt.edu  
 Beck, M. L., Virginia Tech, USA, beckmic@vt.edu  
 Chin, S., College of William and Mary, USA, sychin@email.wm.edu  
 Jachowski, C. M., Virginia Tech, USA, cjachowski@vt.edu  
**Hopkins, W. A.**, Virginia Tech, USA, hopkinsw@vt.edu

#### LOCAL VARIATION IN CLIMATE INFLUENCES PARENTAL CARE AND RESULTANT EMBRYONIC DEVELOPMENTAL CONDITIONS IN A PASSERINE BIRD

Incubation is an important component of avian parental care and slight changes in egg incubation temperature can affect offspring phenotype. However, studies explicitly linking environmental conditions to parental behavior and resultant egg temperatures are lacking. Using 22,816 behavioral observations and > 1 million paired ambient and egg temperatures from 55 nests, we describe the relationships among abiotic factors, female incubation behavior, egg incubation temperature, and incubation period for Tree Swallows (*Tachycineta bicolor*). Average incubation temperature in our population was 33.7 C but averages ranged > 10 C, with daily egg temperatures ranging from 18.0 – 39.2 C. Models generated from our observations predicted that the number of female off-bouts was the lowest under warm and dry conditions while more off bouts were taken under cold and dry or warm and wet conditions. Additionally, females modulated the amount of time they stayed off the nest according to precipitation and temperature patterns. During cold and dry conditions, females stayed off their nest 4 times longer than under warm and dry conditions. However, this pattern was reversed under periods of heavy rainfall; females tended to take shorter off-bouts when it was rainy and cold compared to longer off-bouts during warmer rain events. Furthermore, variation in female behavior was associated with differences in overall incubation temperature such that females that took shorter, more frequent off-bouts produced higher incubation temperatures than those that opted for longer, less frequent off-bouts. Taken together, our results support the idea that the advantages of breeding early (e.g., nest site availability, predator avoidance) may be countered to some extent by cooler, early season temperatures and extreme weather events that cause reproducing females to balance costs of self-maintenance and parental care. (ID 15877 | Poster 112)

**Cohen, E. B.**, Smithsonian Migratory Bird Center, USA, cohene@si.edu  
 Hostetler, J. A., Smithsonian Migratory Bird Center, USA, hostetlerj@si.edu  
 Sillett, T. S., Smithsonian Migratory Bird Center, USA, silletts@si.edu  
 Marra, P. P., Smithsonian Migratory Bird Center, USA, marrap@si.edu

#### A QUANTITATIVE DEFINITION FOR THE STRENGTH OF MIGRATORY CONNECTIVITY

Advances in tracking technology over the past decade have revealed seasonal movement patterns for many migratory bird species, but population-level assessments of migratory connectivity have been qualitative. This has limited our ability to evaluate the strength of connectivity among studies and species, and between phases of the annual cycle. We developed a quantitative index of migratory connectivity between two stationary phases of the annual cycle, such as breeding and over-wintering, that is comparable among organisms with distinct geographic ranges. The inputs required are delineation of sites within both seasonal ranges, distance between sites within seasonal ranges, relative abundance at sites within one of those ranges, and transition probabilities between sites across seasons. The metric can also estimate multiple sources of process and sampling error. Calculation of the index is not specific to a data type. We used simulations to: 1) measure how the metric performed across input values, and 2) examine how robust the metric is to sources of error. Our framework can help move migratory connectivity research from the mapping of population ranges toward an understanding of how connectivity and environmental processes interact to affect population dynamics. (ID 15961)

**Collins, C. T.**, California State University, USA, charles.collins@csulb.edu  
Corey, K. A., U.S. Fish and Wildlife Service, USA, ken\_corey@fws.gov  
Atwood, J. A., Marlborough, NH, USA, jatwood704@gmail.com  
Doherty, Jr., P. F., Colorado State University, USA, paul.doherty@colostate.edu

#### POPULATION DYNAMICS OF ISLAND SCRUB JAYS

The Island Scrub Jay (*Aphelocoma insularis*) is endemic to Santa Cruz Island, located about 35 km from the coast of southern California. The jay is classified as vulnerable on the IUCN Red List. We analyzed 30 years of mark-recapture data to estimate apparent survival, probability of breeding, population growth rate, as well as probability of detection. We correlate these parameters with predictive variables of interest, including season, year, sex, feral animal removal, as well as test hypotheses concerning declines in survival and growth rates. (ID 16182 | Poster 42)

**Commons, K. A.**, Archbold Biological Station, USA, kelly.common26@gmail.com  
Pruett, M. S., Archbold Biological Station, USA  
Bowman, R., Archbold Biological Station, USA

#### DOES THE RESPONSE OF FLORIDA SCRUB-JAYS TO PREDATORS VARY WITH THEIR PERCEIVED RISK OF PREDATION?

Birds drastically alter their behaviors to reduce the risk of predation that they perceive. Perception of risk may be influenced by factors such as habitat, time during breeding season, and nest stage. Direct evidence of a predator, such as nest predation, indicates an increase in the actual risk of predation, and is likely to increase the perceived risk of future predation. The Florida Scrub-Jay (*Aphelocoma coerulescens*, FSJ), is a Threatened species endemic to Florida whose ~60% nest failure rate is mostly attributable to predation. To better understand why FSJ react to predation risk in the manner and intensity they do, we have to understand how they perceive risk. I tested how FSJ responded to experimental exposure to a predator under conditions in which the potential risk of predation varied. Rates of nest predation are higher in overgrown habitat, increase over the breeding season, and peak at hatchling stage. I conducted repeated observations of FSJ response to a model snake predator in open and overgrown habitats, over the course of the breeding season, and before and after actual nest predation events. Responses to predators varied by habitat, season, and nestling stage. In the middle of the season the reaction was more intense in open habitat than in overgrown, with similar intensities at other times. During the nestling stage the reaction was more intense in open habitat than in overgrown, with similar intensities during other stages. The response intensity did not differ before and after predation events. Reactions varied by habitat type during the times and stages when predation risk is highest, indicating that adaptive responses may be habitat dependent. (ID 16254 | Poster 8)

**Conrey, R. Y.**, Colorado Parks and Wildlife, USA, reesa.conrey@state.co.us  
Tripp, D. W., Colorado Parks and Wildlife, USA, dan.tripp@state.co.us  
Youngberg, E. N., Rocky Mountain Bird Observatory, USA, erin.youngberg@rmbo.org  
Panjabi, A. O., Rocky Mountain Bird Observatory, USA, arvind.panjabi@rmbo.org

#### AVIAN RESPONSE TO PLAGUE MANAGEMENT ON BLACK-TAILED AND GUNNISON'S PRAIRIE DOG COLONIES

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. In order to conserve species such as the black-footed ferret (*Mustela nigripes*), a plague vaccination program is being developed for prairie dogs. In 2013, we began studying effects of plague management on avian species, with particular focus on species of concern such as mountain

plover (*Charadrius montanus*) and burrowing owl (*Athene cunicularia*) that are known to respond to plague in prairie dogs. Our objective is to determine how avian communities in areas managed for plague (via oral prairie dog vaccine and insecticidal dusting) compare to unmanaged areas. A second goal is to demonstrate whether avian species associations exist for colonies of Gunnison's prairie dogs (*C. gunnisoni*: GPD) as they do for black-tailed prairie dogs (*C. ludovicianus*: BTPD). Differences in avian and plant communities between treatment and control areas will take time to develop. However, plague epizootics occurred in three BTPD project areas during fall 2013. Our data suggest that GPD colonies may have an avian community that differs from that in the surrounding area, but effects are weaker than for BTPD. Many avian and plant species have been recorded only in one habitat type (BTPD colonies, GPD colonies, or GPD off-colony sites). Of raptor species, burrowing owls and golden eagles (*Aquila chrysaetos*) showed the strongest preference for colonies. (ID 16358)

**Contina, A. J.**, University of Oklahoma/Oklahoma Biological Survey, USA, andrea.contina@ou.edu  
Bridge, E. S., University of Oklahoma/Oklahoma Biological Survey, USA, ebridge@ou.edu  
Ross, J. D., University of Oklahoma/Oklahoma Biological Survey, USA, rossjd@ou.edu  
Kelly, J. F., University of Oklahoma/Oklahoma Biological Survey, USA, jkelly@ou.edu

#### TESTING CANDIDATE GENES FOR MIGRATION IN THE PAINTED BUNTING

Molecular ecologists refer to the "candidate gene approach" when a gene or a pool of genes, hypothetically responsible for the regulation of a particular phenotype in one species, are being conserved across species. By studying these genes in conjunction with observations of the phenotype/s we obtain deep insight on the species evolution and adaptation. In avian movement studies, a complex trait such as "migration" is likely to be regulated by a cluster of genes and needs to be investigated through experiments with captive individuals as well as the more challenging direct observations in nature. Thanks to the technological advances in ultra-light tracking devices, we explored phenotypic variation for the trait "migration" in a small Neotropical migrant, the Painted Bunting (< 20 grams), at the intra-population level. In parallel, we began a candidate-gene approach to identify genes that might contribute to regulate avian migration. Here, we present our preliminary results on genome evolution in relation to songbird migration by using light-level geolocators and molecular techniques. By merging these two datasets, we investigated the possible correlation between regions of the genome of the Painted Bunting and the duration of their fall migration to stop over areas, fall departure dates, and fall arrival dates at the molting sites. To date, we focused on the ADCYAP1 gene and the CLOCK gene, but we found no correlation between these genes and duration or departure dates of fall migration. These results are not in agreement with previous studies on the ADCYAP1 gene in relation to migratory bird restlessness, highlighting the complexity of the genetics of avian migration. (ID 16088)

**Cooper, J. C.**, University of Kansas, USA, jccooper@ku.edu  
Powell, L. L., Smithsonian Conservation Biology Institute, USA, luke.l.powell@gmail.com  
Wolfe, J. D., Louisiana State University, USA, jwolfe5@lsu.edu

#### A RAPID ASSESSMENT OF THE AVIFAUNA OF EQUATORIAL GUINEA: DETERMINING SPECIES COMPOSITION OF A RAPIDLY DEVELOPING CENTRAL AFRICAN NATION

Equatorial Guinea is a small, seldom visited Central African country along the Gulf of Guinea with large tracts of forest on the biogeographically unique island of Bioko as well as the largely unexplored mainland. In November

2013, we conducted the first of several expeditions to this small Central African country focused on assessing bird communities and conservation threats throughout Equatorial Guinea. During the expedition, we documented extensive ongoing development and deforestation throughout the country and had the opportunity to survey bird communities in some of the most remote and well-preserved forests left in the region. Our first expedition yielded several important records including the first country record of *Falco naumanni*, the second country record of *Tringa glareola*, and the first *Batis poensis* seen in over forty years; the known ranges of many species were also extended. Many species on Bioko were found at previously unrecorded elevations (e.g., *Chrysococcyx klaas*), and several other rare Holarctic migrants (e.g., *Sylvia borin*) were found in Bioko's highlands. In addition to documenting species presence, we used capture methodologies to document lifecycle phenology, namely timing of breeding, molt and molt extent for a number of species. Further surveys will help resolve the status and distribution of the avifauna in the country, and shed light on the effects of ongoing development on the country's vulnerable bird populations. (ID 15952 | Poster 33)

**Cooper, N. W.**, Smithsonian Migratory Bird Center, USA, nathanwands@gmail.com

Sherry, T. W., Tulane University, USA, tsherry@tulane.edu

Marra, P. P., Smithsonian Migratory Bird Center, USA, marrap@si.edu

#### EXPERIMENTAL REDUCTION OF WINTER FOOD DECREASES BODY CONDITION AND DELAYS MIGRATION IN A LONG-DISTANCE MIGRATORY BIRD\*

Many tropical habitats experience pronounced dry seasons, during which arthropod food declines, potentially limiting wintering migratory birds. In response to such declines, individuals may alter their space use to enhance access to food. If social dominance structures prevent this, food declines should result in decreased body condition, and delayed migration. To determine if winter food availability affects space use, body condition, and migration timing, we experimentally decreased food available to American Redstarts. We found that food-reduced redstarts did not expand their territories, and instead either became floaters or remained on territory. Regardless of territorial status, food-reduced redstarts all deposited fat compared to control birds. Fat depots provide insurance against the risk of starvation, but for redstarts came at the expense of maintaining pectoral muscle. Food-reduced redstarts experienced on average a one-week delay in departure on spring migration, likely due to the loss of pectoral muscle. Previous work has demonstrated that for each day delayed after the first male arrival on the breeding grounds, redstarts experience an 11% decrease in the chance of successfully reproducing. Thus, our results demonstrate experimentally, for the first time, that fluctuations in winter food-availability can lead to significant fitness costs for migratory birds, and that the mechanism involves a fat-muscle tradeoff. Because tropical forests are expected to become drier in response to global climate change, Neotropical migratory bird populations may experience increased winter food limitation, further magnifying population declines in the coming decades. (ID 15740)

**Cooper, Z. R.**, Oklahoma State University, USA, zoe.cooper@okstate.edu  
O'Connell, T. J., Oklahoma State University, USA, tim.oconnell@okstate.edu  
Cox, S. W., Rio Grande Bird Research Inc., USA, swcox@spinn.net  
Gorbet, A. C., Rio Grande Bird Research Inc., antelope916@hotmail.com  
AGE-RELATED DIFFERENCE IN BODY CONDITION FOR FALL-MIGRANT CHIPPING SPARROWS IN THE MIDDLE RIO GRANDE VALLEY, NEW MEXICO

Survivorship of passerines in the first year is generally lower than that of adults, and the rigors of migration are thought to account in large part for that difference. Compared to those of older individuals, the flight feathers of hatch-year birds tend to be narrower and more susceptible to wear,

potentially leading to greater energetic costs for long-distance flight. Hatch-year (HY) birds might also be less efficient at finding food in unfamiliar environments than are older, experienced birds. Those challenges could combine to leave migratory HY birds in passage in generally lower body condition than after-hatch-year (AHY) birds. We tested the hypothesis that body condition of HY birds would be lower than AHY birds using data on Chipping Sparrows (*Spizella passerina arizonae*) banded during autumn migration in Albuquerque, New Mexico, 1997–2013. We calculated a simple index of body condition by dividing live weight (to the nearest 0.5 g) by unflattened wing chord (mm) and tested for a difference between 735 HY and 156 AHY birds. The body condition index was similar for both groups, indicating that HY and AHY birds in passage were similarly fit for migration. Arrival times differed, however, with HY birds averaging 16 days later than AHY and body condition index increasing for later migrants. Direct comparison of HY and AHY birds during the early season (August) revealed body condition estimates for HY birds that were significantly different and lower than those of AHY birds. (ID 15843)

**Cormier, R. L.**, Point Blue Conservation Science, USA, rcormier@pointblue.org  
Humble, D. L., Point Blue Conservation Science, USA, dhumble@pointblue.org  
Seavy, N. E., Point Blue Conservation Science, USA, nseavy@pointblue.org  
Gardali, T., Point Blue Conservation Science, USA, tgardali@pointblue.org

#### EVIDENCE OF A MIGRATORY DIVIDE ACROSS THE CALIFORNIA WINTERING RANGE OF THE GOLDEN-CROWNED SPARROW

Migratory divides are areas where birds that winter or breed in relatively close proximity to each (hundreds of miles or less) migrate to areas that are predictably much more distant (thousands of miles). As a result, birds that may appear to belong to a single population geographically may in fact represent two very distinct populations ecologically and evolutionarily. To investigate the possibility of a migratory divide across the wintering range of the Golden-crowned Sparrow in central California, we deployed light-level geolocators on 23 individuals at the Palomarin Field Station on the coast of California and 15 individuals at an inland study site (~170 km from the coast) in the foothills of the Sierra Nevada. Our objectives were to compare the breeding locations, migratory phenology, and migration distances and speeds of Golden-crowned Sparrows from these two wintering locations. We discovered that Golden-crowned Sparrows that wintered on the coast bred along the Gulf of Alaska, whereas those that wintered in the Sierra foothills bred in northern British Columbia and in southern Yukon. As a result, migration distances for coastal birds were generally longer compared to those that winter inland. Based on these results, we suggest that a migratory divide exists somewhere between the California Coast and the Central Valley, most likely somewhere in the Central Valley. (ID 16293)

**Cornelius, E. A.**, University of Wisconsin, USA, ecornelius@wisc.edu  
Davis, A. K., University of Georgia, USA, akdavis@uga.edu

#### DO INFECTIONS LEAD TO HIGHER FEATHER MITE LOADS IN BIRDS? A TEST WITH MYCOPLASMAL CONJUNCTIVITIS IN HOUSE FINCHES (HAEMORHUS MEXICANUS)

Current evidence suggests that the health effect of avian feather mites is minimal. However, feather mites can still proliferate without effective preening, such as might occur during sickness. House Finches (*Haemorrhus mexicanus*) are prone to infection by *Mycoplasma gallisepticum*, symptoms of which include conjunctivitis. Impaired vision and lethargy associated with the disease may limit preening ability. We examined trapping data from a 4-year study of *Mycoplasma* infection dynamics in House Finches in Atlanta, Georgia, to determine whether birds with conjunctivitis had higher feather mite loads. Abundance of feather mites (*Proctophylodes* spp.) and conjunctivitis severity were visually scored on >800 House Finches of known age and sex. Feather mite abundance showed a distinct seasonal pattern:



mite loads increased in July and remained high through January. Limiting the analyses to these months, we found that average mite scores were higher in birds with ( $n = 94$ ) than in those without ( $n = 275$ ) conjunctivitis, and mite loads increased with conjunctivitis severity. Although not significant, the mite scores in recaptured birds in relation to infection status support the other findings in the present study. Although these results from field-collected birds do not demonstrate cause and effect, they are consistent with prior studies in which feather mites increased in experimentally infected birds. The implications of this proliferation for the birds require further study, but given that feather mites consume oil and debris from feathers, their high numbers during illness could be beneficial. (ID 15929 | Poster 92)

**Cornell, A.**, Simon Fraser University, Canada, acornell@sfu.ca  
Williams, T. D., Simon Fraser University, Canada, tdwillia@sfu.ca

#### INDIVIDUAL QUALITY AND MULTIPLE BROODING

Multiple brooding, the production of more than one set of offspring per breeding season, is a life history trait potentially doubling or trebling fecundity. However, the environmental factors and individual traits responsible for variation in occurrence of multiple brooding *within species* remain poorly understood. It has been suggested by the date hypothesis that double brooding is related to timing of breeding, with early-breeding individuals being more likely to produce a second brood. These early breeders also decrease clutch size of first broods to optimize clutch size over the multiple broods. The quality hypothesis suggests that individual quality, rather than timing, is responsible for double brooding behaviors. We examined individual phenotypic correlates, breeding productivity and survival associated with double-brooding in the European starling (*Sturnus vulgaris*) a species where breeding is highly synchronous and where timing of breeding (date) is therefore unlikely to explain this strategy. Preliminary results suggest that higher quality individuals are more likely to double brood. Overall, individuals which double brood have higher breeding productivity (average 5.4 annual fecundity versus 2.8). However, although a high percentage of individuals attempt a double brood there is a bi-modal distribution of breeding success for second broods with many individuals showing complete breeding failure. We will address the question of why individuals incur the cost of double brooding (producing and laying a second clutch of eggs) when they do not increase their overall fitness. (ID 15830)

**Correll, M. D.**, The University of Maine, USA, maureen.correll@maine.edu  
Olsen, B. J., The University of Maine, USA, brian.olsen@maine.edu  
Hodgman, T. P., The Maine Department of Inland Fisheries and Wildlife, USA, Tom.Hodgman@maine.gov  
Wiest, W. A., The University of Delaware, USA, whitney.wiest@gmail.com  
Shriver, W. G., The University of Delaware, USA, gshriver@udel.edu

#### A REGIONAL CHANGE COMPARISON OF OBLIGATE AND NON-OBLIGATE BIRDS IN TIDAL MARSHES OF THE NORTH ATLANTIC

Tidal marshes along the Northeastern seaboard of the United States support a significant portion of the world's vertebrate endemics to this habitat. Obligate tidal-marsh birds such as the Saltmarsh Sparrow (*Ammodramus caudatus*) and Eastern Willet (*Tringa semipalmata*) are especially at risk from habitat loss due to sea-level rise. Taxonomically similar non-obligates such as the Red-winged Blackbird (*Agelaius phoeniceus*) and Snowy Egret (*Egretta thula*) may respond differently than their respective obligate counterparts to pressures of climate change due to their supplemental use of non-tidal habitat for breeding and foraging grounds. Collaborators within the Saltmarsh Habitat and Avian Research Program (SHARP) conducted bird surveys at 700 points over the 2011 and 2012 breeding seasons in tidal marshes between Maine and Connecticut. We compare these data to historical bird surveys conducted within the same study area between 1997 and 2000 to identify hotspots of change in our focal species. Overall, we

detected decreases in the occurrence of Saltmarsh Sparrows and Willets as well as Snowy Egrets, but detected no change in occurrence of Red-winged Blackbirds across the same period of time. The analyses presented here are part of a larger effort to explore population trends and covariates for population change in marsh birds from Maine to Virginia. These studies will improve our ability to adequately manage these systems in light of a rapidly changing climate. (ID 16112)

**Covino, K. M.**, University of Southern Mississippi, USA, covinok@gmail.com  
Moore, F. R., University of Southern Mississippi, USA, frank.moore@usm.edu  
Morris, S. R., Canisius College, USA, morriss@canisius.edu

#### PATTERNS OF CIRCULATING TESTOSTERONE IN BLACK-AND-WHITE WARBLERS DURING SPRING MIGRATION\*

Testosterone is a potent hormone that is associated with a variety of breeding characteristics including territoriality, courtship, singing, and the regeneration of the gonads prior to breeding. Although recent studies suggest that testosterone may impact the physiology and behavior of songbirds throughout migration, they are few and have yielded conflicting results. We examined circulating testosterone levels in the Black-and-white Warbler (*Mniotilta varia*), a long-distance migrant, during spring migration at a stopover site in western Louisiana, on the Gulf of Mexico coast. Testosterone levels of males were higher in individuals that were closer to their breeding grounds, whereas testosterone levels of females were not related to breeding destination. Our study demonstrates that male songbirds closer to their breeding grounds are at a more advanced stage of breeding preparation. Our results from females did not provide as clear of a pattern and warrant additional study. (ID 15886)

**Cox, J. A.**, Tall Timbers Research Station and Land Conservancy, USA, jim@ttrs.org  
McCormick, J. K., Environmental Division, Fort Stewart, USA, joshua.k.mccormick.civ@mail.mil

#### REINTRODUCTION OF THE RED-COCKADED WOODPECKER TO A SITE IN NORTH FLORIDA

The Red-cockaded Woodpecker was extirpated from Tall Timbers Research Station (Leon Co., FL) in the early 1980s. Lone individuals have been observed infrequently since extirpation, but re-establishment seemed unlikely without assistance. In 2006, we initiated a reintroduction effort by constructing artificial cavities ( $n = 137$ ) and translocating subadults. Successful nesting occurred in the breeding season following the initial release of subadults ( $n = 8$ ), and translocations were suspended in 2011 once 60% occupancy was achieved. The population has grown steadily since translocations were suspended, and the adult population present at the start of the 2014 breeding season ( $n = 26$ ) included 19 individuals that hatched on TTRS, an immigrant female, and 6 individuals translocated as subadults. The number of subadults translocated ( $n = 26$ ) was lower than the number used in other reintroduction efforts, and reestablishment might have occurred more rapidly had a tropical storm not decimated the population in 2008. Recorded milestones included the first excavation of a natural cavity, two immigration events, and recruitment of locally produced birds into the breeding population. Expenses associated with the reintroduction effort were ca. \$211,000 up until the time translocations were suspended. Afterwards, recurring annual expenses have averaged \$6,500. Infrequent translocations may be needed to offset the depletion of genetic variation expected to occur, but the reintroduction has progressed well and provided valuable educational and conservation services. (ID 15816)

**Cracraft, J.**, American Museum of Natural History, USA, [jlc@amnh.org](mailto:jlc@amnh.org)  
 UNDERSTANDING THE NATURE OF DIVERSITY THROUGH  
 UNDERSTANDING THE NATURE OF TAXA<sup>†</sup>

Why do we name and recognize taxa? For convenience? For some abstract notion of order, in which we reflect or impose some balance to Nature? To impose a simplified system in order to, as Mayr once said, make it easier to remember names? Modern classificatory systems, especially at the lower taxonomic units, spend a lot of time doing all these things. What they often don't do is advance understanding of life's history, its diversity, and how we might ensure its future. There is a much confusion about what taxa are, which is due to a failure to appreciate the ontological nature of evolutionary units, and/or the role of Linnaean ranking. These confusions hinder the science of diversity, its documentation, and its conservation. These issues can be appreciated by using empirical examples, all from recent systematic studies on South American birds. We will see how confusion over taxa and their delimitation hinders the discovery and description of diversity and its origins, and how it makes a mechanistically meaningful analysis of ecosystem history impossible. At stake, moreover, is how we see taxa in terms of evolutionary process, and how thinking about ranking within classification can create a disconnect in studying process. If we do not understand units outside the context of ranking, we have no hope of understanding process correctly. (ID 15865)

**Crombie, M. D.**, University of British Columbia, Canada, [merle.crombie@alumni.ubc.ca](mailto:merle.crombie@alumni.ubc.ca)

Germain, R. R., University of British Columbia, Canada, [r.germain@alumni.ubc.ca](mailto:r.germain@alumni.ubc.ca)  
 Arcese, P., University of British Columbia, Canada, [peter.arcese@ubc.ca](mailto:peter.arcese@ubc.ca)

INVASIVE PLANTS WITH DIFFERENT TRAITS SOLICIT A DISPARATE  
 RESPONSE BY AN ISLAND SONG SPARROW POPULATION

The spread of exotic vegetation is creating novel ecosystems worldwide. Despite studies that show no consistent consequence for birds nesting in exotic plants, such invasions are perceived as having negative consequences for native flora and fauna. We suggest that birds don't respond equally to exotic plant invasions because the classification of 'exotic' doesn't account for specific traits that may represent cues for suitable breeding habitat and thus some exotics will be preferred over others. Using 18 years of nest monitoring records, we assessed the response of a shrub-nesting song sparrow population (*Melospiza melodia*) over a 20-year invasion of two physiologically dissimilar plants, Himalayan blackberry (*Rubus armeniacus*), a thorny, thicket-forming exotic shrub, and red elderberry (*Sambucus racemosa*), a tall, treelike shrub locally invasive to the study area. Our results showed a disparate response by song sparrows to the two invasive shrubs. Nesting densities declined in areas now dominated by red elderberry, but remained stable in areas invaded by Himalayan blackberry. Song sparrows also used Himalayan blackberry as a nest substrate 2.5 times more than expected given abundance, but exhibited no preference for red elderberry. As well, nests placed in Himalayan blackberry were equally successful in fledging young as nests placed in native vegetation. The positive response of sparrows to Himalayan blackberry may reflect similarity to a highly preferred native shrub, trailing blackberry (*Rubus ursinus*). Further, our findings may demonstrate a preference for thorny nesting shrubs, which may be selected by birds to deter nest predation. Our study suggests that plant traits can help predict how birds will respond to novel change in ecosystems and offers insight into the prioritization of exotic species management when the goal is to maximize its quality as nesting habitat for birds. (ID 16322)

**Cruz-McDonnell, K. K.**, University of New Mexico, USA, [kcruzmc@unm.edu](mailto:kcruzmc@unm.edu)  
 Wolf, B. O., University of New Mexico, USA, [wolf@unm.edu](mailto:wolf@unm.edu)

EFFECTS OF INCREASING TEMPERATURES AND DROUGHT ON THE  
 POPULATION DYNAMICS AND REPRODUCTION OF BURROWING  
 OWLS IN THE ARID SOUTHWEST

Assessing species vulnerability to climate change is increasingly important for conservation and management, particularly for species already of conservation concern. To understand species response to climate trends, long-term studies are necessary. Burrowing Owl reproduction and population dynamics have been monitored annually on Kirtland Air Force Base, New Mexico since 1998. Our results demonstrate a strong association between climate variability and the variation in Burrowing Owl population dynamics, productivity, and success in relation to increased air temperatures and drought. Over 16 years, the breeding population has declined 98.1%, from 52 breeding pairs to 1 breeding pair, and nest success and productivity have also declined significantly. Arrival, pair formation, nest initiation, and hatch dates all show significant delays ranging from 9.4 - 25.1 days since 2005. The number of fledglings per pair and the probability of nest success have decreased with later breeding. In addition, adult and juvenile body mass has decreased significantly over time, with a loss of 12.1% and 14.6% for arriving adult males and females, respectively since 1998. The southwestern USA has been identified as a climate change hotspot, with projections including warmer temperatures, less winter precipitation, and an increase in frequency and severity of extreme events such as drought and heat waves. Burrowing Owls may experience increased vulnerability under these extreme conditions, and an increasingly warm and dry climate may contribute to this species' decline. (ID 15797)

**Cuervo, A. M.**, Tulane University, USA, [acuervom@tulane.edu](mailto:acuervom@tulane.edu)  
 Aleixo, A., Museu Paraense Emílio Goeldi, Brazil, [aleixo@museu-goeldi.br](mailto:aleixo@museu-goeldi.br)  
 Bravo, G. A., Museu de Zoologia da Universidade de São Paulo, Brazil, [gbravo1@usp.br](mailto:gbravo1@usp.br)

Brumfield, R. T., Louisiana State University, USA, [robb@lsu.edu](mailto:robb@lsu.edu)  
 Chesser, T., Smithsonian Institution, USA, [chessert@si.edu](mailto:chessert@si.edu)  
 Cracraft, J., American Museum of Natural History, USA, [jlc@amnh.org](mailto:jlc@amnh.org)  
 Moyle, R., University of Kansas, USA, [moyle@ku.edu](mailto:moyle@ku.edu)  
 Silveira, L. F., Museu de Zoologia da Universidade de São Paulo, [lsilveir@usp.br](mailto:lsilveir@usp.br)  
 Harvey, M. G., Louisiana State University, USA, [mharve9@lsu.edu](mailto:mharve9@lsu.edu)  
 Derryberry, G.

Claramunt, S.

Derryberry, E. P., Tulane University, USA, [ederrybe@tulane.edu](mailto:ederrybe@tulane.edu)

PHYLOGENOMICS OF THE PANTROPICAL RADIATION OF SUBOSCINE  
 PASSERINES

The suboscine passerines (suborder Tyranni) form a spectacular pantropical radiation that includes some of the flagship endemic groups of the Old World (Eurylaimides: pittas, broadbills and allies) and New World tropics (Furnariides and Tyraniides: ovenbirds, antbirds, crescentchests, tapaculos, cotingas, manakins and allies). Although delineation of major groups at different taxonomic levels have been historically contentious, deep level relationships have been more difficult to resolve. Approximately 325 genera and 1325 species are currently recognized. We collected genomic data from more than 600 vouchered tissue samples representing 99% of the recognized genera and additional lineages of polyphyletic genera. We implemented a phylogenomic approach to reconstruct a genus-level phylogeny of the Tyranni. We used a single array to target capture approximately 3000 nuclear loci including exons and ultraconserved elements and their flanking sequence (UCEs). After processing in a bioinformatics pipeline, we input different data matrices into gene tree and species tree programs (RAxML, STAR, CloudForest) depending on the representation of the targeted loci across all samples. Phylogenetic analysis recovered a well-supported tree at deep time-scales showing the monophyly of the three major groups (i.e., Eurylaimides, Tyrannides, and Furnariides). In this talk, we will discuss whether relationships among genera within these groups were better resolved than in previous studies, and what classification rearrangements are necessary at different taxonomic levels. This study represents our baseline hypothesis to reconstruct a complete species-level phylogeny for suboscine passerines

that will allow testing hypothesis on the biogeography and the evolutionary processes underlying diversification in the tropics. (ID 16239)

**Curry, C. M.**, University of Manitoba, Canada, curryclairem@gmail.com  
Patten, M. A., University of Oklahoma, USA, mpatten@ou.edu  
EVOLUTION OF REPRODUCTIVE ISOLATION IN A TEMPORALLY  
COMPLEX HYBRID ZONE BETWEEN TUFTED AND BLACK-CRESTED  
TITMICE (PARIDAE)\*

Hybrid zones are useful systems in which to study how isolating barriers evolve because of the interaction between populations with incomplete reproductive isolation. Examining a hybrid zone over time or with contacts of different ages allows us to sort out which comes first—selection against hybrids, innate preferences for hybrid or parental types, or if one barrier type additionally evolves as a result of the other. One such temporally complex hybrid zone is that of two oscine songbirds, the Black-crested (*Baeolophus atricristatus*) and Tufted (*B. bicolor*) Titmice (Paridae) in the southern Great Plains of North America; they differ in song, plumage, and genetics. In Texas, the populations have been interbreeding for several thousands of years across a natural ecotone, whereas in Oklahoma the two species contacted within the past century. Few studies examine multiple contacts within one species complex to compare how selection has changed over time. We examine (1) morphology and plumage; (2) causes of song variation; (3) genetic introgression and signatures of recent range expansion; and (4) sexual selection and reproductive fitness. Our data suggest that ongoing interactions have resulted in a stable older zone where parental species prefer conspecific song and plumage and a younger zone with few preferences. These data best match selection against hybrids, but intrinsic postmating isolation appears to be absent even in the older region. Future work should focus on what ecological or behavioral postmating barriers prevent the region of hybridization from spreading and that could cause the younger zone to evolve increased premating isolation barriers as in the older zone. (ID 16244)

**Curtis, J. R.**, Oregon State University, USA, jenna.curtis@oregonstate.edu  
Robinson, W. D., Oregon State University, USA, douglas.robinson@oregonstate.edu

60 YEARS OF AVIAN COMMUNITY COMPOSITION CHANGE IN  
OREGON'S WILLAMETTE VALLEY

Avian biodiversity is predicted to shift over the next 50 years. Historic datasets present a legacy of information that can be used to understand how and under what conditions avian community changes actually occur. A rare, highly-detailed avian survey of sites in the Willamette Valley, Oregon was conducted in 1952. Because they include count data for all species detected on each survey, these data are uniquely valuable to understanding how avian species assemblages in the Willamette Valley changed. I resurveyed sites in 2013 to determine the nature and extent of community compositional change. Observed differences between historic and modern species assemblage indicated substantial community turnover. Nearly 50% of species were replaced over 60 years, but with little associated change in alpha or beta diversity. Modern species richness was higher than historic richness on local and regional extents. Measures of regional turnover agreed with local turnover, suggesting regional communities may structure species assemblages at smaller spatial extents. Nonparametric permutation and ordination procedures confirmed modern avian communities were significantly different from their historic counterparts. Habitat type was also a significant factor in determining community composition. However, sites underwent relatively little change in vegetation and land use cover between survey eras. This suggests that community change is a complex process that is not simply driven by local habitat change. Instead, communities are dynamic over time and expected to change as a function of both local and regional processes. (ID 15755)

**Cusick, J. A.**, Florida State University, USA, jcusick@fsu.edu  
Cox, J. A., Tall Timbers Research Station, USA  
DuVal, E. H., Florida State University, USA

HOW DO HELPERS HELP? THE CUMULATIVE BENEFITS OF HELPERS  
IN A FACULTATIVE COOPERATIVE BREEDING SPECIES, THE BROWN-  
HEADED NUTHATCH (*Sitta pusilla*)

In cooperatively breeding birds, helpers care for non-descendant kin but how they assist breeders has been difficult to identify in many systems. Helpers may increase nest survivorship or allow reduced parental investment, but few studies have examined the cumulative benefits of helpers across a breeding season. With the goal of evaluating how helpers assist breeders at multiple stages of the breeding process, we quantified helper behavior and its relationship with behavior and fitness in the cooperatively breeding Brown-headed Nuthatch (*Sitta pusilla*). Previous work in this system showed that helpers do not increase nest productivity, and it remains unclear what effects helpers have on a breeding pair. We monitored behavior of color-banded birds at 82 nests from 2013-2014 using video and observations to determine rates of excavation, provisioning, and nest maintenance of individuals in cooperative and non-cooperative groups. Twenty percent of nesting groups had helpers enabling comparisons of breeding groups ranging from 2 to 4+ individuals. Breeding males provisioned nestlings more often than breeding females. Though breeders provisioned nestlings more often than helpers in cooperative groups, breeding males in cooperative groups provisioned at a significantly lower rate than males without helpers. Comparisons of cooperative and non-cooperative breeding groups across the nesting period will assess whether these differences were consistent throughout the nesting period. These results suggest the presence of helpers may be more beneficial to breeding males than to breeding females. Sex-biased benefits of helpers may compensate for the relatively high risk of male helpers for breeding males. Alternatively, benefits of helpers to females may be realized through maternal effects such as egg size. (ID 16360)

**Cutting, K. A.**, Red Rock Lakes National Wildlife Refuge, U.S. Fish and Wildlife Service, USA, Kyle\_Cutting@fws.gov  
Anderson, M. L., University of Montana Western, USA, michelle.anderson@umwestern.edu  
Beever, E. A., Northern Rocky Mountain Science Center, U.S. Geological Survey, USA, ebeever@usgs.gov  
Schroff, S., Animal Range Sciences, Montana State University, USA, sean.schroff@hotmail.com  
Korb, N., The Nature Conservancy, USA, nkorb@tnc.org

SYMPATRY OF SPARROWS IN HIGH-ELEVATION SAGEBRUSH  
APPEARS MORE STRONGLY DRIVEN BY OPTIMAL-FORAGING THAN  
COMPETITIVE DYNAMICS

Changes in resource availability across seasons influence consumers in ways that not only affect intraspecific fitness, but also shape interspecific selective pressures acting on sympatric species. Diets of sympatric species may alternatively reflect competition or optimal foraging. We investigated whether competition or optimal foraging more strongly governed the coexistence of sagebrush-dwelling sparrows, in periods before and after a dramatic increase in their food. The two theories predict different dietary-niche breadth and overlap when food shifts from being limited to significantly more abundant; however, tests to discriminate between these two theories are relatively rare for avian research, especially in aridlands. We tracked flower abundance, biomass of multiple trophic levels of insects, and sparrow abundance during May-July in 2011 and 2013 on the western edge of the Greater Yellowstone Ecosystem. We conducted a stable-isotope analysis of sparrow blood plasma to quantify diet and niche width in relation to changes in their prey availability from multiple trophic levels. After insect (food) abundance increased dramatically, niche breadth of Brewer's and Vesper sparrows decreased by 35



and 52%, respectively, and niche overlap decreased by 88%. The energetic condition of both sparrow species, as indexed by plasma metabolites, also increased significantly from before to after the rapid increase in insect biomass. Our results suggest that optimal foraging theory is a component of the coexistence of these inhabitants of sagebrush ecosystems. Whether food is the predominant driver of sympatry in high-elevation sagebrush sparrows should be further investigated. (ID 16109)

**Dale, C. A.**, Queen's University, Canada, 9cad@queensu.ca  
 Nocera, J. J., Ontario Ministry of Natural Resources and Trent University, Canada, joe.nocera@ontario.ca  
 Franks, S. E., British Trust for Ornithology, United Kingdom, samantha.franks@gmail.com

Kyser, T. K., Queen's University, Canada, kyser@geol.queensu.ca  
 Ratcliffe, L. M., Queen's University, Canada, ratcliff@queensu.ca

#### CORRELATES OF ALTERNATIVE MIGRATORY STRATEGIES IN A PARTIALLY MIGRATORY PASSERINE\*

Partial migration occurs when only some individuals in a population migrate, while others remain resident. Although it is a widespread phenomenon, our understanding of factors determining individual migratory strategies is limited. Previous studies suggest partial migration may occur if condition differences among individuals result in changes to the cost-benefit trade-off of migratory behaviour, and three hypotheses have been proposed to explain how these differences may shape partially migratory systems: the arrival time hypothesis, the dominance hypothesis, and the body size hypothesis. We investigated correlates of alternative migratory strategies in Western Bluebirds (*Sialia mexicana*) breeding at 16 sites in the southern Okanagan Valley of British Columbia from 2011 to 2013. We used hydrogen stable isotope signatures to determine individual migratory strategies, and then asked whether strategy was related to sex, age, or morphology. We found that the proportion of birds migrating varied significantly both between years and across sites. Migratory strategy was not related to sex or morphology. We did find an effect of age on migratory strategy: younger birds were more likely to be resident than older birds. Our data provide no support for the arrival time hypothesis, the dominance hypothesis, or the body size hypothesis. However, hydrogen isotope signatures were strongly correlated between members of a breeding pair, and we found preliminary evidence that females switch strategies to match their mate. These results suggest a bird's migratory strategy may be influenced by its mate, and that sociality may play a role in determining migratory strategy in this system. (ID 16232)

**Danner, R. M.**, Smithsonian Migratory Bird Center, USA, danner.ray@gmail.com  
 Greenberg, R., Smithsonian Migratory Bird Center, USA

#### A CRITICAL SEASON APPROACH TO ALLEN'S RULE: BILL SIZE DECLINES WITH WINTER TEMPERATURE IN A COLD TEMPERATE ENVIRONMENT

Bill size correlates positively with climatic temperature in several avian taxa, hypothetically because the poorly insulated surface area of the bill is selected to dissipate excess heat in hot climates or retain heat in cold climates (Allen's Rule). We hypothesize that the applicability of Allen's Rule will depend upon the season of critical thermal stress, which may vary by location and species. We previously found that bill size increases with high summer temperature in song sparrows (*Melospiza melodia*) of California, supporting the hypothesis that larger bills are selected to release dry heat and minimize evaporative water loss in a hot, dry environment. Song sparrows in eastern North America face a different climatic regime, where summers are warm but moist, and winters are substantially colder than California. We predicted that in such cold temperature systems, bill size would decline to minimize heat loss. We measured the morphology and weight of 274 song sparrows with high spatial resolution across a climatic gradient from the coast of Delaware and

Maryland to the Allegheny Plateau of Maryland. We compared morphology with maximum winter and minimum summer temperatures, annual rainfall, and geography. Bill size was best predicted by, and positively correlated with, cold winter temperatures and distance from the coast, supporting selection on the bill for heat retention rather than heat dissipation. Body size did not change substantially with distance from the coast, indicating that the pattern of bill size was not a result of allometry. Coastal birds experienced relatively mild winters and had bills larger than predicted by a linear effect of minimum temperature, suggesting release from selection in winter. These results suggest that bill size may be shaped by physiological responses to regional climates, and supports the hypothesis that the season of critical thermal stress may vary geographically, even on small spatial scales. (ID 16120)

**Davis, C. A.**, Oklahoma State University, USA, craig.a.davis@okstate.edu  
 Holcomb, E. D., Oklahoma State University, USA, edoxon@att.net  
 Fuhlendorf, S. D., Oklahoma State University, USA, sam.fuhlendorf@okstate.edu

#### APPLYING FIRE-GRAZING INTERACTIONS IN FIRE-DEPENDENT SAGEBRUSH ECOSYSTEMS: IMPLICATIONS FOR AVIAN COMMUNITIES

Rangeland birds in the Southern High Plains evolved within a context of fire and grazing (i.e., pyric herbivory), a disturbance regime that played a dominant role in shaping rangelands in this region but has been absent since the 1880s. A management technique known as patch-burn grazing was used to mimic the heterogeneity in vegetation created by the historical disturbance regime of fire and grazing in sand sagebrush *Artemisia filifolia* rangelands. We compared nest survival of Cassin's Sparrows *Peucaea cassinii*, Field Sparrows *Spizella pusilla*, and Lark Sparrows *Chondestes grammacus*, species richness, and densities of 11 bird species between rangelands managed with patch-burn grazing and rangelands managed with traditional management (i.e., seasonal grazing) in Oklahoma. Estimates of nest survival were similar between patch-burn and traditional pastures (Cassin's Sparrows: 51% and 57%; Field Sparrows: 18% and 22%; and Lark Sparrows: 14% and 12%, patch-burn and traditional, respectively). Species richness was higher in patch-burn pastures compared to traditionally managed pastures. Densities of the majority of avian species (73%) were similar between treatments; however, lark sparrow densities were five times more abundant in patch-burn pastures and Grasshopper Sparrows *Ammodramus savannarum* and Brown-headed Cowbirds *Molothrus ater* were three times more abundant on traditional pastures. Our results suggest that introducing patch-burn grazing management to sand sagebrush rangelands is not detrimental to nesting shrubland birds, and the creation of heterogeneity through patch-burn grazing can increase avian species diversity. Furthermore, some species such as Lark Sparrows may benefit from patch-burn grazing. Patch-burn management may be an important tool to assist in the recovery of biodiversity in this ecosystem. (ID 15920)

**de Zwaan, D. R.**, University of British Columbia, Canada, drdezwaan@gmail.com

Roitberg, B., Simon Fraser University, Canada, roitberg@sfu.ca

#### WESTERN SLATY-ANTSHRIKES HAVE COMPARABLE FORAGING PERFORMANCE ACROSS OLD AND REGENERATING TROPICAL MOIST FOREST IN PANAMA BY ALTERING FORAGING BEHAVIOUR

Deforestation results in loss and degradation of critical avian habitat. Reforestation and natural regeneration create secondary forests that may play an important role in maintaining avian biodiversity. In the tropics, species richness of understory insectivores is reduced in regenerating forests. However, our knowledge of the mechanisms leading to this limited persistence is incomplete. In an observational case study, we investigated the foraging behaviour of a common insectivorous species, the Western Slaty-Antshrike (*Thamnophilus atrinucha*), across three forest age structures to elucidate a behavioural mechanism for understory insectivore loss in

regenerating forests. We observed no change in attack or success rate for *T. atrinucha* across sites, suggesting equal performance levels in forests of different age. Foraging range shifted down forest strata from 8.5 to 4.5 metres and compressed horizontally such that fewer vegetative structures were searched during foraging bouts in regenerating forests. These alterations correlate with increased vegetative structural complexity and higher quality prey choice in lower strata of regenerating forest. The behavioural mitigation detected here for *T. atrinucha* allows constant performance levels to be maintained; however, this strategy may not be possible for species with a narrow diet. We propose a novel hypothesis linking collapsing understory insectivore populations in regenerating forest to increased interspecific competition caused by downward shifts of generalist mid-canopy and understory birds. We suggest this pattern stems from a similar downward shift in vegetative structural complexity and thus the insect community. (ID 15767)

**Deane-Coe, P. E.**, Cornell University, USA, ped36@cornell.edu  
Bogdanowicz, S., Cornell University, USA, smb31@cornell.edu  
Lovette, I. J., Cornell University, USA, ijl2@cornell.edu  
Harrison, R. G., Cornell University, USA, rgh4@cornell.edu

#### GENOMIC SIGNATURES OF RAPID ADAPTIVE DIVERGENCE IN THE SWAMP SPARROW\*

A subspecies of swamp sparrow restricted to the tidal marshes of Delaware and Chesapeake Bays (*Melospiza georgiana nigrescens*) differs from its widespread sister taxon (*M. g. georgiana*) in a number of adaptive traits associated with tidal marsh habitats. The two subspecies have diverged recently, probably since the last postglacial maximum (<15,000 years). Common garden experiments suggest that the unique traits of coastal populations are the product of rapid genotypic evolution. We have now generated genome-wide markers using ddRAD sequencing. Although a substantial fraction of the genome appears undifferentiated between the two subspecies (13,122/13,782 SNPs), 5% contains a significant signal of ecological divergence (660/13,782 SNPs, max  $F_{ST}$ =0.4). We use the recent divergence time of these sparrows, their habitat-specific selection pressures, and ongoing genetic admixture in a contact zone to identify candidate adaptive loci using patterns of differential introgression. (ID 15799)

**Deaner, L. M.**, Georgia Southern University, USA, ld02111@georgiasouthern.edu  
Chandler, C. R., Georgia Southern University, USA, chandler@georgiasouthern.edu

#### NEST SITE SELECTION AND REPRODUCTIVE SUCCESS OF WILSON'S PLOVERS ON CUMBERLAND ISLAND NATIONAL SEASHORE, GEORGIA

Location and the immediate surrounding characteristics of avian nests can play an important role in reproductive success because it may give conservationists and land managers valuable information on maintaining high levels of reproductive success in declining populations. Wilson's Plover (*Charadrius wilsonia*) is a threatened species throughout most of the southeastern United States because much of its habitat has been degraded or lost. Cumberland Island National Seashore, supports the largest breeding population of Wilson's Plovers in the state (ca 110 pairs). Cumberland Island is protected from development and access is limited to either a ferry or private boat, limiting disturbance to nesting shorebirds. In 2012 and 2013 I located 132 nests, collected microhabitat feature measurements to quantify the characteristics of the nests, and followed reproductive success. I systematically sampled microhabitat features throughout the dune system and classified nest location as occurring on the embryonic dune (ED), on the primary dune (PD), or landward of the apex of the primary dune (BD). The ED had less vegetative cover and lower vegetation height than other locations. However plovers nested in microhabitat within the ED that resembled characteristics of the PD and BD. Hatching success did

not differ by location except in 2012 when hatching success was lower for nests in the ED. These results suggest that even though the characteristics of the ED differ, plovers still select nest locations with specific microhabitat characteristics. This may have implications to managing other breeding locations where well-developed dune systems are absent. (ID 16267)

**DeLap, J. H.**, University of Washington, USA, jdelap@uw.edu  
Marzluff, J. M., University of Washington, USA, corvid@uw.edu

#### THE RESPONSE OF BIRD COMMUNITIES TO NEWLY ESTABLISHING HUMAN COMMUNITIES

We monitored bird community composition (fixed-radius point counts) and characterized landscape change (digitized orthophotos) at seven study sites actively transitioning from ex-urban coniferous forest to new residential development from 1998-2010 near Seattle, WA, USA. These included 4 low density (single-family home) and 3 high density (mixed single home/multi-family residence) communities, which we also compared to 4 reference sites where change did not occur (4 forested reserves). We measured the percent land cover of forest, suburban structure (dwellings, roads, sidewalks) and non-forested areas (bare ground, grass, shrubs, water), as well as its configuration over the 12-year period. Mean avian species richness increased significantly (curvilinear relationship) during the middle years of the study in both development types (+63.1%, at low density sites, +29.5% high density sites) as edge- and human-tolerant bird species colonized new habitats. Contrastingly, bird diversity remained relatively flat among the reference sites for the same time period (+8.9%). Developing sites lost some forest-adapted species by study's end which (+33.3% low density sites, +25.3% high density sites) resulted in slightly diminished diversity, though still higher overall than at the start of monitoring. Landscape compositional change largely stabilized within the first 5 years, leaving forest diminished by 22% (65.9-48.3, n=7), while suburban area expanded by three-fold (8.3-22.2, n=7) with non-forested area remaining relatively unchanged (23.0-26.2, n=7). This documented increase in maximum species richness in response to increasing habitat diversity, followed by faunal relaxation after cessation of active development, is consistent with an intermediate disturbance hypothesis. While landscape change has increased species diversity at these study sites, humans interested in stewarding this diversity will need to actively maintain landscape diversity. (ID 16321)

**DeLuca, W. V.**, Northeast Climate Center, University of Massachusetts, USA, wdeluca@eco.umass.edu  
McGarigal, K., University of Massachusetts, USA, kmcgarigal@eco.umass.edu  
Compton, B., University of Massachusetts, USA, bcompton@eco.umass.edu  
Grand, J., University of Massachusetts, USA, jgrand@eco.umass.edu  
Plunkett, E., University of Massachusetts, USA, eplunkett@eco.umass.edu

#### SPECIES DISTRIBUTION MODELS APPLIED TO LANDSCAPE AND CLIMATE CHANGE PROJECTIONS PREDICT DISTRIBUTIONAL CHANGES OF MONTANE BIRDS

Species that inhabit montane ecosystems are believed to be among the most vulnerable to climate change. Although documentation of historical distributional shifts is informative, predictions of where montane species are most likely to persist are important contributions to landscape conservation designs. We developed a landscape change, assessment, and design model for the North Atlantic Landscape Conservation Cooperative that enabled us to incorporate a variety of alternative future climate change and urban growth scenarios. We downscaled general circulation models to predict changes in climate and constructed a regional urban growth model. We then developed spatially explicit habitat capability models and climate niche envelope models for a suite of montane bird species to assess the effects of predicted landscape and climate change scenarios throughout the northeastern United States. We assessed the nature and magnitude of potential habitat gains and

losses due to projected changes in climate and urban growth. We describe the implications for strategic habitat conservation planning given uncertainty in future landscape conditions and develop tools to inform landscape design that effectively combines approaches that simultaneously address habitat loss and potential spatial shifts in species' climate niche envelopes. (ID 16102)

**Demko, A. D.**, University of Windsor, Canada, demko@uwindsor.ca  
Mennill, D. J., University of Windsor, Canada, dmennill@uwindsor.ca  
SEASONAL AND TEMPORAL VARIATION IN THE VOCAL BEHAVIOR OF A TROPICAL RESIDENT SONGBIRD, THE RUFOUS-CAPPED WARBLER (*BASILEUTERUS RUFIFRONS*)

In many bird species, males have repertoires of multiple song types used for different functions such as mate attraction and territory defense. The wood-warblers (Family Parulidae) are a diverse family in which males of many temperate-zone species use different songs or patterns of song delivery depending on time of day and breeding status. The vocal behavior of the tropical wood-warbler genera *Basileuterus*, *Myioborus*, and *Myiothlypis* remains largely undescribed, although tropical bird species differ ecologically and behaviorally from their temperate counterparts. Our research objective is to determine whether male Rufous-capped Warblers (*Basileuterus rufifrons*) have functionally specialized repertoires. Male Rufous-capped Warblers have multiple song types, but it is not known whether song type use or patterns of song delivery vary seasonally or temporally. Using dawn and daytime focal recordings obtained from 25 color-banded males during the breeding and non-breeding seasons in northwestern Costa Rica from April-July 2013 and 2014, we compare song rates, number of song types used, and song switching rate relative to time of day, season, and nesting stage. This research advances our understanding of the diversity of vocal behavior among little-studied tropical warbler genera. (ID 15955 | Poster 96)

**Derbyshire, R. E.**, University of Guelph, Canada, rderbysh@uoguelph.ca  
Strickland, D., Retired Chief Park Naturalist - Algonquin Provincial Park, Canada, perisoreus1@gmail.com  
Norris, D. R., University of Guelph, Canada, rnorris@uoguelph.ca  
AN EXPERIMENTAL SUPPLEMENTATION AND OVER 40 YEARS OF POPULATION MONITORING SHOW THAT A BOREAL FOOD-CACHING SONGBIRD IS FOOD-LIMITED

Several species of birds and mammals rely on cached food during periods when fresh food is not available or in low supply. However, it is not clear whether food-caching animals are food-limited during these periods or if caching always results in animals meeting their nutritional requirements. The Gray Jay (*Perisoreus canadensis*) is a boreal resident songbird that caches food during the late summer and fall and breeds in late winter when fresh food is rarely available. We examined the food limitation hypothesis by supplementing females during the pre-breeding period (late Jan-early Feb) in Algonquin Park, ON over two years. Although there was no evidence that supplemented females had larger clutch sizes or nestlings in better condition than control females, there was strong evidence that supplemented females laid eggs earlier in the season. Furthermore, from our long-term data spanning over 40 years, the number of young at banding was positively related to first egg date, suggesting a fitness advantage to nesting earlier in the season. We also found evidence that females on territories regularly supplemented by Park visitors tended to have earlier lay dates and larger clutches than territories not regularly supplemented by visitors. Our results support the hypothesis that Gray Jays are food limited during the breeding season and suggest that food caching animals may still be faced with significant nutritional limitations that can have a strong effect on fitness. (ID 16123)

**Derryberry, E. P.**, Tulane University, USA, ederrybe@tulane.edu  
Lipshutz, S. E., Tulane University, USA, slipshut@tulane.edu

ASYMMETRIC GENE FLOW AND TERRITORIAL RESPONSE TO SONG ACROSS A SUBSPECIFIC CONTACT ZONE IN THE WHITE-CROWNED SPARROW

In birds, pre-mating isolating mechanisms such as plumage or song, rather than post-mating isolating mechanisms such as hybrid inviability, are thought to represent the primary reproductive barrier between recently diverged species. However, an extensive search for song driven population structure over the past 40+ years has yielded mixed evidence that song divergence reduces gene flow between natural populations or introgression between hybridizing species. Here, we examine genetic and behavioral divergence across a putative contact zone between the Puget Sound (*Zonotrichia leucophrys pugetensis*) and Nuttall's (*Z.l. nuttalli*) subspecies of the white-crowned sparrow. Although previous studies found morphological clinal transitions, molecular studies using allozymes did not find evidence of genetic divergence between the two subspecies. We investigated molecular evidence for hybridization using a SNP dataset, assessed differentiation in song structure, and tested male response to 'pure' and 'hybrid' songs across the putative contact zone. Our results suggest that the two subspecies are both genetically and behaviorally divergent. Males from outside the hybrid zone discriminate among subspecific songs, and coincident with this discrimination, the subspecies are genetically distinct. Within the hybrid zone, males respond less to foreign *pugetensis* songs but equally to foreign *nuttalli* songs. Consistent with this behavioral finding, we find asymmetric patterns of gene flow. These findings contribute to our understanding of the role that learned mating signals play in the early stages of speciation. (ID 15946)

**Dertien, J. S.**, Colorado State University, USA, jdertien1@gmail.com  
Miller, W. B., United States Fish and Wildlife Service, USA  
Winchell, C. S., United States Fish and Wildlife Service, USA  
Doherty, Jr., P. F., Colorado State University, USA

THE IMPORTANCE OF ACCOUNTING FOR INDIVIDUAL DETECTION HETEROGENEITY IN SURVEY PROTOCOLS

Survey protocols to determine the number of individuals is a vital component of many threatened or endangered species conservation management plans. Such surveys are often required of developers so mitigation plans can be negotiated depending on the number of individuals that might be affected by a new development. Accounting for the probability of detecting individuals is widely accepted as an important factor in creating a robust survey protocol. However, individual heterogeneity in detection is often not considered, leading to estimates of detection that may be biased high, and ultimately resulting in too few repeat surveys. As a case species we used repeated resight sampling data of the California Gnatcatcher (*Poliophtila californica*), a federally-listed threatened species occurring in southern California. A total of 43 individually color-banded birds from two populations were surveyed ten times during the breeding season and ten times during the non-breeding season. We used recently developed mark-recapture models that consider individual random effects on detection probability to estimate individual heterogeneity between color-banded birds. We found support for individual heterogeneity amongst individually banded California Gnatcatchers. This heterogeneity appears to vary by season, with greater heterogeneity observed among birds surveyed during the breeding season than during the non-breeding season. Further, without the inclusion of individual heterogeneity in the model, estimates of detection probabilities were markedly increased. Therefore, survey protocols that do not consider individual heterogeneity may underestimate the number of required repeat samples and thus have the potential to falsely assume absence of a species or individual even with the inclusion of a constant detection probability. (ID 15969 | Poster 68)



**Dettling, M. D.**, Point Blue Conservation Science, USA, mdettling@pointblue.org

Seavy, N. E., Point Blue Conservation Science, USA, nseavy@pointblue.org  
Gardali, T., Point Blue Conservation Science, USA, tgardali@pointblue.org

#### CURRENT STATUS OF WESTERN YELLOW-BILLED CUCKOO ALONG THE SACRAMENTO AND FEATHER RIVERS, CALIFORNIA

To evaluate the current population status of the western population of the Yellow-billed Cuckoo (*Coccyzus americanus*) along the Sacramento and Feather rivers in California's Sacramento Valley, we conducted extensive play-back surveys in 2012 and 2013. We also quantified the amount and distribution of potential habitat. We estimated that the total area of potential habitat was 8,134 ha along the Sacramento River and 2,052 ha along the Feather River, for a total of 10,186 ha. Large-scale restoration efforts have created potential habitat along both of these rivers. Despite increases in the amount of habitat, the number of cuckoos we detected was extremely low. There were 8 detection occasions in 2012 and 10 occasions in 2013 on the Sacramento River, in both restored and remnant habitat. We had no detections on the Feather River in either year. We compared our results to 10 historic studies from as far back as 1972 and found that the Yellow-billed Cuckoo had unprecedentedly low numbers in 2010, 2012, and 2013. The current limiting factor for the Yellow-billed Cuckoo in the Sacramento Valley is likely not the amount of appropriate vegetation, as restoration has created more habitat over the last 30 years. Reasons for the cuckoo decline are unclear. (ID 15818)

**DeVault, T. L.**, USDA National Wildlife Research Center, USA, travis.l.devault@aphis.usda.gov

Belant, J. L., Mississippi State University, USA, jbelant@cfr.msstate.edu  
Blackwell, B. F., USDA National Wildlife Research Center, USA,

bradley.f.blackwell@aphis.usda.gov

Martin, J. A., Mississippi State University, USA, jmartin@cfr.msstate.edu

#### BIRD USE OF SOLAR PHOTOVOLTAIC INSTALLATIONS AT U.S. AIRPORTS: IMPLICATIONS FOR AVIATION SAFETY AND BIRD CONSERVATION<sup>†</sup>

Scaling-up for renewable energy such as solar, wind, and biofuel raises a number of environmental issues, notably changes in land use and adverse effects on wildlife. Airports offer one of the few land uses where reductions in wildlife abundance and habitat quality are necessary and socially acceptable, due to risk of bird collisions with aircraft. Here we discuss bird use of renewable energy production facilities at U.S. airports with respect to aviation safety, bird conservation, and energy production for airports and beyond. In particular, we report on a recent field study investigating bird use of solar photovoltaic (PV) arrays at airports compared to that found in extant airfield grasslands. Across five locations in three states, we observed 46 species of birds in airfield grasslands compared to 37 species in PV arrays, although we found slightly more than twice the number of birds per ha surveyed in PV arrays (mean across locations = 3.468) than in airfields (1.598). We also calculated a bird hazard index (BHI) based on the mean seasonal mass of birds per area surveyed. General linear model analysis indicated that BHI was influenced by season, with higher BHI in summer than fall and winter. We found no effect of treatment (PV arrays vs. airfields), location, or interactions among predictors. Our results suggest that the overall level of bird use at airport PV arrays is low, especially considering that airfield grasslands are managed to be largely free of wildlife. However, it also appears that converting airport grasslands to PV arrays would not increase hazards associated with bird-aircraft collisions. (ID 15782)

**Devries, J. H.**, Ducks Unlimited Canada, Canada, j\_devries@ducks.ca  
Clark, R. G., University of Saskatchewan, Canada, bob.clark@ec.gc.ca

#### ADAPTIVE NEST SITE SELECTION IN BIRDS? EFFECTS OF LANDSCAPE COMPOSITION AND BREEDING DENSITY

According to theory, habitat selection by organisms should reflect underlying variation in probability of survival or reproductive success among habitats. Understanding the processes affecting breeding habitat selection is important because reproductive success has the strongest impact on demography in many bird species. Northern pintails (*Anas acuta*) are migratory, temperate-nesting birds that breed in greatest concentrations in the prairies of North America. Declining pintail populations suggest that habitat loss, fragmentation, and changing land use practices may have decoupled formerly reliable fitness cues with respect to choices of suitable nesting habitat. Using data from 62 waterfowl nesting study sites across prairie Canada (1997–2009), we evaluate nest survival, a primary fitness metric, at nest, patch, and landscape scales, along with estimates of habitat selection, to test for evidence of adaptive habitat choice. Pintail nest survival varied with nest initiation date, nest habitat, local pintail breeding pair density, and landscape composition but not with metrics of habitat fragmentation. Selection of nesting habitat reflected patterns in nest survival consistent with the theory that nest habitat selection is adaptive. Selection ratios were generally low for habitats with low nest survival (spring-seeded croplands, wetlands) and high for habitats with high nest survival (fall-seeded cropland, idle grassland). Furthermore, pintails tended to select nesting habitats with higher nest survival at low breeding densities and in landscapes dominated by cropland. However, at larger spatial scales, the relative availability of habitats with low versus high nest survival may reduce reproductive potential. (ID 15943)

**Dhondt, A. A.**, Cornell University, USA, aad4@cornell.edu

Hawley, D. H., Virginia Tech, USA, hawleyd@vt.edu

Dobson, A. P., Princeton University, USA, dobber@princeton.edu

Ley, D. H., North Carolina State University, USA, dley@ncsu

Geary, S., University of Connecticut, USA, steven.geary@uconn.edu

Hochachka, W. M., Cornell University, USA, wmh6@cornell.edu

Dhondt, K. V., Cornell University, USA, kvs9@cornell.edu

Williams, P. D., Princeton University, USA, pauldw@princeton.edu>

Tulman, E., University of Connecticut, USA, edan.tulman@uconn.edu>

#### FACTORS DRIVING RAPID CHANGES IN VIRULENCE OF THE BACTERIAL PATHOGEN *MYCOPLASMA GALLISEPTICUM* IN HOUSE FINCHES *HAEMORHUS MEXICANUS*<sup>†</sup>

Interactions between emerging pathogens and their hosts cause changes in both host and pathogen. A novel strain of the bacterium *Mycoplasma gallisepticum* (MG), a widespread, economically important poultry pathogen, emerged in 1994 in wild passerines in Eastern North America. In house finches – its primary wild bird host – the pathogen causes severe conjunctivitis resulting in reduced survival in the wild. As the epidemic spread rapidly in the eastern (introduced) part of the finch's range it caused massive declines in host abundance. In 2002 MG successfully spread to the western (native) range of the host. Since its emergence we have collected MG samples, primarily from house finches. This made it possible to determine that all house finch MG isolates across North America are derived from a single successful host jump from poultry. Nevertheless, different isolates vary strongly in virulence: MG virulence, as measured by severity and duration of eye lesions, is rapidly and independently increasing both in eastern and western house finches. This provides us with a tractable system to experimentally test causes of genetic changes in virulence and between-host transmission. We will report on experiments that test the hypothesis that increase in virulence is the result of between-strain competition in a system in which hosts can recover from infections, but maintain imperfect immunity after recovery (the immune

escape hypothesis). The ability of MG to evolve in virulence and persist in house finch populations could affect population dynamics of house finches for decades to come. (ID 16002)

**Diehl, R. H.**, US Geological Survey, USA, rhdiehl@usgs.gov  
 Peterson, A. C., University of Minnesota, USA, pete1112@d.umn.edu  
 THE AIRSPACE AS HABITAT<sup>T</sup>

The concept of habitat, one of the most fundamental in ecology and evolutionary biology, has changed little in hundreds of years. The basic tenants of what constitutes a habitat are widely accepted, but for reasons that remain unclear (limits to human perception, bias in education) the scope of its application has missed arguably the largest habitat on Earth, the airspace. It is unclear to what extent behavioral and ecological processes common to terrestrial and aquatic habitats are also operational in the airspace. We should be able to predict the conditions that would allow for such behaviors using terrestrial and aquatic habitats as models combined with an understanding of animal physiology and the energetics associated with occupying aerial habitat. We know essential “life” behaviors typically associated with terrestrial or aquatic habitats also occur in airspace: foraging, resting, reproductive behavior. For some flying animals, these behaviors occur exclusively in aerial habitat (Alpine swift, other aerial foragers). Increasingly, aerial behaviors interact with anthropogenic structures such as wind turbines and communications towers in ways that result in ecological traps. Recent studies show the potential for development of the airspace to affect flying animal populations, yet conservation programs rarely include airspace as a resource that is both measurable and potentially limiting. (ID 16365)

**Dietsch, T. V.**, US Fish and Wildlife Service, USA, thomas\_dietsch@fws.gov  
 AVIAN INTERACTIONS WITH UTILITY-SCALE SOLAR PROJECTS IN SOUTHERN CALIFORNIA.<sup>T</sup>

The federal government has targeted renewable energy expansion as a key part of the Obama administration’s “all-of-the-above strategy” for developing American-made energy. Similarly, California has prioritized renewable energy development to meet CO2 reduction targets with an overall goal of achieving 33% renewable energy production by 2020. Utility-scale solar projects in southern California are a key part of these strategies. As projects near completion and come on line the US Fish and Wildlife Service (Service) is documenting avian interactions with these facilities. In general, the Service collaborates with federal, state, and private partners to identify causes of wildlife mortality and to implement appropriate measures to help avoid, minimize and mitigate impacts during construction and operation of both traditional and renewable energy facilities. The Service has worked with solar project operators to standardize mortality reporting and to implement effective systematic monitoring across solar technology types. Preliminary analysis of avian mortalities at California solar facilities will be presented representing the three types of solar power generation: photovoltaic field, concentrated solar trough, and concentrated solar power tower. Initial hypotheses for the causes of reported mortalities will be discussed along with next steps that the Service is taking in collaboration with other government agencies and the private sector. The Service remains committed to meeting renewable energy goals while working to better understand, avoid, minimize, and mitigate avian mortalities at existing and planned utility-scale solar projects. (ID 16294)

**Dillon, K. G.**, University of Idaho, USA, dillon@uidaho.edu  
 Conway, C. J., U. S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, USA, cconway@usgs.gov  
 WHY ELEVATION MATTERS: INTRASPECIFIC VARIATION IN LIFE HISTORY STRATEGIES

Avian clutch size is negatively correlated with breeding elevation in many regions and study systems, but mechanistic hypotheses to explain the cause of this widespread pattern have not been tested. We tested a suite of experimental and correlative predictions of 3 mechanistic hypotheses—Nest Predation Risk, Food Limitation, and Female Condition—to explain the cause of the negative correlation between clutch size and elevation in red-faced warblers in southeastern Arizona. We found no support for either the Food Limitation or Female Condition Hypotheses, but we did find support for both predictions of the Nest Predation Risk Hypothesis. Females that experienced an experimentally heightened perception of predation risk laid a smaller clutch than control females ( $F = 3.98$ ,  $P = 0.05$ ). Additionally, predation rates at artificial nests were highest at the top of the mountain ( $\Delta AICc = 0.00$ ,  $wAICc = 0.25$ ). While high elevation breeders laid a smaller clutch than low elevation breeders, nestling growth rates were highest at high elevation ( $\Delta AICc = 0.00$ ,  $wAICc = 0.33$ ). Our results provide compelling evidence of elevational shifts in avian life history strategies across local elevational gradients in response to changes in selection pressures. Such changes over relatively small spatial scales need to be considered in efforts to predict climate change impacts. (ID 15863)

**Dinsmore, S. J.**, Iowa State University, USA, cootjr@iastate.edu  
 ADVANCES AND TECHNIQUES IN NEST SURVIVAL MODELING<sup>T</sup>

Ornithologists interested in quantifying the reproductive success of birds have many analytical tools available following several recent methodological advances. These approaches generally model the daily survival rates as a function of covariates with an overall goal of obtaining a best estimate of the overall probability of success. Here, I focus on the application of Program MARK to address a broad range of questions about avian nest survival. I’ll begin with a brief discussion of data formatting and the inclusion of individual, group, and time-varying covariates. The talk will also cover procedures for analyzing data that include multiple nest stages and age effects in nest survival. Using a large dataset I will illustrate the inclusion and interpretation of covariates in a nest survival analysis and offer tips for presenting the results. I will also briefly discuss the use of the Markov-Chain Monte Carlo (MCMC) tool in MARK as it applies to a nest survival analysis. A related topic involves the application of this model to “ragged” telemetry data and this will also be illustrated. Collectively, the information presented here will provide a summary of the basics of nest survival modeling in Program MARK with an emphasis on recent modeling advances. (ID 16206)

**Dinsmore, S. J.**, Iowa State University, USA, cootjr@iastate.edu  
 Knopf, F. L., Fort Collins, CO, USA, flknopf@yahoo.com  
 CASCADING ECOLOGICAL EVENTS: DO BURROWING OWLS REDUCE POPULATION RECRUITMENT OF MOUNTAIN PLOVERS?

The Mountain Plover (*Charadrius montanus*) is an endemic shorebird of the North American Great Plains and often nests on active prairie dog colonies. Recent plover declines in Colorado and Montana are puzzling given the persistence of prairie dogs at both sites. One possible driver is the concurrent increase in Burrowing Owls (*Athene cunicularia*), a potential predator of plover chicks. Here we use a 19-year dataset from Montana to explore the possibility that the presence of owls is correlated with recent plover declines. We conducted presence/absence surveys for plovers and owls on >100 prairie dog colonies three times per year and used a concurrent mark-resight study to estimate the annual survival of plovers. The first-year survival of plover chicks was negatively influenced by the presence of Burrowing Owls on their natal colony, although this effect was weak. First-year plover survival was 0.14 (SE = 0.03) in the presence of owls and 0.17 (SE = 0.04) in the absence of owls. A separate analysis of the co-occurrence of both species on prairie dog colonies revealed that plover occupancy of colonies has declined during the 19-year study period while owl occupancy of those same

colonies has increased. We found no evidence that plovers avoided colonies occupied by owls, although we were unable to test for density-dependent avoidance. Although the two species may continue to co-exist on local prairie dog colonies in the short term, the presence of owls could force long-term population declines when reduced survival of plover chicks is compounded across years. (ID 16119)

**Doll, A. C.**, University of Colorado Denver, USA, [acdoll@gmail.com](mailto:acdoll@gmail.com)  
Wunder, M. B., University of Colorado Denver, USA, [michael.wunder@ucdenver.edu](mailto:michael.wunder@ucdenver.edu)  
Lancot, R. B., US Fish and Wildlife Service, USA, [richard\\_lancot@fws.gov](mailto:richard_lancot@fws.gov)  
Stricker, C. A., US Geological Survey, USA, [cstricker@usgs.gov](mailto:cstricker@usgs.gov)  
ARCTIC CLIMATE EVENTS REVEAL TRADEOFF BETWEEN TIMING OF MIGRATORY AND NESTING BEHAVIORS

The appropriate timing of annual life history events can have dramatic impacts on an individual's fecundity and, ultimately, on population abundance trends. Species that migrate long distances to breed in the high Arctic may be especially vulnerable to small changes in environmental phenologies resulting from climate change. With this in mind, we used stable carbon isotopes in blood samples of Dunlin to estimate the arrival dates of individuals to their northern Alaska breeding grounds. Fortuitously, there was a dramatic disparity in snowmelt dates between the two years of our study that allowed us to consider how changing environmental conditions may interact with breeding schedules. In comparison to recent years, northern Alaska experienced a relatively late snowmelt in 2010 which resulted in a very short nest initiation phase. In contrast, the early snowmelt of 2011 allowed for a much longer nest initiation period; though the median initiation date differed by only one day between years. In turn, median hatch dates were similar in both years; however, the majority of hatches in 2010 occurred over a much shorter timespan as compared to in 2011. Thus, it appears that while the migration times of dunlin display a certain level of plasticity, the breeding schedule is relatively fixed. Therefore, if environmental phenologies, such as the emergence of invertebrate prey, are shifting as a consequence of climate change, populations of migratory birds may be less able to alter their breeding schedules in response. (ID 16028)

**Dos Santos, E. B.**, University of Lethbridge, Canada, [dossantos@uleth.ca](mailto:dossantos@uleth.ca)  
Rendall, D., University of Lethbridge, Canada, [d.rendall@uleth.ca](mailto:d.rendall@uleth.ca)  
POPULATION DIFFERENCES IN SONG STRUCTURE AND ORGANIZATION IN NORTHERN AND SOUTHERN HOUSE WRENS (TROGLODYTES AEDON)

House Wrens (*Troglodytes aedon*) have the widest distribution of any songbird in the western hemisphere, distributed from central latitudes in Canada to Tierra del Fuego. While subject to revision, disparate populations across this range are currently recognized as a single species. At the same time, they show considerable variation in mating system, migratory behavior and life-history patterns, for example being almost entirely migratory and more frequently polygynous with large clutch sizes in North America but sedentary and substantially monogamous with small clutch sizes in most of South America. House Wrens are thus ideally suited to quantifying adaptive behavioral flexibility and to testing the role played by male song in variable mating systems and in potential geographic sub-structuring of populations. Here we present a first detailed description of song structure and organization in a south american population of House Wrens based on analysis of 12,000 songs recorded from 22 males breeding in Mendoza, Argentina. We provide a comparison with song patterns and mating systems of a population of House Wren wrens studied concurrently in Alberta, Canada. Keywords: song structure, migration, mating systems, sexual selection. (ID 15871 | Poster 95)

**Dossman, B. D.**, The Ohio State University, USA, [dossman.2@osu.edu](mailto:dossman.2@osu.edu)  
Mitchell, G. W., Environment Canada, Canada, [gregory.mitchell@ec.gc.ca](mailto:gregory.mitchell@ec.gc.ca)  
Rodewald, P. G., Cornell Lab of Ornithology, USA, [pgr35@cornell.edu](mailto:pgr35@cornell.edu)  
Matthews, S. N., The Ohio State University, USA, [matthews.204@osu.edu](mailto:matthews.204@osu.edu)  
INDIVIDUAL ROUTE CHOICE IS DRIVEN BY FAVORABLE WIND CONDITIONS IN TWO MIGRATORY SONGBIRDS\*

Birds are expected to select migratory routes that facilitate optimal arrival timing on the breeding grounds and subsequent reproductive success. This could be accomplished through changes in either the temporal and/or spatial migratory programs. However, birds are highly consistent in the temporal domain, and yet vary considerably in route selection. Environmental conditions can influence the progression of migration and birds are expected to select migratory routes according to the prevailing environmental conditions. Therefore, individuals should maximize their temporal efficiency by adapting their route selection to facilitate quicker migrations. Using an automated telemetry array located around the western Lake Erie basin, we investigated the factors that influence two distinct route choices: an indirect circumnavigation of the lake or a direct crossing. We compared the probability of taking a direct route versus indirect route with prevalent environmental conditions experienced, which include wind assistance, visibility, and precipitation for two North American passerines. No flights were observed to occur during rainy or visually obscured nights, reflecting decisions made to avoid flight during inclement weather conditions. The probability of taking the direct route, across the Lake, was positively correlated with increasing tailwind component, suggesting that on nights with positive tailwind conditions, birds were more likely to make a direct route across the lake, thereby halving the time required to cross the lake (indirect = 71km, direct = 38km). By adjusting route choices made during the course of migration to stochastic environmental conditions, birds should minimize the time spent on migration. Year-to-year variability in spring environmental conditions underscores the need for birds to exhibit plasticity in migratory route selection to ensure optimal arrival timing in the face of changing environmental conditions. (ID 16253)

Downes, C., Environment Canada, Canada, [connie.downes@ec.gc.ca](mailto:connie.downes@ec.gc.ca)  
**Hudson, M. R.**, Environment Canada, Canada, [marie-anne.hudson@ec.gc.ca](mailto:marie-anne.hudson@ec.gc.ca)  
Smith, A. C., Environment Canada, Canada, [adam.smith@ec.gc.ca](mailto:adam.smith@ec.gc.ca)  
Francis, C. M., Environment Canada, Canada, [charles.francis@ec.gc.ca](mailto:charles.francis@ec.gc.ca)  
THE STATUS OF BIRDS IN CANADA WEBSITE: THE TRIALS AND TRIBULATIONS OF SYNTHESIZING MULTIPLE, DISPARATE DATA SOURCES

The Status of Birds in Canada website, created and hosted by Environment Canada, provides an assessment of the current population status for the 400+ species that occur in Canada. Available survey results and their reliability were evaluated to determine the best population monitoring program(s) for each species, and results were synthesized to provide the assessment. The Breeding Bird Survey (BBS) is one of the longest-running, multi-species avian surveys in North America. As such, BBS trends and indices were used as the main data source for landbirds and a handful of other species. However, like most surveys, the BBS has limitations. One of the most serious of these is uneven survey coverage, which is particularly evident in Canada where the concentration of BBS routes across the southern half of the country leaves the boreal and arctic biomes largely un-surveyed. Whenever possible, BBS data for northern species were synthesized with those from other major avian surveys, such as the Christmas Bird Count, to provide a complete picture as possible of their status. This synthesis was challenging, because surveys have different levels of precision, types of bias, and degrees of understanding of the underlying limitations. Here, we present how we used the BBS and other surveys to assess the species that occur in Canada, the challenges that



underlie this level of synthesis, and how we hope to address some of these challenges. (ID 15874)

**Dreitz, V. J.**, University of Montana, USA, Victoria.Dreitz@umontana.edu  
 Stinson, L. T., Dept. Fish, Wildlife and Conservation Biology, USA, lani.stinson@gmail.com  
 Hahn, B. A., Aldo Leopold Wilderness Research Institute, USA, bhahn@fs.fed.us  
 Lukacs, P. M., University of Montana, USA, Paul.Lukacs@umontana.edu

#### A MULTI-SCALE PERSPECTIVE FOR MANAGING PRAIRIE AVIFAUNA ASSEMBLAGES ACROSS THE WESTERN US

Biodiversity metrics are common indicators for ecosystem services, such as food production. Future demands for increased food production are expected to have severe impacts on prairie biodiversity and ecosystem integrity. The North American prairie avifauna has experienced drastic population declines, prompting numerous conservation efforts, which have been informed primarily by local scale studies. We applied a multi-scale perspective to disentangle local- and broad-scale avian responses by analyzing observations of 20 prairie bird species (17 grassland obligates and 3 sagebrush obligate species) from 2009-2012 in the western prairie region of the United States. We employ a multi-species model approach to examine the relationship of land ownership, habitat and latitude to broad-scale species richness. Our findings suggest that patterns and processes influencing avian assemblages at local scales may not function at broad scales. Individual species responses to land ownership, habitat and latitude were highly variable. The broad spatial extent of our study demonstrates the need include lands in private ownership to assess biodiversity and the importance of maintaining habitat diversity to support avian biodiversity. Lastly, local-scale information can document species presence within a study area, but broad-scale studies provide an essential complement to inform conservation actions and policies by placing local biodiversity in the context of an entire region, landscape or ecosystem. (ID 16163)

**DuBay, S. G.**, University of Chicago, USA, dubaysg@uchicago.edu  
 PHYSIOLOGICAL MECHANISMS OF DIFFERENTIAL ALTITUDINAL MIGRATION BY AGE AND SEX CLASS IN THE HIMALAYAN BLUETAIL (*TARSIGER RUFILATUS*)\*

Differential migration by age and sex class is well documented in birds, yet the underlying mechanisms that facilitate intraspecific differences in migration are poorly understood. I report age and sex class differences in the arrival timing of an altitudinal migrant, the Himalayan Bluetail (*Tarsiger rufilatus*), to its breeding elevation (>3000 m) in the Hengduan Mountains of China. Males in adult plumage arrived first, when snow covered the ground and temperatures routinely dropped below freezing. Adult males were followed by males in subadult plumage and then females. Differences in the arrival timing among classes were associated with differences in body mass and flight muscle mass. Birds generate endogenous heat almost exclusively through shivering of flight muscle. Thermogenic capacity and cold tolerance thus increase in individuals with larger muscles. In the bluetail, body mass and relative flight muscle mass were larger in age and sex classes that arrived earlier in the breeding season, when temperatures were colder and individuals would likely benefit from increased thermogenic capacity. Hemoglobin concentration and hematocrit, however, indicate that cardiorespiratory stress increases in the bluetail as body mass and flight muscle mass increase. Larger individuals require more oxygen for aerobic metabolic function (such as thermogenesis), a task which becomes increasingly difficult at higher elevations and earlier in the season. The results suggest a physiological trade-off between increasing flight muscle mass to increase thermogenic capacity and maintaining sufficient oxygen supply to muscle under cold, hypoxic high-elevation conditions. (ID 16023)

Dugger, K. M., US Geological Survey, OR Cooperative Wildlife Research Unit, USA, katie.dugger@oregonstate.edu

**Forsman, E. D.**, USDA Forest Service, PNW Research Station, USA, eforsman@fs.fed.us

Clark, D. A., Oregon Department of Fish and Wildlife, USA  
 Davis, R. J., USDA Forest Service, PNW Research Station, USA  
 and 33 others, ..

#### STATUS AND TRENDS OF THE NORTHERN SPOTTED OWL (*STRIX OCCIDENTALIS CAURINA*): RESULTS OF A RANGE-WIDE META-ANALYSIS

We used meta-analyses of mark-recapture data on known-age individuals and fecundity data from reproductive surveys to evaluate the status and trends of the Northern Spotted Owl in 1985-2013. We also investigated associations between owl vital rates and covariates that might be influencing observed trends. Fecundity was highest for adults versus subadults, and in the mixed-conifer region in WA; however there was a high degree of annual variation in fecundity, with strong declines observed on 5 of 11 study areas. Apparent annual survival was negatively associated with increasing numbers of Barred Owls on 10 of 11 study areas, and in 7 cases this effect was quite strong. Habitat and climate factors were also associated with variation in fecundity and survival, but the covariates receiving support, and the direction and magnitude of these effects were highly variable among study areas. Overall, populations were declining on all study areas and the average rate of decline was 3.8% per year. Total population declines on the 11 study areas ranged from 31–77% since the onset of monitoring. Range-wide declines of Northern Spotted Owls were primarily associated with increasing numbers of Barred Owls, loss of habitat, and climate patterns. Retention of suitable habitat for Northern Spotted Owls is critically important if they are to have a chance of competing with the invasive Barred Owl. In addition, understanding relationships between owl vital rates and current climate patterns may be important for managing Northern Spotted Owls in the face of future climate change. (ID 16231)

**Dugger, K. M.**, US Geological Survey, OR Cooperative Wildlife Research Unit, USA, katie.dugger@oregonstate.edu  
 Ainley, D. G., H.T. Harvey and Associates, USA  
 Ballard, G., Point Blue Conservation Science, USA  
 Lyver, P., Landcare Research, New Zealand  
 Barton, K., BartonK Solutions, New Zealand

#### BREEDING PROPENSITY AND AGE-SPECIFIC SURVIVAL OF ADÉLIE PENGUINS IN RELATION TO COLONY SIZE WITH RESULTING EFFECTS ON AGE-AT-1ST REPRODUCTION

Survival and movement probabilities of breeding Adélie penguins (*Pygoscelis adeliae*) vary between colonies of different sizes and in relation to environmental disturbance. However, age-related variation in key demographic parameters is still poorly understood for this species. Using data collected on individuals banded as chicks, we estimated age-related variation in survival, age-at-1st reproduction and breeding propensity over 13 years from a 3-colony metapopulation in the Ross Sea, Antarctica. Survival varied in relation to breeding status (non-breeder>pre-breeder>breeder), age (lowest survival observed the first 2 years), colony size (lower survival at smallest colony), and by year. Recruitment rate into the breeding population increased through age 8, with no differences observed between colonies. However, because survival was lower at the smallest colony, more individuals per cohort recruited at age 5 at the small colony vs. age 6 at the larger colonies. This resulted in a lower mean age-at-1st reproduction at the smallest colony compared to the larger colonies (6.2 yrs, SE=1.8 vs. 6.8 yrs, SE=1.95), and far fewer birds per cohort recruited into the breeding population by age 11 at the small colony compared to the other 2 colonies (16% vs. 50%). Breeding propensity was lower than expected, as the probability of transitioning from

a breeder to a non-breeder ranged from 0.22 to 0.44 depending on age. Thus, penguins do not breed every year after recruitment into the breeding population and survival differences between colonies is likely one of the demographic mechanisms responsible for maintaining large colony size discrepancies on Ross Island. (ID 16225)

**Dunham, S. W.**, University of Maine, USA, stephen.dunham@maine.edu  
Harrison, D. J., University of Maine, USA, harrison@maine.edu

#### HABITAT SELECTION OF FEMALE SPRUCE GROUSE DURING BROOD REARING IN COMMERCIALY MANAGED FORESTS

Spruce grouse (*Falcipennis canadensis*) are a medium-sized species of grouse associated with conifer-dominated forests. Although abundant across Canada and Alaska, their geographic range intersects only the northern extent of the contiguous United States, where populations are rare or declining. This area includes the Acadian forests of the Northeast, where spruce grouse are officially designated as "state endangered" in Vermont and New York, and are "a species of special concern: near-threatened" in New Hampshire. Although there is no hunting season on the species in Maine, little else is known about their current status. Because commercially managed forests represent > 10 million acres in Maine, forest harvest practices are likely to influence spruce grouse habitat. We studied habitat selection by female spruce grouse across 5 different forest harvest treatments during the brood rearing season (June-October). During the summers of 2012 and 2013 we conducted repeated call-back surveys in 30 stands representing mature conifer, regenerating clearcuts, two ages of pre-commercially thinned stands, and selection harvests. We captured and individually marked 31 adult female grouse and equipped 26 with necklace mounted radio transmitters to monitor habitat use, movements, survival, and reproductive success. Vegetation characteristics were measured within surveyed stands and vegetation structure was measured at 20 individual radiolocations verified for each female. We also modeled effects of habitat composition on home range areas for 22 females and compared vegetation at each radio location with available vegetation characteristics in the surveyed stands to determine if the females were selecting or avoiding habitat conditions present in areas with forest harvest treatments commonly applied within eastern Acadian Forests. (ID 16324)

**DuVal, E. H.**, Florida State University, USA, ehduval@bio.fsu.edu

#### SHOWING YOUR AGE: AGE-LINKED MALE PHENOTYPES ARE UNRELATED TO FEMALE MATE CHOICE IN THE LANCE-TAILED MANAKIN, DESPITE AGE-SPECIFIC MALE REPRODUCTIVE SUCCESS

Correlations of individual phenotype and reproductive success have shaped current thought about sexual selection in wild populations. However, phenotypes may be age-dependent, complicating interpretations when successful and unsuccessful males are morphologically distinct. Furthermore, traits indicating age may be targets of female choice, as older males have demonstrated survival ability. Longitudinal data on male phenotypes and related selection pressure is needed to assess the age-dependence of traits influenced by sexual selection. Lance-tailed Manakins (*Chiroxiphia lanceolata*) are cooperatively lekking birds in which social status is critical for reproduction. Alpha-status are morphologically distinct from other males and both age and experience of alphas relate to siring success. I quantified age-dependence of male phenotypes in a wild population of Lance-tailed Manakins, assessed whether population-wide relationships between age and phenotype were the result of ontogenetic or selective processes, and tested the hypothesis that female choice favors age-indicating male traits. Older males had smaller bills, more parasites, lower mass given size, and longer central rectrices. Longitudinal data (777 captures of 318 known-aged males) analyzed with mixed models demonstrated that distinctive alpha phenotypes result from a combination of selective disappearance (bill), changes induced by becoming alpha (parasites and body condition), and individual ontogeny

(tail). Siring success was unrelated to variation in these traits. Though mate choice is related to male age in this species, these results demonstrate that age-related phenotypes are not the basis of choice. (ID 16359)

**Dybala, K. E.**, Univ of California, Davis, Museum of Wildlife and Fish Biology, USA, kedybala@ucdavis.edu

Engilis, A., Univ of California, Davis, Museum of Wildlife and Fish Biology, USA

Trochet, J. A., Univ of California, Davis, Museum of Wildlife and Fish Biology, USA

Engilis, I. E., Univ of California, Davis, Museum of Wildlife and Fish Biology, USA

Truan, M. L., Univ of California, Davis, Museum of Wildlife and Fish Biology, USA

#### QUANTIFYING LONG-TERM CHANGES IN ECOSYSTEM FUNCTION AND RESILIENCE TO GUIDE CONSERVATION IN A NOVEL RIPARIAN ECOSYSTEM

Human-modified, novel ecosystems now dominate Earth's terrestrial surface, and biodiversity conservation increasingly depends on effectively managing these novel ecosystems. Yet, setting conservation goals for novel ecosystems is not straight-forward; modifications to the landscape are often largely irreversible, making true ecological restoration to an undisturbed state an unachievable goal. Instead, we propose achievable goals of long-term increases in ecosystem function and resilience, defined as increases in the density, diversity, and stability of the communities they support. We evaluated long-term changes in the function and resilience of a highly-modified, novel riparian ecosystem in the Central Valley of California, U.S.A. by quantifying changes in the density, diversity, stability, and structure of the breeding bird community and its functional groups. Consistent with a long-term improvement in ecosystem function and resilience, we detected increases in the density, stability, and dominance of riparian-dependent species as a group. However, we detected little to no long-term changes for several other functional groups, indicating ecosystem attributes that may be missing, such as a lack of standing snags that would benefit primary cavity-nesters. These insights provide opportunities to formulate new conservation plans that would benefit these groups. Our approach provides a tractable way of assessing management success and guiding conservation planning in novel ecosystems. (ID 16411)

**Dybala, K. E.**, University of California, Davis, USA, kedybala@ucdavis.edu  
Truan, M. L., University of California, Davis, USA, mltruan@ucdavis.edu  
Engilis Jr, A., University of California, Davis, USA, aengilisjr@ucdavis.edu

#### SUMMER VS. WINTER: ESTIMATING THE CONSERVATION VALUE OF RIPARIAN HABITAT THROUGHOUT THE ANNUAL CYCLE

Winter habitat quality can have significant effects on survival, body condition, migration timing, and reproductive success, playing a key role in avian population regulation. Yet, particularly for landbirds in temperate regions, there are few comprehensive studies of winter ecology, and conservation plans remain largely focused on breeding birds. A large number of species overwinter in temperate regions, including millions of boreal-breeding, neotemperate migrants, which are threatened by accelerating rates of development and climate change. Thus, by designing conservation plans to take into account the habitat requirements of birds throughout the full annual cycle, the value of one habitat conservation project can be maximized. To examine the degree to which the winter bird community should be included in riparian habitat conservation plans in California's Central Valley, we used hierarchical multispecies occupancy models to compare the species richness and phylogenetic diversity of the summer and winter riparian bird communities in two watersheds. We found that the winter bird communities were equally as species rich and more phylogenetically diverse than the

summer bird communities, suggesting that the value of this riparian habitat is high throughout the year. Further, nearly all of the winter visitors are boreal-breeding, neotemperate migrants, 32% of which are significantly declining across North America. Our results demonstrate that the impact of one riparian habitat conservation project could be maximized by considering the needs of winter bird communities, as well as underscore the need for additional research on the winter ecology of birds and consideration of how to restore and manage riparian habitat for winter birds. (ID 16302 | Poster 46)

**Eaton, R. A.**, Michigan State University, USA, [eatonrac@msu.edu](mailto:eatonrac@msu.edu)  
**Lindell, C. A.**, Michigan State University, USA, [lindellc@msu.edu](mailto:lindellc@msu.edu)  
**Homan, H. J.**, USDA-WS-National Wildlife Research Center, USA, [jeffrey.h.homan@aphis.usda.gov](mailto:jeffrey.h.homan@aphis.usda.gov)  
**Linz, G. M.**, USDA-WS-National Wildlife Research Center, USA, [george.m.linz@aphis.usda.gov](mailto:george.m.linz@aphis.usda.gov)

#### INTER-SPECIFIC VARIATION IN AMERICAN ROBIN AND CEDAR WAXWING USE OF CULTIVATED CHERRY ORCHARDS

Birds are documented consumers of cultivated sweet cherries (*Prunus avium*), but we lack species-specific studies of bird use of orchards throughout the cherry-growing season. We used radio telemetry to track the habitat use of American Robins (*Turdus migratorius*) and Cedar Waxwings (*Bombycilla cedrorum*) in Michigan sweet cherry orchards from June to September 2013. Sweet cherries are relatively high in sugar and low in proteins and lipids. Robins consume larger proportions of invertebrates and prefer lipid-rich fruits, while waxwings prefer sugary fruits. These interspecific differences should result in variable use of cherry orchards and impacts on the cherry industry. Our objective was to quantify the day-to-day frequency of bird visits to orchards and the amount of time birds spent in orchards within a day over the cherry season. To do this we used both a less- and more-strict metric of orchard use that was based upon a bird's proximity to an orchard. Waxwings spent more days using orchards than Robins, according to the less strict metric ( $p = 0.03$ ); the median percentage of day-to-day use was 16% (inter-quartile-range (IQR) = 26.4%) for Waxwings and 2.1% (IQR = 9.0%) for Robins. Waxwings and Robins did not differ in day-to-day orchard use ( $p = 0.27$ ) according to our stricter metric. However, waxwings did spend more time in orchards than Robins on a given day, according to our stricter metric ( $p = 0.03$ ). Both species showed high individual variation in orchard use. By tracking birds' orchard use throughout the cherry season, our work can provide growers with species-specific information for targeting efforts to mitigate bird damage to fruit and financial loss. (ID 16166)

**Eichholz, M. W.**, Southern Illinois University Carbondale, USA, [eichholz@siu.edu](mailto:eichholz@siu.edu)

#### MECHANISMS FOR LATITUDINAL VARIATION IN SPECIES RICHNESS: WATERFOWL AS A CASE STUDY

Geographic distribution and species richness is a fundamental characteristic of ecology. Although a number of mechanisms have been proposed to explain variation in species richness, the role of food availability, total area, habitat heterogeneity, diversification rate, and time are currently considered the most likely mechanisms. Unlike most other birds, waterfowl have a positive relationship between latitude and species richness in North America. I review support for total area of habitat, habitat heterogeneity, predation, time, rate of diversification, and food availability as causal mechanisms by reviewing evidence for latitudinal gradients consistent with the observed variation in waterfowl species richness. I also compared demographic parameters of waterfowl at various latitudes to predictions from the predation and food availability hypotheses. I found no evidence for latitudinal variation in wetland surface area or wetland heterogeneity. Furthermore, recent glaciations have dramatically limited colonization time in northern

latitudes, excluding wetland heterogeneity, surface area, and time as causal mechanisms. Comparisons between nest success and pre-fledging survival of waterfowl breeding at various latitudes were not consistent with predictions based on the predation hypothesis. I found evidence that latitudinal variation in waterfowl food availability is consistent with the food availability hypothesis and breeding demographics of species in more southern latitudes are consistent with populations facing food limitations. I conclude food availability is the most likely explanation for the observed pattern in latitudinal variation of waterfowl species richness. (ID 16249)

**Elizondo, L.**, Oklahoma State University, USA, [lisa.elizondo@okstate.edu](mailto:lisa.elizondo@okstate.edu)  
**Maple, A.**, Oklahoma State University, USA, [alicia.maple@okstate.edu](mailto:alicia.maple@okstate.edu)  
**Loss, S. R.**, Oklahoma State University, USA, [scott.loss@okstate.edu](mailto:scott.loss@okstate.edu)

#### INVESTIGATION OF FREE-RANGING DOMESTIC CAT ABUNDANCE IN STILLWATER, OKLAHOMA: POTENTIAL ASSOCIATIONS WITH HUMAN POPULATION DENSITY AND BIRD ABUNDANCE\*

Free-ranging domestic cats likely constitute the largest source of direct human-caused mortality for birds, and cats are reservoirs for several diseases that pose a health risk to humans. Despite these ecological and public health concerns, methods for determining free-ranging cat population size and patterns of habitat use remain underdeveloped. We conducted a field study across an urban-to-rural gradient in Stillwater, Oklahoma to assess whether trail cameras can be used to estimate cat abundance, to determine whether cat abundance is related to human population density, and to investigate whether relative abundance of individual bird species is related to cat abundance. We were able to confidently identify 91.5% of individual cats photographed by trail cams. We found no difference in the abundance of free-ranging cats among urban population density classes, and we also found no relationship between relative abundance of several common and widespread bird species and cat abundance. The data collected to date suggests that free-ranging cats are relatively abundant regardless of human population density within a small U.S. city and that larger cat populations are not necessarily associated with reduced abundance of common bird species. However, further modeling of cat and bird detectability is needed to generate density estimates for both animal groups, and research at a larger number of survey points is needed for confident conclusions to be drawn and management recommendations to be made. Nonetheless, we conclude that trail cameras provide a viable means to identify the vast majority of free-ranging cats and are therefore a viable tool for estimating cat population density based on sight-resight data analysis. (ID 16136 | Poster 39)

**Elizondo, P.**, Instituto Nacional de Biodiversidad INBio, Costa Rica, [jpelizondo@pifcostarica.org](mailto:jpelizondo@pifcostarica.org)  
**Ralph, C. J.**, US Forest Service, USA, [cjralph@humboldt1.com](mailto:cjralph@humboldt1.com)  
**Wolfe, J. D.**, USA, [jdwolfe80@yahoo.com](mailto:jdwolfe80@yahoo.com)

#### USING BANDING DATA IN THE UNDERSTANDING OF THE NATURAL HISTORY OF TROPICAL SPECIES, THE CASE OF COSTA RICA.

Global warming, habitat destruction and fragmentation imposed important challenges in the way research is conducted, requiring researchers to fully maximize the value added of banding in estimating and documenting natural history events and their implications to the ecology and conservation of species. Since 1994 the Costa Rica Bird Observatories have established bird monitoring efforts in Costa Rica, based primarily in Tortuguero until 2008, when the observatories decided to take a nation wide approach, starting operations in the highlands of the Cerro de la Muerte and urban ecosystems at INBioparque. Here we present the progress of our research and findings pertaining the timing of molt, breeding and condition of resident and nearctic-neotropical migratory birds as well as the implications for conservation. (ID 16348)



**Elliott, L. H.**, University of Minnesota, USA, [harnx012@umn.edu](mailto:harnx012@umn.edu)

#### EVALUATING THE GRASSHOPPER SPARROW (*AMMODRAMUS SAVANNARUM*) AS A MANAGEMENT INDICATOR SPECIES

Reductions in grassland habitat due to agricultural conversion have resulted in severe declines in grassland bird species. The need to focus conservation efforts in grasslands and other habitats has resulted in various approaches that aim to efficiently manage reserves for wildlife conservation. One such approach is to select and monitor a single species that serves as an indicator of management effectiveness. A good management indicator species should have similar patterns of presence and abundance to other species of concern that share its habitat. The Grasshopper Sparrow (*Ammodramus savannarum*) is an obligate dry upland prairie species that has been identified as both a Species in Greatest Conservation Need and a potential management indicator species within the Minnesota. To evaluate whether this species would make a suitable indicator for grassland birds, I compared avian community composition between grassland sites where Grasshopper Sparrows were present versus sites where they were not detected during surveys in southwestern Minnesota. In addition, I examined the strength of correlations in the abundance of Grasshopper Sparrows with those of other grassland species: Dickcissel (*Spiza americana*), Savannah Sparrow (*Passerculus sandwichensis*), Bobolink (*Dolichonyx oryzivorus*), Western Meadowlark (*Sturnella neglecta*), Henslow's Sparrow (*Ammodramus henslowii*), Clay-colored Sparrow (*Spizella pallida*), and Sedge Wren (*Cistothorus platensis*). (ID 15868 | Poster 30)

**Emery, C. S.**, Oregon State University, USA, [emeryc@onid.oregonstate.edu](mailto:emeryc@onid.oregonstate.edu)  
Jackson, A. K., Oregon State University, USA, [allyson.jackson@oregonstate.edu](mailto:allyson.jackson@oregonstate.edu)  
Eagles-Smith, C. A., US Geological Survey, USA, [ceagles-smith@usgs.gov](mailto:ceagles-smith@usgs.gov)

#### UNFEATHERING MERCURY EXPOSURE IN SONGBIRDS: ARE FEATHERS REALLY INFORMATIVE INDICATOR TISSUES?

Mercury (Hg) occurs in the environment as a contaminant from anthropogenic activities, which can cause negative behavioral and physiological effects on birds. Blood is widely considered as the most useful non-lethal metric to assess Hg exposure in birds, but blood collection is time consuming, stressful to the bird, and requires training. Conversely, feathers are much easier to sample and store, but they can also be difficult to interpret, especially in migratory species. Mercury concentrations in feathers are related to the body burden of Hg at the time the feather was grown, but it is still unknown whether the relationship between blood and feathers differs among feather tracts. To better understand how the relationship between blood and feather Hg concentrations varies between individuals and species, we sampled blood, breast, and tail feathers of riparian songbirds (N = 670) in the Willamette Valley, Oregon. Preliminary data for 20 species suggest that breast and tail feathers often vary considerably, but show a strong correlation with blood Hg, suggesting that feather-tract specific relationships between blood and feather may be needed to correctly interpret feather Hg concentrations. Sampling and analyzing entire feather tracts from donated specimens will aid in understanding variation between feather tracts within individual birds. Understanding the correlation between blood and feather mercury concentrations could increase the use of non-invasive sampling methods in the field and the ability to interpret feather values collected from museum specimens. (ID 15817 | Poster 121)

**Enbody, E. D.**, Tulane University, USA, [eenbody@tulane.edu](mailto:eenbody@tulane.edu)  
Chatfield, M., Tulane University, USA, [mattchat@tulane.edu](mailto:mattchat@tulane.edu)  
Lantz, S., Tulane University, USA, [samlantz@gmail.com](mailto:samlantz@gmail.com)  
Baldassarre, D., Cornell University, USA, [db547@cornell.edu](mailto:db547@cornell.edu)  
Hazelhurst, J., Tulane University, USA, [jhazlehu@tulane.edu](mailto:jhazlehu@tulane.edu)  
Billy, S., Conservation International, Papua New Guinea, [serena.billy@gmail.com](mailto:serena.billy@gmail.com)  
Karubian, J., Tulane University, USA, [jk@tulane.edu](mailto:jk@tulane.edu)

#### SOCIAL STRUCTURE AND BEHAVIOR OF A MALURUS WREN WITH VARIABLE FEMALE PLUMAGE

Elaborate ornamentation in male birds first motivated the theory of sexual selection, and subsequent research has provided robust support for the fundamental principles of male competition and female choice. Female ornamentation, in contrast, has received comparatively little attention despite a growing realization that a full understanding of the evolution of sexual dimorphism depends upon understanding the female perspective. For this reason, the signaling function of female ornamentation is a core issue of the contemporary behavioral ecology research agenda. This project examines the basic breeding biology of the White-shouldered Fairy-wren (*Malurus alboscapulatus*: WSWF) of New Guinea and the influence of female plumage on social systems. The six subspecies of WSWF vary in degree of adult female ornamentation, but male plumage remains constant throughout the island. We investigate how variable female plumage has arisen in this species using a hierarchical approach comparing individual behaviors, between population variations, and within the species as a whole. I will report here on our findings over four field seasons collecting observations in a population with elaborate female plumage in Milne Bay Province, Papua New Guinea and a preliminary field season from a population showing dull female plumage in Western Province, Papua New Guinea. I will report on our findings in three areas; 1) our findings that suggest a high degree of fine scale genetic structure that are comparable in both males and females, suggesting high female philopatry; 2) photospectrometry results showing differences in qualitatively similar plumages between males and females in Milne Bay Province; and 3) a preliminary comparison of the social group composition and relatedness between the two populations studied. (ID 15932 | Poster 108)

**English, P. A.**, Simon Fraser University, Canada, [penglish@sfu.ca](mailto:penglish@sfu.ca)  
Nocera, J. J., Ontario Ministry of Natural Resources and Trent University, Canada, [joenocera@trentu.ca](mailto:joenocera@trentu.ca)  
Green, D. J., Simon Fraser University, Canada, [davidg@sfu.ca](mailto:davidg@sfu.ca)

#### HOMELESS AND HUNGRY: FACTORS INFLUENCING DISTRIBUTION AND ABUNDANCE OF A NOCTURNAL AERIAL INSECTIVORE

The eastern whip-poor-will (*Antrostomus vociferous*) is a threatened species in Canada, yet the cause of their population decline is unknown. Whip-poor-wills seem to prefer young, open forests and forest edges for foraging and nesting; but this habitat type is frequently lost through agricultural intensification and forest maturation. As a result, breeding ground habitat loss has been suggested as a primary factor in their population decline. Alternatively, similar population declines in other aerially insectivorous bird species suggest that food availability may also be a limiting factor. We explored the relationships between land-cover, insect abundance, and the distribution and abundance of whip-poor-wills at two spatial scales by using point counts, acoustic recordings, and breeding bird atlas data. We defined land cover based on satellite and topographical maps, and sampled night-flying insects at point count and acoustic monitoring stations. Local whip-poor-will abundance was best predicted by the amount of open-forest/savannah type habitat and not the amount of forest edge, while increasing density of anthropogenic linear features was negatively related to the abundance of whip-poor-wills. Both results were unexpected given that whip-poor-wills use edges for foraging. Local abundance of large Coleopterans also helped to predict whip-poor-will abundance after controlling for land cover features. At the regional scale, distribution during atlas was positively related to forest area, and the presence of whip-poor-wills on acoustic recordings is also positively related to abundance of insects sampled concurrently. Our results suggest that open-canopy forests, like rock barrens, may be more important than other open and edge habitats for this species in this area; and that changes in insect abundances may play a role in whip-poor-will population declines. (ID 15869)

**Erickson, W.**, WesternEcoSystems, Cheyenne, USA, werickson@west-inc.com  
 Gehring, J. L., Federal Communications Commission, USA, Joelle.Gehring@FCC.gov

#### THE IMPACTS OF WIND ENERGY ON BIRDS: ATTRACTION, AVOIDANCE, FATALITIES, AND METHODS TO REDUCE IMPACTS<sup>†</sup>

Aerodevelopment such as tall buildings, communications towers, powerlines, and wind turbines, can impact birds by attracting them to potentially harmful structures or displacing them from previously used areas. For example, high elevation areas can be ideal for the effective placement of communications towers but also attract birds migrating over mountainous terrain. Similarly, high wind areas such as shorelines and mountain passes can be highly productive sites for wind energy but can also concentrate migrating raptors; thereby, putting them at risk for collisions. Aerodevelopment on otherwise open, flat landscapes or seascapes can also displace some bird species not adapted to tall structures in their environments. Current estimates for the United States suggest that tall buildings and windows account for 98 million - 980 million bird fatalities per year, communications towers are estimated to cause approximately 6.8 million avian fatalities per year, powerlines can cause as many as 174 million bird fatalities per year, and wind turbines are estimated to cause between 134,000 and 230,000 bird fatalities each year. Passerines make up the majority of the bird collisions with tall structures, but population level impacts are possible with species of many taxa. Regulations such as the Endangered Species Act, the Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act protect birds and their habitats. When considering aeroecology, airspace is habitat for birds and aerodevelopment can negatively impact bird habitat. Cost effective, realistic methods to minimize risks to birds from aerodevelopment need to be further identified and implemented. (ID 16407)

**Etterson, M. A.**, U.S. Environmental Protection Agency, USA, etterson.matthew@epa.gov  
 Greenberg, R., Smithsonian Migratory Bird Center, USA, etterson.matthew@epa.gov  
 Hollenhorst, T., U.S. Environmental Protection Agency, USA, hollenhorst.tom@epa.gov

#### LANDSCAPE AND REGIONAL CONTEXT DIFFERENTIALLY AFFECT NEST PARASITISM AND NEST PREDATION FOR WOOD THRUSH IN CENTRAL VIRGINIA, USA

Many empirical studies have shown that forest-breeding songbirds suffer greater rates of nest predation and nest parasitism in smaller forest patches and in fragmented landscapes. To compare the performance of different metrics of spatial habitat configuration resulting from deforestation, we studied nest predation and nest parasitism rates at 200 Wood Thrush (*Hylocichla mustelina*) nests in eight forest fragments ranging from 82 to 9,171 ha in central Virginia, USA. We analyzed nest parasitism rates using logistic regression and we analyzed daily nest predation rates under a multistate competing risks design. For both analyses we compared the performance of 16 covariates, 11 of which related to the spatial configuration of habitat (e.g., patch size, distance to edge, percent core forest) and 5 of which were unrelated to habitat (e.g., year, serial date, nest height). Distance to agriculture gained the greatest support in analyses of nest predation and suggested that elevated predation rates are manifest primarily within 50 m of edges; at 5, 10, and 20 m, respectively, the estimated predation rates were 87%, 76%, and 68%. In contrast, biogeographic region received the greatest support in analyses of nest parasitism, which also showed increasing rates of Brown-headed Cowbird (*Molothrus ater*) parasitism with percent agricultural land and road density within 500 m of a nest. Among regions, the greatest difference seemed to be a virtual absence of nest parasitism along the Blue Ridge in the absence of disturbance (agriculture or road incursion) whereas the other two biogeographic regions showed 20–50% rates of nest parasitism

as background rates. Interactive models between spatial configuration metrics and region gained little support from nest predation analyses, but considerable support from the nest parasitism analyses, suggesting regional context plays a more important role in nest parasitism than in nest predation at these central Virginia sites. (ID 16133)

**Evans, B. S.**, University of North Carolina, Smithsonian Migratory Bird Center, USA, bsevens.unc@gmail.com  
 Ryder, T. B., Smithsonian Migratory Bird Center, rydert@si.edu  
 Reitsma, R., Smithsonian Migratory Bird Center, USA, reitsmar@si.edu  
 Hurlbert, A. H., University of North Carolina, USA, Hurlbert@bio.unc.edu  
 Marra, P. P., Smithsonian Migratory Bird Center, USA, marrap@si.edu

#### ANNUAL SURVIVAL OF LAND BIRDS ALONG A RURAL-TO-URBAN LAND USE GRADIENT USING CITIZEN AND SCIENTIST GENERATED DATA

Bird species that persist in urbanized areas are thought to have life histories strategies that allow them to be successful in human-dominated landscapes. Despite high abundances of some species in urban landscapes, little is known of the demographic consequences of urbanization on urban-adapted bird species. In this study, we investigated the effects of urbanization on the survival of seven species of birds common to urban environments in the Greater Washington D.C. metropolitan area. We used mark-recapture data collected during the breeding seasons of 2000-2012 to address how apparent survival and detectability varied with the proportion of impervious surface, a common proxy for characterizing urban land cover, surrounding a banding site. Six of our seven focal species exhibited differential survival about the rural-to-urban gradient. Two of our target species, American Robin and Song Sparrow, showed peak survival at intermediate levels of urbanization while Northern Cardinal and Gray Catbird exhibited higher survival rates with increasing urbanization. The remainder of our species showed no (Carolina Chickadee) or slightly negative response (Carolina Wren and House Wren) to urban land cover. Our results demonstrate variation in species vital rates in response to urban land use practices and highlight the need to address the mechanisms by which urbanization affects species persistence. (ID 16297)

**Evans, B. S.**, University of North Carolina, Smithsonian Migratory Bird Center, USA, bsevens.unc@gmail.com  
 Powell, L. L., Smithsonian Migratory Bird Center, USA, luke.l.powell@gmail.com

#### ASSESSING THE DISTRIBUTION OF WINTERING RUSTY BLACKBIRD POPULATIONS USING CITIZEN SCIENTIST GENERATED DATA

Once common, Rusty Blackbirds (RUBL) populations have experienced one of the steepest known declines of any North American bird (declining by 90% since 1960). Habitat loss, predominantly of forested wetlands, in RUBL's wintering range has been implicated as a key contributor to the decline, however our ability to assess the effects of this or other contributing factors is limited by uncertainties in the distribution of RUBL populations during the nonbreeding season. To address this, eBird and the RUBL Working Group established the Winter Hotspots Blitz, a citizen science project in which participants reported RUBL observations between Jan. and Feb. of 2009-2011. Using these data, in conjunction with 15 bioclimatic variables thought to predict RUBL habitat, we developed habitat suitability models to assess how RUBL distributions might vary by flock size and within environmental space. Average monthly precipitation and minimum temperatures were most predictive of RUBL presence across flock size classes (< 20, 20-99, and > 100 individuals). The proportional landscape composition of floodplain forests was positively associated with RUBL presence, as was row crop, pasture, and mixed forest habitat. Shrub, hardwood, and upland forests were negatively associated with RUBL presence. Flock size classes were found to occupy different portions of environmental niche space, with a differential response

to floodplain forest (increasing importance with flock size) being the primary contributor. Likewise, predicted suitable habitat area within our study region decreased with increasing flock size. This project will aid our understanding of how RUBL populations are distributed and help us isolate areas in which research and conservation efforts might be most effective. (ID 16344)

**Eyes, S. A.**, Humboldt State University, USA, Stephanie.Eyes@humboldt.edu  
 Roberts, S. L., United States Geological Survey, USA, sroberts.sierra@gmail.com  
 Johnson, M. D., Humboldt State University, USA, Matthew.Johnson@humboldt.edu

#### THE EFFECTS OF FIRE SEVERITY ON CALIFORNIA SPOTTED OWL HABITAT USE PATTERNS

Fire is a dynamic ecosystem process in mixed-conifer forests of the Sierra Nevada, however there is limited scientific information addressing wildlife habitat use in burned landscapes. Recent studies suggest stand-replacing wildfires may be a major source of habitat loss for spotted owls (*Strix occidentalis*). While fire promotes heterogeneous forest patches, high severity fire may create large canopy gaps that can fragment closed-canopy habitat preferred by spotted owls. Large areas of high severity fire may eliminate protective cover or perch sites for spotted owls, while unburned or low to moderate severity fire containing intact forest canopy may provide protective cover or high prey availability. I used radio telemetry to determine whether foraging California spotted owls in Yosemite National Park showed selection for particular types of fire severity. My results suggest that spotted owls exhibited habitat selection for lower fire severities, edge sites, and locations near the roost within their home range. Although owls selected high contrast edges with greater relative probabilities than low contrast edges, I did not detect a statistical difference in these edge types. Protecting the remaining forests from stand-replacing fires via mechanical thinning or prescribed fire is a priority for management agencies, and my results suggest that fires of low to moderate severity can create habitat conditions suitable for California spotted owls. (ID 15768)

**Fairhurst, G. D.**, University of Saskatchewan, Canada, graham.fairhurst@usask.ca  
 Berzins, L. L., University of Northern British Columbia, Canada, berzins@unbc.ca  
 Bradley, D. W., University of Guelph | Bird Studies Canada, Canada, bradleyd@uoguelph.ca  
 Romano, A., University of Milan, Italy, andreawromano@gmail.com  
 Romano, M., University of Milan, Italy, maria.romano@guest.unimi.it  
 Scandolaro, C., University of Milan | Swiss Ornithological Institute, Italy, chiara.scandolaro@gmail.com  
 Ambrosini, R., University of Milan, Italy, roberto.ambrosini@unimib.it  
 Dawson, R. D., University of Northern British Columbia, Canada, dawsonr@unbc.ca  
 Hobson, K. A., Environment Canada, Canada, Keith.hobson@ec.gc.ca  
 Liechti, F., Swiss Ornithological Institute, Switzerland, felix.liechti@vogelwarte.ch

#### FEATHER CORTICOSTERONE LEVELS ARE UNAFFECTED BY GEOLOCATORS IN TWO SPECIES OF MIGRATORY AERIAL INSECTIVORE

The use of light-sensitive geolocators to study avian migration ecology has increased in recent years because the devices now weigh less than 1 g and can be used on small-bodied passerines. Despite obvious benefits of using geolocators to track migration, concerns have been raised over apparent negative effects, including reduced survival, particularly in aerial insectivores. Geolocators may act as a handicap and instrumented birds would be expected to increase energetic exertion to compensate. Factors that negatively influence energetic balance during migration could reduce

survival, providing a physiological mechanism underlying reported effects of geolocators. We explored this idea using measures of the energy-regulating hormone corticosterone from feathers (CORT<sub>f</sub>) because physiological effects may be particularly evident during energetically demanding periods such as moult. We compared post-deployment levels of CORT<sub>f</sub> from birds returning with geolocators to CORT<sub>f</sub> levels of returning controls in three populations of Tree Swallows (*Tachycineta bicolor*) and eight populations of Barn Swallows (*Hirundo rustica*) over a three-year period. Preliminary analyses suggest that CORT<sub>f</sub> did not differ between instrumented and control birds in either species, and data from 30 Tree Swallows sampled before and after deployment indicate that geolocators did not increase CORT<sub>f</sub> within individuals. Thus, to the extent that CORT<sub>f</sub> reflects energy management, our results suggest that geolocators apparently did not act as a strong handicap for small aerial insectivores that returned post-deployment, though we cannot rule out effects of geolocators on behaviour and survival. (ID 16265)

**Falk, A. R.**, Biology Department, Southwestern Oklahoma State University, USA, amandarfalk@gmail.com  
 Burnham, D. A., University of Kansas, USA, dinosaur@ku.edu

#### NEW INSIGHTS ON THE LIFE HABITS OF *CONFUCIUSORNIS*

*Confuciusornis*, a basal, beaked bird from the Early Cretaceous of China, provides a unique glimpse into the biology of early birds. Although there are thousands of *Confuciusornis* specimens known, details of their morphology remain largely undocumented. This has led to polarized interpretations concerning *Confuciusornis* flight ability; previous studies either suggest the primary feather rachises were too weak and thin to support powered flight, or that the wings were long and narrow, as in modern fast-flying birds (e.g., swifts). *Confuciusornis* life habits have also been debated as either arboreal or terrestrial. Recent examination of *Confuciusornis* specimens confirm that the primary feather rachises are thick and robust, and shows the wing shape as much more rounded than previously described. New work using UV and laser fluorescence show *Confuciusornis* possessed a modern patagial system, consisting of both pro- and postpatagium. In modern birds, the propatagium between the shoulder and wrist provides lift and the postpatagium provides a broad area of insertion for the flight feathers to prevent twisting under the duress of flight. With the new wing profile reconstruction, this strongly suggests *Confuciusornis* was indeed capable of powered flight. Even more compelling is the discovery of new morphological features demonstrating *Confuciusornis* was clearly arboreal, in contrast to previous studies suggesting it occupied a terrestrial niche. In modern arboreal birds, the toes possess expanded phalangeal pads and reduced interphalangeal pads to facilitate grasping. Some arboreal birds (e.g., parrots) also have a foot morphology with reticulate scales and no scutate scales. *Confuciusornis* displays a foot morphology identical to that of modern arboreal birds. Fluorescence also reveals a diminutive *m. gastrocnemius* for *Confuciusornis*, another trait of arboreal birds. (ID 15976)

**Farley-Dawson, E. A.**, Texas Tech University, USA, elizabeth.farley-dawson@ttu.edu  
 Schmidt, K. A., Texas Tech University, USA, kenneth.schmidt@ttu.edu  
 USE OF A NOVEL NEST SUBSTRATE IN A NEOTROPICAL MIGRATORY BIRD, THE VEERY (*CATHARUS FUSCESCENS*)

Global weirding is the phenomena of an increase in aberrant weather events as an outcome of human-induced climate change. Currently, little is known on how and whether such events may influence wildlife populations. In 2011, an early, record-breaking snowstorm in the Hudson Valley (NY) downed thousands of oak (*Quercus* spp.) limbs at our study site. These fallen oak limbs (FOL) retained brown leaves through the following two summers, providing a novel nesting substrate, averaging 40.7 FOL/ha (range 3-126). Fifty-four and twenty-nine percent of Veery nest attempts were in FOL in



2012 and 2013, respectively, compared to <2% of nests from 1998-2011. In comparison, barberry (*Berberis thunbergii*) held 24% of nests annually from 1998-2013. Estimated proportion of successful nests did not differ between FOL and barberry (0.28 – 0.34). Plot occupancy by Veeries was not predicted by number of FOL per plot ( $r^2 = 0.07$ ,  $p = 0.37$ ), though plots with <10 FOL/plot were unoccupied. Nearest neighbor ratios indicated significant nest clustering in 2012 (0.39,  $z = -14.16$ ,  $p < 0.001$ ), more so than 2010 (0.51,  $z = -9.86$ ,  $p < 0.001$ ), 2011 (0.59,  $z = -7.72$ ,  $p < 0.001$ ), or 2013 (0.61,  $z = -7.17$ ,  $p < 0.001$ ). The coincidence of high nest clustering with availability and high use of FOL in 2012 suggests a possible connection. Veery females appear cryptic nesting in FOL, in contrast with common alternative substrates. This suggests Veery females may select nest substrates that increase their crypticity, thereby increasing the survival of themselves and nests, particularly when they perceive predation risk to be high. This is an avenue of research that we plan to experimentally test in the future. (ID 16256 | Poster 85)

**Farnsworth, A.**, Cornell Lab of Ornithology, USA, af27@cornell.edu  
 Van Doren, B. M., Cornell University, USA  
 Sheldon, D., University of Massachusetts, Amherst, USA  
 Geervarghese, J., University of Massachusetts, Amherst, USA  
 Winner, K., University of Massachusetts, Amherst, USA  
 Irvine, J., Oregon State University, Corvallis, USA  
 Fink, D., Cornell Lab of Ornithology, USA  
 La Sorte, F., Cornell Lab of Ornithology, USA  
 Dietterich, T. G., Oregon State University, Corvallis, USA  
 Kelling, S. T., Cornell Lab of Ornithology

#### STRATEGIES FOR MASS TRANSIT IN THE AEROSPHERE: RELATING PATTERNS OF AUTUMN NOCTURNAL MIGRATION FROM RADAR TO OBSERVATIONAL DATA IN THE NORTHEASTERN US<sup>1</sup>

Billions of birds migrate annually over North America. These massive movements are salient features of the atmosphere, dominating this dynamic habitat at certain times of year, primarily at night, with other biota such as bats and insects. Variation in these movements can exhibit drastic changes with atmospheric conditions and persistent patterns across more stable climatologies. We sought to investigate relationships between these movements, their variability, and strategies that nocturnal migrants have evolved for timing and positioning movements to reach diverse destinations. We characterized autumn nocturnal migration phenology in the Northeastern US in 2010 and 2011 using archived weather surveillance radar (WSR) and eBird observational data. We quantified density, direction, and speed of movements from nearly 40,000 hourly scans from 13 WSR stations and daily changes in the frequencies of occurrence for species from eBird data. Our results show that nocturnal migration is a saltatory process varying with date, time and location and that patterns of magnitudes, directions, and speeds of movements relate to changes in the atmosphere and in migrant species composition. We highlight examples: a shift in migrant headings in coastal Massachusetts from over-water flights in August and September to over-land flights in October and November; drastic differences in movement magnitudes between inland and coastal areas; more trans-Atlantic flights originating from Massachusetts in August and September than from Maine; and more over-water flights earlier in autumn in contrast to more coastal and trans-continental flights later in the season. Radar and observational data are complementary for describing the patterns of migrant traffic in the atmosphere, and the union of these descriptors shows great promise for examining how migration changes across years and for predicting how movements might change in a rapidly changing climate. (ID 16149)

**Farquhar, M. L.**, Trent University, Canada, melaniefarquhar@gmail.com  
 Nocera, J. J., Ontario Ministry of Natural Resources and Trent University, Canada, joe.nocera@ontario.ca  
 Morin, A. M., Atomic Energy of Canada Limited, Canada, morina@aecl.ca

#### HABITAT USE WITHIN AND AMONG ROOSTS OF CHIMNEY SWIFTS

Within the guild of aerial insectivores, the Chimney Swift has experienced the steepest population declines in recent decades. Among other factors, reduced availability of suitable roosting and nesting habitat (primarily masonry chimneys) may be contributing to population declines of Chimney Swifts. However, this remains conjectural as, despite the close association between Chimney Swifts and urban areas, their roosting ecology is poorly understood. We sought to determine whether patterns existed in how Chimney Swifts use roosts at a large landscape scale. Specifically, we test the hypothesis that roosting habitat will be more limited in northern locations, resulting in larger (and thus more ecologically sensitive) roosts. To do this, we analyzed roost count data collected from across Ontario and Quebec between 1997 and 2013 and compared these data to geographical position. We found that roost size increased with latitude (negative binomial regression;  $z = 6.38$ ,  $p < 0.001$ ,  $n = 203$ ) and that very large roosts (>1000 birds) only occurred at latitudes north of 45 degrees. As these patterns not only relate to habitat availability but also to ambient temperatures, we will discuss the role of temperature on the organization of Chimney Swifts inside a roost based on preliminary analysis of video footage from inside a roost in eastern Ontario. (ID 15935)

**Farr, C. M.**, Colorado State University, USA, cooper.farr@rams.colostate.edu  
 Pejchar, L., Colorado State University, USA, Liba.pejchar@colostate.edu  
 Reed, S. E., Wildlife Conservation Society, Colorado State University, USA, Sarah.Reed@colostate.edu

#### EFFECTS OF CONSERVATION DEVELOPMENT DESIGN AND STEWARDSHIP ON BIRD COMMUNITIES IN NORTHERN COLORADO

Conservation development (CD) is a private land conservation strategy designed to decrease negative environmental impacts of residential sprawl by clustering houses in a small portion of a property while preserving the remaining land as protected open space. Despite widespread use, it is unclear whether CD successfully preserves habitat for local bird communities. Using point count data and an occupancy modeling framework, we examined the relative effects of subdivision design and open space management on songbirds and raptors. CDs with a higher proportion of preserved area supported greater species richness; CDs with over 85 percent open space had 1.5 times the number of bird species compared with those with less than 75 percent open space. Factors such as vegetation structure and house density were influential in determining occupancy by certain human-sensitive species such as Horned Larks and Spotted Towhees. This research contributes to fundamental ecological knowledge on how birds react to human disturbances along the urban-rural gradient. Our results can inform the design and stewardship of human communities that also support healthy and diverse bird populations. (ID 15737)

#### **Feduccia, A.**, University of North Carolina, USA, feduccia@bio.unc.edu BIRD ORIGINS: PALEONTOLOGY'S TOPSY-TURVY PHYLOGENY<sup>1</sup>

Debate on the origin of birds and avian flight from within the archosaurian radiation is almost as old as the discovery of the Jurassic urvogel *Archaeopteryx* in the early 1860s. Although there is general agreement that birds are related to theropod dinosaurs at some level, debate centers on whether birds are derived directly from highly advanced theropods, the current orthodoxy, or from an earlier common ancestor lacking suites of derived anatomical characters. Recent discoveries from China have illuminated early birds and their history, but have led to much speculation. Here I attempt to identify some areas of potential paleontological missteps, on both bird and flight origins. Among the problematic areas are interpretations of the life of urvogels and basal birds, the origin of flight (ground up or trees down), the existence of protofeathers, and the assumption that earth-bound theropods evolved modern pennaceous remiges. Did flight remiges and the highly derived avian hand evolve their striking aerodynamic features in a non-flight context, as exaptations in earth-bound dinosaurs? Are

the four-winged gliders such as the Early Cretaceous microraptors, and the Jurassic Anchiornis, scansoriopterids, etc., true theropods or a separate clade, distinctive from the main lineage of Theropoda, a remnant of the early avian radiation, exhibiting all stages of flight and flightlessness? (ID 15789)

**Feldman, R. E.**, University of Massachusetts-Amherst, USA, richardf@eco.umass.edu

Miller-Rushing, A. J., Schoodic Education and Research Center and Acadia National Park, USA, abe\_miller-rushing@nps.gov

King, D. I., USDA Forest Service Northern Research Station, USA, daveking@eco.umass.edu

Griffin, C. R., University of Massachusetts-Amherst, USA, cgriffin@eco.umass.edu

#### THE SHAKE-UP OF THE SPECIES RANGE: TEMPERATURE CHANGE SHIFTS THE INTERNAL STRUCTURE OF AVIAN SPECIES RANGES

By quantifying temporal changes in the latitude of species range centroids and boundaries, a number of studies have demonstrated species moving north in response to climate change. However, quantifying the range with a single metric masks internal dynamics that arise from individual population responses to climate. For example, regions of high abundance may shift spatially over time even if the range's centroid or boundary is static. We studied this internal dynamism by using data from the North American Breeding Bird Survey to rank the populations of 110 species according to their abundance. We computed the ranks in 1983 and in 2012 and measured the latitudinal displacement for each rank. We predicted that latitudinal shifts in ranks would mirror latitudinal shifts in temperature. In order to evaluate the relationship, we constructed a null model whereby rankings in 1983 could move to any site in 2012. We found that observed shifts in the internal range structure of North American birds between 1983 and 2012 was not random: latitudinal shifts in rankings were positively associated with latitudinal shifts in temperature, a phenomenon we did not observe for randomly shuffled species ranges. We found the rank-temperature association was most apparent for sites 3° - 7° north of the species range center. Here, ranks moved less south than expected when temperature moved north and more south than expected when temperature moved south. Our study demonstrates a novel effect of climate change on species distributions: even if range boundaries are stable, the locations of the peaks and tails of abundance distributions shift in order to maintain an equilibrium with temperature change. Yet, such temperature tracking may be limited to a species' northern populations. (ID 16135)

**Feldman, R. E.**, University of Massachusetts, Amherst, USA, richardf@eco.umass.edu

King-Johnston, A., Schoodic Inst. at Acadia National Park, USA, ajohnston@schoodicinstitute.org

Powers, A., Schoodic Inst. at Acadia National Park, USA, apowers@schoodicinstitute.org

Webber, H., Schoodic Inst. at Acadia National Park, USA, hwebber@schoodicinstitute.org

Colangelo, J., Schoodic Inst. at Acadia National Park, USA, jcolangelo@schoodicinstitute.org

Benz, S., Schoodic Inst. at Acadia National Park, USA, sbenz@schoodicinstitute.org

Miller-Rushing, A. J., Schoodic Inst. at Acadia National Park, USA, abe\_miller-rushing@nps.gov

#### ARE PHENOLOGICAL MISMATCHES DEVELOPING DURING FALL MIGRATION AT ACADIA NATIONAL PARK, MAINE?

Recent evidence suggests that climate change affects local species abundances by disrupting long-held species interactions. In particular, warming temperatures have advanced the timing of food and animal production but to different degrees resulting in phenological mismatches. For birds, the best evidence for mismatches occurs during spring migration and

the breeding season when insects are the main food source. It is not known whether phenological mismatches are also occurring during fall migration when fruit is a key resource. The coastal forests in Maine's Acadia National Park is a critical stop-over habitat for fall migrating birds. The park has an abundance of fruit including blueberry, huckleberry, mountain ash, and mountain holly. Yet, it is unknown whether most of the fruit is consumed prior to the arrival of fall migrants, consumed by fall migrants, or goes unconsumed. Moreover, it is not known whether climate change is affecting bird-fruit interactions. On the Schoodic Peninsula of Acadia National Park, we are initiating a long-term study measuring how fruiting phenology is timed with fall migration and describing the web of interactions among major fruiting species and their bird consumers. We are also developing a program to involve citizen scientists in monitoring biodiversity changes in the park. To this end, we have implemented a study evaluating the precision by which citizen scientists can monitor fruit and bird phenology. (ID 16408 | Poster 48)

**Fike, J. A.**, USGS, USA, fikej@usgs.gov

Tomback, D. F., University of Colorado at Denver, USA, Diana.Tomback@ucdenver.edu

Wunder, M. B., University of Colorado at Denver, USA, Michael.Wunder@ucdenver.edu

Siepielski, A. M., University of San Diego, USA, adamsiepielski@sandiego.edu

Schaming, T. D., Cornell University, USA, tazaschaming@gmail.com

Oyler-McCance, S. J., USGS, USA, sara\_oyler-mccance@usgs.gov

#### EXAMINING GENETIC STRUCTURE ACROSS THE RANGE OF CLARK'S NUTCRACKER

Clark's nutcrackers (*Nucifraga columbiana*) are foraging specialists, depending on conifer seeds from whitebark and limber pine. Both pines are affected by unprecedented outbreaks of mountain pine beetle, white pine blister rust, and fire-suppression. Nutcracker numbers and movements are sensitive to loss of pine forests occurring throughout western North America. Thus, understanding the spatio-temporal dynamics of nutcracker populations is essential for conservation of both pine communities. Nutcracker gene flow has been examined by one study, yet further information could provide a baseline for detecting future changes in nutcracker movements and distribution resulting from declines in whitebark pine ecosystems. To investigate the genetic structure of nutcracker populations, we sequenced portions of the mitochondrial control region and cytochrome b gene for 122 samples from across the species' range, and genotyped those samples over 10 polymorphic microsatellite loci. We found a star-like phylogeny among the 19 control region haplotypes, indicating population expansion from a single refugium after the last glacial maximum. We also found little genetic structure across the species range (STRUCTURE results  $K = 1$ ), suggesting that gene flow among populations throughout the range is high. Our results are consistent with reports of episodic mass emigrations of nutcrackers in response to cone crop failures, as well as long-range movements of some individuals from local populations. Restoration projects to restore whitebark pine communities in several regions are underway; these findings suggest that nutcrackers may repopulate these regions as forests mature. (ID 16057 | Poster 36)

Fischelli, N. A., National Park Service, USA, Nicholas\_Fischelli@nps.gov

**Monahan, W. B.**, National Park Service, USA, Bill\_Monahan@nps.gov

Peters, M. P., USDA Forest Service, USA, MatthewPeters@fs.fed.us

Matthews, S. N., The Ohio State University, USA, matthews.204@osu.edu

#### FORECASTING BREEDING BIRD HABITAT SUITABILITY FOR THE ACADIA NATIONAL PARK REGION: IMPLICATIONS FOR MONITORING, MANAGEMENT, AND EDUCATION

Climate change poses distinct challenges to the stewardship of bird populations inside national parks and other protected areas. Understanding projected

rates and directions of change may help direct monitoring, management, and visitor education. To support such efforts for Acadia National Park, we analyzed projected changes in habitat suitability for 130 breeding bird species for three future periods (2040, 2070, and 2100). We present model output under 'least change' and 'most change' scenarios that represent plausible lower and upper bounds of future climatic conditions. General trends indicate strongly decreasing habitat suitability for 25 species (19%), minor change for 57 species (44%), and large increases or new habitat for 48 species (37%). Projected changes in habitat suitability varied by habitat preference and migratory status. For example, extant Neotropical migrants, such as Magnolia and Black-throated Green warblers, generally show decreases in potential habitat, while others that are presently rare or absent gain substantial potential habitat in the future. Even under the 'least change' scenario, several species previously absent or rare in the Acadia region (e.g., Summer Tanager, Worm-eating Warbler, Hooded Warbler) are likely to have habitat gains by the end of the 21st century. Many resident birds (e.g., Northern Cardinal, White-breasted Nuthatch) maintain or have increases in potential habitat over the next several decades. We discuss how results may be used to inform monitoring and management of bird populations and breeding habitat, as well as educate park visitors on the possible effects of climate change. (ID 15765)

**Fletcher, R. J.**, University of Florida, USA, robert.fletcher@ufl.edu  
Robertson, E. P., University of Florida, USA, robertsonep@gmail.com  
Kitchens, W. M., Florida Cooperative Fish and Wildlife Research Unit, USA

#### THERE'S NO PLACE LIKE HOME: NATAL HABITAT EFFECTS ON DISPERSAL, NEST-SITE SELECTION, AND POPULATION STRUCTURE IN AN ENDANGERED BIRD

Understanding habitat selection and dispersal behaviors is central to many problems in ecology, evolution, and conservation. One often hypothesized factor thought to influence habitat selection in animals is the natal environment experienced by juveniles. Nonetheless, empirical evidence for the effect of natal environment in wild birds remains limited and is often difficult to disentangle from natal philopatry. Using 18 years of nesting and mark-resight data across an entire geographic range of an endangered bird, the Snail Kite (*Rothamus sociabilis plumbeus*), we tested for natal effects on dispersal and nest-site selection at multiple spatial scales. Despite the fact that this species is thought to be relatively nomadic and moves great distances throughout its geographic range, kites exhibited a strong degree of natal site philopatry (43%) and dispersed greater distances when born in palustrine wetlands than in lacustrine wetlands. Furthermore, independent of dispersal distance effects, kites were more likely to nest as adults in their natal habitat type (lacustrine versus palustrine wetlands). Importantly, kites breeding in natal habitats had lower nest success (36%) than kites that did not (54%), highlighting that this natal habitat preference may be maladaptive. Substrate of the natal nest did not influence nesting substrates chosen later in life. These results provide a mechanism for recently described spatial structure in movements across the geographic range of this species and suggest that assortative breeding may occur in this population, potentially impacting gene flow and creating maladaptive breeding behaviors in a wide-ranging, endangered bird. (ID 15936)

**Folkerts, M. M.**, Louisiana State University in Shreveport, USA, folkertsm19@lsus.edu  
Ingold, J. L., Louisiana State University in Shreveport, USA, James.Ingold@lsus.edu  
Johnson, E. I., Audubon Louisiana, National Audubon Society, USA, ejohnson@audubon.org  
Westphal, K. A., Audubon Louisiana, National Audubon Society, USA, kwestphal@audubon.org  
Vincent, T. J., Audubon Louisiana, National Audubon Society, USA, tvincent@audubon.org

#### VARIATION IN GREEN HERON NESTING SUCCESS IN COASTAL LOUISIANA MARSHES

The Green Heron (*Butorides virescens*) is an under-studied wading bird with a flexible nesting strategy, nesting colonially, solitarily, or in loose aggregations. We initiated a Green Heron project in summer 2013 at Audubon's Paul J. Rainey Wildlife Sanctuary (Vermilion Parish, Louisiana) to determine factors that drive nesting flexibility and influence nest success. We located 244 nests, banded 142 nestlings from 71 nests and estimated nest success to be 51.1% from 184 nests. Of the 244 nests, 44 occurred in trees with multiple nests, while the remaining were solitary. Nest success in multi-nest trees was 48.6% (n=35), whereas nest success in solitary trees was 51.7% (n=149), suggesting sociality may not be the most important factor in predicting nest success. However, nest tree size was found to significantly differ ( $t(42) = -5.593$ ,  $p < 0.001$ ) between solitary nests and those in same-tree aggregations, suggesting the availability of large nest trees may influence nesting flexibility. Nests were found in eight tree and shrub species, with the highest success of 85.7% in *Baccharis halimifolia* (n=7) and the greatest number (n=95) in *Acacia farnesiana*, with 48.9% success (n=88). Variation in nest success may also be associated with access to foraging sites and water-level stability, which we will continue to examine in 2014. As study continues in 2014, nest success appears to be lower than in 2013, suggesting that annually variable environmental factors may influence nest success and may have contributed to the evolution of flexible nesting behavior in this species. (ID 16283)

**Fomina, C.**, Rockford University, USA, cf132840@rockford.edu  
Marshall, J. S., Rockford University, USA, jmarshall@rockford.edu

#### ROLES OF MIGRANT AND RESIDENT BIRDS IN THE SPREAD OF INVASIVE HONEYSUCKLE

Bush honeysuckles (genus *Lonicera*) are common invasive species in forests of the Eastern US. Despite being bird-dispersed, they do not provide a particularly high nutrient value. Berries emerge in the early fall when both resident and migrant birds could disperse seeds. Residents have much less urgent energy needs and more information about suitable food resources than do migrants, who need quick refueling in unfamiliar settings. If birds are making optimal foraging choices, then we predict that migrants will be more likely than residents to choose the less nutritious honeysuckle. We mist-netted birds in two north-central Illinois sites in the fall of 2013 and collected fecal samples to look for honeysuckle seeds. Migrants had honeysuckle seeds (13%) more often than residents (1%;  $p = 0.0013$ ). The results support our prediction that migrants would be more involved in the spread of honeysuckle. We suggest managers remove honeysuckle before the fall migration if trying to prevent the spread of the invasive. (ID 16046 | Poster 53)

**Forrester, T. R.**, Simon Fraser University, Canada, timothyf@sfu.ca  
Green, D. J., Simon Fraser University, Canada, djgreen@sfu.ca  
Bishop, C. A., Environment Canada, Canada, cab.bishop@ec.gc.ca

#### TEMPORAL VARIATION IN THE DEMOGRAPHY AND TERRITORY QUALITY OF RIPARIAN SONGBIRDS IN THE OKANAGAN VALLEY

Habitat loss and fragmentation has been argued to be a major driver of population declines of riparian dependent songbird species in the Okanagan Valley, which boasts the most diverse breeding bird community in Canada. We assessed trends in the diversity, abundance, and productivity of riparian species in reference sites and restoration sites (that had been degraded and subsequently received restoration activities) over 12 years. All sites saw an increase in overall abundance but no changes in diversity. Yellow Warbler (YEW) increased in abundance and Yellow-breasted Chat (YBCH) experienced higher parasitism rates in all sites. In restoration sites, YBCH increased in abundance. In reference sites, Brown-headed



Cowbirds decreased in abundance and Gray Catbirds increased nest success. Song Sparrows (SOSP) in restoration sites had lower productivity. YEWA experienced lower parasitism in reference sites. In all sites, parasitized SOSP and Willow Flycatcher (WIFL) nests had lower nest success and productivity than non-parasitized nests. Local scale vegetation variables did not affect nest success of YBCH but did have an effect on productivity and parasitism rates. We conclude that the dominant riparian songbird species in the Okanagan increased in abundance but overall community diversity did not change. We cannot conclude that habitat restoration has increased the abundance or diversity of the songbird community, but it has within ten years been beneficial to individual species such as YBCH. However, productivity and parasitism rates of SOSP and WIFL indicate more local habitat improvement is necessary for these species. (ID 15831)

**Francis, C. D.**, California Polytechnic State University, USA, cdfranci@calpoly.edu

#### BEYOND THE HABITAT EDGE: LARGE-SCALE UNCONVENTIONAL GAS EXTRACTION IMPACTS ON BIRD COMMUNITIES VIA SENSORY POLLUTION

Hydraulic fracturing or "fracking" has recently entered the popular lexicon and is closely associated with concerns about water quality, greenhouse gas emissions and even earthquakes. Less recognized is the fact that fracking has paved the way for a massive geographical expansion of gas exploration, drilling and production, bringing surface impacts to wildlife and ecosystems in areas that would have remained undeveloped using conventional technologies. Accompanying the habitat loss and fragmentation that comes with the expanding energy sector is industrial noise, a sensory pollutant that has received relatively little attention until recently. Relative to typical edge effects, which can extend up to 100-200 m, noise from drilling operations, trucks and gas compressor stations can alter the acoustic environment as far as 1km from the source. Long-term research in the gas fields of NW New Mexico suggests that these changes to the acoustic environment can reduce avian diversity, change patterns of nest success and disrupt critical ecological services provided by birds. In this talk I will provide an overview of these changes, point to some of the mechanisms at work and identify several critical gaps in our understanding of how this pollutant affects birds. (ID 16033)

**Franklin, A. B.**, USDA-APHIS-WS National Wildlife Research Center, USA, alan.b.franklin@aphis.usda.gov

Huyvaert, K. P., Colorado State University, USA, Kate.Huyvaert@ColoState.edu

Root, J. J., USDA-APHIS-WS National Wildlife Research Center, USA, jeff.root@aphis.usda.gov

Shriner, S. A., USDA-APHIS-WS National Wildlife Research Center, susan.a.shriner@aphis.usda.gov

#### OPENING REMARKS: ECOLOGICAL PRINCIPLES OF EMERGING INFECTIOUS DISEASES IN BIRDS SYMPOSIUM

Emerging infectious diseases are increasingly becoming a global problem in wildlife conservation. Understanding the ecological principles driving emergence is paramount for developing effective conservation strategies. In this symposium, speakers will provide overviews of general principles of avian ecology on disease emergence, anthropogenic factors affecting emergence, and ecoimmunology, as well as case studies applying these principles to emerging pathogens, such as hematozoa in island systems, *Mycoplasma gallisepticum*, avian influenza virus, and West Nile virus. This talk will introduce the symposium and provide an overview of the conceptual flow for the overall structure of the symposium. (ID 16138)

**Frantz, M. W.**, West Virginia University/WV Cooperative Fish and Wildlife Research Unit, USA, mwfrantz@mix.wvu.edu

Wood, P. B., U.S. Geological Survey/WV Cooperative Fish and Wildlife Research Unit/West Virginia University, USA, pbwood@wvu.edu

Sheehan, J., West Virginia University/WV Cooperative Fish and Wildlife Research Unit, USA, jsheeha3@mix.wvu.edu

George, G., West Virginia University/WV Cooperative Fish and Wildlife Research Unit, USA, gregory.george@delval.edu

#### RESPONSE OF LOUISIANA WATERTHRUSH TO SHALE GAS DEVELOPMENT

We examined effects of shale gas well and infrastructure development on Louisiana Waterthrush (*Parkesia motacilla*) at Lewis Wetzel Wildlife Management Area (WMA), WV. During 2009-2013, we quantified waterthrush nesting survival, territory density, and return rates on 57.9 km of headwater streams (n=12). We assessed vegetation immediately surrounding nests, and quantified a waterthrush Habitat Suitability Index (HSI) and the EPA Rapid Bioassessment protocol for instream characteristics important to aquatic macroinvertebrate prey. During 2013, we quantified epigenetic (DNA methylation) differentiation of adults and nestlings in impacted versus unimpacted streams as an evolutionary adaptive response to a rapidly changing and potentially stressful environment. Early in the study (2009-2011) when little shale gas activity had occurred, we observed high annual return rates (57% in 2010, 61% in 2011) of 73 banded adults, territory density had minimal correlation with percent of stream impacted (2009:  $r^2 = 0.03$ ; 2010:  $r^2 = 0.24$ ; 2011  $r^2 = 0.04$ ), and nest survival within territories classed as impacted by shale gas development (43.2%; n=39) was similar to unimpacted territories (46.7%; n=84). However, the HSI and EPA indices were lower for nests in shale gas impacted territories suggesting that habitat quality had declined. Data from 2013 are currently being analyzed, and will be included in the presentation. Preliminary epigenetic lab results indicate that there is DNA methylation variation between individuals. One additional result of note was the parasitism of waterthrush nests in 2013 by Brown-headed Cowbirds (*Molothrus ater*); no parasitism occurred before 2013. (ID 15958)

**Freeman, B. G.**, Cornell University, USA, benjamin.g.freeman@gmail.com

Class Freeman, A. M., Cornell Lab of Ornithology, USA, amc359@cornell.edu

#### NEW GUINEAN MONTANE BIRDS ARE RESPONDING TO GLOBAL WARMING BY RAPIDLY SHIFTING THEIR DISTRIBUTIONS UPSLOPE

Temperate zone species have responded to warming temperatures by shifting their distributions poleward and upslope. Thermal tolerance data suggests that tropical species should respond to warming temperatures even more strongly than temperate zone species, but this prediction has yet to be tested. We addressed this data gap by conducting resurveys to measure distributional responses to temperature increases in the elevational limits of the avifaunas of two geographically and faunally independent New Guinean mountains, Mt. Karimui and Karkar Island, 47 and 44 years after originally surveyed by Jared Diamond. Though species richness is roughly five times greater on mainland Mt. Karimui than oceanic Karkar Island, upslope distributional shifts at both sites were similarly strong, with some variation potentially explained by competitive ability. We incorporated these results into a meta-analysis to compare distributional responses of tropical species to those of temperate zone species, tentatively finding that average upslope shifts in tropical montane species match temperature increases significantly more closely than in temperate zone species. This tropical sensitivity has global conservation implications and supports hitherto untested models that predict widespread extinctions in upper-elevation tropical endemics with small ranges. (ID 15731)

**Freeman, F.**, Villanova University, USA, kfreema6@villanova.edu  
 IMPACTS OF COOPERATIVE GROUP PERSONALITY ON THE  
 REPRODUCTIVE SUCCESS OF THE ENDANGERED WHITE-BREASTED  
 THRASHER

In the burgeoning field of animal personality, recent research highlights the importance of studying personality in a social context. Cooperatively breeding bird species present an ideal opportunity to study the relationship between personality and social behavior. The White-breasted Thrasher (*Ramphocinclus brachyurus*; WBTH) is an endangered songbird endemic to the West Indies. In this cooperative breeder, social groups have one breeding pair with 1-3 helpers; however, specific roles and impacts of helpers are poorly understood. I used behavioral assays to investigate the role of individual and breeding group personality in the context of nest defense. I conducted fieldwork in the dry coastal forest of St. Lucia to determine whether cooperative groups show consistent individual personality differences, and to infer whether helpers boost reproductive success by deterring predators. I monitored WBTH nests May-August 2013 and 2014, using predator stimuli experiments to test the hypothesis that groups with helpers exhibit a stronger nest defense response. I presented breeding groups with stimulus models during the incubation and nestling stage, recording the vocal and spatial responses of color banded adult birds to measure strength of individual and group response to threat. I used GLMMs to quantify personality differences, and found WBTH groups with helpers exhibited stronger vocal and spatial response. There were consistent differences between individual, as well as group responses, indicating boldness in nest-defense may represent a component of thrasher personality. Correlations between group personality and nesting-success remain under investigation and may have conservation implications for this species. (ID 16382)

**Frei, B.**, University of Ottawa & McGill University, Canada, barbara.frei@mail.mcgill.ca  
 Fyles, J. W., McGill University, Canada, jim.fyles@mcgill.ca  
 Cardille, J. A., McGill University, Canada, jeffrey.cardille@mcgill.ca  
 Nocera, J. J., Trent University, Canada, joe.nocera@utoronto.ca  
 MISSING THE SMALL PICTURE: MAPPING GEOGRAPHIC-DEPENDENCY  
 IN THE RELATIONSHIP BETWEEN A THREATENED WOODPECKER  
 AND ITS COMPETITOR

The ongoing population declines of Red-headed Woodpeckers (*Melanerpes erythrocephalus*), a threatened species in Canada in several states in the U.S., are poorly understood. Our research at the northern edge of the species' range revealed that the abundance of the non-native, interference competitor European Starling (*Sturnus vulgaris*) at Red-headed Woodpecker nest sites is the dominant factor driving lower nest survival for the species. Our findings contradict those from previous studies, suggesting that interference competition between the two species may be spatially and/or temporally variable. We hypothesize that such a spatially variable relationship would be ill suited for the typical global comparisons used for ecological data, for although these models are useful for their predictive abilities, their findings may be inaccurate when applied to spatially variable data. Instead, we explore the use of a spatially explicit technique, geographically weighted regression, capable of interpreting the non-stationarity often found in ecological relationships. Using Breeding Bird Survey data from 1966-2011, divided into four time periods, we demonstrate high spatial autocorrelation, non-stationarity, and low model fit for comparisons of Red-headed Woodpecker vs. European Starling abundances in global models. Using geographically weighted regression, we exponentially increase model fit and demonstrate heterogeneity across time and space in the relationships between the two species, providing insight into the population dynamics of these important organisms whose life histories are often interconnected. We suggest that the mapping of the model interaction in geographically weighed regression may

be a useful tool to illustrate research potential and customize management goals across a species' range. (ID 15895)

**Friedman, N. R.**, Palacký University, Czech Republic, nicholas.friedman@upol.cz  
 Remeš, V., Palacký University, Czech Republic, vladimir.remes@upol.cz  
 GLOBAL GEOGRAPHIC PATTERNS OF SEXUAL SIZE DIMORPHISM IN  
 BIRDS: SUPPORT FOR A LATITUDINAL TREND?

Sexual size dimorphism (SSD) is widespread among birds, and is a common indication of differential selection among males and females. Sexual selection theory predicts that SSD should increase as one sex competes more fiercely for access to mates, but it is unclear what effect spatial variation in ecology may have on this behavioral process. To address this, we mapped the global distribution of SSD from published descriptions of body size across 2581 species of birds. We examined correlations between SSD and nine predictor variables representing physical geography, climate, and climate variability. Our results show guarded support for a latitudinal trend in SSD, with a strong prevalence of species with low or female-biased SSD in the far North. However, this relationship and several others lacked support from phylogenetically corrected analyses, and were not supported consistently among zoogeographical regions. These results broadly agree with studies of SSD in other groups, and suggest that SSD is linked to behavioral dynamics that may be largely independent of environmental conditions. (ID 15999)

**Fristoe, T. S.**, University of New Mexico, USA, tfristoe@unm.edu  
 Murthy, A., University of New Mexico, USA, amurthy@unm.edu  
 Burger, J. R., University of New Mexico, USA, jrburger@unm.edu  
 THE HOMOGENIZING EFFECT OF URBAN LAND COVER ON NORTH  
 AMERICAN WINTER BIRD DIVERSITY

Urbanization is widespread throughout the United States and Canada. Studies at different scales have shown mixed consequences of urban areas for ecological communities and biodiversity. Here, we used geographic data on urban extent and Christmas Bird Count surveys to investigate the influence of urbanization on winter bird diversity over a continental scale. We compared 42 urban bird communities with nearby wild sites across North America. Alpha diversity (species richness) was statistically indistinguishable between urban and wild sites when controlling for latitude. Community similarity decreased more rapidly over distance in wild compared to urban sites. This shows that spatial homogenizing due to urbanization results in lower beta diversity. Rank-frequency of occurrence plots reveal that eighteen exotic or native generalists occur across all urban sites, whereas no species occur in all wild sites. This is likely due to the similarity in habitats across cities compared to nearby wild lands. Mean-variance scaling shows urban bird populations are less variable (more stable) across space compared to wild sites. This is possibly due to urban resource subsidies. Both of these interacting processes contribute to the widespread homogenizing effect of urban landscapes on winter bird communities. (ID 15888)

**Fuhlendorf, S. D.**, Oklahoma State University, USA, sam.fuhlendorf@okstate.edu  
 Engle, D. M., Oklahoma State University, USA, david.Engle@okstate.edu  
 Elmore, R. D., Oklahoma State University, USA, dwayne.elmore@okstate.edu  
 Davis, C. A., Oklahoma State University, USA, craig.davis@okstate.edu  
 Hovick, T. J., Oklahoma State University, USA, torre.hovick@okstate.edu  
 Allred, B. W., University of Montana, USA, allredbw@gmail.com  
 Hamilton, R., The Nature Conservancy, USA, bhamilton@TNC.ORG  
 PYRIC HERBIVORY: INTERACTIVE DISTURBANCE PROCESSES THAT  
 SHAPE GRASSLAND ECOSYSTEMS<sup>†</sup>

It is well recognized that fire and grazing are important for conservation and restoration of many ecosystems. Unfortunately, most studies of these

processes are based on small-scale experimental studies and focus on main effects of each disturbance independent of the other. Any discussion of an interaction between fire and grazing is usually based on a statistical interaction from a traditional factorial design that ignores the spatial and temporal interaction that occurs on complex landscapes. We propose a new focus on the ecological interaction of fire and grazing where each disturbance is dependent upon the other resulting in a shifting mosaic that is critical to ecological structure and function of many ecosystems. We have termed this spatio-temporal interaction pyric-herbivory (literal interpretation means grazing driven by fire). We present data from the southern Great Plains demonstrating the interaction between free-roaming bison and random fires that promote heterogeneity and becomes the foundation for biological diversity and ecosystem function of North American grasslands. Pyric-herbivory with any grazing herbivore is likely more effective at restoring evolutionary disturbance patterns than a focus on restoring any large vertebrate while ignoring the interaction with fire and other disturbances. (ID 15925)

**Garcia, V.**, Virginia Tech University, Blacksburg, VA, USA, [vgarcia@vt.edu](mailto:vgarcia@vt.edu)  
Walters, J. R., Virginia Tech University, Blacksburg, VA, USA

#### ASSOCIATION BETWEEN CLIMATE AND CHANGING LIFE HISTORY TRAITS IN RED-COCKADED WOODPECKERS

As with other species, Red-cockaded Woodpeckers (*Picoides borealis*) show a pattern of earlier laying in recent decades, possibly in response to climate change (Schiegg et al. 2002). We wanted to determine whether this trend is continuing, and to also examine whether other traits are changing in response to climate change. We used long-term data (1980-2012) to examine whether laying date, variance in laying date, clutch size, partial brood loss, hatching asynchrony, and number of fledglings produced each year were associated with changes in temperature and rainfall at two study sites in North Carolina. The local climate variables used were the annual means of the monthly averages from Dec-Mar for temperature, rainfall, departure from normal temperature, and departure from normal rainfall. We found that although traits show clear linear patterns of changing in ways predicted by climate change (e.g., earlier laying, larger clutches), most traits were not associated with the local climate variables we measured. This was largely because although temperature and rainfall both increased from 1980-1998, these patterns do not continue in the latter part of the study. These results highlight the difficulty of finding the climate variables that appropriately describe how climate change is affecting local conditions. (ID 16394 | Poster 18)

**Gardali, T.**, Point Blue Conservation Science, USA, [tgardali@pointblue.org](mailto:tgardali@pointblue.org)  
Gilbert, M. M., Point Blue Conservation Science, USA, [mgilbert@pointblue.org](mailto:mgilbert@pointblue.org)  
Seavy, N. E., Point Blue Conservation Science, USA, [nseavy@pointblue.org](mailto:nseavy@pointblue.org)  
LARGE-SCALE, LONG-TERM BIRD RESPONSE TO RIVER RESTORATION IN CALIFORNIA'S GREAT CENTRAL VALLEY

In ecosystems that have been severely degraded, ecological restoration is needed to create the conditions where the environment can support multiple ecosystem services. The science and practice of restoration however remains relatively young and even information on restoration performance is lacking. The Sacramento and San Joaquin rivers in California have been highly altered and only about 5% of the historic extent of riparian forest remains. Many riparian restoration projects on these rivers are now over 20 years old and are of a relatively large-scale. One objective of the large-scale, long-term restoration projects on these rivers is to increase the abundance and diversity of resident and migratory landbirds. We used distance-based point count surveys from the Central Valley Floodplain Forest Bird Survey to examine whether landbirds were responding to the riparian revegetation projects. We compared survey points from revegetated, extant, and a random sample to

evaluate bird response. We found that a diverse community of landbirds was responding positively to the restoration work on both rivers. For the majority of species we examined, density increased as the restoration project aged. In many cases, densities on the restoration plots were approaching those on the remnant ones and in some cases were even higher on the restored plots. We also discovered increasing trends in density on the remnant plots suggesting that restoration may be having a positive net increase for landbirds throughout the region. Large-scale restoration on California's two largest rivers is benefiting a diverse landbird community. (ID 16257)

**Garfinkel, M.**, Humboldt State University, USA, [MBGarfinkel@gmail.com](mailto:MBGarfinkel@gmail.com)  
Johnson, M., Humboldt State University, USA, [matthew.johnson@humboldt.edu](mailto:matthew.johnson@humboldt.edu)

#### PEST-REMOVAL SERVICES PROVIDED BY SONGBIRDS ON SMALL ORGANIC ROW CROP FARMS IN HUMBOLDT COUNTY, CA

Many studies have established that birds may provide a pest removal service on farms, although few studies have taken place on row crop farms. Wildlife-friendly agricultural practices such as organic farming and the use of hedgerows can in turn provide needed habitat for birds in developed landscapes. I used sentinel pest experiments, which simulate pest outbreaks, on 29 small organic row crop farms to determine how probability of pest removal varies with microhabitat characteristics within the farm, and with bird population parameters between farms. I used enclosure experiments to determine whether birds provide a significant pest removal service in organic row-crop agriculture. In the sentinel pest experiments, 0 - 80% of caterpillar presentation stations were depredated by birds within seven hours, with a mean of 24% depredation per farm; the probability of pest removal was higher in areas close to uncultivated shrub habitat ("hedgerows"). There was only weak evidence that the probability of pest removal was higher on farms with higher avian insectivore richness, and no evidence that pest removal varied with species diversity or abundance. Enclosure experiments on kale crops showed no significant effects of bird enclosure treatment on arthropod abundance or crop yield. However, caterpillar densities were relatively low (approximately one caterpillar per m<sup>2</sup>) during the enclosure experiment. These results suggest that birds may be more helpful in responding to changes in pest density than in controlling pests at non-irruptive densities on organic row crop farms in this study system. The prevention of pest outbreaks is an essential ecosystem service on any farm, and the rapid response of birds to pest outbreak conditions is an indicator of resiliency in the agroecosystem. Therefore, the retention of uncultivated shrub habitat in agricultural landscapes could benefit both birds and farmers. (ID 15851)

**Gastezzi-Arias, P.**, Universidad Estatal a Distancia (UNED), Costa Rica, [pgastezzi@gmail.com](mailto:pgastezzi@gmail.com)  
Vargas-Masis, R., Universidad Estatal a Distancia (UNED), Costa Rica, [ornatehawkeagle@gmail.com](mailto:ornatehawkeagle@gmail.com)  
Di Mare-Hering, M., Universidad Estatal a Distancia (UNED), Costa Rica, [tati@di-mare.com](mailto:tati@di-mare.com)  
Martínez, D., Unión de Ornitólogos de Costa Rica, [jacamerops@yahoo.com](mailto:jacamerops@yahoo.com)  
Maglianesi-Sandoz, M., Universidad Estatal a Distancia (UNED), [mmaglianesi@uned.ac.cr](mailto:mmaglianesi@uned.ac.cr)

#### COMPARISON OF BIRDS' REPRODUCTIVE EVENTS IN CONVENTIONAL AND ORGANIC PINEAPPLE CROPS IN SAN CARLOS, COSTA RICA (2012-2013)

Pineapple production is currently one of the major income activities in Costa Rica, where rich biodiversity lands occur together with croplands. Analysis of conventional and organic practices may provide tools to achieve sustainable development where conservation and development are optimized. In 2012 and 2013 we visited 7 sites that consisted of forest patches besides pineapple crops that were grown either under organic or conventional practices (3



conventional and 4 organic sites) and counted bird nests along transects during the birds' reproductive season twice a month. For each site, one transect was in the forest patch and the other was an external belt that bordered the patch. We registered general climatic measures for each site (humidity, temperature and wind speed). For each nest, we registered bird taxon when possible, whether the nest was active or not, birds' reproductive activities and geographical position. We compared nest occurrence through a Generalized Lineal Model R-analysis in organic versus conventional crop sites. There was no difference among sites in relation to climatic variables. We registered 123 nests during the study period: 26 in 2012 (6 in conventional and 20 inorganic sites), and 64 in 2013 (33 in conventional and 64 in organic sites). There was a higher number of avian nests in organic than in conventional pineapple crop sites (AIC: 181.92; df: 34;  $p=0.026$ ). More nests occurred in the forest patches (92 nests) compared to the external border (33 nests) and the pineapple crops (3 nests). Forest patches in croplands possibly play an important role in biodiversity conservation, particularly in tropical environments. (ID 16300)

**Geary, B.**, Tulane University, USA, bgeary@tulane.edu  
 Walter, S. T., Tulane University, USA, scott.t.walter@gmail.com  
 Leberg, P. L., University of Louisiana at Lafayette, USA, leberg@louisiana.edu  
 Karubian, J., Tulane University, USA, jk@tulane.edu

#### USE OF GPS TELEMETRY TO RELATE BROWN PELICAN FORAGING AND BREEDING ECOLOGY IN THE GULF OF MEXICO

The productivity of breeding bird populations is determined by a suite of factors, from characteristics of individuals to ecosystem-level processes. As the complexities of these types of relationships become increasingly appreciated, concurrent technological advances have enabled ecologists to acquire vast quantities of data on study animals as well as the environments that they inhabit. The field of telemetry has shown particular growth, allowing for greater understanding of the behaviors of highly mobile species such as seabirds. We used GPS transmitters to monitor the foraging ecology of brown pelicans (*Pelecanus occidentalis*), an iconic top predator in the northern Gulf of Mexico whose behavior is relevant to a variety of important conservation issues in the region. Our study took place during two breeding seasons, the summers of 2012 and 2014. In addition to observing the spatial distribution of birds, accelerometer data (both years) and activity loggers (in 2014) allow for the identification of dive events, resulting in accurate measures of individual foraging efficiency. These measures, along with subsequent nesting success, were then examined in relation to bird characteristics (e.g. sex, body condition) as well as important environmental variables (e.g. weather, marine hypoxia). Our preliminary results serve as a valuable foundation upon which other ecological processes, such as predator-prey interactions, breeding site fidelity, and the trophic effects of Gulf hypoxia, will be explored. (ID 16221)

**Gehring, J. L.**, Federal Communications Commission, USA, Joelle.Gehring@FCC.gov  
 Erickson, W., Western EcoSystems Technology, Inc., USA, werickson@west-inc.com

#### UNDERSTANDING THE IMPACTS OF COMMUNICATION TOWERS ON BIRDS AND THE POTENTIAL TO REGULATE AS BIRD HABITAT<sup>†</sup>

Aerodevelopment such as tall buildings, communications towers, powerlines, and wind turbines, can impact birds by attracting them to potentially harmful structures or displacing them from previously used areas. For example, high elevation areas can be ideal for the effective placement of communications towers but also attract birds migrating over mountainous terrain. Similarly, high wind areas such as shorelines and mountain passes can be highly productive sites for wind energy but can also concentrate migrating raptors; thereby, putting them at risk for collisions. Aerodevelopment on otherwise open, flat landscapes or seascapes can also displace some bird species not

adapted to tall structures in their environments. Current estimates for the United States suggest that tall buildings and windows account for 98 million - 980 million bird fatalities per year, communications towers are estimated to cause approximately 6.8 million avian fatalities per year, powerlines can cause as many as 174 million bird fatalities per year, and wind turbines are estimated to cause between 134,000 and 230,000 bird fatalities each year. Passerines make up the majority of the bird collisions with tall structures, but population level impacts are possible with species of many taxa. Regulations such as the Endangered Species Act, the Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act protect birds and their habitats. When considering aerocology, airspace is habitat for birds and aerodevelopment can negatively impact bird habitat. Cost effective, realistic methods to minimize risks to birds from aerodevelopment need to be further identified and implemented. (ID 16355)

**Geist, N. R.**, Sonoma State University, USA, nick.geist@sonoma.edu  
 DIFFERENCES IN REPRODUCTIVE BEHAVIOR AND EMBRYONIC AND JUVENILE DEVELOPMENT IN DINOSAURS AND BIRDS: IMPLICATIONS FOR AVIAN ORIGINS

Our understanding of the reproductive biology and developmental patterns of extinct animals is often hampered by the absence of direct fossil evidence. However, fossilized eggs and embryos as well as intact nests from a number of dinosaurs and extinct Mesozoic birds provide a unique opportunity to assess and compare the data gleaned from these fossils with information drawn from modern archosaurs, i.e., crocodilians and birds. Despite previous reports that fossil nests and embryos of both ornithischian and saurischian dinosaurs indicate bird-like behaviors and developmental patterns, and thus strengthen the case for a close evolutionary relationship between dinosaurs and birds, our analysis indicates significant differences between them that challenge this notion. Additionally, recent discoveries of pre-*Archaeopteryx* proto-birds from China, as well as a reevaluation of the phylogenetic status of several Cretaceous bird-like dinosaurs suggests they likely represented an early adaptive radiation of flightless birds, and further contradicts conventional wisdom regarding the supposed linear evolutionary relationship of maniraptoran theropod dinosaurs and birds. (ID 15884)

George, T. L., Colorado State University, USA, t.luke.george@gmail.com  
**Shenk, T.**, National Park Service, USA, Tanya\_Shenk@nps.gov  
 Engelman, F., fcengelman@earthlink.net  
 Engelman, T., fcengelman@earthlink.net

#### FACTORS INFLUENCING ANNUAL SURVIVAL OF BROAD-TAILED HUMMINGBIRDS IN ROCKY MOUNTAIN NATIONAL PARK

Broad-tailed Hummingbirds (*Selasphorus platycircus*) are a conspicuous member of the breeding avifauna of Rocky Mountain National Park, and their abundance is known to vary dramatically from year-to-year possibly as a result of weather-related effects on their survival. To examine variation in survival and the potential influence of regional weather patterns, we estimated the annual survival of 3,166 Broad-tailed Hummingbirds banded in Rocky Mountain National Park over the period 2003-2012. Birds were captured between May and early August at feeder traps and mist nets in the northeast corner of the park. Because broad-tailed hummingbirds are known to occasionally move several kilometers during the breeding season to exploit nectar sources, we distinguished between residents (birds that were recaptured at least 6 days after their initial capture in the year they were banded) and transients. To examine factors influencing annual survival we modelled the survival parameter  $\Phi$  as constant and as combinations of time, sex, and residency. We also included models with two regional climate parameters the El Niño Southern Oscillation and the North Atlantic Oscillation both of which have been found to influence annual survival in other migratory bird species. Models of capture probability included the

null model and combinations of time and sex resulting in 36 models in the model set. We identified the most parsimonious model using AICc. The top model included the parameters time, residency, and sex for survival and time variation in capture probability. Annual survival was approximately 0.53 for resident females and 0.43 for resident males. Survival varied among years greatly (range 0.42-0.62 and 0.32-0.54 in females and males, respectively) but was not related to either of the climate indices we included in our analyses. Further investigations of factors influencing annual survival of this species are warranted. (ID 16303)

**Gibbons, R. E.**, Louisiana State University Museum of Natural Science, USA, rgibbo3@gmail.com

Otto, M., Technische Universität Berlin, Germany, Marco.Otto@klima.TU-Berlin.de

#### CLIMATE CHANGE DRIVEN IMPLICATIONS FOR BIRDS ASSOCIATED WITH HIGH ANDEAN PEATLANDS

High Andean peatlands are among the most unique habitats in the tropical Andes and among the least studied. These high elevation (4000 m-5200 m) peatlands, sustained by ground water runoff and seasonal precipitation, are used by a unique community of organisms including Austral and Nearctic-Neotropical migratory birds e.g. Baird's Sandpiper, Pectoral Sandpiper, and Lesser Yellowlegs and High Andean endemics that are strongly associated with peatland habitat e.g. Diademed Sandpiper-Plover, Olivaceous Thornbill, and White-bellied Cincloides. Environmental data for the region are coarse presenting a conservation challenge; given the threats of climate change, water diversion projects, peat mining, overgrazing, and subsequent erosion. We used remote sensing data and ground truthing to estimate the extent (2.5%) and dispersion of peatland habitat in the study region. The assessment of climate change driven implications relied on the assumption that permanent snow or glacier cover and the topographic characteristics (e.g. slope) of a basin are essential variables in the occurrence of high Andean peatlands. All basins were projected to have a decrease in peatland habitat density due to snow-line uplift and consequent insufficient water supply, specifically during the dry season. Total peatland loss was predicted for two basins in the semi-arid part of the study area with a snow-line uplift to 5600 m. This study is a first attempt to provide quantitative data for more informed conservation decisions with regard to high Andean peatland habitat. (ID 16190)

**Gifford, G. L.**, Cornell University, USA, glg57@cornell.edu  
Rodewald, A. D., Cornell University, USA, adr79@cornell.edu

#### FOREST BIRD CONSERVATION IN TROPICAL AGROECOSYSTEMS USING EBIRD AND OCCUPANCY MODELING

Key to meeting the great conservation challenges of our time is identifying management strategies that provide the opportunity to simultaneously conserve species and meet human needs within working landscapes. Unlike "land-sparing" approaches that restrict conservation to protected areas without intensive human use, "land-sharing" approaches create multi-functional landscapes that are managed to simultaneously meet human and ecological needs. Such land-sharing is especially important in tropical landscapes where rich biodiversity and poverty often converge. However, relatively few studies have examined the extent to which working landscapes may be able to support habitat specialists. An eBird database created by a Guatemalan NGO, Community Cloud Forest Conservation, provides new insights regarding occupancy of 54 resident bird species in tropical agroecosystems. We used data from three monitoring trails in agroecosystem-cloud forest landscapes in Alta Verapaz, Guatemala. Birds were surveyed using point counts along trails from 2011-2013 and then analyzed using single-season occupancy models with the unmarked package in R. Of 54 bird species, only 16 had greater than 75% probability of occupying primary cloud

forest, compared to 32 and 34 species likely (>75%) to occupy secondary forest or agricultural land. Of the 16 birds considered to be cloud forest specialist species, 6 still had high occupancy rates in agriculture (>75%). Three species, Spot-crowned Woodcreeper, Spotted Woodcreeper, and Scaly-throated Foliage-gleaner, had high occupancy rates in primary cloud forest alone. These data show that working landscapes do have potential to support forest specialists, though most species were associated with some level of human disturbance. Creating occupancy models from eBird checklists shows its growing potential to assist ecologists in the conservation of tropical species beyond species richness. (ID 15931 | Poster 31)

**Gill, F. B.**, Academy of Natural Sciences, USA, frankgill4@gmail.com

#### WORLD BIRD SPECIES – PAST AND FUTURE<sup>T</sup>

A new explosion of world bird species taxonomy is underway. The number of extant species (ca 10,500) has increased over 20 percent since Mayr and Amadon's (1951) prediction that the "final figure will be within 2 per cent of 8600." The actual number of species could surge to 15,000 or more by the middle of the 21st century as we parse independent species lineages fused historically within so-called polytypic species. Essential reproductive isolation is more pervasive than previously recognized, and explorations of neglected avifaunas enhanced by new data sets reveal surprising numbers of cryptic species. These advances will help to accelerate the timely completion of a modern evolutionary inventory of bird species diversity that should prevail over emerging numerical indices for setting conservation priorities. (ID 15815)

**Gillespie, C. R.**, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska--Lincoln, USA, caitlyn.gillespie@gmail.com  
Fontaine, J. J., U.S. Geological Survey, Nebraska Cooperative Fish & Wildlife Research Unit, USA, jfontaine2@unl.edu

#### STOPOVER HABITAT DECISIONS IN A VANISHING LANDSCAPE\*

Predicting habitat selection by migratory species is challenging because multiple sources of ecological variation have fitness consequences that are mediated by behavioral decisions. 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 due to anthropogenic change. Increasing agricultural intensity likely alters habitat characteristics that influence condition and hinder migratory success, as shorebirds prefer agricultural wetlands which have lower food abundance. The Rainwater Basin and the Prairie Pothole Region are two distinct stopover areas along the migratory route, each of which varies in habitat availability; however, the scope and scale of anthropogenic change is more pronounced in the Rainwater Basin. Our current research examines the stopover decisions of a suite of *Calidris* shorebird species in both regions, the habitat characteristics of preferred wetlands, and the behavioral and physiological responses associated with stopover habitats. Closer examination of stopover habitat decisions, seasonal patterns in wetland availability and suitability, and ecological characteristics associated with preferred habitats in two different landscape contexts may illuminate potential consequences of escalating land-use change for migratory shorebirds, and enhance our ability to take management actions that may ameliorate the costs of migration in altered landscapes. (ID 16063)

**Gillespie, L. M.**, University of Southern Mississippi, USA, lauren.gillespie@eagles.usm.edu

Jawor, J. M., University of Southern Mississippi, USA, jodie.jawor@usm.edu

#### BEHAVIOR, PHYSIOLOGY, AND ORNAMENTATION OF MALE BLUEBIRD NEST DEFENSE AGAINST CONSPECIFIC INTRUDERS IN A CHRONICALLY DISTURBED AREA

The ecology of Eastern Bluebirds (*Sialia sialis*) often results in exposure to environmental disturbances as individuals often reside in human-modified habitats. Human-provided nest boxes have helped to reestablish bluebird populations in the eastern United States after numbers had declined due to habitat loss, but this also increased exposure to human activities and disturbance. As behavioral traits can increase survival in altered habitats, this study examines effects of level of human disturbance on behavior, endocrine physiology, and ornaments in male bluebirds. Male bluebird parental and aggressive behavior, levels of corticosterone (CORT) and testosterone (T), and ornaments will be assessed in chronically human disturbed and undisturbed areas. Male nest defense may contribute to fitness, and ornaments may indicate behavioral or hormonal phenotypes, and all of these may be impacted by human disturbance. Data from a disturbed area found that males with higher CORT move less in response to live, conspecific intrusions during nesting. Birds sampled during intrusions with darker melanin pigmentation also had lower T. Data from the undisturbed population is currently under collection. Preliminary site comparisons reveal that birds from the disturbed population are significantly more vigilant than those from the reference site and have a longer latency to attack, though not significantly so. This study explores selection for traits related to enhanced survival and fitness for individuals living in disturbed environments and whether the level of disturbance influences expression of these traits. (ID 15870)

**González-Medina, E.**, UNAM, Posgrado de Ciencias del Mar y Limnología, Mexico, gmedinaerick@gmail.com

Castillo-Guerrero, J. A., Centro de Investigación en Alimentación y Desarrollo A.C., Unidad Mazatlán, Mexico, alfredocas@gmail.com

Santiago-Quesada, F., University of Extremadura, Conservation Biology Research Group, Zoology, Spain, fquesada@unex.es

Villegas, A., University of Extremadura, Conservation Biology Research Group, Zoology, Spain, villegas@unex.es

Masero, J. A., University of Extremadura, Conservation Biology Research Group, Zoology, Spain, jamasero@unex.es

Sánchez-Guzmán, J. M., University of Extremadura, Conservation Biology Research Group, Zoology, Spain, jsanchez@unex.es

Fernández, G., UNAM, Instituto de Ciencias del Mar y Limnología, Unidad Académica Mazatlán, Mexico, gfernandez@ola.icmyl.unam.mx

#### EXPERIMENTALLY MODIFIED DEMANDS ON PARENTS IN A LONG-LIVED SEABIRD: INTERGENERATIONAL CONSEQUENCES

Parental care in long-lived bird species involves a trade-off between the benefits of increasing the effort expended on the current offspring and the costs that this represents for future reproductive output. It has been shown that long-lived seabirds can cover some reproductive costs by adjusting their breeding effort to benefit their offspring, but data about the intergenerational effects in short-term are still poorly understood. In this study, we performed a cross-fostering experiment to evaluate whether increasing or decreasing the parental reproductive costs led to intergenerational effects in the blue-footed booby *Sula nebouxi*. Specifically, we have tested the influence of experimentally changing the parental reproductive costs on the offspring's physiological condition (plasma metabolites, heterophil to lymphocyte ratio [H/L], and body condition index) and survival. When reproductive costs were increased, the offspring showed lower body condition index and alkaline phosphatase (ALP) levels, and higher H/L ratios than controls. However, offspring's whose parent reproductive costs were decreased showed higher body condition index and ALP levels, and lower  $\beta$ -OH-butyrate levels and H/L ratios than controls. Treatments did not affect to triglyceride levels or chicks' survival rates. Our findings support a limited ability of parents blue-footed boobies to adjust their breeding effort according to the demands of offspring, and that selective pressures involved in the regulation of reproductive effort may have short-term effects on offspring fitness. (ID 15873)

**Gow, E. A.**, University of Saskatchewan, Canada, eliz.gow@usask.ca  
Wiebe, K. L., University of Saskatchewan, Canada, karen.wiebe@usask.ca

#### THE INFLUENCE OF EXTRINSIC FACTORS ON MIGRATORY TIMING AND REPRODUCTION IN A DIFFERENTIAL MIGRANT

Migration is common among animals, and the migration strategy depends on how an animal can best maximize fitness. Differential migrants, where migration distances can vary within a population, are ideal for studying how migratory behaviours influence fitness. Endogenous circannual rhythms control the timing of migration in long-distance migrants, whereas the timing may be related to environmental factors in short-distance migrants, but this has not been tested in short distance migrants in the wild. Here, using a differential short-distance migrant, we used geolocator data from 17 northern flickers (*Colaptes auratus*) retrieved between 2011–2014, to examine what factors influence migratory patterns. Fall departure from the breeding grounds was influenced by year, with all birds in 2010 leaving the study site earlier due to a forest fire. Environmental conditions (drought) also appeared to affect movements during the non-breeding period. Birds with earlier first egg dates arrived significantly earlier on the breeding site, and earlier first egg dates resulted in more young fledged. The timing of reproduction did not affect migration distance, and migration distance did not affect arrival the next spring. Although earlier arrival to the study area is reproductively advantageous, arrival is not associated with migration distance or fixed innate circannual rhythms but instead the timing is influenced by environmental conditions. (ID 15878)

**Graham, B. A.**, University of Windsor, Canada, graham1g@uwindsor.ca  
Heath, D. D., University of Windsor, Canada, dheath@uwindsor.ca  
Mennill, D. J., University of Windsor, Canada, dmennill@uwindsor.ca

#### DOES PHILOPATRY PROMOTE POPULATION STRUCTURE IN A RESIDENT TROPICAL BIRD?

Identifying potential barriers to gene flow is important for developing a deeper understanding of evolution. Physical barriers (e.g. mountain ranges, large bodies of water, and gaps in habitat), ecological and behavioural differences, and isolation by distance can all reduce gene flow between populations. Within the tropics heightened habitat specialization and strong philopatry suggests that many species may experience reduced rates of gene flow. To examine genetic structure and gene flow between populations in a resident tropical animal, we genotyped 157 individuals from five populations of Rufous-and-white Wrens (*Thryophilus rufalbus*), a resident songbird found in Central and South America. Based on data from 11 different polymorphic microsatellite loci, we found small but significant  $F_{ST}$  pairwise comparisons ranging from 0.01 to 0.06. Our data demonstrate reduced gene flow between populations over a 500 km transect. Results using the Bayesian Clustering model STRUCTURE further suggest distinct population structure and support the existence of three distinct genetic groups. The strong population structure observed in this species is higher than that reported for other resident species with similar distributions, suggesting high philopatry and/or limited dispersal by Rufous-and-white Wrens. Furthermore we examined fine-scale genetic structure to better understand how philopatry and dispersal influence gene flow. Reduced rates of gene flow between populations may also help to further explain other behavioural variations between populations, in particular song a trait that has both a genetic and a cultural component. (ID 15850 | Poster 58)

**Gratto-Trevor, C. L.**, Environment Canada, Canada, cheri.gratto-trevor@ec.gc.ca

Tibbitts, T. L., U.S. Geological Survey, USA, ltibbitts@usgs.gov

#### POTENTIAL SEX DIFFERENCES IN MIGRATORY CONNECTIVITY OF MARBLED GODWITS BREEDING IN ALBERTA, CANADA



Approximately 60% of Marbled Godwits breed in prairie Canada, and winter in coastal California and Mexico. However, little is known about specific migratory routes and staging sites used by these birds. In 2013, four adults (2 pairs) were equipped with 9.5 g solar satellite transmitters on the breeding grounds in southern Alberta. Both females migrated relatively directly to winter in San Francisco Bay, California, arriving 5 and 12 days after leaving the nesting area. One female stopped briefly at agriculture areas in Idaho and California during this passage. The males followed a more easterly route, and both wintered at Ojo de Liebre Lagoon in Baja California Sur, Mexico, arriving 9 and 40 days after leaving the nesting area. These preliminary findings bring into question earlier conclusions that virtually no Alberta godwits winter in California (only one Alberta bird, a female, was reported from California during an extensive banding study in the 1990s). Further work will determine whether sex differences in migration routes and wintering sites are consistent. (ID 15806)

**Green, D. J.**, SIMON FRASER UNIVERSITY/CENTRE FOR WILDLIFE ECOLOGY, Canada, [djgreen@sfu.ca](mailto:djgreen@sfu.ca)  
 Richmond, A., SIMON FRASER UNIVERSITY/CENTRE FOR WILDLIFE ECOLOGY, Canada, [arr2@sfu.ca](mailto:arr2@sfu.ca)  
 Drake, A., SIMON FRASER UNIVERSITY/CENTRE FOR WILDLIFE ECOLOGY, Canada, [aedrake@sfu.ca](mailto:aedrake@sfu.ca)

#### ENSO-RELATED CLIMATE CONDITIONS AND ANNUAL SURVIVAL OF YELLOW WARBLERS: UNRAVELLING THE EFFECTS OF WESTERLY WINDS, STORMS AND RAINFALL ON MIGRATION

Populations of migratory songbirds are influenced by climatic condition at all stages of their annual cycle. However, recent work on western neotropical migrants suggests that ENSO-related climate conditions on migration have a greater influence on annual apparent survival than conditions on the wintering grounds or breeding grounds (Drake et al. 2014 PLoS ONE 9(5): e97152, LaManna et al. 2012 Auk 129(4):734-743). We examine how El Nino Southern Oscillation effects on westerly wind speeds during the migration period, storms on migration, and dry season precipitation in the southwestern region of the migratory flyway influence the apparent annual survival of yellow warblers (*Setophaga petechia*) breeding in western Canada using data collected from 2004-2014. We show that westerly windspeeds during a two month period (April-May) explain more of the variation in annual apparent survival than conditions over a longer or shorter migratory period. Wind-speed effects on apparent survival are not explained by increases in the prevalence of wind or rain-storms during this migratory period. We compare the level of support for survival models including ENSO effects on wind speed at elevations used by neotropical migrants, and dry season precipitation that will influence conditions at stopover sites, and contrast our results with previous studies on neotropical and palearctic-African migrants. (ID 15876)

**Gregory, N. C.**, USAID, USA, [ngregory@usaid.gov](mailto:ngregory@usaid.gov)  
 Sensenig, R. L., Goshen College, USA, [rlsensenig@goshen.edu](mailto:rlsensenig@goshen.edu)  
 Wilcove, D. S., Princeton University, USA, [dwilcove@princeton.edu](mailto:dwilcove@princeton.edu)

#### SAVANNA HOME COMPANIONS: FIRE, PASTORALISM, DROUGHT, BIRDS, AND DEVELOPMENT IN EAST AFRICA

In East Africa, fire and grazing by wild and domestic ungulates maintain savannas, and pastoralists historically set fires and herded livestock through the use of temporary corrals called bomas. In recent decades, traditional pastoral practices have declined, and this may be affecting biodiversity. We investigated the effects of prescribed fires and bomas on savanna bird communities in East Africa and compared abundance, richness, and community composition on 9-ha burned plots, recently abandoned bomas, and control plots in the undisturbed matrix habitat over a 3-year period. Generally, recently burned areas and abandoned bomas attracted

greater densities of birds and had different community assemblages than the surrounding matrix. The effects of disturbances were influenced by interactions between primary productivity, represented by the normalized difference vegetation index, and time. Bird densities were highest and a greater proportion of species was observed on burned plots in the months following the fires. Drought conditions equalized bird densities across treatments within 1 year, and individuals from a greater proportion of species were more commonly observed on abandoned bomas. Yearly fluctuations in abundance were less pronounced on bomas than on burns, which indicate that although fire may benefit birds in the short term, bomas may have a more-lasting positive effect and provide resources during droughts. Several Palearctic migrants were attracted to burned plots regardless of rainfall, so continued fire suppression may threaten their already-declining populations. Most notably, the paucity of birds observed on the controls suggests that the current structure of the matrix developed as a result of fire suppression. Traditional pastoralism appears critical to the maintenance of avian diversity in these savannas, and successful management is tied to the development challenges of the region and must be informed by environmental history. (ID 15837)

**Greig, E. I.**, Cornell Lab of Ornithology, USA, [eig9@cornell.edu](mailto:eig9@cornell.edu)  
 Webster, M. S., Cornell Lab of Ornithology, USA, [msw244@cornell.edu](mailto:msw244@cornell.edu)

#### HOW DO NOVEL SIGNALS ORIGINATE? THE EVOLUTION OF FAIRY-WREN SONGS FROM PREDATOR TO DISPLAY CONTEXTS

Revealing the evolutionary origin of novel traits is a long-standing challenge in evolutionary biology. The dynamics of antipredator signalling and conspecific advertisement provide one framework in which to investigate this phenomenon, because shifts in signal context may lead to new signal functions, novel evolutionary pressures and ultimately novel phenotypes. Several species of fairy-wrens (*Maluridae: Malurus*) give song-like trills ("Type II song") in response to vocalizations of avian predators. Despite this predator context, in some species the trills appear to function as conspecific-directed displays. We investigated two hypotheses for the evolutionary origin of predator-elicited Type II songs: (1) they originated as antipredator signals, then shifted to a display context and subsequently became more elaborate because selection pressures changed; or alternatively (2) they originated as conspecific-directed songs, then shifted to a predator context to exploit an effective communication window. We found that many *Malurus* species gave trills in response to predators, but only a subset gave unprompted trills during dawn chorus displays, and ancestral state reconstructions suggested that the predator-elicited context evolved first. Additionally, species that used trills more often tended to have longer trills with a faster note rate, suggesting that trills have evolved a higher performance as they became a more important part of the repertoire. Our results support the hypothesis that trill displays originated through the elaboration of predator context calls and provide an example of a shift in signal context leading to novel signal phenotypes. (ID 15787)

**Grende, A. R.**, University of Minnesota Duluth, USA, [agrende@d.umn.edu](mailto:agrende@d.umn.edu)  
 Niemi, G. J., University of Minnesota Duluth, USA, [gjniemi@d.umn.edu](mailto:gjniemi@d.umn.edu)  
 OCCUPANCY DYNAMICS OF CANADA WARBLERS IN MINNESOTA'S NATIONAL FORESTS

Based on the USGS Breeding Bird Survey, Minnesota's northern forest ecosystems have among the richest diversity of breeding bird species in North America. Due to concerns with increased levels of forest harvesting and management and effects of climate change in Minnesota, a long-term (1995-2013) forest bird monitoring program was established in two of Minnesota's National Forests. Over 16,000 10-minute point counts were gathered in 346 forest stands for 18 years in the National Forests. Canada Warbler is a species of high conservation importance because of its low

overall density, rapid deforestation in its tropical wintering grounds, and moderate yet, widespread population declines on the breeding grounds. This species appears tolerant of moderate disturbance, including silvicultural practices favoring regeneration of shrubs however, the sensitivity to forest fragmentation and habitat alteration is poorly known in much of its range. Trends from Minnesota's National Forest Bird Monitoring Project indicate that this species has increased significantly ( $P < 0.01$ ) in Chippewa NF by 5.80% while population increase is not significant ( $P = 0.18$ ) in Superior NF. Using the data from this project, occupancy models were developed for Canada Warblers ( $n = 2048$ ) to determine the relative influence of habitat patch characteristics (understory vegetation, canopy cover), landscape context (edge, forest patch size), and species co-occurrence for occupancy, colonization, and extinction parameters over 18 years in Minnesota's National Forests. The results of this study will be useful for ultimate incorporation into long-term management objectives within this region. (ID 16235)

**Grond, K.**, Kansas State University, USA, kgrond@ksu.edu  
 Lanctot, R. B., U.S. Fish and Wildlife Service, USA, richard\_lanctot@fws.gov  
 Santo Domingo, J. W., U.S. Environmental Protection Agency, USA, santodomingo.jorge@epamail.epa.gov  
 Ryu, H., U.S. Environmental Protection Agency, USA, ryu.hodon@epamail.epa.gov  
 Sandercock, B. K., Kansas State University, USA, bsanderc@ksu.edu

#### LINKING GUT MICROBIOTA COMPOSITION TO LIFE-HISTORY AND INDIVIDUAL QUALITY OF ARCTIC-BREEDING SHOREBIRDS \*

Arctic-breeding shorebirds use different regions of the world to breed, stage and winter, and migrate long distances in between. These life history traits expose them to a wide variety of microorganisms. Changes in gut microbial community lead to diseases in mammals, but little is known about how change in gut microbiota influences bird health. Health is a challenging parameter to measure in free-living birds. Our first step in assessing how change in gut microbiota impacts arctic-breeding shorebirds was to relate variation in shorebird gut microbial communities to key life-history characteristics including migration route, mating system, age and sex. To investigate how gut microbiota influences birds on an individual level, we related gut microbiota variation to individual quality parameters, such as breeding success and body condition. Research collaborators of the Arctic Shorebird Demographics Network collected 624 fecal samples and data on individual quality from 11 shorebird species at 10 arctic sites in northern Alaska and Canada. We compare similarities and differences of gut microbiota within and among individuals and species, and relate these patterns to individual qualities and life-history characteristics. (ID 15725 | Poster 91)

**Grunst, A. S.**, University of California, Riverside and Indiana State University, USA, agrun001@ucr.edu  
 Rotenberry, J. T., University of Minnesota, USA, john.rotenberry@ucr.edu  
 Grunst, M. L., University of California, Riverside and Indiana State University, USA, mgrun002@ucr.edu

#### AGE-DEPENDENT RELATIONSHIPS BETWEEN MULTIPLE SEXUAL PIGMENTS AND CONDITION IN MALES AND FEMALES

The reliability of sexual signaling may change across age classes due to shifts in resource allocation patterns. Two contrasting hypotheses exist regarding how the condition-dependence of ornaments may shift with age, and both have received empirical support. On one hand, ornaments may more reliably reflect condition and quality in older individuals, because younger individuals of high quality invest in survival over signaling effort. On the other hand, the condition-dependence of ornaments may decline with age, if older individuals in poor condition terminally invest in ornaments, or if resource constraints decline with age. Further, the expression and condition-

dependence of different ornaments may shift with age in unique ways, such that multifaceted sexual displays maintain reliable signaling across age classes. In yellow warblers (*Setophaga petechia*) of both sexes, we assessed how relationships between carotenoid- and phaeomelanin-based sexual pigmentation, pre-nesting body reserves, and condition at molt (reflected by growth bars and feather quality) vary across age classes. Melanin coverage correlated with condition at molt across age classes in males, and showed high repeatability in both sexes. In contrast, carotenoid saturation increased longitudinally with age in males, and correlated with condition at molt in different age classes in the two sexes. Specifically, carotenoid saturation correlated positively with condition at molt in younger, but not older males, whereas in females the situation was reversed, with a positive correlation present only in older females. Results suggest that age-dependent signaling may promote maintenance of multifaceted sexual displays, and that age-dependent signaling dynamics depend on sex. (Behavioral Ecology 2014, doi:10.1093/beheco/art124) (ID 15857)

**Grunst, M. L.**, University of California, Riverside, USA, mgrun002@ucr.edu  
 Grunst, A. S., University of California, Riverside, USA, agrun001@ucr.edu  
 Parker, C., Tufts University, USA  
 Romero, M., Tufts University, USA  
 Rotenberry, J. T., University of Minnesota, USA, john.rotenberry@ucr.edu

#### PIGMENT-SPECIFIC RELATIONSHIPS BETWEEN FEATHER CORTICOSTERONE LEVELS AND SEXUAL COLORATION IN THE YELLOW WARBLER (SETOPHAGA PETECHIA)

The adrenocortical stress response may divert energy away from sexual ornamentation, such that ornaments signal exposure or resistance to physiological stress. Alternatively, steroid glucocorticoids released via the stress response may support ornament development by stimulating foraging and metabolism. The relationship between glucocorticoids and ornamentation may vary with ornament type and across age and sex classes that experience different resource allocation tradeoffs. In yellow warblers (*Setophaga petechia*), we conducted the first study to simultaneously assess whether relationships between corticosterone (the primary avian glucocorticoid) and ornamentation depend on sexual pigment type, age, and sex. We quantified carotenoid- and phaeomelanin-based pigmentation using spectrometry, and assayed corticosterone in feathers (CORTf) to derive an integrative metric of corticosterone levels during molt. Yellow warblers with lower carotenoid hue (lambda R50) had higher CORTf, suggesting that carotenoid hue may signal stress during molt across age and sex classes. Carotenoid chroma also negatively correlated with CORTf. However, this correlation was absent in older males, suggesting lower condition-dependence of chroma in older males, which display more saturated pigmentation and may be more efficient foragers. Young males with higher CORTf also tended to have poor quality tertial feathers, indicating poor condition at molt. Phaeomelanin-based pigmentation was largely unrelated to CORTf, suggesting that pleiotropic effects of melanocortins do not link phaeomelanogenesis and CORT release. Finally, CORTf was repeatable across years within individuals. Thus, carotenoid- and phaeomelanin-based pigmentation communicate non-equivalent information about physiological stress, with carotenoid pigmentation having the potential to signal stable differences in stress levels that could affect fitness. (ID 15856)

**Grunzel, D. P.**, University of Maine, USA, david.grunzel@maine.edu  
 Olsen, B. J., University of Maine, USA, brian.olsen@maine.edu

#### LONGER DISTANCE MIGRANT PASSERINES ARE MORE AVERSE TO PREDATION RISK DURING MIGRATION\*

Migratory animals balance the energetic requirements of large-scale movement with predation risk in unfamiliar habitats. Optimality theory predicts that species migrating different distances prioritize time and energy

differently, and the tradeoff shapes their response to predation risk. We conducted two investigations along the coast of Maine to determine the behavioral and population-scale responses of migrating birds to predation risk as a function of their migration distance. First, by observing bird activity in a field aviary before and after exposure to a predator call, we tested whether time-energy optimization correlated with migration distance in four Passerine species and whether this relationship changed with increased predation risk. Second, we used banding records of the same species to test whether different anti-predator behaviors explained size-corrected mass across nine sites varying in raptor abundance. Contrary to Optimality Theory, there were no differences in bird behavior by migration distance prior to predator exposure. Further, longer distance migrants were less active under increased risk relative to shorter distance migrants. At the population-scale, bird mass for all species decreased as predator abundance increased, but mass loss was greater for longer distance migrants. We hypothesize that these individual and population-scale responses to risk may result from differential life expectancy. Longer distance migrants may be more risk averse to maximize future reproductive opportunities, while shorter distance migrants may prioritize current condition over long-term survival to avoid negative carryover effects on the subsequent breeding season. (ID 15981)

**Gulson, E. .**, Cornell University, USA, [ergulson@hotmail.com](mailto:ergulson@hotmail.com)  
 Danner, R. M., Smithsonian Migratory Bird Center, USA, [danner.ray@gmail.com](mailto:danner.ray@gmail.com)  
 James, H., Smithsonian Institution, USA, [JAMESH@si.edu](mailto:JAMESH@si.edu)  
 Dzielski, S., Cornell University, USA, [sdzielski22@hotmail.com](mailto:sdzielski22@hotmail.com)  
 Frank, D. ., Cornell University, USA, [df265@cornell.edu](mailto:df265@cornell.edu)  
 Winkler, D. W., Cornell University, USA, [dww4@cornell.edu](mailto:dww4@cornell.edu)

#### HABITAT-SPECIFIC DIVERGENCE OF AIR CONDITIONING STRUCTURES IN THE BIRD BILL

Birds are particularly susceptible to challenges of balancing body heat and water because of their high metabolic rates and thus heat generation, and low capacity to carry water. Little is known, however, about the structure and evolution of birds' turbinates, which are complex structures in the nasal capsule that are thought to condition air via counter-current heat exchange. We hypothesized that hotter and water-limited environments would select for larger or more complex turbinates to capture more moisture during exhalation and in turn cause the evolution of deeper and wider bills. We provide the first intra-specific comparison of turbinate size and structure in birds, based on high-resolution ct-scans of two subspecies of song sparrows (*Melospiza melodia*) that inhabit climatically distinct habitats. Median and anterior turbinates were larger in individuals with larger nasal cavities. After correction for nasal cavity size, the subspecies that inhabits hot and dry coastal dunes (*M. m. atlantica*) had larger median turbinates and greater overlap of the median and anterior turbinates than a nearby inland subspecies, which inhabits cooler, moister environments (*M. m. melodia*). The locations of maximum complexity of both turbinates were more distal in the dune-endemic subspecies. These anatomical differences suggest divergent selection pressures on turbinate structure and external bill morphology. The larger median turbinate in the dune subspecies may allow greater water recapture while exhaling, and the typically deeper and wider bill of the dune subspecies may have evolved to accommodate larger turbinates. (ID 16229 | Poster 26)

**Gutierrez Ramirez, M.**, NOAA Environmental Cooperative Science Center, Delaware State University, USA, [mariamargutierrez@hotmail.com](mailto:mariamargutierrez@hotmail.com)  
 Kneidel, A. H., NOAA Environmental Cooperative Science Center, Delaware State University, USA, [akneidel@gmail.com](mailto:akneidel@gmail.com)  
 Lester, L. A., NOAA Environmental Cooperative Science Center, Delaware State University, USA, [lorilester@gmail.com](mailto:lorilester@gmail.com)  
 Heckscher, C. M., NOAA Environmental Cooperative Science Center, Delaware State University, [heckscher@desu.edu](mailto:heckscher@desu.edu)

#### AN ASSESSMENT OF REFUELING PERFORMANCE BY SELECT SPRING TRANS-GULF MIGRANTS ON A FLORIDA GULF COAST BARRIER ISLAND

The availability of suitable habitat along migratory routes is necessary for the successful migration of birds. For birds using a spring trans-Gulf migration strategy, barrier islands along the north coast of the Gulf of Mexico may provide critical stopover habitat. St. George Island is a barrier island located approximately 7 km from the mainland on the southern edge of Apalachicola Bay, Florida. To assess the ecological function of these islands as avian stopover sites, we studied *Catharus* thrushes and Gray Catbird (*Dumetella carolinensis*) during spring migration in 2013 and 2014. Using constant effort mist-netting, we documented the physical condition of birds, including body mass, amount of subcutaneous fat reserves, and pectoral muscle score, and obtained blood samples. Blood plasma was extracted to perform triglyceride and beta-hydroxybutyrate assays, while red blood cells were used to perform PCR-based sex determination. Upon arrival, birds had depleted fat reserves and low pectoral muscle scores. Recapture data indicated *Catharus* thrushes increased in mass; both Swainson's Thrush (*C. ustulatus*) and Veery (*C. fuscescens*) increased by an average of 0.6 g per day (n=6) in 2013. Plasma triglyceride concentration is a good indicator of stopover refueling rate. Assays were conducted on plasma samples from Gray Catbird (n=39, 2013 and n=66, 2014) and *Catharus* thrushes (n=39, 2013 and n=12, 2014). This is the first study to quantify the ecological function of barrier islands to spring trans-Gulf migrants on the Florida panhandle. Our results confirm that Apalachicola barrier islands are internationally important stopover sites for Gulf migrants comparable to stopover sites along the central and western Gulf coast. (ID 16260)

**Gutowsky, S. E.**, Dalhousie University, Canada, [sarahegutowsky@gmail.com](mailto:sarahegutowsky@gmail.com)

Leonard, M., Dalhousie University, Canada, [mleonard@dal.ca](mailto:mleonard@dal.ca)  
 Jonsen, I., Macquarie University, Australia, [ian.jonsen@mq.edu.au](mailto:ian.jonsen@mq.edu.au)  
 Shaffer, S., San Jose State University, USA, [scott.shaffer@sjsu.edu](mailto:scott.shaffer@sjsu.edu)

#### SHIFTING ACTIVITY BUDGETS WITHIN THE OVERWINTER PHASE OF NON-BREEDING IN TWO SISTER ALBATROSS SPECIES\*

Long-distance migrants adjust activity budgets as competing demands for limited time and energy shift across the annual cycle. Activity during breeding and migration are generally well studied, especially for pelagic seabirds, but the prolonged overwinter phase following migration is less studied despite the importance of this time for recovery from breeding, plumage replacement and gaining energy stores for return migration and the next breeding attempt. We aimed to identify patterns in daily activity budgets (i.e. time in sustained flight, water loafing and active foraging) during overwinter for the Laysan (*Phoebastria immutabilis*) and Black-footed albatross (*P. nigripes*), using state-space models and generalized additive mixed-effects models applied to time-series of positional and immersion-state data. Both species presented a consistent 'reduced activity stage' during overwinter beginning c. 30 days after initiating migration and lasting c. 40 days, characterized by frequent long bouts of water loafing, very little sustained flight, infrequent active foraging and subsequently minimal daily movements. Activity gradually shifted toward increased time in flight and active foraging, less time loafing, and greater daily travel distances until colony return c. 155 days after initial departure. Our results demonstrate that these species make parallel adjustments to activity budgets at a daily time-step within the overwinter phase of non-breeding despite different at-sea distributions. The 'reduced activity stage' likely reflects compromised flight from active moult while the subsequent gradual increase in activity may occur as priorities shift toward mass gain for breeding. Identifying patterns in activity budgets for birds facing shifting energetic constraints during this demanding phase of the annual cycle can help to elucidate how events occurring outside of the breeding period influence the demography of migratory populations. (ID 16016)



**Gutzwiller, K. J.**, Baylor University, USA, kevin\_gutzwiller@baylor.edu  
 Riffell, S. K., Mississippi State University, USA, sriffell@cfr.msstate.edu  
 Flather, C. H., USDA Forest Service, USA, cflather@fs.fed.us

#### THE PREVALENCE OF RELATIVELY SIMPLE BROAD-SCALE LIMITING FACTORS ON AVIAN PERSISTENCE BELIES THE COMPLEXITY OF ASSEMBLAGE-LEVEL CONSERVATION

We used Breeding Bird Survey data, the National Land Cover Database, and multivariate adaptive regression splines to assess the prevalence of species persistence thresholds in relation to landscape pattern. Across three regional assemblages, 42-60% of species exhibited threshold relationships that had biologically meaningful effect sizes. Most of the relationships involved one landscape variable, and influences from land-type amounts were much more common than were influences from land-type configurations. These results imply that landscape management may be comparatively straightforward because the number of apparent landscape-level limiting factors on a species' persistence was typically low, and because the focus could be on relatively simple conditions (one land-type amount variable) rather than on relatively complex conditions (multiple variables and land-type configurations). But the simple nature of most of the relationships belies the difficulty of broad-scale conservation. Our findings expose threshold relationships as pervasive, diverse, and often conflicting patterns that impose a more complicated set of circumstances for assemblage-level conservation of birds than has been widely recognized. To cope with these circumstances, conservationists can consider using optimization analyses and multispecies frameworks during conservation planning. (ID 15723)

**Hale, A. M.**, Texas Christian University, USA, a.hale@tcu.edu  
 Hatchett, E. S., Texas Christian University, USA  
 Stevens, T. K., Texas Christian University, USA  
 Meyer, J. A., Texas Christian University, USA  
 Rubenstahl, T. G., Texas Christian University, USA  
 Karsten, K. B., California Lutheran University, USA  
 Bennett, V. J., Texas Christian University, USA, v.bennett@tcu.edu

#### LIMITED EVIDENCE OF INDIRECT EFFECTS OF WIND TURBINES ON GRASSLAND SONGBIRDS<sup>†</sup>

Wind energy development has the potential to negatively impact wildlife populations, and yet the indirect effects of wind turbines (e.g., displacement from otherwise suitable habitat) have received less attention than collision mortality. Thus over a three-year period, we investigated the indirect effects of wind turbines on grassland songbirds at an operational wind facility in the cross timbers and prairies ecoregion of north-central Texas. The study site consists of 75 1.5-MW wind turbines (hub height = 80 m, blade length = 42 m) arrayed within cattle pastures, hay fields, and agricultural lands. We found no negative effect of wind turbines on nesting success in Scissor-tailed Flycatchers (*Tyrannus forficatus*) in 2009 (n = 32 nests) or Dickcissels (*Spiza americana*) in 2010 and 2011 (n = 195 nests). Moreover, nest survival in both species increased with proximity to wind turbines. Using two different methods to estimate breeding bird density (line transects in 2009 and 2010 and plot surveys in 2011), we found no evidence of displacement in Dickcissels, Grasshopper Sparrows (*Ammodramus savannarum*), or Eastern Meadowlarks (*Sturnella magna*). Over two winters (2009/2010 and 2010/2011), we used an area-search method to survey 210 1-ha plots, and found no evidence of displacement in Sprague's Pipits (*Anthus spragueii*), Savannah Sparrows (*Passerculus sandwichensis*), or meadowlarks (*Sturnella sp.*). In contrast, the Le Conte's Sparrow (*Ammodramus leconteii*) was significantly more likely to occupy suitable plots as distance to turbine increased. Thus, indirect effects appear to be species-specific and possibly seasonal in this grassland songbird community. Future research should focus on 1) identifying the mechanism behind increased nest survival close to wind turbines, and 2) determining which species are most likely to be displaced from suitable habitat in the presence of wind turbines. (ID 15827)

**Hallworth, M. T.**, Migratory Bird Center - Smithsonian Conservation Biology Institute, USA, mhallworth@gmail.com  
 Sillett, T. S., Migratory Bird Center - Smithsonian Conservation Biology Institute, USA, silletts@si.edu  
 Rockwood, L. L., George Mason University, USA, lrockwoo@gmu.edu  
 Marra, P. P., Migratory Bird Center - Smithsonian Conservation Biology Institute, USA, Marrap@si.edu

#### SEASONAL INTERACTIONS INFLUENCE INDIVIDUALS AND THE POPULATION GROWTH RATE OF A LONG DISTANCE MIGRATORY SONGBIRD\*

Understanding how stages of the annual cycle interact to shape individual- and population-level dynamics is critical for effective management and conservation. Population dynamics are influenced by carry-over effects, a type of non-lethal seasonal interaction experienced by individuals that produce residual effects in subsequent seasons; thus conservation efforts need to consider the full annual-cycle. Here, using archival light-level geolocators we identify how seasonal interactions from non-breeding to breeding periods influence reproductive performance and population growth rate ( $\lambda$ ) for the Ovenbird (*Seiurus aurocapilla*). Males that arrived early to breeding grounds paired earlier and at higher rates, and improved their body condition throughout the season compared to late arriving males. Using geolocators, we found that departure from the non-breeding grounds was directly linked to breeding season arrival, highlighting the importance of the non-breeding season in the annual cycle. Incorporating carry-over effects into  $\lambda$  estimates suggests that early arriving males contribute significantly to population growth while late arriving males do not. For each day of delayed arrival,  $\lambda$  decreased by  $0.028 \pm 0.003$ . Reproductive performance had no effect on departure date from the breeding grounds identified using geolocators. Our findings show a strong carry-over effect in spring mediated by departure date from the non-breeding grounds but no carry-over effect in the fall arising from reproductive effort. This study highlights the importance of integrating seasonal interactions on both individuals and population dynamics. (ID 15962)

**Hamilton, R. G.**, The Nature Conservancy, USA, bhamilton@tnc.org  
 APPLICATION OF THE FIRE-GRAZING INTERACTION MODEL FOR BIODIVERSITY CONSERVATION IN THE TALLGRASS PRAIRIE OF OKLAHOMA, USA<sup>†</sup>

The 1.5M ha Flint Hills of Oklahoma and Kansas comprise the largest tallgrass prairie landscape in North America. Cattle grazing regimens typically utilized in this privately owned grassland stress uniformity, which combined with high fire frequency, result in a largely homogeneous habitat with lowered grassland bird richness and biodiversity potential. Increasing prairie heterogeneity is a goal of The Nature Conservancy (TNC) in the Flint Hills. The first step in addressing the landscape homogeneity concern has been development and demonstration of biodiversity-focused range management tools. At TNC's 16,100 ha Tallgrass Prairie Preserve in northeastern Oklahoma, a free-ranging bison herd has for the past 20 years interacted with randomly selected burn patches that approximate the historic seasonality and frequency of fire. The resident herd of 2,700 bison graze on 9,600 ha of tallgrass prairie and crosstimbers woodlands. The fire-bison interaction produces an ever-shifting landscape patch mosaic that supports the full array of native grassland birds. Recognizing that the fire-bison regime is not likely to be exportable to the region's private rangelands, TNC has been working with Oklahoma State University since 2001 to develop "patch-burn grazing" regimes that promote heterogeneity using cattle. Research results have been encouraging: heterogeneity and grassland bird richness and overall biodiversity can be enhanced with little or no decrease in livestock production. An additional outreach strategy has been engaging ranchers in an effort to restore Greater Prairie-Chickens through range management practices that promote grassland heterogeneity. (ID 15926)

**Handel, C. M.**, USGS Alaska Science Center, USA, cmhandel@usgs.gov  
 Sauer, J. R., USGS Patuxent Wildlife Research Center, USA, jrsauer@usgs.gov  
 Amundson, C. L., USGS Alaska Science Center, USA, camundson@usgs.gov  
 Matsuoka, S. M., U.S. Fish and Wildlife Service, USA, steve\_matsuoka@fws.gov  
 HIERARCHICAL ANALYSIS OF BREEDING BIRD SURVEY DATA FROM  
 ROADSIDE AND REMOTE AREAS TO ESTIMATE POPULATION TRENDS  
 IN ALASKA

Arctic and boreal regions are experiencing some of the most rapid ecological changes globally in response to climate warming. These biomes host substantial populations of breeding birds, many of which are largely restricted to northern regions. Remoteness of most of these areas, however, renders the populations difficult and expensive to monitor. The Boreal Partners in Flight working group has made a concerted effort during the past two decades to consistently survey a series of North American Breeding Bird Survey (BBS) routes along the geographically-limited road system in Alaska. To complement this road-based effort, beginning in 2003 Boreal Partners in Flight also implemented the Alaska Landbird Monitoring Survey (ALMS), which is designed to monitor breeding birds across a stratified random sample of mini-grids in remote areas. The standardized point-transect protocol combines distance sampling and time-removal modeling in a unified framework to adjust counts for detection probability. Here we compare decadal trend estimates derived from the roadside BBS and off-road ALMS programs in a Bayesian hierarchical analysis to (1) evaluate concordance of the trend estimates for an array of species and (2) assess the feasibility and potential benefits of deriving composite estimates to meet regional monitoring goals. (ID 15950)

**Hanser, S. E.**, U.S. Geological Survey Forest and Rangeland Ecosystem Science Center, USA, shanser@usgs.gov  
 Knick, S. T., U.S. Geological Survey Forest and Rangeland Ecosystem Science Center, USA, sknick@usgs.gov

#### FALL HABITAT SELECTION AND MIGRATORY PATHWAYS OF SAGEBRUSH-OBLIGATE PASSERINES IN THE INTERMOUNTAIN WEST

Migratory bird species often navigate a wide variety of unfamiliar habitats, topographic features, and human disturbances that do not occur on their breeding or wintering range. Consequently, understanding the characteristics of migration pathways may help explain annual trends in bird populations. Brewer's (*Spizella breweri*) and sagebrush (*Artemisiospiza nevadensis*) sparrows breed in sagebrush habitats throughout the Intermountain West and have diffuse migratory systems with birds from individual breeding sites wintering throughout southwestern United States and Mexico. We first developed habitat suitability models for each species using eBird checklist data from the Fall migration period. We determined migratory endpoints between 19 breeding locations to 79 potential winter locations using an index of similarity for isotope levels measured in feathers. We then used circuit theory to model potential flow of migrating individuals across a surface of variable resistance. Preliminary analyses indicate that multi-scale evergreen shrub components, including sagebrush, were important predictors for sagebrush sparrows and elevation was important for Brewer's sparrows. Predicted migratory pathways for these species delineated a system of corridors containing multiple pinch points where individuals may concentrate during migration and decision points where corridors separate to multiple winter areas. Identification of these migratory pathways can inform future conservation actions in key areas for migrating Brewer's and sagebrush sparrows. (ID 16217)

**Hardy, M. A.**, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, USA, mahardy@wisc.edu  
 Hull, S. D., Bureau of Science Services, Wisconsin Department of Natural Resources, USA  
 Zuckerberg, B., Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, USA

#### DISTRIBUTION OF SHARP-TAILED GROUSE IN THE NORTHWEST SANDS ECOLOGICAL LANDSCAPE, WISCONSIN, USA

Sharp-tailed Grouse (*Tympanuchus phasianellus*) have exhibited significant long-term population declines in Wisconsin, USA and currently occupy highly fragmented landscapes in the northwestern portion of the state where patch connectivity and gene flow are thought to be limited. In 2013, researchers from the Wisconsin Department of Natural Resources and the University of Wisconsin-Madison initiated a multi-year study to assess the distribution and long-term population viability of Sharp-tailed Grouse under various land management and climate change scenarios. As part of this study, we conducted occupancy surveys in northwestern Wisconsin from 31 March-23 May 2014. We surveyed 117 roadside routes 2-3 times each ( $2.87 \pm 0.03$ ) during 3, 18-day sampling periods. Preliminary analyses suggested that occupancy ( $\psi = 0.16 \pm 0.06$ ) and detection ( $p = 0.30 \pm 0.11$ ) rates were both low during the first year of the study. These data will ultimately be combined with existing demographic data in a spatially- and temporally-explicit population viability analysis. Results of this study will provide researchers and managers with a better understanding of the factors that influence the distribution and persistence of sharp-tailed grouse populations in Wisconsin and facilitate more effective conservation and management of the focal species. (ID 16202 | Poster 16)

**Hargrove, L.**, San Diego Natural History Museum, USA, lhargrove@sdnhm.org  
 Unitt, P., San Diego Natural History Museum, USA, punitt@sdnhm.org  
 POOR REPRODUCTIVE SUCCESS OF THE GRAY VIREO (VIREO  
 VICINIOR) IN CALIFORNIA WHERE POPULATIONS ARE DECLINING

Since 1940, California populations of the Gray Vireo have collapsed, presumably because of parasitism by the Brown-headed Cowbird, which invaded the vireo's California range about 1915. The vireo is nearly extirpated from the San Jacinto Mountains, a former stronghold. Therefore, in 2012-2013 we studied the vireo's nest success in two regions of San Diego County, sites of California's largest known populations. The rate of nest failure was extremely high: only 17 of 95 nests fledged any young. By exposure days, the probability of nest survival was only 9%. Of the failures, 83% were due to predators. Video cameras revealed the Western Scrub-Jay as the most frequent nest predator. After all 10 instances of cowbird parasitism, the vireos abandoned the nest soon after it was parasitized. Models indicate that nests in the southern part of the county fared better than in the northern, while date, year, and nest-site measurements had little effect. The population in northern San Diego County has decreased substantially from that recorded 1997-2001 for the San Diego County Bird Atlas: in 2012-2013 only 6 territories located at a single site, out of 7 formerly occupied sites. This continuing range collapse contradicts recent climate-change models' predictions that the vireo's range should expand. The leading role of the scrub-jay rather than the cowbird in depressing nest success currently will make recovering the Gray Vireo more challenging than recovering the Least Bell's Vireo. (ID 16061)

**Harris, J. P.**, Oklahoma State University, USA, jonathan.harris@okstate.edu  
 O'Connell, T. J., Oklahoma State University, USA, tim.oconnell@okstate.edu  
 HABITAT USE OF GROUND-BASED PREDATORS: UNDERSTANDING  
 RISK FOR NESTING NORTHERN BOBWHITE (COLINUS VIRGINIANUS)

Populations of mesocarnivores have increased in temperate North America, potentially increasing predation rates on ground-nesting birds, such as the declining Northern Bobwhite (*Colinus virginianus*). The goal of this study was to identify areas of bobwhite habitat that are at high risk for nest predation by measuring predation rates of artificial bobwhite nests and mapping habitat suitability of common nest predators. We constructed 151 artificial bobwhite nests across 12 discrete patches representing 4 broad-scale cover types in western Oklahoma: upland grassland (3), riparian grassland (3), upland shrubland (3), and riparian shrubland (3). After 7 days, 76 nests (50.3%) were

depredated, with rates higher in riparian grassland and conversely lower in upland grassland and both riparian and upland shrubland. Maxent software was used to model spatial habitat use of mesocarnivores using occurrence data collected from scent station, spotlighting, transects for sign, and camera trap surveys, in conjunction with fine-scale vegetation data. Coyotes (*Canis latrans*) were widespread in the study area, although density and activity levels were greater along the riparian corridor. Striped Skunks (*Mephitis mephitis*) primarily used upland grassland of little bluestem (*Schizachyrium scoparium*) and switchgrass (*Panicum virgatum*). Our results suggest that shrub cover could be important to reduce nest predation on bobwhite relative to grass cover, and that efforts to increase nesting in uplands could reduce exposure of nests to patrolling predators like coyotes. (ID 16378)

**Harris, R. B.**, University of Washington, USA, rbharris@uw.edu

SPECIATION IN EURASIAN WAGTAILS (AVES: MOTACILLA): INFERRING PHYLOGENY, DELIMITING SPECIES, AND ESTIMATING GENE FLOW USING SNPS.

The use of next generation sequencing techniques to answer questions in phylogeography and phylogenetics is relatively new. Here I explore the use of reduced-representation genome sequencing to answer questions about inter- and intra-specific relationships in the passerine genus *Motacilla*. Relationships within this group are unclear, as the current taxonomy does not reflect the mitochondrial gene tree. Of the 11 recognized *Motacilla* species, the Yellow and White Wagtail species are continuously distributed across Eurasia during the breeding season and exhibit high levels of geographic variation in plumage signaling color within species. Eurasia is a range of enormous east-west expanse, but with few current major geographic barriers to migratory birds. Major climate changes caused by cyclical glaciation in the Pleistocene may have resulted in differentiation due to genetic drift and natural selection in isolation. Refugial areas are thought to have existed in western, eastern, and southern regions of Eurasia. To understanding what forces are involved in genetic and phenotypic divergence, I conduct estimate a species tree, conduct species delimitation, and estimate levels intra- and inter-specific gene flow in *Motacilla*. (ID 16072)

**Harrod, S. E.**, Texas State University, USA, seh122@txstate.edu  
Green, M. C., Texas State University, USA, claygreen@txstate.edu  
Weckerly, F. W., Texas State University, USA  
Simpson, T. R., Texas State University, USA

THE EFFECTS OF LANDSCAPE CHARACTERISTICS ON NESTING ECOLOGY OF CAVITY-NESTING BIRDS

Across Texas, cavity-nesting birds are under increasing pressure from habitat loss and degradation. Central Texas has undergone a radical transformation in the last 150 years; agricultural practices have decimated tall savanna grasslands and allowed for juniper woodlands to proliferate. Globally, cavity-nesting birds show varying responses to edge; in China, Grey-faced (*Picus canus*) and Great Spotted Woodpeckers (*Dendrocopos major*) showed little change in reproductive success at varying distances-to-edge, whereas Great Tits (*Parsus major*) and Yellow-rumped Flycatchers (*Ficedula zanthopygia*) showed decreased reproductive success when nesting close to edges. The only edge studies in Central Texas have focused on the endangered Golden-cheeked Warbler (*Dendroica chrysoparia*), leaving little knowledge as to how other cavity-nesters are affected by edge effects. Forty bluebird boxes were set-up among a variety of habitats at the Freeman Center outside of San Marcos. Eastern Bluebirds (*Sialia sialis*), Bewick's Wrens (*Thryomanes bewickii*), Black-crested Titmice (*Baeolophus atricristatus*), and Ash-throated Flycatchers (*Myiarchus cinerascens*) utilized the boxes and successfully fledged young. Within 35 meter buffers around each box, habitat variables such as percent of woody vegetation, habitat patch size, and perimeter-area ratio of the patch size were measured. A MANOVA was

conducted to test how well these predictors explained the overall success and the number of species at each box. Patch size and the interaction between perimeter-area ratio and percent of woody vegetation were found to be significant. I conclude that these variables best determine the overall success at each box, as well as the total number of species likely to use each box. Further research should be conducted to determine which other variables may influence nest success and species selection at each site. (ID 16018 | Poster 21)

**Harvey, M. G.**, Louisiana State University Museum of Natural Science, USA, mharve9@lsu.edu

Seeholzer, G. F., Louisiana State University Museum of Natural Science, USA, gseehol1@lsu.edu

Judy, C. D., Louisiana State University Museum of Natural Science, USA, cduffy1@lsu.edu

Maley, J. M., Moore Laboratory of Zoology, Occidental College, USA, jmaley@oxy.edu

Brumfield, R. T., Louisiana State University Museum of Natural Science, USA, robb@lsu.edu

COMPARATIVE PHYLOGEOGRAPHY USING GENOMIC DATASETS\*

With the increasing availability of genomic data in birds, comparisons across datasets are possible and have the potential to uncover general processes responsible for avian diversity. Comparisons are complicated, however, by the difficulty of obtaining the same genomic regions across species and by variation across datasets introduced by bioinformatics processing. In particular, the thresholds used for assembling sequencing reads may differentially bias datasets based on the level of variation present. Differential biases across species complicate comparisons. We examine these issues using datasets from two sets of markers, ultraconserved elements and markers associated with restriction enzyme cut sites (RAD-Seq loci), that contain different levels of variation. We also examine RAD-Seq data from four species that differ in their evolutionary histories (the *Rallus longirostris* / *elegans* group, *Trochilus polytmus* / *scitulus*, *Cranioleuca antisensis* / *baroni*, and *Xenops minutus*). We find that a relatively small proportion of RAD-Seq loci are orthologous across species. We also find that setting conservative thresholds for sequence read assembly biases inferences and reduces comparability across datasets. We discuss potential solutions to both of these issues and present ideas for best practices for comparative phylogeography using genomic data. (ID 16201)

**Hauber, M. E.**, Hunter College/CUNY, USA, mark.hauber@hunter.cuny.edu

MAFIA OR FARMER? COEVOLUTIONARY CONSEQUENCES OF RETALIATION AND FARMING AS PREDATORY STRATEGIES UPON HOST NESTS BY AVIAN BROOD PARASITES

Many host species of avian brood parasites have evolved to recognize and reject foreign eggs and chicks in the nest. Yet, other hosts accept and care for parasitic young, despite the fitness losses associated with raising non-kin. It has been suggested that nest predation upon host nests by brood parasites could select for coevolved acceptance by hosts, even when their cognitive and motor traits allow for the successful rejection of brood parasitism. Using a modeling approach, I analyzed the conditions that favor the evolution of two predatory strategies by parasites and the acceptance of parasitism in the presence of predatory parasites. The Mafia strategy represents retaliatory parasites that punish rejecter hosts by depredating their nests. In contrast, the Farmer strategy represents farming parasites which depredate advanced-stage host nests. Both predatory strategies benefit when hosts become available for future parasitism by renesting. The modeling showed that higher rates of parasitism and rejection, and lower rates of discovery of re-nests by farmer parasites, favor the Mafia strategy over Farmer. Host acceptance of parasitism never yielded greater fitness payoffs over the rejection of



parasitic eggs by hosts, implying that lack of host rejection in the presence of predatory brood parasites should not be taken as evidence of coevolution yielding an evolutionary equilibrium. Further experimental and empirical work should concentrate on documenting the frequency and context in which parasites discover and prey upon host nests, to better predict the conditions under which different strategies of predatory parasites are favored. (ID 15735)

**Hayward, J. L.**, Andrews University, USA, hayward@andrews.edu  
Henson, S. M., Andrews University, USA, henson@andrews.edu

#### HOT AND BOTHERED: CLIMATE CHANGE, CANNIBALISM, AND OVULATION SYNCHRONY IN GULLS

El Niño events can be used to study the effects of climate change on a short timescale. We found that (1) egg cannibalism in a Glaucous-winged Gull colony increased during El Niño events, when resources are scarce, and that (2) females laid eggs synchronously in dense parts of the colony. We use mathematical models and field experiments to test the hypotheses that (A) cannibalism can be adaptive when resources are low, and that (B) ovulation synchrony can be adaptive in the presence of cannibalism, because female gulls that lay eggs synchronously reduce the chance that their eggs will be cannibalized by neighbors. (ID 16074)

**Heath, S. K.**, University of California, Davis, USA, skheath@ucdavis.edu  
McCreedy, C., Point Blue Conservation Science, USA, cmccreedy@pointblue.org  
Latif, Q. S., Rocky Mountain Research Station, U.S. Forest Service, USA, qlatif@fs.fed.us  
Tonra, C. M., Migratory Bird Center, Smithsonian Conservation Biology Institute, TonraC@si.edu

#### RESPONSES OF RIPARIAN BIRDS TO (MOSTLY) PASSIVE RESTORATION OF MONO LAKE TRIBUTARIES

Riparian ecosystems of three major tributaries of Mono Lake, CA, USA have been subjected to decades of cumulative ecological damage caused by water diversions, water impoundments, and livestock grazing. Negotiations leading up to a landmark 1994 legal decision and a 2011 settlement agreement initiated restorative processes on these streams as early as the mid 1980's. Some active restoration has taken place (e.g., plantings, channel reopenings, and large woody debris placement), but most restoration has been passive (namely returning minimum requirement water flows and the cessation of livestock grazing). Court-ordered restoration plans did not prescribe bird population monitoring as a means by which to measure restoration progress. Nonetheless, interested stakeholders, including non-governmental organizations, academic institutions, and governmental agencies undertook sixteen years (1998-2013) of riparian bird research and monitoring to assess avian responses to restoration efforts. The comparison of contemporary bird species composition data to historic accounts and environmental impact assessments provides evidence that restoration efforts have been generally successful in creating breeding habitat for an expected assemblage of riparian breeding birds. Relative densities of shrub and ground nesting birds versus canopy and cavity nesting birds differed among tributaries, however, suggesting variability in community responses to different restoration trajectories among sites. Research on species of conservation concern including the Yellow Warbler (*Setophaga petechia*), Willow Flycatcher (*Empidonax traillii*), and brood parasite Brown-headed Cowbird (*Molothrus ater*) revealed multi-scale stressors affecting population processes. We found that while some local stressors can be addressed by restoration plans and practices (e.g., vegetation and water management), larger scale stressors (e.g., distances to source populations, cowbird foraging behaviors) are often not. (ID 16277)

**Heckscher, C. M.**, Delaware State University, USA, checkscher@desu.edu  
Gutierrez Ramirez, M., Delaware State University, USA, mariamargutierrez@hotmail.com

Kneidel, A. H., Delaware State University, USA, akneidel@gmail.com

#### NON-TRADITIONAL USE OF GEOLOCATORS REVEAL PRECISE SPATIOTEMPORAL ASPECTS AND EFFECTS OF VEERY TRANS-GULF-YUCATÁN VERSUS TRANS-GULF-CARIBBEAN SEA MIGRATION ROUTES TO SOUTH AMERICA

Autumn trans-Gulf migrants are generally assumed to travel across the Gulf of Mexico to the Yucatán Peninsula. Often overlooked is that many birds may cross both the Gulf and the Caribbean Sea en route to South America, avoiding Central America altogether. Using a non-traditional method, we were able to use light archival data to examine precise spatiotemporal aspects of Veery migration from North to South America including general routes traveled (i.e., the traditional Gulf- Yucatán route or Gulf-Caribbean Sea route). Our method remained reliable during equinox periods when estimates of latitude are often impossible using geolocators. We also examined potential costs associated with each route. Of >20 individuals, 48% traveled via the Gulf-Caribbean Sea (GCS) and 52% traveled the Gulf- Yucatán (GY) route. There was no difference between the two groups in departure date from North America. Birds traveling over the Gulf arrived at their initial destination (Central America, Greater Antilles) after nightfall following 13 to 24 hrs of nonstop flight, and those traveling over the Caribbean Sea typically arrived in South America between noon and late afternoon following a nonstop flight of between 7 and 18 hrs. GCS birds moved from North to South America in less time, and entered South America earlier, than those using a GY route. However, despite early arrival of GCS birds into South America, there was no difference in the date of arrival at wintering locations. No other variables compared between the two groups differed. Although sample size is small, this study is the first to track individuals representing a forest songbird species to examine the potential implications and carry over effects of the two migratory routes to South America. (ID 15986)

**Heimbuch, M. R.**, University of Washington-Seattle, USA, michael.heimbuch@gmail.com

Cimprich, D. A., Department of the Army, USA, david.a.cimprich2.civ@mail.mil

#### TESTING INTERPUBIC DISTANCE AS A MORPHOMETRIC FOR SEXING WHITE-EYED VIREOS

White-eyed vireos (*Vireo griseus*) are a sexually monomorphic species that can be difficult to sex in the field. Standard morphometric measurements, such as wing and tail length, are not as useful due to a high degree of overlap between sexes. Males ( $n=56$ , mean=60.223, SD=1.025) and females ( $n=21$ , mean=58.929, SD=1.238) wing lengths differed ( $t_{75}= 3.973$ ,  $p=0.0002$ ). A technique for measuring the interpubic distance, the distance between the distal ends of the pubic bones, has been developed and used to reliably sex other bird species. In 2013 and 2014 we captured and color banded white-eyed vireos in central Texas and measured their interpubic distance. We determined the sex of captured birds through a combination of resighting birds singing, tending nests with known sex birds, or the presence or absence of a brood patch later in the breeding season (cloacal protuberances are poorly developed in white-eyed vireos). Interpubic measurements of male ( $n=57$ , mean= 7.175, SD= 1.025) and female ( $n=21$ , mean= 9.912, SD= 1.136) white-eyed vireos differed ( $t_{76}= 10.160$ ,  $p<0.0001$ ). Interpubic distance may be a valid technique for sexing white-eyed vireos especially when augmented with other morphometrics, however these results should be verified with a larger sample size. Interpubic distance has potential for determining the sex of other sexually monomorphic species and could be a useful and efficient tool for field identification. (ID 16346 | Poster 72)

**Heinrichs, J.**, University of Washington/ Colorado State University, USA, jheinrx@u.washington.edu  
 Aldridge, C., Colorado State University, USGS Fort Collins Science Center, USA  
 O'Donnell, M., USGS Fort Collins Science Center, USA  
 Garman, S., USGS Geosciences and Environmental Change Science Center, USA  
 Schumaker, N., US EPA, USA  
 Homer, C., USGS/EROS Data Center, Sioux Falls, USA  
 Gummer, D., Parks Canada, USA

#### ASSESSING THE EFFECTIVENESS OF CORE AREAS FOR GREATER SAGE-GROUSE CONSERVATION: A SPATIALLY-EXPLICIT DEMOGRAPHIC APPROACH USING MANAGEMENT AND RESOURCE DEVELOPMENT SCENARIOS

Across the Greater Sage-grouse range, land managers are tasked with identifying populations that are secure versus those likely to decline. Even regionally, this is an onerous task with large, landscapes, multiple diverse threats and data sources, and an uncertain future. We present an integrative habitat and population approach that enables the quantitative investigation of the long-term dynamics of Sage-grouse populations under alternative protection, oil and gas development, and future climate scenarios. An initial spatially-explicit individual-based population model was constructed to assess the persistence of the critically endangered Canadian populations with static nest/brood-rearing habitat conditions. Even under optimistic parameterization, results suggest that multiple, simultaneous habitat protection, restoration and population recovery actions are needed avert near-term extirpation and meet Canadian recovery goals. An expanded version of the model is being applied across Wyoming, and includes habitat selection models for three life stages/seasons. The model is being used to assess the effectiveness of the currently identified core areas to support long-term persistence, using the core areas as static refuges surrounding leks. Within the WLCI region, we are modeling Sage-grouse responses to surface disturbance by oil and gas development, as well as interactions with climate change. We aim to create a framework that will be helpful in identifying key areas for conservation in Wyoming. With the availability of similar base layers in other regions, this modeling framework could be modified and applied to Sage-grouse populations throughout the western US. (ID 16412 | Poster 127)

**Hekel, J. R.**, Tulane University, USA, jhenkel@tulane.edu  
 Sigel, B. J., Nevada State College, USA, Bryan.Sigel@nsc.edu  
 Taylor, C. M., Tulane University, USA, caz@tulane.edu

#### OILING RATES AND CONDITION INDICES OF SHOREBIRD COMMUNITIES IN THE NORTHERN GULF OF MEXICO FOLLOWING THE DEEPWATER HORIZON OIL SPILL

The U.S. coastline of the Gulf of Mexico is an important wintering and stopover region for migratory shorebirds. The Deepwater Horizon oil spill (April – August 2010) impacted more than 1700 km of this coastline. Given the already declining population trend of many shorebird species, this event has the potential to affect populations through long-term exposure to toxins, degraded habitats, and altered food chains. We investigated the exposure to Deepwater Horizon oil on seven species of shorebirds that winter or stopover along the northern Gulf of Mexico. From October 2010 – May 2012, we captured and banded 691 shorebirds at six non-breeding sites that experienced varying levels of contamination from the spill. Of birds sampled, 22 were visibly lightly oiled. Three oiled birds were trapped more than one year after the well was capped. While only 3% of the total birds captured between 2010-2012 showed visible signs of oiling, an unknown but potentially larger number of shorebirds were likely exposed to indirect effects of the spill, such as decreased foraging time due to oiling of sites, or disturbance from cleanup activities. Fuel stores and fattening rates, as measured through plasma metabolites, in one species, Dunlin (*Calidris alpina*), were not influenced by site oiling level. However, level of disturbance at

study sites was a significant predictor of both fuel stores and glycerol levels, suggesting that shorebirds stopping over on spring migration may have had difficulty reaching necessary pre-migratory fuel stores in spring 2011 due to the high level of disturbance from cleanup activity on oiled beaches. (ID 15757)

**Henderson, M.**, Boise State University, USA, michaelhenderson2@u.boisestate.edu  
 Anderson, A. M., Boise State University, USA, alexandraanderson@u.boisestate.edu

Urban, E. H., Boise State University, USA, urbanhawk137@gmail.com  
 Heath, J. A., Boise State University, USA, julieheath@boisestate.edu

#### DO RESIDENT AMERICAN KESTRELS (*FALCO SPARVERIUS*) MAINTAIN TERRITORIES AND PAIR-BONDS YEAR-ROUND?

In partially migratory populations, the ability of birds to remain resident on breeding grounds may be affected by anthropogenic change such as: warmer winters, changes in land use, and availability of supplemental food (in the form of bird feeders). Resident birds that maintain territories or pair-bonds throughout the year may have the advantage of nesting earlier than migrants that leave the breeding grounds during the winter. In southwestern Idaho, American kestrels (*Falco sparverius*) are partially migratory and use shrub-steppe, agricultural, or rural habitat during the breeding and non-breeding seasons. Further, in most years, residents nest earlier than non-resident birds, and tend to pair with a bird of the same migratory strategy. We tested the hypothesis that residents nest earlier than non-residents because residents maintain year-round territories and pair-bonds. Also, we examined whether year-round territoriality depended on habitat type. From 2011-2014, we captured, marked, and resighted American kestrels in our study area during the non-breeding season (Nov-Feb), and then captured birds in nest boxes during the breeding season (April-June). We calculated distances between wintering locations and nesting sites and considered birds within 1 km of a nesting site as within its breeding territory. To examine pair-bonds, we calculated distances between paired birds in the previous winter. We observed 50 (n = 26 females, 24 males) kestrels in both breeding and non-breeding seasons. There was evidence that both males and females remained within 1 km of their nest site during the winter, regardless of habitat type. In addition, paired birds were typically caught or resighted within 3 km of each other during the non-breeding season. Results from the study will contribute to our understanding of how anthropogenic impacts may affect the costs and benefits of migratory strategies. (ID 16143 | Poster 62)

**Henson, S. M.**, Andrews University, USA, henson@andrews.edu  
 Saint Martin, W., Andrews University, USA, henson@andrews.edu  
 Hayward, J. L., Andrews University, USA, hayward@andrews.edu  
 TRADEOFF BETWEEN DAILY AND YEARLY REPRODUCTIVE SYNCHRONY IN COLONIAL SEABIRDS

On a yearly timescale, colonial birds breed approximately synchronously in an annual pulse within a time window set by photoperiod. If a nesting colony is sufficiently dense, higher frequency reproductive oscillations on a daily timescale can form within the annual pulse due to synchronized ovulation cycles. Tight annual pulses do not afford sufficient time for ovulation cycles to synchronize. Data from a colony of Glaucous-winged Gulls support the hypothesis that the degree of yearly synchrony is inversely related to the degree of ovulation synchrony. Yearly synchrony may be advantageous due to predator satiation (Fraser Darling effect); similarly, ovulation synchrony may be advantageous due to cannibal satiation during El Nino years with high cannibalism rates. This suggests a tradeoff between strategies of synchronous reproduction on two timescales. (ID 16079)

**Hepp, M. G.**, Simon Fraser University, Canada, mhepp@sfu.ca  
Green, D. J., Simon Fraser University, Canada, djgreen@sfu.ca  
van Oort, H., Cooper Beaudesne and Associates Ltd., Canada, hvanoort@cooperbeaudesne.com

Suzanne Beaudesne, S., Cooper Beaudesne and Associates Ltd., Canada  
Cooper, J., Cooper Beaudesne and Associates Ltd., Canada

#### IMPACT OF RESERVOIR OPERATIONS ON JUVENILE SURVIVAL OF A RIPARIAN OBLIGATE SONGBIRD

Post-fledging juvenile survival is a driving factor in avian population growth rates. However, measuring and determining factors that influence juvenile survival is challenging for neotropical migrants. This becomes more difficult for birds nesting in habitat impacted by reservoir operations where juvenile survival studies are lacking. We investigate whether flooded habitat due to reservoir operations may decrease post-fledging survival of a nesting riparian obligate, the yellow warbler (*Dendroica petechia*). To do this, we use a nine year recapture data set from breeding sites around the Arrow Lakes Reservoir in British Columbia supplemented by two years of post-fledging radio telemetry data. Using time to event analysis in conjunction with a generalized linear mixed model we will test our hypothesis that fledglings from nests in flooded territories will have lower juvenile survival than those from nests in dry territories. (ID 16334 | Poster 65)

**Hernandez-Palma, A.**, Louisiana State University, USA, ahern32@lsu.edu  
Stouffer, P. C., Louisiana State University, USA, pstouffer@lsu.edu

#### EVALUATION OF SECONDARY GROWTH FORESTS AS SUITABLE HABITATS FOR AMAZONIAN UNDERSTORY BIRDS

Deforestation in the Amazon rainforest is continuing to destruct habitat at an alarming pace. However about one-third of these clear-cut areas have been recently abandoned, allowing forests to regenerate. These secondary forests are now pervasive in Amazonia, yet their value to wildlife is not well understood, so there is an urgent need to assess the suitability of these habitats to forest wildlife, since they are about to become an important feature in human-dominated landscapes, and could play a major role in the conservation of Amazon megadiversity. Secondary forests may help mitigate some of the detrimental effects of fragmentation on the birds' nutritional condition. The Biological Dynamics of Forest Fragments Project (BDFFP) near Manaus, Brazil, is an ideal study area for addressing questions about the suitability of secondary forests; it allows for comparisons of the nutritional condition of birds living in secondary forests, forest fragments, and primary forests, as well as assessing the landscape effects and understanding its role in bird conservation. Here, I propose the use of five biomarkers: feather growth rate, feather quality, fluctuating asymmetry of tarsi length, stress hormone concentrations from feather samples, and structural color. These biomarkers help estimate the overall physical condition of Amazonian understory birds in order to evaluate the suitability of secondary forests to bird populations living in them. Preliminary results suggest that as secondary forests mature, the nutritional condition of birds significantly improves, suggesting a recovery point for most Amazonian understory bird guilds. Currently, secondary forests are an unplanned consequence of changing land-use practices and socio-economic conditions. However, they are increasingly being recognized for their potential to recover populations in fragmented landscapes. (ID 16376 | Poster 22)

**Hertel, F.**, CA State University, Northridge, USA, fritz.hertel@csun.edu  
Campbell, Jr., K. E., Natural History Museum of Los Angeles Co., USA, kcampbell@nhm.org

#### FLIGHT ARCHITECTURE, SPLAYED LEGS, AND THE EVOLUTION OF WADDLING IN BIRDS

Birds adapted their skeletal posture in response to a series of selective pressures related to the development of powered flight and an arboreal

lifestyle. Some of these concomitant changes involved the loss of the long bony tail, the development of a pectoral flight apparatus, and a less upright posture with splayed hindlimbs. Here we focus on differences between theropods and modern birds in the manus and hindlimb/pelvic regions. The forelimb digits of modern birds are rotated 90 degrees from the primitive condition such that their fingers flex/extend in the horizontal plane.

Archaeopterygians have their digits rotated almost 90 degrees, whereas all theropod dinosaurs examined exhibit the primitive condition with flexion/extension in the vertical plane. These differences likely relate to the ability of early birds to grasp vertical structures with their forelimbs and still hold their remiges in the horizontal plane, a movement different from that in theropods. This horizontal flexural position also was adaptive for a power stroke during flapping flight, movements not found in theropods. With a greater development of flight musculature, and the loss of a bony tail, the center of gravity moved forward of the acetabula, and the hindlimbs assumed a more flexed and splayed posture. In response to these hindlimb changes, the antitrochanter evolved to minimize hindlimb abduction and to transfer loads from the body to the hindlimb while rotating the suspended body over the supporting hindlimb during terrestrial locomotion. These structural features resulted in the waddle exhibited to varying degrees by all modern birds. Evolution of the osteological features characteristic of this evolving system of flight and balance of birds can be traced in the earliest avialans, including Archaeopteryx. They appear well developed in enantiornithine and early neornithine birds but are absent in theropods. (ID 16030)

**Hick, K. G.**, University of Windsor, Canada, hick1@uwindsor.ca  
Doucet, S. M., University of Windsor, Canada, sdoucet@uwindsor.ca  
Mennill, D. J., University of Windsor, Canada, dmennill@uwindsor.ca

#### DOES EXPERIENCE INFLUENCE INTER-SPECIFIC INTERACTIONS IN COMPETING NEOTROPICAL BIRD SPECIES?

Animals that defend resources are expected to be able to discriminate between rivals that represent a threat versus individuals that may either represent a mating opportunity or no threat at all. Misidentifying the species of a potential rival or a potential mate can have significant fitness consequences, therefore false recognition should be selected against. Experience may be an important component of interspecific recognition, allowing animals to learn to recognize novel competitors that they face due to changing environments. To investigate whether species discrimination is influenced by experience, we conducted playback experiments to a neotropical wren species, the Rufous-and-white Wren (*Thryophilus rufalbus*), that lives in sympatry and in allopatry with the Banded Wren (*Thryophilus pleurostictus*) in different parts of its distribution. These two species are closely related congeners that compete for resources, including nesting trees and food. By conducting playback to 24 territorial pairs in a zone of sympatry and 22 pairs in a zone of allopatry, we show that Rufous-and-white Wrens respond more strongly to conspecific songs than to congeneric songs. The responses to conspecific versus congeneric rivals, however, do not differ in areas of allopatry or sympatry, suggesting that experience has little influence on species discrimination. By comparing animals' responses to conspecific and congeneric rivals we can gain insight into the mechanism of species discrimination. Our research may shed light on how changing environmental conditions, leading to changes in species distributions, may influence competition between closely related species. (ID 15924 | Poster 2)

**Hill, G. E.**, Dept. Biol. Sci., Auburn Univ., USA, ghill@auburn.edu  
THE DUAL NATURE OF AVIAN ORNAMENTATION

Biologists have long debated the evolution of animal ornamentation via female choice. Early in this discussion, a dichotomy in explanations emerged in which mate choice was proposed to be either adaptive, leading to the evolution of condition-dependent signals of quality, or arbitrary, leading



to the evolution of aesthetic traits. In recent reviews, the evolutionary processes leading to adaptive or arbitrary mate choice have been recast as ends of a continuum. I propose that ornamental traits that signal condition are distinct from arbitrary signals of attractiveness in degree of elaboration, in the information that they convey, and in the evolutionary processes through which they evolve. Condition-dependent traits evolve as signals of respiratory efficiency and especially signals of mitonuclear compatibility. In contrast, aesthetic traits evolve as signals of species identity allowing females to choose mates with shared mitochondrial types. Once they are fixed in a population, arbitrary signals of species identity can be elaborated through a runaway sexual selection process into the gaudy traits displayed by some species. The outcome of these processes is two distinctly different types of ornaments that evolve to serve distinctly different signal function. Display traits can be fully understood only by embracing this dual nature of animal ornamentation. (ID 16037)

**Hille, D. C.**, University of Oklahoma, USA, hilledavid@gmail.com  
Wiedenfeld, D. A., American Bird Conservancy, USA, dwiedenfeld@dwiedenfeld.org

Lezama-Lopez, M., Paso Pacifico, Nicaragua, nicapinol2002@yahoo.com  
Brightsmith, D., Texas A & M University, USA, dbrightsmith@cvm.tamu.edu  
Patten, M. A., University of Oklahoma, USA, mpatten@ou.edu

#### OCCUPANCY TRENDS OF THE AVIAN FAMILY PSITTACIDAE IN NICARAGUA OVER A 20-YEAR MONITORING PERIOD

Biodiversity monitoring is a valuable conservation tool when assessing potential conservation and management decisions and can be successfully applied to psittacine conservation. Psittacines are of worldwide conservation concern and Nicaragua, a Central American country in the Neotropics, has a representation of psittacines that are confronted with similar conservation problems as are seen throughout the world: habitat loss and pressures from pet trade. We collected data through a national psittacine monitoring program in Nicaragua in 1994/1995, 1999, 2004, and 2013 to produce a 20-year data set in order to assess population trends for the 16 species of psittacines in Nicaragua. Surveys included up to 313 point counts, which broadly spanned the three ecological regions of the country. Conclusions imply that both increasing and decreasing population trends are driven by land use/land cover change as a result of deforestation, but there may also be evidence to suggest effects of pressures of pet trade as well. The results lay the foundation for establishing species-specific priorities in resource allocation for conservation and management action to ensure the conservation of psittacine diversity in Nicaragua and the whole of Central America. (ID 16106)

**Hillenius, W. J.**, College of Charleston, USA, hilleniusw@cofc.edu  
GROWING A RACHIS: THE TALE OF THE MARCHING BARBS. <sup>†</sup>

Birds are nearly ubiquitous, readily observable, and therefore intensively studied. Likewise, feathers – the quintessential avian feature – are easily recognizable and universally familiar. Feather regeneration, however, remains one of the more poorly understood and understudied aspects of avian biology. Textbook treatments of feather replacement processes are oversimplified and incomplete at best; they may be incomprehensible at worst. Feather regeneration involves a number of interconnected processes that take place simultaneously as well as sequentially, and which characterize different locations within and beyond the follicle. The interplay of multiple processes, temporally in three-dimensional space, no doubt contributed to the difficulty in reconstructing the signature events of feather regeneration, and in communicating these interpretations. One of the more persistent issues that bedevils descriptions of feather regeneration is the putative causal relationship between barb and rachis formation. Since the early 1930's it has been routinely stated that the "rachis forms from fusion of barbs," despite clear published evidence indicating that rachis formation

proceeds independently from barb formation, and should be considered a distinct developmental program. This talk will review the historical basis for the contrasting concepts of rachis formation and propose a generally understandable reconciliation of the available data. (ID 15777)

**Hobson, K. A.**, Environment Canada, Canada, Keith.Hobson@ec.gc.ca  
COMBINING GEOLOCATORS AND STABLE ISOTOPES TO INVESTIGATE MIGRATORY CONNECTIVITY IN BARN SWALLOWS

Barn swallows have experienced a dramatic population decline at their northern breeding sites but appear to be relatively stable at the southern extent of their range in North America. This situation provides a useful means of testing paradigms related to differential population trajectories through the comparative approach. My lab has been experimenting with several means of contrasting differences in migratory connectivity between decreasing (n=9) and stable or increasing (n=3) populations across North America. We have used geolocators with limited success (n=10 useable recoveries) but have also examined stable isotope ratios in feathers (n>500) grown on the wintering grounds ( $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ ,  $\delta^{34}\text{S}$ ,  $\delta^2\text{H}$ ). We have assigned birds to winter molt origin using a multi-isotope cluster approach and also a spatially explicit assignment approach to a dual isotope ( $\delta^{13}\text{C}$ ,  $\delta^2\text{H}$ ) feather surface. In general, barn swallows showed low levels of migratory connectivity throughout their range. Geocator results hint at northeastern populations being longer distance migrants to southern South America and western populations being more short-distance migrants to Central America and northern South America with possibly a mid-continent migratory divide. We compared isotope data from feathers of birds with recovered geolocators and were able to provide limited comparisons with the predicted isotope values. In general, these comparisons were favorable. In particular, we suggest that feather  $\delta^{34}\text{S}$  measurements may provide useful insights into the occurrence of molt in coastal marshes. Stable isotope assays can provide important complimentary information to geolocators studies. (ID 15828)

**Hobson, K. A.**, Environment Canada, Canada, Keith.Hobson@ec.gc.ca  
Van Wilgenburg, S. L., Environment Canada, Canada, Steve.Vanwilgenburg@ec.gc.ca

#### THE FUTURE OF STABLE ISOTOPE METHODS TO DETERMINE MIGRATORY CONNECTIVITY IN A GEOLOCATOR WORLD

The advent of light-sensitive geolocators to track the movements of small passerines during migration has greatly added to the toolbox of researchers interested in the study of migratory connectivity. Several researchers now consider this approach to surpass previous attempts to use naturally occurring endogenous markers such as stable isotopes to assign birds to molt origins. Here, we argue that large-scale isotopic atlasing combined with data, models and hypotheses from other data sources (e.g. extrinsic markers and BBS) is the most efficient means to rapidly establish large-scale connectivity for migratory wildlife. Our position is based on considerations of cost, the inherent advantages of endogenous markers, applicability to archived tissues and the utility of Bayesian assignment frameworks to assign individuals to origin using prior information. We use a number of applications from both the Nearctic-Neotropical and Palearctic-Afrotropical migratory systems to demonstrate how isotopic atlasing and recent assignment to isoscape approaches have rapidly advanced our understanding of connectivity for numerous species. In addition, we demonstrate how multi-isotope approaches based on long-term measured patterns of deuterium in precipitation and on models of plant and soil stable-carbon and nitrogen isotope ratios have advanced our ability to infer origins of migratory animals. Therefore, we advocate a coordinated approach to sampling Neotropical migrants on their wintering grounds as a rapid means of describing coarse-scale patterns of migratory connectivity that can better inform the use of other technologies like geolocators. (ID 15829)

**Hockman, E. V.**, University of Tennessee, USA, ehockman@vols.utk.edu  
 Buehler, D. A., University of Tennessee, USA, dbuehler@utk.edu  
 Prevost, S., University of Tennessee, USA, sprevest@vols.utk.edu

# GEOGRAPHIC VARIATION IN BIRDSONG: WILL AUTOMATED DETECTION ALGORITHMS EVER WORK?

The use of acoustic monitoring with automatic recording equipment has grown in the past decade and provides many useful solutions to persistent problems by monitoring multiple locations simultaneously, creating indisputable documentation of bird communities, and creating permanent audio records. Recording equipment can generate large volumes of acoustic data, however the development of automatic song detection programs has a long way to go. Song quality and structure can vary within an individual's repertoire, between birds, or between populations and can cause complications with automatic detection algorithms in even ideal recording environments. We used automated recording units to record typical and alternate songs from six different passerines (Bachman's Sparrow (*Peucaea aestivalis*), Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow (*Ammodramus savannarum*), Henslow's Sparrow (*Ammodramus henslowii*), Indigo Bunting (*Passerina cyanea*), and Prairie Warbler (*Setophaga discolor*)) in four different states over three breeding seasons to measure the amount of signal variation between different populations. We used Principle Component Analysis and Discriminate Function Analysis to determine which song characteristics were consistent and which song characteristics differed across each species' populations. We optimized automatic detection algorithms on each species' population by state and compared the accuracy of results after applying each state algorithm to other populations using the XBAT sound analysis program, developed by Cornell Lab of Ornithology's Bioacoustics Program. We present the key results from these acoustic analysis and draw conclusions about the use of automated detection analysis in bird song research. (ID 16261)

**Holland, A. E.**, University of Georgia, Warnell School of Forestry & Natural Resources/Savannah River Ecology Lab, USA, aeholland@srel.uga.edu  
 Byrne, M. B., University of Georgia, Warnell School of Forestry & Natural Resources/Savannah River Ecology Lab, USA, mbyrne13@uga.edu  
 Bryan, A. L., Savannah River Ecology Laboratory, USA, lbryan@srel.uga.edu  
 DeVault, T. L., USDA/APHIS/WS National Wildlife Research Center, USA, Travis.L.DeVault@aphis.usda.gov

Rhodes, O. E., University of Georgia, Odum School of Ecology/Savannah River Ecology Laboratory, USA, rhodes@srel.uga.edu  
 Beasley, J. C., University of Georgia, Warnell School of Forestry & Natural Resources/Savannah River Ecology Lab, USA, beasley@srel.uga.edu

# FINE-SCALE ASSESSMENT OF SEASONAL HOME RANGES FOR RESIDENT BLACK AND TURKEY VULTURES IN THE SOUTHEASTERN UNITED STATES\*

Fine-scale analyses of the spatial ecology of black (*Coragyps atratus*) and turkey vultures (*Cathartes aura*) are surprisingly limited, despite the importance of these species for ecosystem function and the substantial economic costs associated with conflicts between humans and vultures. Using solar-powered Groupe Spécial Mobile/Global Positioning System (GSM/GPS) transmitters, we gathered fine-scale location data, and quantified home ranges and core areas using the dynamic Brownian Bridge Movement Model for 6 black ( $n = 20,219$ ) and 7 turkey ( $n = 24,201$ ) vultures resident in the southeastern United States. We determined sex for each individual via molecular methods and analyzed home range data as a function of species, sex, and season (breeding vs. non-breeding). Previous studies of vulture space use have revealed considerable variation within and among species. Our study is the first to examine the influence of sex and seasonality on the movement patterns of individual vultures. The use of GPS satellite tracking devices and fine-scale sampling regimes, coupled with determination of

individual vulture sex and season, greatly improves our understanding of the factors that underlie vulture movement and dispersal patterns. This study will advance our understanding of vulture spatial ecology, benefiting conservation of these ecologically important species and providing managers with enhanced tools for predicting vulture presence and ultimately reducing economic costs of bird-strikes and other conflicts. (ID 16327)

**Hooper, D. M.**, University of Chicago, USA, dhooper1@uchicago.edu  
 Price, T. D., University of Chicago, USA, pricet@uchicago.edu

# GENOMIC REARRANGEMENT IN ESTRILID FINCHES: GENE FLOW AND POPULATION SIZE PREDICT EXTENT OF KARYOTYPE DIVERGENCE

Birds have long been used as models of speciation and are the best-studied group with respect to how behavior and ecology contribute to population divergence but an integrated evaluation requires an assessment of factors that drive post-mating isolation as well. Despite strong evidence that chromosome rearrangements contribute to adaptation and speciation in other groups, the degree to which they do so in birds remains to be examined. Indeed, chromosome rearrangements have been dismissed as unimportant in avian evolution despite the paucity of study and some evidence to the contrary. The Old-World finch family Estrildidae (order Passeriformes) provides an ideal system for studying variation in rates of chromosome evolution and the underlying factors responsible. The Estrildids comprise over 100 morphologically and karyotypically diverse species broadly distributed across Africa, Asia, Australasia, and Melanesia. A phylogenetic approach to investigating the drivers of inversion evolution in Estrildids based on a combination of cytological, demographic, and geographic data shows that the rate of inversion evolution varies almost 4-fold between equivalently aged continental and island radiations. The fixation rate of inversions differs greatly between groups of Estrildids; inversions accumulate four times faster on average in continental groups. Rates of rearrangement are strongly correlated with range overlap of species and marginally with population size. My results support an adaptive model of karyotype evolution whereby gene flow between diverging populations establishes the selective advantage for chromosomal rearrangement. (ID 15745)

**Horton, K. G.**, University of Oklahoma, USA, hortonkg@ou.edu  
 Stepanian, P. M., University of Oklahoma, USA, step@ou.edu  
 Kelly, J. F., University of Oklahoma, USA, jkelly@ou.edu

# SPRING MIGRATION ALONG THE EAST COAST, A LOOK AT REFLECTIVITY AND POLARIMETRIC MOMENTS

Deciphering taxonomic composition of migrant birds from weather surveillance radar reflectivity is exceedingly difficult. The use of avian flight calls can aide in this interpretation, yet currently this method of monitoring is limited in its geographic scope, and can be subject to detection biases. However, the 2013 upgrade of all WSR-88D radars to dual-polarization holds promise of deciphering coarse taxonomic classifications, yet validation of radar echo signatures at large ecological scales poses numerous logistical obstacles. Citizen science data, specifically eBird observations, can help to determine on the ground migrant composition, and may lend support to the composition of radar signatures of reflectivity. To this end, we present the first examination of seasonal patterns of polarimetric variables in reference to migratory passage. We focused our efforts on the spring of 2013, gathering measures from 33 WSR-88D radars spanning from Maine to Florida. We used radar reflectivity, correlation coefficient ( $\rho_{hv}$ ), differential reflectivity ( $Z_{DR}$ ), and specific differential phase (KDP) to explore how these metrics can be used to track the mass movements of large taxonomic groupings. (ID 16295)

**Hosner, P. A.**, University of Florida, USA, hosner@uf.edu  
 Kimball, R. T., University of Florida, USA, rkimball@ufl.edu  
 Braun, E. L., University of Florida, USA, ebraun68@ufl.edu

#### PHYLOGENY AND DIVERSIFICATION OF THE NEW WORLD QUAIL (ODONTOPHORIDAE)

The New World quail are familiar birds of Northern, Central, and tropical South America, but little is known about their systematic relationships. Here, we present a molecular phylogenetic hypothesis of the Odontophoridae, including all nine recognized genera and 21 of 32 recognized species. We sequenced eight unlinked nuclear introns and three mitochondrial genes, resulting in a matrix of 8,000 aligned nucleotides. DNA sequence data were analyzed in concatenated and coalescent frameworks using Bayesian and Maximum likelihood tree reconstruction. Results support that all currently recognized genera are monophyletic. We recovered two strongly supported clades: one comprised of primarily temperate/desert/savanna species (*Oreortyx*, *Colinus*, and *Callipepla*), and one comprised of primarily tropical woodland/forest species (*Cyrtonyx*, *Dactylortyx*, and *Odontophorus*). Biogeographical reconstructions supported a North/Central American origin of Odontophoridae, and that occurrence in South America is the result of multiple recent colonization events from Central America. Species diversity in the tropical forest genus *Odontophorus*, which includes approximately half of all Odontophorid species, is the result of a recent and rapid radiation. The sister group of the monotypic *Rhynchortyx* was unresolved due to strong cyto-nuclear discordance: nuclear genes strongly supported *Rhynchortyx* sister to other tropical quails (*Cyrtonyx*/*Dactylortyx*/*Odontophorus*), while mitochondrial genes strongly supported *Rhynchortyx* sister to all other New World Quail. (ID 16248)

**Hostetler, J. A.**, Smithsonian Conservation Biology Institute, USA, hostetlerj@si.edu  
 Marra, P. P., Smithsonian Conservation Biology Institute, USA, marrap@si.edu  
 Sillett, T. S., Smithsonian Conservation Biology Institute, USA, silletts@si.edu

#### THE EFFECTS OF MIGRATORY CONNECTIVITY ON AVIAN POPULATION VIABILITY

The strength of migratory connectivity (MC) has been shown to have an important effect on response to habitat loss, local adaptation, range expansion, and equilibrium population size for migratory populations, but its effects on population viability have not been explored. We present two hypotheses: 1) that MC affects viability through effective population size, source-sink dynamics, and winter competition; and 2) that MC mediates the relationship between environmental factors and viability. We test our hypotheses using a four-season population projection model that includes multiple populations, environmental stochasticity in all seasons, and density-dependence in summer and winter. We estimate probability of quasi-extinction at the population and species levels and examine sensitivity of extinction risk to vital rates under a range of MC strengths. We found little effect of MC alone on population extinction risk, but a large effect if MC affected the strength of dispersal between breeding populations. MC can affect species extinction risk both directly and indirectly. The strength of winter density-dependence affects the importance of MC. Non-identical habitat quantity and quality can also increase the importance of MC, through altering competitive interactions and use of winter sites of different quality. Increased MC can increase the importance of other vital rates on extinction risks. These results can inform decisions about research priorities for migratory birds of conservation concern. (ID 15951)

**Hovick, T. J.**, Oklahoma State University, USA, torre.hovick@gmail.com  
 Elmore, R. D., Oklahoma State University, USA, dwayne.elmore@okstate.edu  
 Fuhlendorf, S. D., Oklahoma State University, USA, sam.fuhlendorf@okstate.edu  
 Engle, D. M., Oklahoma State University, USA, dave.engle@okstate.edu  
 Hamilton, R. G., The Nature Conservancy, USA, bhamilton@tnc.org

#### SPATIAL HETEROGENEITY INCREASES DIVERSITY AND STABILITY IN GRASSLAND BIRD COMMUNITIES

Grasslands are inherently dynamic in space and time evolving with frequent disturbance from fire and herbivores. As a consequence of human actions, many remaining grasslands have become homogenous which has led to reduced ecosystem function, biodiversity loss, and decreased ecological services. We used a sophisticated experimental design to examine avian response to interacting fire and grazing across multiple experimental landscapes that represented a gradient of fire and grazing dependent heterogeneity. We used seven landscapes (480-900 ha) with varying levels of patchiness ranging from annually burned (one single patch) with spring only fires to a four year fire-return-interval with spring and summer fires (eight patches). This design created a range of heterogeneity as a result of pyric herbivory, an ecological process in which fire and grazing are allowed to interact in space and time. We found that greater heterogeneity across experimental landscapes resulted in increased avian diversity and stability over time. Turnover in the bird community, quantified as the sum of the range of detrended correspondence analysis axis scores, was nearly four times greater in the most homogenous experimental landscape when compared to the most heterogeneous experimental landscape. Species responses were consistently positively associated with increased heterogeneity at the landscape scale and within patch responses were most often related to litter cover, litter accumulation, and vegetation height. Overall, we conclude that increased fire and grazing dependent heterogeneity can result in high variability in the bird community at finer scales within patches but increased diversity and stability at broad landscape scales. We recommend future management efforts in rangelands focus on restored disturbance processes to increase heterogeneity and improve grassland bird conservation. (ID 15898)

**Hubbard, J. K.**, University of Colorado Boulder, USA, joanna.hubbard@colorado.edu  
 Hund, A. K., University of Colorado Boulder, USA, amanda.hund@colorado.edu  
 Albrect, T., Academy of Sciences of the Czech Republic, Czech Republic, albrecht@ivb.cz  
 Safran, R. J., University of Colorado Boulder, USA, Rebecca.safran@colorado.edu

#### GENETIC AND ENVIRONMENTAL CONTRIBUTIONS TO A DIVERGENT PLUMAGE TRAIT IN BARN SWALLOWS

A central theme of evolutionary research is to understand the source and function of phenotypic variation. For most phenotypic traits, sources of variation can be partitioned into genetic or environmental variation. Identifying the proportion of variance due to these components allows for predictions regarding phenotypic responses to variable environments and selection to be made. Barn swallow subspecies have divergent phenotypes and it appears that the focal trait for female preferences has also diverged. We examined the sources of phenotypic variation of melanin-based ventral plumage in two populations of barn swallows: North America (Colorado) and Europe (Czech Republic). In North America, male coloration is the target of sexual selection with darker males achieving higher reproductive success. However, it is unclear what role coloration plays in mate choice decision for our study population in the Czech Republic. In both populations, we found that coloration is explained by both genetic and environmental variation. However, comparative analyses suggest that there is no divergence among these populations in the additive genetic covariance structure for color traits. These results provide insight into the possible mechanisms that lead to phenotypic divergence between these recently diverged subspecies. (ID 16139)

**Hudson, E. J.**, University of Nebraska-Lincoln, USA, emilyjanehudson@gmail.com  
 Shizuka, D., University of Nebraska-Lincoln, USA, dshizuka2@unl.edu



# DIALECT DISCRIMINATION IN NESTLING, BUT NOT ADULT, GOLDEN-CROWNED SPARROWS

The ability to select appropriate conspecific song models is likely critical to a young songbird's reproductive success as an adult. However, studies of song learning in the lab have shown the extent to which innate preferences for conspecific songs can be overridden and heterospecific songs learned. We assayed nestling and adult Golden-crowned sparrows (*Zonotrichia atricapilla*) for behavioral discrimination between local and foreign conspecific dialects. Nestlings were tested at 7-8 days post-hatching by playing a three minute song file with either a local conspecific song type, a foreign conspecific song, or a heterospecific (but syntopic) White-crowned sparrow (*Z. leucophrys*) song. Adult male Golden-crowned sparrows were tested on their territories for behavioral response strength to the same songs used in the nestling protocol. We found that nestlings responded (chirped) significantly more to conspecific local songs than to either heterospecific or foreign conspecific songs. Adult males, by contrast, responded equally to both local and foreign songs, while they did not respond to heterospecific songs. These results suggest that early song preferences are locally specific, whether due to local adaptation or early experience. In contrast, the more generalized response of adult males to non-local dialects indicates that territorial responses may not accurately reflect discrimination ability. Our results highlight the need for further research into mechanisms that facilitate generalization. (ID 15808)

**Hudson, P. J.**, Pennsylvania State University, USA, pjh18@psu.edu  
**Almberg, E. S.**, Pennsylvania State University, USA, esa5046@psu.edu  
**Manlove, K. R.**, Pennsylvania State University, USA, krm17@psu.edu  
**Aiello, C. M.**, Pennsylvania State University, USA, cxa322@psu.edu

# PATTERNS AND ECOLOGICAL PRINCIPLES OF DISEASE INVASION<sup>T</sup>

A review of emerging diseases shows us that we know very little about the crucial steps of spillover from one host species to the next so this talk will examine the processes and patterns of disease invasion. What happens when we introduce a new host species? - how do they acquire infections from residents and what are the consequences for their dynamics and the residents? - what happens when we perturbate populations by adding hosts? We will look at the general patterns and illustrate them with data from recent studies and the consequences for wildlife management. (ID 16385)

**Humple, D. L.**, Point Blue Conservation Science, USA, dhumple@pointblue.org  
**Cormier, R. L.**, Point Blue Conservation Science, USA, rcormier@pointblue.org  
**Seavy, N. E.**, Point Blue Conservation Science, USA, nseavy@pointblue.org  
**Geupel, G. R.**, Point Blue Conservation Science, USA, ggeupel@pointblue.org  
**Gardali, T.**, Point Blue Conservation Science, USA, tgardali@pointblue.org

# BANDING DATA AS A RESOURCE FOR STUDYING LONG-TERM PATTERNS IN AVIAN PHENOLOGY

Banding data from constant-effort mist-netting programs provides an exciting opportunity to explore changes in avian phenology. Most publications on avian phenology in relation to climate change have focused on arrival or departure dates on migrants, which serve as a proxy for length of breeding season. While long-term nest monitoring programs reveal phenological patterns, such studies are relatively uncommon; more widespread constant-effort mist-netting programs have the potential to reveal phenological patterns that may help us assess impacts of climate change at multiple scales. Such programs produce metrics of breeding phenology (brood patch, cloacal protuberance, juvenile capture) and molt. Using a 43-year dataset from the Palomarin Field Station where intensive netting occurred and data from nearby sites where netting occurred approximately every 10 days, we investigated the utility of these data to evaluate phenological changes. Over this time period, population sizes of some species changed significantly, as did some data-collection methods. Palomarin's 34-year nest-monitoring dataset provides an additional opportunity to calibrate the mist netting

results, providing applications for sites where only netting occurs. Our results demonstrate some of the opportunities as well as challenges of assessing potential impacts of changing climatic conditions on avian phenology, and the ability to assess phenological patterns in resident landbirds and not merely migrants. (ID 16336)

**Hund, A. K.**, University of Colorado at Boulder, USA, amanda.hund@colorado.edu  
**Hubbard, J. K.**, University of Colorado at Boulder, USA, joanna.hubbard@colorado.edu  
**Safran, R. J.**, University of Colorado at Boulder, USA, rebecca.safran@colorado.edu

# PARASITE-MEDIATED SEXUAL SIGNALING: WHAT DO FEMALES GAIN?

The Hamilton-Zuk hypothesis proposes that host-parasite co-evolution maintains the honesty of sexual traits and predicts that attractive males with the greatest degree of sexual trait expression have lower parasite loads. Accordingly, this hypothesis also predicts that females use these signals as indicators of parasite resistance. Parasites are common in many species and represent a cost to their host as they can limit investment in reproduction and affect breeding success. Using parasite-linked sexual traits in mate selection could confer benefits to females in at least two ways: attractive males could 1) have greater genetic resistance to parasite (indirect benefits), and/or 2) offer a better environment for developing nestlings to avoid or offset the costs of parasites (direct benefits). In a breeding population of North American barn swallows *Hirundo rustica* in Colorado, I applied a reciprocal cross-fostering design where I experimentally manipulated parasites in nests to establish the degree to which females use male ventral coloration – a sexual signal in this population of barn swallows - for information about parasite-resistant genotypes or parasite-free environments. Because parasites differ across spatial scales, parasite-mediated signaling may be based on different suites of parasites in different populations. This study will help me to tease apart the role of parasites in driving sexual selection and mate choice in North America allowing for comparative studies on barn swallow subspecies with divergent sexual selection on different plumage-based traits in the Czech Republic and in Israel. (ID 16039)

**Hunt, P.**, NH Audubon, USA, phunt@nhaudubon.org  
**Parent, K.**, Plymouth State University, USA, kwparent@gmail.com

# EXTRA-TERRITORIAL MOVEMENTS BY EASTERN WHIP-POOR-WILLS (ANTROSTOMUS VOCIFERUS)

In the course of conducting research into the habitat use of the Eastern Whip-poor-will (*Antrostomus vociferus*), we discovered two males that did not follow the typical pattern of remaining within a restricted territory during the breeding season. Over a six week tracking period, these two birds were detected at five different sites scattered across approximately 250 hectares, with three of these sites being used by both birds at least once, sometimes simultaneously. Eight other male whip-poor-wills tracked in 2010-12 never exhibited this wandering behavior, and instead remained faithful to territories of 1-12 ha (mean = 4.8). Because male Eastern Whip-poor-wills share in incubation and brooding duties, we assume that neither male had successfully obtained a mate. However, the reasons for their extra-territorial behavior remain unknown. (ID 16004 | Poster 4)

**Husak, M. S.**, Cameron University, USA, michaelh@cameron.edu  
**Landoll, D. V.**, University of Oklahoma, USA, dvl04@hotmail.com

# COMPARING NESTING SUCCESS AND PREDATION RATES OF SCISSOR-TAILED FLYCATCHERS AMONG THREE HABITAT TYPES

While previous studies have addressed nesting success for Scissor-tailed Flycatchers (*Tyrannus forficatus*), none have been of sufficient duration to

address variation in success rates and factors contributing to nest failure across years. We tracked >800 nests over seven breeding seasons in southwestern Oklahoma, USA. Our study sites contained three distinct habitat types: oak (*Quercus* spp.)-elm (*Ulmus* spp.) savannah associated with native mixed-grass prairie, mesquite (*Prosopis glandulosa*) savannah associated with invasive grass species, and urban habitat in and around the city of Lawton, Oklahoma. Nesting success varied significantly among years (22% - 44%) and among habitat types. Nest success was highest in urban habitats and lowest in the oak-elm savannah. Low success in the oak-elm savannah was associated with higher predation rates than the other two habitat types, accounting for up to 85% of nest failures in some years. Nesting failure due to weather-related events were uncommon, with the exception of one year of observation in which almost 30% of nest loss was due to wind. We used wildlife cameras positioned in nest trees to determine primary predators of Scissor-tailed Flycatcher eggs and nestlings for two breeding seasons. All predation events to date were associated with raptor species. A single nest failure due to Brown-headed Cowbird (*Molothrus ater*) parasitism was also documented. (ID 16313 | Poster 119)

**Huyvaert, K. P.**, Colorado State University, USA, kate.huyvaert@colostate.edu  
Franklin, A. B., USDA/APHIS/National Wildlife Research Center, USA, alan.b.franklin@aphis.usda.gov  
Root, J. J., USDA/APHIS/National Wildlife Research Center, USA, jeff.root@aphis.usda.gov  
Shriner, S. A., USDA/APHIS/National Wildlife Research Center, USA, susan.a.shriner@aphis.usda.gov

#### CLOSING REMARKS: ECOLOGICAL PRINCIPLES OF EMERGING INFECTIOUS DISEASES IN BIRDS SYMPOSIUM<sup>T</sup>

Understanding the ecological principles driving emergence is paramount for developing effective conservation strategies. This symposium will have provided an overview of general principles of avian disease ecology and ecoimmunology, a description of patterns of disease emergence in birds, and work focused on the anthropogenic factors affecting emergence. In this talk, we will provide a synthesis of lessons learned from the talks in the symposium as well as thoughts on gaps in our knowledge in the field with an emphasis on needs for future research. (ID 16142)

**Igl, L. D.**, US Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, ND, USA, ligl@usgs.gov

#### DECISION SUPPORT FOR RESTORATION AND MANAGEMENT OF NATIVE PRAIRIES IN THE NORTHERN GREAT PLAINS: IMPLICATIONS FOR GRASSLAND BIRD COMMUNITIES.

More than 100,000 ha of native prairies are managed by the U.S. Fish and Wildlife Service (FWS) in the northern Great Plains. Although prairies in this region evolved with grazing, fire, and climatic variability, management of FWS grasslands often has been passive and involved extended periods of rest (i.e., no disturbance). Extended rest has been implicated as a contributing factor in large-scale invasions by woody vegetation and cool-season exotic plants on FWS grasslands. FWS grasslands in this region differ by degree of invasion, species composition of invasive plants, and other attributes (e.g., precipitation), making management of these grasslands a complex problem with many uncertainties. In 2008, the U.S. Geological Survey and the FWS initiated a collaborative effort (Native Prairie Adaptive Management Project [NPAM]) to develop an adaptive decision-support system to guide and support FWS management actions that address invasive plant issues and restoration efforts on FWS grasslands in the northern Great Plains. By explicitly addressing uncertainties through application of adaptive management, FWS refuge biologists and managers (i.e., the end users) are using iterative cycles of decision making, management action, and monitoring to reduce uncertainty and thereby improve future management decisions.

The framework of NPAM rests on a set of models that express competing hypotheses about vegetation response to these management treatments. Realistically, shifts in vegetation structure and composition through time also influence habitat quality and quantity for grassland birds. In 2011-2013, we included a grassland breeding-bird component to the NPAM effort and developed competing models for the response of grassland breeding birds to the various management strategies (rest, fire, livestock grazing, and grazing with fire) that are being used to restore floristic composition of native grasslands on FWS-owned management units. (ID 15910)

**Iko, W. M.**, US Geological Survey, USA, ikob@usgs.gov  
Fike, J. A., US Geological Survey, USA, fikej@usgs.gov  
Stendell, R. C., US Geological Survey, USA, rstendell@roadrunner.com  
Oyler-McCance, S. J., US Geological Survey, USA, sara\_oyler-mccance@usgs.gov

#### INVESTIGATING CURRENT AND HISTORIC WHITE-TAILED KITE POPULATION TRENDS USING MOLECULAR GENETIC TECHNIQUES

The White-tailed Kite (*Elanus leucurus majusculus*) has demonstrated large population fluctuations over the last 150 years. Once common in California, Texas, and the southeast United States, kite numbers declined to very low levels in the 1900s. By the 1930s, the species was considered on the verge of extinction. By the 1940s, however, a trend towards recovery was apparent, and increasing numbers were observed during the following decades. Today, the White-tailed Kites are common residents throughout much of California, with slow but steady increases in population numbers in the Central Plains states, Texas and Florida. It is unknown whether current U.S. populations suffered a severe genetic 'bottleneck' in the early 1900s and have rebounded since, or whether current U.S. population growth has been related to immigration from Central and South America populations. We used next generation sequencing techniques (shotgun sequencing) to isolate and develop primers for a suite of 18 polymorphic microsatellite markers from White-tailed Kites. We genotyped 23 "modern" kites collected in California in the 1990s using those 18 loci and found moderate to low genetic diversity compared to other avian microsatellite studies, suggesting that a genetic bottleneck may have occurred. To further investigate this question, we plan to genotype ~20 White-tailed Kite museum specimens that were collected before the 1930s and compare their genetic diversity to our modern samples. This information will provide clues as to whether modern Kites in California in fact have low diversity due to a genetic bottleneck or whether they were founded and sustained by immigrants from other continents. (ID 16230 | Poster 64)

**Inselman, W. M.**, South Dakota State University, USA, will.inselman@sdstate.edu  
Datta, S., South Dakota State University, USA, Shubham.Datta@sdstate.edu  
Jenks, J. A., South Dakota State University, USA, Jonathan.Jenks@sdstate.edu  
Jensen, K. C., South Dakota State University, USA, Kent.Jensen@sdstate.edu  
Swanson, C. C., U.S. Fish and Wildlife Service, USA, chris\_swanson@fws.org  
Grovenburg, T. W., South Dakota State University, USA, Troy.Grovenburg@sdstate.edu

#### BUTEO ECOLOGY: AN INTENSIVE STUDY OF SWAINSON'S HAWKS (BUTEO SWAINSONI) ON THE NORTHERN GREAT PLAINS

Swainson's hawk is a long-distance migratory raptor that nests primarily in isolated trees situated in areas of high grassland densities. In recent years, anthropogenic conversion of grassland habitat has raised concerns about the status of the current breeding population in the Northern Great Plains. In 2013, we initiated a study to investigate the influence of local- and landscape-scale factors influencing the reproductive success of Swainson's hawks in north-central South Dakota and south-central North Dakota. Using ground and aerial surveys, we located and monitored nesting Swainson's hawk pairs: 70 in 2013 and 119 in 2014. Adult survival during the breeding

season was 90.9% (95% CI=0.56-0.98). Additionally, we used Program MARK and estimated that nest survival was 11.9% (95% CI=0.05-0.26) in South Dakota and 52.7% (95% CI=0.36-0.68) in North Dakota. During 2013, 34 chicks fledged; 1.75 fledglings/pair in South Dakota and 1.43 fledglings/pair in North Dakota. In 2013, we captured and radio marked 13 breeding Swainson's hawks to evaluate home range size and adult survival during the breeding season. Minimum convex polygon home range estimates (95% and 50%) for 10 adult Swainson's hawks averaged 1.91 km<sup>2</sup> and 0.24 km<sup>2</sup>, with males and females exhibiting similar home ranges ( $P = 0.12$ ). Land cover variables and anthropogenic development did not have an effect on overall nest survival. Home ranges were smaller than previously documented studies suggesting the availability of high quality habitat. These results will provide management agencies critical baseline information on the impacts of continuous grassland conversion on the reproductive ecology of Swainson's hawks on the Northern Great Plains. (ID 16236)

**Jackson, A. K.**, Oregon State University Department of Fisheries and Wildlife, USA, allysonkjackson@gmail.com  
Eagles-Smith, C. A., U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, USA, ceagles-smith@usgs.gov

#### AQUATIC NUTRIENT AND MERCURY CONTAMINANT SUBSIDIES TO WILLAMETTE VALLEY RIPARIAN SONGBIRDS

Mercury, a contaminant historically thought to be isolated in aquatic systems, has recently been shown to also impact terrestrial foodwebs that rely on aquatic nutrient subsidies. As we develop a better understanding of the effects of mercury (Hg) exposure on riparian songbirds, several basic questions remain, including why species vary considerably in their Hg exposure. The objectives of this study are to explain variation in Hg exposure between individuals and species based on diet, traced through stable isotopes of carbon and nitrogen. In 2013, songbird blood samples ( $n = 707$ ) were collected at 24 sites along the Willamette River in Oregon, a water body with a legacy of mercury pollution from gold and mercury mining in its headwaters. Preliminary data suggest that mercury exposure in songbirds varies throughout the system based on habitat, species, and individual differences. Aquatic and terrestrial invertebrates were also sampled at each site, and mixing models were used to understand how much aquatic-sourced prey is found in riparian songbird blood. This study has important implications for understanding the connection between aquatic and terrestrial systems; bird species that eat more aquatic-based prey likely bioaccumulate higher levels of Hg. (ID 15781)

**Jackson, M. M.**, University of British Columbia, Canada, michellegooch@gmail.com  
Martin, K., University of British Columbia, Canada, kathy.martin@ubc.ca  
Gergel, S., University of British Columbia, Canada, sarah.gergel@ubc.ca  
CLIMATE-INDUCED HABITAT DECLINES FOR AN ENDEMIC ALPINE SPECIALIST IN A COASTAL ALPINE ECOSYSTEM

Coastal alpine ecosystems in western North America are especially vulnerable to climate change, often existing as isolated patches at relatively low elevations. We ask how climate change will affect suitable habitat for Vancouver Island White-tailed Ptarmigan (WTP), an endemic subspecies restricted to coastal alpine and subalpine habitat. We developed models using summer occurrence data from field surveys (1995-1998;  $N = 207$  ptarmigan locations) and 7 topographic and climatic predictors. The models (Random Forest, Boosted Regression Trees, GLM, GAM and an ensemble model) were validated against an independent opportunistic dataset collected by hikers (1995-2013;  $N = 140$ ). Elevation, aspect, mean summer temperature, and precipitation as snow contributed the most to model predictions. According to the ensemble model, three global climate models and two IPCC climate change scenarios, 48-50% of suitable habitat for Vancouver Island WTP will

be lost by 2080. Patches of suitable habitat are predicted to become smaller, with a mean patch size decrease of 55%. Predicted future habitat will be located primarily in Strathcona Provincial Park, in the center of Vancouver Island and the current core ptarmigan range. These results strongly justify the continued protection of this provincial park and should be used to inform management of other coastal alpine species. As ptarmigan are year-round residents, further research will quantify changes in winter habitat and connectivity between seasonal habitats based on ptarmigan seasonal movement distances. (ID 16053)

**Jankowski, J. E.**, University of British Columbia, Canada, jankowsk@biodiversity.ubc.ca  
Londoño, G. A., University of California, Riverside, USA, galondo2010@gmail.com  
Robinson, S. K., University of Florida, USA, srobinson@flmnh.ufl.edu  
COMPETITION, NEST PREDATION, AND ELEVATIONAL RANGE LIMITS OF TROPICAL BIRDS

Tropical mountains support diverse avian communities due to high species turnover generated by narrow elevational ranges. We investigate the importance of biotic factors in reinforcing elevational ranges, specifically focusing on interspecific competition and nest predation, two biotic interactions that may have widespread effects on species distributions. We find that the strength of interspecific competition between species with parapatric distributions may depend upon the density and occupancy of congeners at range margins. We also find a dramatic shift in nest predation with elevation, with a transition from high nest predation in the lowlands and foothills to lower nest predation at higher elevations. Remarkably, species turnover was highest where rates of nest predation and composition of the predator community changed the most. These shifts in the nest predator community and rates of nest predation can explain variation in nesting success and could thereby limit elevational ranges, with community-wide effects. Taken together, we show that biotic interactions can have important species-specific and community-level consequences, and the strength of interactions may vary in predictable ways. Empirical data on the strength of various biotic interactions will be crucial to make informed predictions for how species and communities respond to shifting climates. (ID 16141)

**Jenkins, J. M.**, University of Missouri, USA, jmappp@mail.missouri.edu  
Thompson, F. R., Northern Research Station, US Forest Service, USA, thompsonf@missouri.edu  
Faaborg, J. R., University of Missouri, USA, faaborgj@missouri.edu  
POSTFLEDGING DISPERSAL AREA LANDCOVER AND SURVIVAL OF ACADIAN FLYCATCHERS AND OVENBIRDS IN A MISSOURI FOREST FRAGMENT

In species with complex lifecycles, habitat requirements and risks vary among life stages. The juvenile stage is the least understood life stage in Neotropical migratory birds. Recent research has reported high mortality rates for juveniles during the first few weeks out of the nest. Understanding how postfledging forest songbirds use habitat during this period will help inform conservation. Our objective was to conduct a preliminary analysis of habitat use and survival for postfledging juvenile Ovenbird, *Seiurus aurocapillus* (OVEN) and Acadian Flycatchers, *Empidonax virens* (ACFL) in a large forest fragment. In 2012 and 2013, 11 OVEN and 10 ACFL were tracked for more than a day postfledging. OVEN were observed for an average of 13.45 days (min=1, max=48) and ACFL were tracked an average of 19.4 days (min=1, max=44). Five birds were observed past 22 days, into the independent-postfledging stage. We estimated daily survival and proportion of landcover within minimum convex polygon use areas for the dependent-postfledging period. Ovenbirds had lower survival probabilities than Acadian Flycatchers in the first few weeks out of the nest. Both species were found



more often in open understory areas (interior forest; 85-87% of dispersal areas) than in areas of dense understory (edge and regenerating gaps; 13-15% of dispersal areas). (ID 15798)

**Jennings, S.**, Oregon State University, USA, scott.jennings@oregonstate.edu  
Varsani, A., University of Canterbury, New Zealand, arvind.varsani@canterbury.ac.nz

Dugger, K. M., Oregon State University, USA, katie.dugger@oregonstate.edu  
Ballard, G., Point Blue Conservation Science, USA, gballard@pointblue.org  
Ainley, D. G., H.T. Harvey and Associates, USA, dainley@penguinscience.com  
SEX-BASED DIFFERENCES IN ADÉLIE PENGUIN CHICK GROWTH RATES ON ROSS ISLAND, ANTARCTICA

We measured growth of Adélie Penguin (*Pygoscelis adeliae*) chicks during 2 breeding seasons with contrasting reproductive success at Cape Crozier, Ross Island, Antarctica. Mass (g) and flipper, bill, tibiotarsus, and foot length (mm) were measured at 5-day intervals for 45 male and 40 female individually-marked chicks. Chick sex was determined molecularly from feathers collected from each individual. We observed no differences in sex ratio by hatching order ( $X^2 = 0.35$ ;  $P$ -value=0.84), and between seasons ( $X^2 = 0.21$ ;  $P$ -value=0.65). We used linear mixed effects models to compare daily growth rate to chick sex, hatching order (A, B, or single chick) and season, and included nest as a random effect to account for lack of independence between siblings. We compared AIC values to select the model with the best combination of additive main effects and in some cases interactions that we hypothesized might be important. Accounting for season and hatching order, male chicks gained mass an average of  $15.6 \text{ g day}^{-1}$  (95% CI:  $5.6\text{-}25.5 \text{ g day}^{-1}$ ) faster than females ( $t$ -value=3.12;  $P$ -value=0.004). Growth in bill length showed a similar pattern ( $t$ -value=2.90,  $p$ -value=0.004) but the magnitude of the difference may not be biologically meaningful ( $0.05 \text{ mm day}^{-1}$ , 95% CI:  $0.02\text{-}0.09$ ). There was no evidence for sex based differences in growth of other skeletal measurements. While skeletal growth appears to be relatively fixed between sexes and possibly across seasons, it appears that male and female chicks gain mass at different rates, with potentially-important implications for fledging size, recruitment rates, and ultimately population change. (ID 15909)

**Jirinec, V.**, College of William & Mary, USA, vjirinec@email.wm.edu  
Leu, M., College of William & Mary, USA, mleu@wm.edu

WOOD THRUSH MICROHABITAT ASSOCIATIONS: IMPLICATIONS FOR SPECIES PERSISTENCE IN A HUMAN-MODIFIED LANDSCAPE

Following the trend of many populations of migratory birds, the Wood Thrush (*Hylocichla mustelina*) has experienced long-term range-wide declines over the last few decades. A number of studies indicate that the Wood Thrush is an area-sensitive species: nest success and probability of occurrence decline with decreasing forest patch size. However, our five-year point count study in suburban and rural areas in coastal Virginia provides little evidence for decreased probability of occurrence in smaller forest fragments. Perhaps then, low-density housing development per se is not necessarily detrimental to Wood Thrush population viability, as long as certain habitat requirements are met. Although the species has been extensively researched, there is little information available on Wood Thrush microhabitat use. We hypothesize that microhabitat features explain the space-use pattern in the species, and predict that high-use areas within home ranges will have: a) a specific set of vegetation structural characteristics not found in low-use areas, and b) a higher invertebrate prey abundance than low-use areas. To track habitat use, we captured and radio-tracked 40 birds over two breeding seasons (2013, 2014) in tandem with vegetation and food abundance sampling. Preliminary analyses of the 2013 data indicate that high-use areas ( $n=20$ ) have more downed woody debris, maple and American Holly saplings, and contain

higher dry mass of worm and beetle-like leaf litter invertebrates than low-use areas. Understanding microhabitat use can be important in informing conservation plans for this quickly-declining species. (ID 16098)

**Jodice, P.**, South Carolina Cooperative Research Unit, USA, pjodice@clemson.edu

Mackin, W., Guilford College, USA, willmackin@gmail.com  
Satge, Y., Clemson University, USA, ysatge@clemson.edu  
Harrison, A. L., Clemson University, USA, autumnl@clemson.edu  
Phillips, R., British Antarctic Survey, United Kingdom, raphil@bas.ac.uk  
USE OF MID-LATITUDE AND PELAGIC WATERS BY BAHAMIAN SEABIRDS

Much of the research that has focused on seabirds in the northwest Atlantic has been conducted in northern latitudes with little effort expended on seabirds that breed in the Caribbean. As part of a growing effort to better understand the ecology and conservation of Caribbean seabirds we have been deploying tracking devices on breeding birds at colonies in The Bahamas, Jamaica, St. Eustatius, Trinidad & Tobago, and Mexico. Here we discuss movement patterns and use of marine habitats by Audubon's Shearwater (*Puffinus lherminieri*) and White-tailed Tropicbird (*Phaethon lepturus*). We attached BAS geolocators to 11 shearwaters and 13 tropicbirds in June 2008 at colonies in The Bahamas. We retrieved 6 devices from shearwaters and 5 from tropicbirds between 2009 and 2013. While breeding birds occurred primarily in north Caribbean waters nonbreeding birds quickly departed colonies for higher latitudes and remained outside of Caribbean waters for 6-8 months. There was a moderate amount of spatial overlap among individuals within species during the nonbreeding season but not between species. Shearwaters tended to winter closer to the North-American shelf while tropicbirds wintered in pelagic waters, in some cases nearing the mid-Atlantic ridge. An assessment of the probability of occurrence within marine ecoregions also confirms that the two proximally breeding species tend to occur in different regions of the northwest Atlantic during much of the nonbreeding period. Conservation efforts for Caribbean seabirds should recognize that at-sea threats may be far-ranging and varied even for species breeding on nearby islands. (ID 16222)

**Jodice, P.**, SC Cooperative Research Unit/Clemson Univ., USA, pjodice@clemson.edu

Ronconi, R., Acadia University, Canada, rronconi@yahoo.com  
Rupp, E., Grupo Jaragua, Dominican Republic, ernstrupp@web.de  
Freifeld, H., American Bird Conservancy, USA, hfreifeld@abcbirds.org  
Wallace, G., American Bird Conservancy, USA, gwallace@abcbirds.org

FIRST SATELLITE TRACKS FOR BLACK-CAPPED PETRELS

Black-capped Petrels are one of the most threatened seabirds in the north Atlantic. The breeding population is estimated to be 600 – 2,000 pairs and the few known breeding sites occur in remote areas in Haiti and the Dominican Republic. Although it is not uncommon to observe adults at sea off the coast of Cape Hatteras, North Carolina, little is known about their at-sea distribution, habitat use, or movement patterns during either the breeding or non-breeding seasons. We captured three breeding adults at nest sites in the Sierra de Bahoruco along the border between the Dominican Republic and Haiti during early April, 2014. Individuals were outfitted with 9.5 gram, solar-powered satellite transmitters programmed with an 8 hour on/24 hour off duty cycle. During the initial two months of satellite tracking birds occupied waters between ca. 10 and 32 degrees N latitude and between -18 and -21 degrees longitude. All three birds occupied waters of the Caribbean Sea from areas near Hispaniola, Cuba, and Jamaica south to the coasts of Colombia and Venezuela. Two birds also traveled north through The Bahamas to shelf waters ca. 150 km off the coast of the southeastern US near the Blake Spur. Birds demonstrated a capacity to cover up to 600 km in a 24-hour period.

Nest visits were difficult to accurately detect based strictly on satellite tag data due to the duty cycle and likely short attendance time at nests, but data from remote cameras will be paired with location data to estimate the likelihood and timing of nest attendance. Our data suggest that satellite-tagging of Black-capped Petrels is feasible and to date the tracking data clearly show substantial use of the Caribbean Sea and shelf waters off the coast of the southeastern US during the breeding season. (ID 16216)

**Johnson, A. S.**, Cornell University, USA, asj43@cornell.edu  
Perz, J. S., Trent University, Canada, perz.johanna@gmail.com  
Senner, N. R., University of Groningen, n.r.senner@rug.nl  
Nol, E., Trent University, Canada, enol@trentu.edu  
Lovette, I. J., Cornell University, USA, ijl2@cornell.edu  
Van Doren, B. M., Cornell University, USA, bmv25@cornell.edu

#### CONNECTING HABITATS AND HEMISPHERES: NON-STOP MIGRATORY FLIGHTS IN WHIMBRELS (*NUMENIUS PHAEOPUS*)

The conservation of migratory shorebirds requires internationally coordinated efforts, hinged first on understanding population dynamics and connectivity throughout a species' range. Recent years have seen a substantial increase in the number of individual-tracking studies addressing these questions, especially using geolocator technology. The Whimbrel (*Numenius phaeopus*) is a widespread long-distance migratory shorebird with a declining hemispheric population; the degree of connectivity between two disparate North American breeding populations remains unclear. We deployed 25 light-level geolocators in 2012 to track the migrations of Whimbrels from their breeding grounds near Churchill, Manitoba, Canada. In 2013, we recovered 11 geolocators, yielding complete annual tracks for 8 individuals. In both spring and fall, the population relied on two distinct stopover sites in the mid-Atlantic Seaboard of the United States and primarily wintered along the northern coast of Brazil. Stopovers during southbound and northbound migration averaged 23.2 and 33.9 days, respectively. The observed migratory phenology suggests that Whimbrels may employ a capital breeding strategy, using extended spring stopovers to store additional nutrients for breeding. Three non-stop southbound flights were recorded from Churchill to Brazil, each covering at least ~8,000 km. Flights of this distance have not been recorded in this species, and rank among the longest recorded movements in avian migration. This breeding population exhibits a high degree of connectivity between stopover and wintering sites, and confirms the importance of preserving networks of specific habitats across the Western hemisphere to support declining shorebird species. (ID 16331)

**Johnson, D. H.**, USGS Northern Prairie Wildlife Research Center, USA, douglas\_h\_johnson@usgs.gov

#### ESTIMATING FATALITY RATES: FINDING THE RIGHT DENOMINATOR<sup>T</sup>

The Anthropocene Period is marked by increasing risks of mortality to birds, most recently wind energy development. To evaluate anthropogenic risks, investigators attempt to estimate the number of birds killed by, for example, wind farms. Doing so requires not only diligent searching for carcasses, but also adjusting the numbers found to account for 1) incomplete sampling, both spatially and temporally; 2) decomposition of carcasses before searches are conducted; 3) removal of carcasses by scavengers; and 4) imperfect perceptibility by searchers. Much attention has been given to these issues. Less consideration has been given to casting estimates of fatality numbers in an appropriate context. Sometimes the number of fatalities at a studied wind facility is divided by the output capacity of the facility; this is done to allow projections of fatalities to unstudied facilities with known output capacity. Sometimes estimated wind-related fatality rates are compared with rates associated with other risk factors, such as cat predation. Estimated numbers of fatalities can be divided by estimated population sizes, to compare species, for example. Each of these approaches has some purpose. If the objective is

to assess the effect of wind-related fatality on population dynamics, however, I suggest that a preferable denominator for the number of wind-related fatalities is the (estimated) annual mortality of the population in question. (ID 16188)

**Johnson, E. I.**, National Audubon Society, USA, ejohnson@audubon.org  
Wolfe, J. D., Louisiana State University, USA, jwolfe5@lsu.edu  
Jackson, A., Oregon State University, USA, Allyson.Jackson@oregonstate.edu  
Eagles-Smith, C. A., USGS Forest and Rangeland Ecosystem Science Center, USA, ceagles-smith@usgs.gov

#### SEASONAL VARIATION IN BLOOD MERCURY LEVELS IN LOUISIANA SONGBIRDS

Mercury (Hg) is a persistent environmental toxin with numerous deleterious effects on bird reproduction and behavior. Hg methylation by anaerobic bacteria increases exposure risk to bird species living in or near aquatic environments. Songbirds, as a group, seem to be particularly sensitive reproductively to Hg, but there has been little work to document Hg contamination during other seasons. We sampled songbirds at two lowland hardwood forest sites adjacent to seasonally flooded bald cypress-tupelo swamp in central Louisiana, where Hg exposure risk is expected to be high. We sampled birds year round, allowing us to quantify variation in Hg exposure throughout the entire avian life cycle including molting, wintering and breeding seasons for three species: Brown Thrasher (*Toxostoma rufum*), Carolina Wren (*Thryothorus ludovicianus*), and Northern Cardinal (*Cardinalis cardinalis*). In 2013, preliminary data indicate that each species showed variation in blood Hg concentration throughout the year, being lowest during and following the fall molt and highest during the breeding season (range: <0.001 – 2.6 ppm, dry weight). Carolina Wrens showed the highest contamination and widest variation in blood Hg concentration related to time of year; breeding season samples were more than twice as high as samples collected immediately following molt. This preliminary research indicates that, for at least some songbirds, blood Hg concentrations are greatest during the especially sensitive period of breeding. (ID 16174 | Poster 125)

**Johnson, J. M.**, Louisiana Tech University, USA, joshua0991@yahoo.com  
Maness, T. J., Louisiana Tech University, USA, tmaness@latech.edu

#### PLAYBACK AND PISHING REDUCES FORAGING ACTIVITY OF WINTERING BIRDS

Ornithologists have used playback as an effective survey tool, but amateur use is controversial because of potential negative effects on birds. Despite limited peer-reviewed research, conservation organizations worldwide have limited or banned the use of playback. Some birders prefer to vocally imitate avian alarm calls, or pishing, as an alternative to playback. We investigated the effects of playback and pishing on wintering birds in Northern Louisiana by emulating typical birder practices. We used an online survey to determine behavior of Louisiana birders and selected six experimental sites based on survey responses. Four experimental treatments were performed at each site: baseline (no birder), control (birder present - no sound), pishing (birder pished five times), and playback (birder played three bird songs). Each site was observed for 45min split into three 15min sections: "pre", "during", and "post" experimental exposure. Observers in hunting blinds recorded the behavior of all birds in the area at 30s intervals. Total activity was not affected by order of presentation, location, or treatment. However, foraging activity significantly declined, while vocal activity significantly increased, during and post playback and pishing treatments. Reduced foraging implies that birds spent less time gathering food, while increased vocal activity may indicate increased stress levels. Our results suggest that playback and pishing are detrimental to wintering birds, so we recommend cautionary use of playback in winter. (ID 15983 | Poster 3)

Johnson, K., Natural Heritage New Mexico, USA, kjohnson@unm.edu  
**Wickersham, L.**, Animas Biological Studies, USA, lynn@animasbiological.com  
 Smith, J., Natural Heritage New Mexico, USA, jacquelinewoodsmith@yahoo.com  
 Sadoti, G., University of Nevada, USA, gsadoti@syr.edu  
 Neville, T., Natural Heritage New Mexico, USA, tneville@unm.edu  
 Wickersham, J., Animas Biological Studies, USA, john@animasbiological.com

#### NEST-SCALE HABITAT USE BY PINYON-JUNIPER BIRDS ON DEPARTMENT OF DEFENSE LANDS

Pinyon-juniper woodlands cover approximately 40 million ha across the western US and represent the dominant woody vegetation on at least six Department of Defense (DoD) installations. Pinyon-juniper habitats are threatened by drought, insects, disease, and fire, all of which can be exacerbated by climate change. We investigated habitat use at multiple scales (landscape, territory/colony, nest) by two pinyon-juniper DoD Species at Risk (SAR), Pinyon Jay (*Gymnorhinus cyanocephalus*) and Gray Vireo (*Vireo vicinior*), on three installations. Here, we present the results of the nest-scale analyses for Pinyon Jay at Kirtland Air Force Base (KAFB) and White Sands Missile Range (WSMR), and Gray Vireo at KAFB, Camel Tracks Training Area (CTTA) and WSMR. We located nests and collected BBIRD data on nest and randomly-selected plots. We used GIS to derive topographic variables and distances to nearest road, military infrastructure, and habitat edge. We modeled nest-scale habitat use for 71 Gray Vireo and 97 Pinyon Jay nests via conditional logistic regression. Gray Vireos selected nest sites with more southward-facing aspects, slightly more negative (bowl-shaped) curvature, and more and taller trees relative to random plots. Pinyon Jays nested in areas with greater canopy cover, larger root crown diameters, and higher litter relative to non-nest trees. Roads and military infrastructure were not important factors in nest-site selection for Pinyon Jays; however, our data indicate a slight avoidance of buildings by Gray Vireos at one installation. We provide specific management recommendations to DoD installations with populations of Pinyon Jays and/or Gray Vireos. (ID 15736)

**Johnson, K. M.**, University of British Columbia, Canada, kate1@ualberta.ca  
 Arcese, P., University of British Columbia, Canada, peter.arcese@ubc.ca

#### COMPETITION BETWEEN SONG SPARROWS AND FOX SPARROWS ON MANDARTE ISLAND

Invasions and range shifts are facilitating novel interactions among potentially competing species in many communities, but predicting which interactions may result in the extirpation of subordinate competitors is challenging. I used behavioral interactions between colonizing fox sparrows (*Passerella iliaca*) and resident song sparrows (*Melospiza melodia*) on Mandarte I., BC, to test the hypothesis that competition explains a long-term decline in this song sparrow population. Since 1960, song sparrows have declined 0.6% per year as fox sparrows have increased at 0.5% annually to now outnumber song sparrows. Territory maps indicate 100% overlap of fox and song sparrow breeding territories, and mount presentations revealed no response of song sparrows to simulated fox sparrow intrusions, offering no evidence of interference competition during breeding. In contrast, winter seed resources declined dramatically from 1985 to 2013 and prior results show that fox sparrows overlap 100% in seed preference with song sparrows, suggesting that competition occurs for winter food. Winter arena experiments showed that song sparrows were displaced from seeds in 96% of 25 contests, confirming that fox sparrows exclude them from preferred food. Because song sparrows experience high mortality over-winter and juveniles are socially subordinate to all other song and fox sparrows, the observed 0.99% annual decrease in the survival of juvenile song sparrows after 1975 ( $R^2=0.87$ ) suggests that competition has driven the song sparrow decline. A winter removal experiment will be conducted in 2014 to confirm that fox sparrows exclude song sparrows from high quality feeding habitat and intake rates of feeding song sparrows are increased in the absence of fox sparrows.

Confirming these predictions will offer a clear example of an intra-guild invader causing a rapid decline of an established species by limiting access to winter food resources. (ID 16354)

**Johnston, R. A.**, University of California, Los Angeles, USA, racheljo@ucla.edu  
 Paxton, K. L., University of Southern Mississippi, USA, kristina.paxton@gmail.com  
 Moore, F. R., University of Southern Mississippi, USA, frank.moore@usm.edu  
 Smith, T. B., University of California, Los Angeles, USA, tbsmith@ucla.edu

#### IDENTIFYING GENES ASSOCIATED WITH MIGRATION IN THE SWAINSON'S THRUSH

Avian migration is a complex trait crucial to the survival of a broad range of species, yet knowledge of how this widespread behavior has evolved is limited by a poor understanding of the genes that underlie this trait. We utilized RNA-Seq and transcriptome-level gene expression analyses to investigate the suite of gene expression changes associated with migration in the Swainson's thrush (*Catharus ustulatus*). We analyzed gene expression data from twenty Swainson's thrushes that were monitored for migratory restlessness through time. Several candidate genes were identified whose expression is associated with migratory behavior, including genes involved in muscle development and oxidative stress. Results provide insight into molecular mechanisms important for migration and may be valuable for studying evolutionary processes that have led to this extraordinary behavior. (ID 16263)

**Jones, C. D.**, University of Georgia, Warnell School of Forestry and Natural Resources, USA, bacs@uga.edu  
 Stodola, K. W., University of Illinois, Department of Natural Resources and Environmental Sciences, USA, kstodola@illinois.edu  
 Coombs, J., University of Georgia, Warnell School of Forestry and Natural Resources, USA, jason.coombs@gmail.com  
 Cooper, R. J., University of Georgia, Warnell School of Forestry and Natural Resources, bcooper@uga.edu  
 Ward, M. P., University of Illinois, Department of Natural Resources and Environmental Sciences

#### EFFECTS OF FRAGMENTATION ON MOVEMENTS OF BACHMAN'S SPARROWS (*PEUCAEA AESTIVALIS*) AND PRAIRIE WARBLERS (*SETOPHAGA DISCOLOR*): OVER THE FIELD OR THROUGH THE WOODS?

Habitat fragmentation and loss of patch connectivity has led to the decline of many species. As habitats become more fragmented and patches become less connected, species are exposed to increased risks such as predation and parasitism that threaten population persistence. The longleaf pine savannas of the southeastern United States have experienced some of the highest rates of fragmentation and loss of connectivity of any ecosystem in North America. Consequently, they are home to many federally endangered and declining species across a wide variety of taxa. Corridors are one tool that can be used to alleviate some of the effects of fragmentation by increasing the connectivity between existing patches. We tested habitat permeability and corridor use in pine savannas in southern Georgia for Bachman's Sparrows (*Peucaea aestivalis*) and Prairie Warblers (*Setophaga discolor*) using displacement experiments and radio telemetry (Bachman's Sparrows only). Permeability was highest in unfragmented habitats for Bachman's Sparrows, but Prairie Warblers were less sensitive to the effects of fragmentation. Results from radio-telemetry indicated that Bachman's Sparrows used corridors designed with an existing ArcGIS tool (Corridor Designer) on their return paths suggesting corridors are likely useful tools for the conservation of Bachman's Sparrows in southern pine savannas. Efforts to increase connectivity of existing pine savannas in the Southeast will likely benefit habitat specialists in these settings. (ID 16183)



**Jones, K. N.**, Oregon State University, USA, kristin.jones@oregonstate.edu  
 Rivers, J. W., Oregon State University, USA, jim.rivers@oregonstate.edu  
 Betts, M. G., Oregon State University, USA, matt.betts@oregonstate.edu

#### NEGATIVE EFFECTS OF INTENSIVE FOREST MANAGEMENT ON REPRODUCTIVE SUCCESS IN A CAVITY-NESTING SONGBIRD

Future climate change scenarios rely on large-scale climate envelope models that cannot account for the local climatic conditions to which organisms most closely respond. Shifts in species distributions and phenology driven by global climate change are well-documented, yet we lack a strong understanding of how climate change may interact with land management to influence avian populations, especially in intensively managed landscapes. In a landscape-scale experiment to assess intensive forest management (IFM) effects on avian demography, we quantified the effects of herbicide application on microclimate and reproductive success in the House Wren (*Troglodytes aedon*). We quantified reproductive output on 24 forest stands in the Oregon Coast Range representing four distinct treatments: control, light, moderate, and intense herbicide application (6 stands per treatment). In addition, we quantified air temperature on stands across the breeding season. We found that average seasonal ambient temperature increased with increasing IFM intensity, an effect that was achieved by a combination of increasing daily minimums and maximums and became stronger with increasing elevation. Further, we found that although nestling body size was not influenced by IFM intensity, the proportion of nests surviving and fledgling production decreased with increasing management intensity. Our results indicate that the number of offspring produced, but not the quality of young, was inversely related to management intensity, with changes in air temperature serving as a putative mechanism behind these differences. (ID 16070 | Poster 15)

**Joo, E.**, Korea National University of Education, Republic Of Korea, ynhj31@hanmail.net  
 Yoon, J., Korea National University of Education, Republic Of Korea, migrate2u@gmail.com  
 Yoon, H., Korea National University of Education, Republic Of Korea, hanjiow@empas.com  
 Jung, J., Korea National University of Education, Republic Of Korea, jduri@hanmail.net  
 Park, S., Korea National University of Education, Republic Of Korea, srpark@knu.ac.kr

#### POST-MATING SEXUAL BEHAVIORS OF ORIENTAL STORKS (*CICONIA BOYCIANA*) IN CAPTIVITY: DO PRE-INCUBATION BEHAVIORS PREDICT SUBSEQUENT PARENTAL BEHAVIORS IN SEXES?

In birds, parental behaviors that vary with parent's sex and breeding stage are considered to facilitate the survival of the young. Females should invest time and energy to reproduce depending up the level of direct and/or indirect benefits provided by males. The males should also face trade-offs among depending territories or nests, seeking additional mating opportunities, and provision the young. In this paper, we examined whether or not post-mating sexual behaviors such as mating and nest-building effort are associated with reproductive investments made by males and females. The oriental stork (*Ciconia boyciana*) is known as a solitary breeder that nests on high trees and provides biparental care with long post-hatching development. In captivity, synchronous allopreening and bill-clattering as mating behaviors in pairs were highly skewed to the pre-incubation period. Males participated in nest-building more than females although both sexes similarly shared parental care during the incubation and nestling period. Overall, nest-building effort by males was negatively correlated with nest attentiveness by males during the nestling period. The results suggest that male oriental storks with more nest-building effort may spend more time taking precautions against conspecific intruders or nest predators near the nests with the chicks while females attending the nests in the form of biparental care. (ID 15749 | Poster 111)

**Joos, C. J.**, University of Missouri, USA, carajjoos@gmail.com  
 Kendrick, S. W., University of Missouri, USA, sarahwkendrick@gmail.com  
 Porneluzi, P. A., Central Methodist University, USA, ppornelu@centralmethodist.edu  
 Thompson, F. R., United States Department of Agriculture, Forest Service, USA, frthompson@fs.fed.us  
 Faaborg, J. M., University of Missouri, USA, faaborgj@missouri.edu

#### TERRITORY DENSITY RESPONDS TO STAND LEVEL FOREST STRUCTURE: EVIDENCE FROM A LONG TERM EXPERIMENT

Long-term landscape-scale experiments allow for the detection of trends in bird abundance in different forest management treatments. Landscape experiments usually focus on large site-scale changes in breeding bird abundance, but analyses of long-term experiments at a finer stand level scale can identify potential drivers of changes in abundance. Here we examine how forest structure resulting from harvest and regeneration at the stand scale (1 - 62 ha) influenced territory density of neotropical migrant songbirds in the Missouri Ozarks. We measured stand-level forest structure and territory density of 7 mature forest and 4 shrub and successional species across 19 years of the Missouri Ozark Forest Ecosystem Project (MOFEP), a 100-year experiment designed to study the effects of even-age and uneven-age harvest treatments on wildlife. We spot-mapped territories in 228 stands from 5 years pre-harvest and 10 years post-harvest to assess the effects ecological landform type (ELT), distance to clearcut, and stem density of understory, mid-story, and over-story trees on stand territory density. Response to forest structure was species specific and crossed habitat associations. Seven species responded to ELT and 9 species responded to distance to clearcuts. While 7, 3 and 2 species responded to understory, midstory and overstory stem density, respectively. Responses to forest structure and distance to clearcuts did not follow habitat associations. For example forest associated species and shrub and successional species both responded positively to understory stem density. This illustrates that management at the guild level may not benefit all species. Stand scale analyses (opposed to 300-500 ha sites) allowed us to describe finer scale drivers of abundance, which advances our knowledge of how forestry harvest practices interact with forest characteristics to influence abundance of forest associated breeding migrant songbirds in the Midwestern USA. (ID 16340)

**Joseph, L.**, Australian National Wildlife Collection, CSIRO, Australia, Leo. Joseph@csiro.au

#### AUSTRALO-PAPUAN PERSPECTIVES ON MOLECULAR BIOGEOGRAPHY AND THE CLASSIFICATION CRISIS<sup>†</sup>

In this paper I will review a number of recent data sets from molecular phylogeographic and phylogenetic studies of Australo-Papuan birds pertinent to the Symposium theme. I focus on resolving the interesting but always informative conflicts they set up with taxonomy. Broad categories I will discuss are mito-nuclear discordance, selection and the impact on conservation and management, cryptic diversity revealed by molecules and whether taxonomy is incomplete or incorrect, historical demography and traps in interpretation of mtDNA data, introgression, and generic level diversity. The question of what we want taxonomy to convey at the species level and below recurs in my consideration of these cases that I will present and provides a helpful starting point for synthesizing the examples. (ID 15845)

**Judy, C. D.**, Louisiana State University, USA, judyc@lsu.edu  
 Graves, G. R., National Museum of Natural History, USA, gravesg@si.edu  
 Brumfield, R. T., Louisiana State University, USA, robb@lsu.edu

#### SPECIATION AND HYBRIDIZATION IN JAMAICAN-ENDEMIC STREAMERTAIL HUMMINGBIRDS

The Red-billed Streamertail (*Trochilus polytmus*) and the Black-billed Streamertail (*T. scitulus*) are sister species of hummingbirds that appear to

have diverged in situ on Jamaica, West Indies. Bill color, the secondary sexual character that distinguishes the pair, transitions from coral red in *T. polytmus* to pure black in *T. scitulus* over a distance less than seven kilometers. The origin and maintenance of such a narrow hybrid zone linking species with high dispersal capabilities on a small oceanic island defies traditional explanations. We found no fixed differences in the mitochondrial control region, three nuclear introns, six microsatellite loci, or single nucleotide polymorphisms (SNPs) identified from sequenced amplified fragment length polymorphisms (AFLPs). Using a genotyping-by-sequencing approach, we characterize larger portions of the genome for these close relatives, recovering 6,451 high-quality SNPs for 160 parental types and putative hybrids. We use these data to examine patterns of genomic differentiation and introgression, and to look for signatures of selection across the hybrid zone. We discuss the implications of these results for *Trochilus*, and more broadly, the utility of next-generation sequencing data for hybrid zone studies between recently diverged taxa. (ID 15906)

**Kaiser, S. A.**, Cornell Lab of Ornithology, USA, sak275@cornell.edu  
 Risk, B. B., Cornell University, USA, bbr28@cornell.edu  
 Sillett, T. S., Smithsonian Conservation Biology Institute, USA, silletts@si.edu  
 Webster, M. S., Cornell Lab of Ornithology, USA, msw@244@cornell.edu  
 ECOLOGICAL AND TEMPORAL CONSTRAINTS AFFECT THE OPPORTUNITY FOR EXTRA-PAIR MATING IN THE BLACK-THROATED BLUE WARBLER

Extra-pair paternity (EPP) is highly variable within populations of socially monogamous birds, but the ecological factors that drive mating decisions and patterns of EPP remain poorly understood. The spatial and temporal distribution of available mates and resources may influence individual variation in the probability of gaining EPP. We hypothesized that reproductive trade-offs and resource availability within males' territories would influence where and when males sired extra-pair young (EPY). We studied the black-throated blue warbler (*Setophaga caerulescens*), a migratory songbird with bi-parental care, at the Hubbard Brook Experimental Forest, NH, USA. We found that extra-pair mating opportunities were not limited to neighbors' nests and that males minimized the constraints imposed by reproductive trade-offs by primarily siring EPY during the incubation stage of their social mates. Males with high quality territories had a lower probability of siring EPY than males with low quality territories, and also were less likely to sire EPY in nests far away from their territories. We detected no effect of local breeding density on the distance between females and their extra-pair mates. These results indicate that factors affecting the relative timing of breeding between a male's social mate and available fertile females may have a strong effect on the opportunity for extra-pair mating. Reproductive trade-offs appear to constrain male extra-pair mating in black-throated blue warblers, rather than spatial factors. (ID 15741)

**Kaluthota, C. D.**, University of Lethbridge, Canada, kaluthota@uleth.ca  
 Rendall, D., University of Lethbridge, Canada, d.rendall@uleth.ca  
 SONG ORGANIZATION AND VARIABILITY IN NORTHERN HOUSE WRENS (TROGLODYTES AEDON)

Northern House Wrens (*Troglodytes aedon*) are, like other wrens, noted for complex song, but detailed studies are lacking. As a first step towards functional tests of song complexity, we report patterns of syllable and song diversity from 15,600 songs recorded from 15 males, in Southern Alberta, Canada. The population syllable repertoire was 27, most syllables shared by all males but used variably. Songs were a concatenation of multiple syllable types (mean=4), each type produced one to several times before switching. Repertoires of song types (unique syllable type sequences ignoring differences in repetition number) were large and ranged to 194 with no evidence of a ceiling. However, 'working repertoires' of commonly produced

song types were much smaller (n=25) and singing bouts typically involved repeating a song type many times before switching. Additional constraints in syllable sequencing and song diversity were evident and captured using song templates summarizing common song construction pathways. Ultimately, male house wrens combined tremendous potential syllable and song diversity with a comparatively monotonous short-term singing style. (ID 16041 | Poster 97)

**Karubian, J. O.**, Tulane University, USA, jk@tulane.edu  
 Ottewell, K., Western Australian Conservation Science Centre, Australia, Kym.Ottewell@dec.wa.gov.au  
 DiFiori, A., University of Texas, Austin, USA, anthony.difiore@austin.utexas.edu  
 Browne, L., Tulane University, USA, lbrowne@tulane.edu  
 Link, A., Universidad de los Andes, Colombia, a.link74@uniandes.edu.co

A COMPARISON OF THE GENETIC CONSEQUENCES OF SEED DISPERSAL BY LONG-WATTLED UMBRELLABIRDS VS. SPIDER MONKEYS IN ECUADORIAN RAINFOREST.

Most tropical rainforest tree species depend upon animals for seed dispersal, but the quality of dispersal provided varies considerably. Dispersal outcomes are driven in part by foraging ecology and behavior of dispersal agents, as when repeated use of resting or display sites yields relatively high numbers of seeds in these locations. The consequences of clumped distributions of seeds away from the source tree for the genetic composition of recruiting seedlings are poorly understood, at both local- and landscape-scales. Combining movement data with genetic analyses of seedlings of a canopy palm, *Oenocarpus bataua*, in Ecuadorian rainforest, we contrast patterns generated by two distinctive disperser behaviors: use of traditional display (lek) sites by Long-wattled Umbrellabirds *Cephalopterus penduliger* and use of traditional sleeping trees by spider monkeys *Ateles belzebuth*. We report considerable variation in seed source diversity within and among both leks and sleeping trees, though Umbrellabirds typically generate more diverse seed pools than do spider monkeys. Seed source sharing was higher between lek sites than between sleeping trees despite similar pairwise distances, suggesting that Umbrellabirds are dispersing seeds more broadly at the landscape scale. Additional analyses indicate that habitat fragmentation and hunting is disrupting these dispersal mutualisms and restricting seed dispersal. (ID 16314)

**Kasahara, S.**, Japan Bird Research Association, Japan, kasahara@bird-research.jp

DISTRIBUTION AND NEST-SITE PREFERENCES OF TWO SYMPATRIC PLOVERS, *CHARADRIUS PLACIDUS* AND *CHARADRIUS DUBIUS*, ON THREE RIVERS IN CENTRAL JAPAN.

The amount of exposed gravel along Japanese rivers has declined over recent decades and the influence of this change on river-dependent organisms is of great concern. Understanding the habitat of riparian species is essential when engaging in river management. In this study, I investigated the distribution and nest-site preferences of two sympatric plovers, *Charadrius placidus* and *C. dubius*, during 2013 and 2014. Within each 48–68 km section along each of three rivers in central Japan, I established 20–22 study areas where I observed and recorded the numbers of individual plovers during 30-minute point censuses. Nests were located, their distances from the river edge and from grassland were measured, as was gravel size in the vicinity (1 m<sup>2</sup>) of each nest. I also measured gravel sizes within 1 m<sup>2</sup> plots at 10–20 random points in each study area. In 2014, 75 *C. placidus* nests and 45 *C. dubius* nests were found. Along each of the three rivers, both species preferred to nest where gravel was smaller in size than that of random points in the study areas, and the ratio of sand or small gravel around nests was higher for *C. dubius*. The distances at which nests were located from river edge and grassland differed between the two species along each river. This study suggests that maintaining areas of

sand and small gravel along rivers is very important for the successful nesting of these two plovers. Inhibition of the natural downstream movement of sand, resulting from the construction of upstream dams and weirs, is considered likely to affect negatively the nesting habitat of both species. My research and conference attendance were supported by grants from the Water Resources Environment Technology Center Japan, and the Yamashina Institute for Ornithology. (ID 15991 | Poster 81)

Kearns, A. M., University of Maryland, Baltimore County, USA, anna.m. Kearns@gmail.com

Johnsen, A., Natural History Museum, University of Oslo, Norway, arild.johnsen@nhm.uio.no

**Szabo, I.**, University of British Columbia Beaty Biodiversity Museum, Canada, ildiko@zoology.ubc.ca

Marzuff, J. M., University of Washington, USA, corvid@uw.edu

Restani, M., St Cloud State University, USA, restani@stcloudstate.edu

Omeland, K. E., University of Maryland, Baltimore County, USA, omeland@umbc.edu

#### DEEP MITOCHONDRIAL DIVERGENCE WITHIN COMMON RAVENS: SPECIATION IN REVERSE IN THE WESTERN US AND CANADA?

There is increasing evidence that gene flow between phenotypically distinct bird 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. 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, especially in fishes. However, most of these cases involve recent divergences (e.g., ~12,000 ybp) and are human caused. In contrast, several 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. We found no evidence of phenotypic differences between the clades and no evidence of assortative mating or reproductive isolation (Webb et al. 2011, Molecular Ecology). However, preliminary data from a Z-linked intron provides strong support for two formerly distinct lineages. We are now using a range of next generation and multilocus coalescent approaches to test the hypothesis of speciation reversal. We are still in need of additional samples from the western US and Canada, especially from Colorado, Utah, Oregon and Arizona. (ID 16077 | Poster 128)

**Kearns, B. V.**, Kansas State University, USA, bvkearns@ksu.edu

McDowell, S., Stephen F. Austin State University, USA, smcdowell@sfasu.edu

Moon, J., United States Fish and Wildlife Service, USA, jean\_moon@fws.gov

Rigby, E., Minnesota Cooperative Fish and Wildlife Research Unit, elizabethrigby@gmail.com

Conway, W., Stephen F. Austin State University, USA, wconway@sfasu.edu

Haukos, D. A., Kansas State University, USA, dhaukos@ksu.edu

#### LEAD EXPOSURE IN WATERFOWL: SOURCES, PATHWAYS, AND SOLUTIONS

Lead (Pb) contamination in North American avian habitats has been of concern for many years; effects are especially acute in wetland habitats that have been hunted or exist near industry. Although management efforts have sought to mitigate areas of high Pb contamination, a perhaps more important task in relation to avifaunal species is to elucidate sources of ongoing contamination. This study addresses these issues in relation to the habitat usage of a non-migratory waterfowl species in decline, the mottled duck (*Anas fulvigula*), on the Texas Coast of the Gulf of Mexico. Pb levels in soil, vegetation, and blood were assessed on two National Wildlife Refuges through isotope analysis, and modeled using geospatial techniques to indicate

areas of high exposure risk for mottled ducks and landscape-level indicators of contamination. All samples were additionally tested for Pb deposition sources using Pb isotope ratios. Values for both Pb level and source indicate great variation in exposure risk and deposition pathway, with both variables dependent on habitat type. We suggest the use of directed management to reduce the effects of potential ecological traps contributing to declines. (ID 15724)

**Kellermann, J. L.**, Oregon Institute of Technology, USA, jherime.

kellermann@oit.edu

Lajoie, J. L., Southern Oregon University, USA, lajoiej@sou.edu

Mohren, S., Crater Lake National Park, USA, sean\_mohren@nps.gov

#### BLACK-BACKED WOODPECKER DISTRIBUTION AND HABITAT SELECTION IN CRATER LAKE NATIONAL PARK, OR

Woodpeckers are ecosystem engineers sensitive to changes in habitat and disturbance, regulate wood-boring beetle populations, and provide indicators of biodiversity. The Black-backed Woodpecker (*Picoides arcticus*) occurs within boreal and montane forests of North America and is closely associated with recent high severity forest fires, although they also use historically unburned areas and beetle kill regions. Most research on this species is from boreal regions; however, an isolated population exists in the Cascade Mountains of southern Oregon. Management activities related to provision of habitat for this species are a concern for natural resource agencies, especially in light of recent petitioning and "candidate" listing of this population under the Endangered Species Act. Crater Lake National Park is situated in the southern Cascades of Oregon and provides a wide range of potential Black-backed Woodpecker habitats. Understanding the distribution and habitat use of this species in the park is important for management related to forest structure and fire. We perform broadcast surveys and point counts across forest types, burned and historically unburned areas, and mountain pine beetle (*Dendroctonus ponderosae*) kill areas to assess occupancy and habitat selection relative to forest characteristics associated with fire and beetle kill. We present preliminary results from an information theoretic approach to model development and evaluation. Results from this study will help inform active forest and wildlife management decisions throughout park with implications for other portions of this isolated population range in Oregon, California, and Washington. (ID 16176 | Poster 83)

**Kelly, J. F.**, University of Oklahoma, USA, jkelly@ou.edu

Horton, K., University of Oklahoma, USA, khorton@ou.edu

Stepanian, P., University of Oklahoma, USA, step@ou.edu

Chilson, P. B., University of Oklahoma, USA, chilson@ou.edu

#### INTEGRATING HUMAN AND RADAR OBSERVATION NETWORKS TO UNDERSTAND PHENOLOGY OF SONGBIRD MIGRATION. <sup>†</sup>

Change in the timing of seasonal events (phenology) is one of the primary indicators of the direction and magnitude of the impacts of human-induced land cover and climate change. Most phenological studies are based either on aggregations of direct observations made by people or on automated remotely sensed observations. Each of these data sources provides limited inference about the phenology of vertebrate consumers. Studies that rely on networks of human observers excel at provide detailed taxonomic information, but until recently, were limited by the amount and repeatability of data that could be collected, making it difficult to infer scaling patterns in phenology. Remote sensing overcomes this difficulty, but most remote sensors cannot directly measure animal distribution or abundance, limiting the inferences these studies can make about animal populations. Weather surveillance radars have unique potential to directly measure the phenology of seasonal changes in distribution and abundance of airborne animals; however radars have limited ability to provide the species-level inference at which human observers excel. We compare recent measurements from



networks of human observers (ebird) and radar remote sensing (NEXRAD) to quantify the phenology of songbird migration. We propose ways that these data might be integrated to leverage the strengths of each network to provide a richer understanding of songbird migration phenology. Correspondence between ebird-based and radar-based phenologies motivates future analysis of long-term changes in migration phenology based primarily on retrospective analyses of radar data. (ID 16010)

**Kimball, R. T.**, University of Florida, USA, rkimball@ufl.edu  
 Braun, E. L., University of Florida, USA, ebraun68@ufl.edu  
 Hosner, P. A., University of Florida, USA, idiopilton@gmail.com  
 Glenn, T. C., University of Georgia, USA, travis.glenn@gmail.com  
 Faircloth, B. C., University of California, Los Angeles, USA, brant@faircloth-lab.org

#### RESOLVING CONFLICTS AMONG GALLIFORM PHYLOGENIES USING ULTRA-CONSERVED ELEMENTS

The resolution of rapid evolutionary radiations or “bushes” in the tree of life has been one of the most difficult and interesting problems in phylogenetics. The avian order Galliformes appears to have undergone several rapid radiations, particularly within the largest family, the Phasianidae. This has led to conflict among recently published studies, obscured the relationships among taxa that are important as model systems (chicken, turkey, Japanese quail) or that have been well-studied in other contexts (e.g., grouse, ring-necked pheasants, peafowl). We collected a large number of ultra-conserved elements (UCEs) from over 70 galliform species. Sampling included representatives of all major clades but focused around rapid radiations within the Phasianidae. We analyzed the data using both concatenation and coalescent-based methods to estimate the galliform species tree. The increased sampling of unlinked nuclear genes provided strong bootstrap support for all but a small number of relationships. Despite the novel insights we obtained using this increased sampling of gene regions, a few nodes remain poorly supported; these may reflect hard polytomies due to periods of rapid diversification. Overall our analyses now appear to support a robust backbone for this order. (ID 16307)

**Kirsch, E. M.**, USGS, USA, ekirsch@usgs.gov  
 Wellik, M. J., USGS, USA, mwellik@usgs.gov

#### SPRING WEATHER AND TREE PHENOLOGY INFLUENCES TREE PREFERENCES OF FORAGING BIRDS DURING SPRING MIGRATION IN UPPER MISSISSIPPI RIVER FLOODPLAIN FORESTS

Spring weather conditions during 2010-2013 in the Upper Midwest contrasted sharply between warmer and colder than normal, with concomitant differences in leaf development phenology of trees. We observed foraging behavior of foliage gleaning songbirds during the spring migration period, 2010-2013 in Upper Mississippi River floodplain forest and noted marked differences in tree preferences between warm and cold years. Four bird species were abundant enough all four years to examine yearly differences in tree preferences. American Redstart (*Setophaga ruticilla*), Baltimore Oriole (*Icterus galbula*), and Warbling Vireo (*Vireo gilvus*) breed in the area and their preference for silver maple, the dominant tree in this forest, was more pronounced during warm years when leaves completed development early and migration may have occurred more quickly. Tree preferences of Yellow-rumped Warbler (*Setophaga coronata*), a transient migrant in this area, varied each year. However, during warm years Yellow-rumped Warblers more strongly preferred oaks and avoided silver maple. During cold years this species tended to increase use of other tree species especially hackberry and cottonwood. (ID 16264)

**Kleist, N. J.**, University of Colorado-Boulder, USA, nathan.kleist@gmail.com  
 Guralnick, R., University of Colorado-Boulder, USA, robert.guralnick@colorado.edu

Cruz, A., University of Colorado-Boulder, USA, alexander.cruz@colorado.edu  
 Francis, C. D., California Polytechnic State University, USA, cdfranci@calpoly.edu

#### THE COSTS OF NOISE POLLUTION: STRESS, BEHAVIOR AND FITNESS IN HIGH DESERT SECONDARY CAVITY NESTERS

Health experts report that exposure to noise pollution has negative physiological effects in humans, but whether free-living animals experience similar effects is unclear. Birds are viewed as especially sensitive to noise, because of their reliance on vocalizations. Exposure to noise may compromise growth, reproduction, and even territory defense and parental behaviors. We used a unique system in the natural gas fields of northern New Mexico where the influences of noise are isolated from factors that complicate studies in urban habitats to determine whether continuous noise pollution acts as a long-term source of stress in several secondary cavity nesting birds. Blood samples, nest success and morphometric parameters were recorded to isolate species and age-specific responses to noise pollution from natural gas extraction activity. The four focal species of our study show interspecific variation in the relationship between baseline stress hormone (cort) levels and ambient noise levels at the nest site. Although trends vary, the overall effect of noise pollution across all species is an increase in baseline stress hormone levels. The effects of noise on cort levels and the subsequent effects of those hormones on reproductive success metrics vary by species and age group. Uncovering how these stress responses differ within and across species and life stage will be an important step towards untangling the complexities of how noise pollution from oil and gas activity is related to reproductive success. (ID 15793)

**Klicka, J.**, University of Washington / Burke Museum, USA, klicka@uw.edu

#### ON THE RELATIVE WORTH OF “BIO-SPECIES”, “PHYLO-SPECIES” AND SUBSPECIES IN AVIAN EVOLUTIONARY STUDIES

The relative utility of different species concepts depends largely on one's intended uses of “species”. Species classification may be viewed as a “man-made system of pigeonholes” devised for the purpose of subdividing biotic variation into convenient units. If this is the goal, any number of species definitions would be adequate, including that of the biological species. If, however, species are instead viewed as the fundamental units of evolution, ecology, and conservation a more rigorous definition may be required. In this talk, I argue that for purposes of studying evolution and biodiversity-related questions, “phylogenetic species” (phylo-species) provide better resolution and greater precision than do biological species. The latter overlook significant levels of biological diversity that warrant inclusion in evolutionary studies. Published works conclude that 36% of described subspecies represent distinct evolutionary lineages and that on average, nearly 1/3 of all distinct evolutionary lineages are not recognized as biological species. New data presented here indicate that 412 currently recognized New World species examined, represent 824 evolutionary lineages (2.00 lineages per biological species). Neotropical species on the whole contain more cryptic diversity (i.e. phylo-species) than do their Nearctic counterparts. Using empirical examples, I show that when phylo-species are excluded from studies of biodiversity, diversification rates, and patterns of species accumulation, quantitatively different results may be obtained. (ID 16196)

**Klicka, L. B.**, San Diego State University, USA, klicks87@gmail.com  
 Burns, K. J., San Diego State University, USA, kburns@mail.sdsu.edu  
 Title, P. O., University of Michigan, USA, ptitle@umich.edu  
 Kus, B. E., US Geological Survey, USA, barbara\_kus@usgs.gov

# PHYLOGEOGRAPHY AND CONSERVATION GENETICS OF THE BELL'S VIREO\*

The Bell's Vireo (*Vireo bellii*) is a widespread species of North American bird consisting of four subspecies (*V. b. pusillus*, *V. b. medius*, *V. b. bellii*, and *V. b. arizonae*) breeding from central Mexico to the central and southwestern United States. Subspecies were delimited in the late 1800's and early 1900's on the basis of plumage variation. The subspecies *V. b. pusillus* is federally endangered, and the other three are listed by Partners in Flight as birds of conservation concern. This is the first study to examine geographic variation in the Bell's Vireo using genetic data. We reconstructed evolutionary relationships within the complex using mitochondrial ND2 and genome wide variation in the form of SNPs. We sequenced ND2 for 87 individuals from throughout the breeding range of the Bell's Vireo, and obtained SNP data for a subset of those individuals. Bayesian analyses of these data identified two major clades within Bell's Vireo. The two clades follow an east/west division with a potential contact zone in New Mexico. The eastern clade contains *V. b. bellii* and *V. b. medius*, while the western clade contains *V. b. pusillus* and *V. b. arizonae*. Support for these clades, and additional within clade structure, was discovered with the SNP data. Most notably, all the endangered Least Bell's Vireo individuals grouped into a well-supported clade. The east and west clades are approximately 3% divergent in their mitochondrial sequence data, a similar level to that observed between other avian species. Using BEAST and an ND2 divergence rate of 0.0115 per lineage per million years, we estimate the two clades diverged from 1.1 - 2.0 million years ago. (ID 15826)

**Klug, P. E.**, U.S. Geological Survey Fort Collins Science Center, USA, pklug@usgs.gov

Reed, R. N., U.S. Geological Survey Fort Collins Science Center, USA, reedr@usgs.gov

Yackel Adams, A. A., U.S. Geological Survey Fort Collins Science Center, USA, yackela@usgs.gov

Brindock, K. M., U.S. Naval Base Guam-Santa Rita, Guam, Kevin.Brindock@fe.navy.mil

Mazurek, M. J., Cherokee Services Group, USA, mmazurek@usgs.gov

Pitt, W. C., USDA/APHIS National Wildlife Research Center-Hawaii Field Station, USA, will.pitt@aphis.usda.gov

# PROTECTION OF CAVES IMPORTANT TO THE ENDANGERED MARIANA SWIFTLET FROM INVASIVE BROWN TREESNAKES THROUGH EFFECTIVE DEPLOYMENT OF CONTROL TOOLS

On the island of Guam, the endangered Mariana swiftlet (*Aerodramus bartschi*) is currently restricted to three caves resulting in a need to protect these focal areas. Multiple factors may have contributed to the decline of Mariana swiftlets, but large populations of invasive brown treesnakes (*Boiga irregularis*; BTS) may be limiting recovery. Since 2011 we have removed 85 BTS from swiftlet caves. Of the BTS necropsied 48 were female and 15 male. Of the 13 BTS that had stomach contents eight had swiftlets remains, lending urgency to reducing BTS found in caves. The first goal of the study was to assess the background rate at which BTS use caves on Guam and characteristics of those snakes, including general necropsy analysis and evaluation of diet using stable isotopes. The second goal was to assess the current BTS trapping strategy with trials to examine how the placement of mouse-baited traps affects BTS capture and contact with swiftlets. The data presented focus on whether placing BTS traps within focal areas would attract snakes and increase potential predation on swiftlets. Our results suggest that deploying mouse-baited traps within a focal area does not increase BTS contact with prey of concern and may alleviate risk by suppressing the BTS population. Thus deploying mouse-baited traps within or at the mouth of caves may be a valuable management strategy for reducing BTS in swiftlet caves. (ID 16148 | Poster 40)

**Kneidel, A. H.**, Delaware State University, USA, akneidel@gmail.com

Gutierrez Ramirez, M., Delaware State University, USA, mariamargutierrez@hotmail.com

Lester, L. A., Delaware State University, USA, llester@desu.edu

Heckscher, C. M., Delaware State University, USA, checkscher@desu.edu

# THE INFLUENCE OF LOCAL WEATHER ON USE OF A FLORIDA BARRIER ISLAND BY TRANS-GULF MIGRANTS

Many Nearctic-Neotropical songbird species are experiencing significant declines. In addition to pressures on their breeding and wintering grounds, declines are also attributed to increased pressures during migration, including the loss of suitable stopover sites. After crossing an ecological barrier such as the Gulf of Mexico, finding a site to rest and refuel is of paramount importance. Variation in weather conditions can affect when and if migrants stop to locate a stopover site. Changes in wind direction and precipitation can also increase the energy expenditure of a flight. Although research has been performed on the central and western Gulf Coast, little is known about the stopover significance of the Florida Gulf Coast barrier islands during spring migration. We performed constant effort mist-netting on St. George Island, Florida, during the spring of 2013 and 2014. We used mist-net data and local weather data to determine whether local weather patterns were associated with the magnitude, temporal variability, and physical condition of migrants using the island as a migratory stopover site. (ID 16341 | Poster 56)

Knight, E. C., Simon Fraser University, Canada, ecknight@sfu.ca

**Mahony, N. A.**, Environment Canada, Canada, nancy.mahony@ec.gc.ca

Green, D. J., Simon Fraser University, Canada

# LOCAL AND LANDSCAPE EFFECTS ON THE BIRD COMMUNITY IN SAGEBRUSH SHRUBSTEPPE

Habitat fragmentation can change the community composition of species in remnant habitat patches. We studied the impacts of fragmentation on the bird community in heavily fragmented areas of the sagebrush shrubsteppe in western North America. We used a multivariate framework to examine whether the bird community in sagebrush habitat near orchards and vineyards was different from the community in interior sagebrush habitat, and evaluated whether observed differences could be explained by predator abundance, local vegetation, or the composition of the surrounding landscape. The bird community in edge and interior habitat differed: edge habitats were dominated by generalist bird species, while Vesper Sparrows, which are sagebrush specialists in this region, were more abundant in interior habitat. Edge effects on species composition were associated with differences in the local (1 km) landscape and local vegetation, rather than the presence and abundance of predators. We suggest that differences in the bird community within edge and interior habitat are the result of multiple mechanisms: avoidance of invasive grasses in edge habitat, attraction to resources in both adjacent habitats, and spill-over of generalist birds from the adjacent agriculture. The results of this study suggest that sagebrush bird conservation areas should be placed away from intense agricultural development and that conservation plans should include land use at a landscape scale in addition to local vegetation management. (ID 15915)

**Knutsen, C. J.**, Colorado State University-Pueblo, USA, carley.knutsen@gmail.com

Varian Ramos, C. W., Colorado State University-Pueblo, USA, claire.amos@colostate-pueblo.edu

# VARIATION IN MERCURY BIOACCUMULATION AMONG SPECIES OF PASSERINE BIRDS IN COLORADO

As a persistent global toxin, mercury is of high concern in the biological community. Mercury bioaccumulates in organisms and biomagnifies up the food chain. Many wildlife species are at risk from mercury accumulation,

particularly fish-eating birds, and more recently recognized, passerine birds. Mercury is a known endocrine disrupter in birds and causes behavior changes leading to reduced reproductive success. Ecotoxicologists often ignore variation between species when assessing the risk of contaminants to birds, however, the levels to which different species accumulate mercury varies widely. This variation is poorly explained. Differences in diet, metabolism, and evolutionary history of species may all affect mercury accumulation. Here we examine the impacts of foraging guild and phylogeny on bioaccumulation of mercury in the blood of passerine birds sampled from the Fountain Creek watershed in Colorado in the summer of 2014. Differences in blood mercury concentration are expected for families with unique foraging behaviors and phylogenetic history. It is important to understand variation between species to assess which species may be at greatest risk from mercury accumulation. (ID 16071 | Poster 124)

**Koper, N.**, University of Manitoba, Canada, nicola.koper@umanitoba.ca  
 Rosa, P., University of Manitoba, Canada, patriciarosa.udem@gmail.com  
 Swider, C., University of Manitoba, Canada, cswider@syr.edu  
 Nenninger, H., University of Manitoba, Canada, nenningh@myumanitoba.ca  
 Bernath-Plaisted, J., University of Manitoba, Canada, bernathj@myumanitoba.ca

#### EFFECTS OF OIL INFRASTRUCTURE AND OPERATING NOISE ON GRASSLAND SONGBIRDS

New oil wells are continually being drilled across the Great Plains, but we have little understanding of their impacts on grassland songbirds. We have evaluated effects of power-grid powered and generator-powered oil pumpjacks on abundance and nesting success of grassland songbirds in 47 quarter-sections in southern Alberta, Canada, since 2012. To determine whether effects of infrastructure were caused by noise, in our design we included active units, silent (inactive) units, sites that lacked oil infrastructure but included large-scale continuous playbacks of infrastructure noise, and control sites with no infrastructure or playbacks. Preliminary analyses suggest that some species have significantly higher or lower relative abundances in sites that include infrastructure, whether noisy or silent, suggesting that some species respond to the infrastructure itself, and this effect is not caused by noise or traffic. Similarly, Savannah sparrows had lower nesting success in sites with infrastructure, regardless of whether infrastructure was noisy. Conversely, vesper sparrows showed a negative response to noisy but not quiet infrastructure. Our results suggest that the presence of anthropogenic infrastructure significantly influences the distribution of many species of grassland songbirds across the prairie landscape, and that efforts to minimize noise from infrastructure might mitigate effects on some, but not all species. (ID 15756)

**Kovach, A. I.**, University of New Hampshire, USA, akovach@unh.edu  
 Hatcher, P., University of New Hampshire, USA, pjh@cs.unh.edu  
 Kordonowy, L., University of New Hampshire, USA, Lauren.Kordonowy@unh.edu  
 Okamoto, K., University of New Hampshire, USA  
 Ramsdell, J., University of New Hampshire, USA  
 Solorzano, E., University of New Hampshire, USA, Eleanne.Solorzano@unh.edu  
 Walsh, J., University of New Hampshire, USA, jlw27@wildcats.unh.edu  
 Thomas, W. K., University of New Hampshire, USA, Kelley.Thomas@unh.edu  
 COMPARATIVE ANALYSIS OF TWO TIDAL MARSH BIRD GENOMES

Tidal marsh birds are ideal subjects for studying adaptation and speciation, because they have evolved specialized adaptations to harsh environmental pressures of the tidal marsh ecosystem, including in bill morphology, kidney structure and function, social behavior, and reproductive strategies. We used genomic tools to investigate ecological adaptation in two young, sister species of tidal marsh passerine, the Saltmarsh Sparrow (*Ammodramus caudacutus*)

and Nelson's Sparrow (*A. nelsoni subvirgatus*), that diverged ~600,000 years ago and differ in their historical association with tidal marshes, their current niche breadth, and their reproductive behavior. We generated high quality de novo assembly drafts of the *A. caudacutus* (n=6) and *A. nelsoni* (n=1) genomes from Illumina sequence data, with N50 contig sizes of 16 and 30 KB, respectively, 100X coverage, and a total assembled genome size of about 1 GB. Ab initio gene prediction with MAKER2, using the Augustus algorithm, and informed by RNASeq data, identified 14,138 and 15,543 gene models, for the two genomes, among which we were able to identify > 95% of the expected conserved eukaryotic orthologs and 80% of core eukaryotic proteins assembled. Comparative gene analysis of 3,033 paralogs in the two *Ammodramus* genomes and *Geospiza fortis* identified several gene family expansions and contractions, including proteins with immune and essential cellular functions, beak morphology and tendon, ligament and muscle structure. We also discuss ongoing analyses to identify positive selection in the *Ammodramus* lineage and next steps for identifying habitat-associated ecological divergence between *A. caudacutus* and *A. nelsoni*. (ID 15996 | Poster 25)

**Krebs, E. A.**, Environment Canada, Canada, Elsie.Krebs@ec.gc.ca  
 Hindmarch, S., Environment Canada, Canada, Sofi.Hindmarch@gmail.com  
 Bishop, C. A., Environment Canada, Canada, CAB.Bishop@ec.gc.ca

#### PREDICTING ROAD MORTALITY OF BARN OWLS IN THE FRASER VALLEY, BC: IDENTIFYING TEMPORAL AND SPATIAL HOTSPOTS

The relative importance of direct mortality versus indirect habitat effects of urbanization and human development on bird populations is poorly understood. Recent work suggests that significance of direct mortality of birds in human-impacted landscapes may have been underestimated. For example in Canada, more than 30 million birds are estimated to die annually due to collisions with buildings, transmission lines and vehicles, three of the top four sources of human-related bird mortality. Species, such as barn owls (*Tyto alba*), that occupy lowland human-impacted landscapes and forage near roads are especially vulnerable to collisions with vehicles. In western Canada, barn owls have been listed as a Species at Risk due to declines in grassland foraging habitats and nest sites. However, previous work in the UK has correlated local extirpations of barn owls, not to habitat loss, but to road densities. Our research in British Columbia found that barn owls are less likely to occupy roosts and nest sites located in proximity to highways. Here we analyse 19 years (1995-2013) of roadside survey data (809 mortalities) from the Fraser Valley, British Columbia to further understand the factors impacting road mortality of barn owls. We identify spatial and temporal hotspots, as well as the land use and demographic factors associated with increased risk of road mortality. In addition we recommend management actions to minimize road mortality for this species. (ID 16093 | Poster 38)

**Kus, B. E.**, USGS Western Ecological Research Center, USA, barbara\_kus@usgs.gov

#### RESTORING HABITAT FOR ENDANGERED SPECIES: THE CASE OF THE LEAST BELL'S VIREO

For the last 30 years, habitat restoration has been a primary focus of recovery-oriented management of the endangered Least Bell's Vireo, a riparian obligate brought to the brink of extinction by the loss of over 90% of its historic habitat in California. Early attempts to increase the availability of suitable vireo habitat created riparian habitat by planting nursery container stock and pole cuttings within floodplains where vegetation had been removed or degraded. We developed a quantitative model of habitat suitability based on vegetation structure in occupied vireo habitat, and used it to assess the suitability of created habitat for nesting vireos. Testing at three sites over 5 years post-planting validated the power of the model in predicting vireo use: young, developing sites were used by vireos for foraging, but territory establishment and nesting occurred only when created habitat



achieved the structural attributes described by the model. In addition to habitat creation, habitat restoration in the form of removing exotic vegetation such as giant reed from riparian woodlands is converting large portions of degraded drainages to suitable vireo habitat. Our long-term monitoring of vireo use of sites before and after restoration shows that while density of vireos declines in restored sites immediately following exotics removal, density increases within 1-2 years as native vegetation recovers to equal or exceed vireo density in native-dominated reference sites. Moreover, vireo productivity in restored habitat is comparable to that in reference habitat. Done under proper hydrologic and soil conditions, riparian habitat creation and restoration can yield habitat within a relatively short timeframe that supports nesting Least Bell's Vireos and other riparian inhabitants, and is an important tool in reversing declines of riparian systems. (ID 16287)

**Kuspa, Z. E.**, University of California, Santa Cruz, USA, zkuspa@ucsc.edu  
Finkelstein, M. E., University of California, Santa Cruz, USA, myraf@ucsc.edu  
Eng, C., Los Angeles Zoo and Botanical Gardens, USA, curtis.eng@lacity.org  
Wolstenholme, R., Pinnacles National Park, USA, rachel\_wolstenholme@nps.gov

Goodnight, A., Oakland Zoo, USA, andreag@oaklandzoo.org  
Smith, D. R., University of California, USA, drsmith@ucsc.edu

#### HORMONAL STRESS RESPONSE OF THE CHRONICALLY LEAD-EXPOSED CALIFORNIA CONDOR (*GYMNOGYPS CALIFORNIANUS*).

Elevated stress can reduce avian reproduction and survival, and lead exposure has been shown to impair the vertebrate stress response. Accurately evaluating stress hormones via blood sampling in wild birds is problematic, but measuring stress hormone metabolites in fecal samples as a proxy for stress in birds has been shown to be a promising, non-invasive method for understanding effects of toxic substances on the avian stress response. However, the stress hormone response and hormone metabolism can differ widely among species. Additionally, fecal hormone metabolite concentrations are known to change over time at ambient temperature, introducing additional challenges for field studies. Therefore, to determine effects of an environmental contaminant on a wild population, one should first characterize species-specific stress hormone responses and metabolism, including metabolite stability. California condors are critically endangered and chronically lead poisoned. Nonetheless, effects of lead on the condor stress response have not yet been determined. Here we first determined the stability of fecal stress hormone metabolites in samples over time at ambient temperatures to inform sample collection and processing methods. Using these results, we then characterized the stress hormone metabolites present in California condor fecal and urate samples, and stress hormone metabolite excretion profiles in captive condors over a 24-hour period following an acute stressor (e.g., a routine capture and handling event). Our findings will be used to investigate lead-induced alterations in the condor stress response and potential impacts to California condor recovery. (ID 16262 | Poster 106)

**Kwon, E.**, Kansas State University, USA, ebkwon@k-state.edu  
Sandercock, B. K., Kansas State University, USA, bsanderc@ksu.edu  
TEST OF ECOLOGICAL MISMATCHES IN AN ARCTIC NETWORK\*

Responses to climate change vary across functional groups and trophic levels, which can cause decoupling of biological interactions or a 'phenological mismatch'. Recent studies that have tested the phenological mismatch hypothesis in birds are limited to single species studies at relatively small spatial scales. In this study, we examined timing of hatching in shorebird communities in response to the environmental constraints at a regional scale. At ten arctic breeding sites in Alaska and northern Canada, which are participants in Arctic Shorebird Demographics Network, nests of six shorebird species (N = 3,040) were surveyed daily and the abundance of invertebrate prey were surveyed every three days during 2010 - 2012. We

estimated the degree of phenological mismatch for individual nest as the temporal difference between the date of food peak and the date when food requirements are greatest for the shorebird young. We found geographic and interspecific variation in the degree of phenological mismatch between shorebirds and their prey. Phenological mismatch may have implications for declining shorebird populations and understanding future ecological responses to changing environmental conditions. (ID 15739)

**Landoll, D. V.**, University of Oklahoma, USA, dvl04@hotmail.com  
Husak, M. S., Cameron University, USA, michaelh@cameron.edu

#### TESTING THE PREDICTED RELATIONSHIP BETWEEN WING AND TAIL MORPHOLOGY AND FLIGHT PERFORMANCE USING SCISSOR-TAILED FLYCATCHERS\*

Wing and tail morphology are related to flight and survival in birds. For birds with long, forked tails, both wing and tail length should interact with asymmetry to impact flight performance. Thomas's 1993 model suggests that asymmetry in the portion of the wing and tail that provide lift will decrease flight performance (acceleration, flight speed, angles of attack). Increasing the length of these features will decrease the impact of asymmetry on flight. Asymmetry in ornamental portions should have a low aerodynamic cost because they do not provide lift or acceleration. However, as ornament length increases, the cost of asymmetry also increases due to increased drag on one side of the body. I investigated these predictions using the sexually dimorphic Scissor-tailed Flycatcher (*Tyrannus forficatus*). I filmed birds flying through an enclosed tube in which they navigated a set of obstacles. My results supported the model's predictions. Birds with longer, more symmetrical wings and outer primary attenuations more successfully navigated the obstacles. Birds with longer tails, wings, and primary attenuations approached the obstacles with level flight and corrected less as they entered the obstacles. Increased tail length also increased the speed at which birds flew through the tube. These results indicate that wing and tail length strongly impact flight speed, maneuverability, and angle of attack. Wing asymmetry was more important than tail asymmetry, but tail asymmetry was primarily in the long, ornamental portion of the tail. This agrees with Thomas's prediction that ornament asymmetry has a lower impact than lift surface asymmetry. (ID 15997)

**Lansdorp, O. C.**, Simon Fraser University, Canada, olansdor@sfu.ca  
Terpsma, C., Delta Farmland and Wildlife Trust, Canada, christine@deltafarmland.ca

#### FORAGING VALUE OF TEMPORARY GRASSLANDS TO BARN SWALLOWS IN AN AGRICULTURALLY DOMINATED LANDSCAPE

Barn Swallows, like many of their feeding guild of aerial insectivores, have experienced population declines across North America including this study area in southwestern British Columbia. The agricultural landscape in the Fraser River delta is highly anthropogenically modified and under constant development pressure but is situated along the Pacific Flyway and functions as overwintering, migratory stop-over, and breeding habitat to many clades of birds. Since Barn Swallows predominantly breed in agricultural areas, within the context of a shrinking agricultural land base we want to understand the ecological implications of different types of farmland management. In the Metro Vancouver area the Grassland Set-Aside Program, administered by the non profit organization Delta Farmland and Wildlife Trust annually enrolls approximately 200 hectares of farmland to function as patches of grassland for 4-6 years. They are planted to a forage/clover seed mix and largely left untouched for up to six years. Potato fields, on the other hand, are intensively cultivated, fertilized and sprayed with fungicides and sometimes pesticides and herbicides throughout the growing season. We studied the ability of temporary grasslands to provide feeding habitat to breeding Barn Swallows in southwestern British Columbia. I sampled and analyzed the insect community

and compared quantities and phenology of feeding Barn Swallows over temporary grassland and conventionally managed agricultural fields in 2013 and 2014. Temporary grasslands have more Araneae (P-value=0.007), Diptera (P-value=0.007) and Neuroptera (P-value=0.048), while more Homoptera were found in conventionally managed agricultural fields. Araneae, Collembola, Heteroptera, Mites and Neuroptera were found only over grassland fields. In 2013 fields with higher arthropod abundance and diversity had more feeding Barn Swallows. (ID 16279)

**Lantz, S. M.**, Tulane University, USA, samlantz@gmail.com  
Karubian, J. O., Tulane University, USA, jk@tulane.edu

#### ADVENTITIOUS MOLT INCREASES REDNESS IN CAROTENOID-BASED PLUMAGE OF A TROPICAL PASSERINE

Signal development and the timing of expression have important consequences for our understanding of signal evolution and sexual selection. In birds, plumage is traditionally considered to be a static signal because of molt cycle constraints, but in some cases plumage signals can be changed outside of normal molt periods, for example via cosmetic alteration. In theory, birds may also be able to modify plumage via adventitious molt outside of main molt cycles, but there is little evidence that this occurs in nature. We investigated the potential trade-off between molt date and signal quality in the red-backed fairy-wren (*Malurus melanocephalus*), a small passerine, in northern Australia. In fairy-wrens, molt into nuptial plumage occurs over an extended period and early molt is thought to be an accurate predictor of reproductive success. In red-backed fairy-wrens more intense red carotenoid-based plumage is thought to be preferred by females during breeding. We measured hue and chroma of red back feathers, and compared feather characteristics between early and late molting males at the time of molt and during the subsequent breeding season. We found low levels of adventitious back molt during the breeding season in early-molting males. These early-molting males were significantly more red in the breeding season than during the nonbreeding season, and importantly, were more red during the breeding season than late-molting males. This indicates that males may be able to improve signal quality via adventitious molt. As such, our findings further our understanding of signal evolution, emphasizing the potential for signal enhancement to impact sexual selection. (ID 15990)

**Larned, A. F.**, University of Maryland Baltimore County, USA, alar1@umbc.edu  
Lohr, B., University of Maryland Baltimore County, USA, blohr@umbc.edu  
SONG OF THE PUERTO RICAN GRASSHOPPER SPARROW  
(*AMMODRAMUS SAVANNARUM BORINQUENSIS*)

We examined the structure of Puerto Rican Grasshopper Sparrow (*Ammodramus savannarum borinquensis*) song as a comparison with the song of other subspecies of this declining bird. Principle advertisement songs ("buzz" songs) of 26 individuals were recorded from three populations in the north central, northwest, and southwest of the island. We divided songs into several structural sections and measured the duration and acoustic frequency of these song sections using the SIGNAL sound analysis software. In North American birds, this song typically consists of four introductory notes followed by a longer, rapidly amplitude-modulated ("RAM") sequence, in turn followed by a final note. Puerto Rican Grasshopper Sparrows differed from mainland North American subspecies: their songs typically contained only two introductory notes, and had a less discrete transition between song sections. The acoustic frequency of the first note of Puerto Rican songs was also higher, and the frequency of the last note substantially lower, than in mainland songs. Finally, the introductory portion of the RAM sequence was significantly longer in Puerto Rican songs. These results suggest that studies of song variation may point to interesting and unique distinctions at the subspecies level for a bird in which some subspecies are of critical conservation concern. (ID 15758)

**Latimer, C. E.**, University of Wisconsin-Madison, USA, celatimer@wisc.edu  
Zuckerberg, B., University of Wisconsin-Madison, USA, bzuckerberg@wisc.edu  
WEATHER AND LANDSCAPE MEDIATED FORAGING PATTERNS IN WINTERING BIRDS

Climate plays an important role in determining the geographic range of species. Most species distribution modeling approaches use gridded climate data that do not represent the fine-scale variability of abiotic conditions that organisms experience throughout daily life. Studies that do address fine-scale variability in climate do so in topographically complex areas and rarely incorporate biological or population-level responses to local climate variation. Using radio-frequency identification equipped feeding stations, we examined how individual foraging rates of wintering birds (a metric previously shown to influence overwinter survival) varied in relation to local weather and landscape features throughout Dane County, Wisconsin. We also discuss the energetic consequences of wintering birds inhabiting landscapes with high variation in local temperature conditions, and the potential implications this has for predicting species range shifts with future climate change. We found considerable variation in local temperature that increased throughout the winter and was best explained by elevation, percent forest cover in the surrounding landscape, and forest patch shape complexity. Foraging rates decreased as minimum temperatures increased to an extent and then decreased with further decreases in temperature. Variation in local weather conditions as a function of landscape composition and configuration caused daily energy expenditures of black-capped chickadees (*Poecile atricapillus*) to vary up to 25% across the study region. (ID 16285)

**Latta, S. C.**, Naional Aviary, USA, steven.latta@aviary.org  
Marshall, L., National Aviary, USA  
Frantz, M., West Virginia University, USA  
Toms, J., Eco-Logic Consulting, Canada

#### WIDESPREAD EVIDENCE INDICATES BIOACCUMULATION OF CONTAMINANTS FROM HYDRAULIC FRACTURING IN A RIPARIAN-OBLIGATE SONGBIRD

New technologies have recently allowed the profitable extraction of gas and oil from extremely deep shale layers, and opened up development to previously unexploited regions. Hydraulic fracturing (or fracking) has been particularly prevalent and highly controversial, but until now there has been little scientific evidence of contamination from fracking entering food chains. The Louisiana Waterthrush (*Parkesia motacilla*) is a species which requires forested, freshwater streams, and has been shown to be an excellent bioindicator of riparian habitat quality. As a top predator, the waterthrush may be exposed to (and bioaccumulate) chemical contaminants occurring in the ecosystem. Here we present a multi-regional study from the Marcellus Shale and the Fayetteville Shale to test the hypothesis that in watersheds where hydraulic fracturing is occurring, birds will bioaccumulate contaminants used in the fracking process. Using barium and strontium as indicators for a suite of fracking-related contaminants, we show that waterthrush in watersheds with fracking activity carry significantly higher loads of these contaminants than individuals sampled in watersheds without fracking, and higher loads than individuals sampled in the 1990s before any fracking occurred. Our goal is to provide rigorous data to inform the debate on the environmental consequences of fracking, and to help researchers, environmental activists, industry, and policymaker's best address the consequences of fracking to wildlife and human health. (ID 15995)

**Laughlin, A. J.**, Tulane University, USA, alaughli@tulane.edu  
Sheldon, D. R., University of Massachusetts, USA, sheldon@cs.umass.edu  
Winkler, D. W., Cornell University, USA, dww4@cornell.edu  
Taylor, C. M., Tulane University, USA, caz@tulane.edu

# WINTER ROOST SITE SELECTION IN TREE SWALLOWS: TESTING 'HABITAT LIMITATION' VERSUS 'TRADITION'

Many species of birds aggregate into dense and large roosts at night, but roost site selection is not well understood. Some species appear to aggregate at 'traditional' sites within and between years, but it is often not clear if roost sites are traditional due to lack of suitable habitat nearby ('habitat limitation' hypothesis) or because of site fidelity to roost locations ('tradition' hypothesis). We tested these hypotheses in Tree Swallows (*Tachycineta bicolor*), a migratory aerial insectivore that forms large roosts during the non-breeding period. We chose two study sites, one in which swallows roost in discrete wetland reed beds (central Florida) and another in which they roost within a nearly continuous habitat of sugarcane fields (southeastern Louisiana). Using Doppler weather radar, we labeled and collected locations of swallow roosts each day during the study period (winter, 1996 – 2012) and performed cluster analysis on the radar-determined roost locations. Support for the 'habitat limitation' hypothesis would be characterized by more clustered roosts in Florida (where the habitat is discretized into roosting versus non-roosting habitat) than in Louisiana (where the habitat is nearly continuous). Instead, we found strong evidence for the 'tradition' hypothesis in both Florida and Louisiana, where roosts were in the same locations each night and across years. We propose that such fidelity to roost locations may be an important driver of roost formation and maintenance, and that winter habitat and roost site conservation has important implications for this species and other aerial insectivores that gather in such large nocturnal roosts. (ID 15832)

**Lautenbach, J. M.**, Kansas State University, USA, lautenba@ksu.edu  
**Plumb, R. T.**, Kansas State University, USA, rtplumb@ksu.edu  
**Haukos, D. A.**, Kansas Cooperative Fish and Wildlife Research Unit, USA, dhaukos@ksu.edu  
**Pitman, J. C.**, Kansas Department of Wildlife, Parks, and Tourism, USA  
**SURVIVAL AND HABITAT SELECTION OF LESSER PRAIRIE-CHICKEN CHICKS AND BROODS**

The lesser prairie-chicken (*Tympanuchus pallidicinctus*), a threatened grassland bird, is found within three distinct landscapes in Kansas and eastern Colorado. Concurrently monitoring reproductive success among regions will provide insight into population trends for each distinct landscape. Chick survival varies across lesser prairie-chicken range and represents a critical life stage that managers target to increase prairie-chicken recruitment. In 2013, we captured and fitted 106 adult females with satellite and VHF transmitters in 2013 across Kansas and Colorado. We found 60 nests, of which 16 were successful. Within 1-5 days of hatching, 0.6-g VHF transmitters were attached to 2 chicks/brood. In addition, broods were flushed once per week to record brood survival. Initial results suggest that the first 10 days are critical to survival. Daily survival rates (DSR) of chicks increased from 0.795 at day 1 to 0.903 at day 10. We observed regional variation in brood survival with DSR ranging from 0.977 in south-central Kansas to 0.667 in northwest Kansas. By providing adequate brood-rearing habitat, managers can work to increase population recruitment. (ID 15754)

**Lautenbach, J. M.**, Kansas State University, USA, lautenba@ksu.edu  
**Plumb, R. T.**, Kansas State University, USA, rtplumb@ksu.edu  
**Haukos, D. A.**, U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, USA, dhaukos@ksu.edu  
**Pitman, J. C.**, Kansas Department of Wildlife, Parks, and Tourism, USA, jim.pitman@ksoutdoors.com  
**Hagen, C. A.**, Oregon State University, USA, Christian.Hagen@oregonstate.edu  
**IMPACTS OF TREE ENCROACHMENT ON LESSER PRAIRIE-CHICKENS**  
Lesser prairie-chickens (*Tympanuchus pallidicinctus*; hereafter prairie-chicken), a species of prairie grouse native to the southwest Great Plains,

have experienced major population declines since the early 1900s resulting in being listed as threatened under the federal Endangered Species Act of 1973. Tree encroachment into grasslands has been identified as a source of habitat loss. While tree encroachment has been implicated as a source of habitat loss, it is poorly understood how tree encroachment into grasslands impacts prairie-chickens. In 2013 and 2014, satellite and VHF transmitters were attached to 62 females, 9 males, and 7 juveniles in south-central Kansas, where tree encroachment into grasslands is a concern. We found 11.6% of all prairie-chicken locations were located within 100 m of trees and 36.9% of prairie-chicken locations were within 200 m of trees. Tree densities of habitat patches ranged from 0.01 trees/ha to 22.90 trees/ha, with a mean of 3.09 trees/ha. We observed 88.6% of all prairie-chicken locations were in habitat patches with <1.0 trees/ha and 95.5% of all prairie-chicken locations were in patches with <1.5 trees/ha. Understanding how tree encroachment into grasslands is important to managing and improving habitat for prairie-chickens and other grassland birds. (ID 16255 | Poster 84)

**Lavender, J.**, Georgia Southern University, USA, jl03921@georgiasouthern.edu  
**Deaner, L.**, Georgia Southern University, USA, ld02111@georgiasouthern.edu  
**Chandler, C. R.**, Georgia Southern University, USA, chandler@georgiasouthern.edu

# POTENTIAL PREDATORS AT NESTS OF WILSON'S PLOVERS ON CUMBERLAND ISLAND, GEORGIA

Nest predation can be a major source of mortality in bird populations. This is especially true in ground-nesting birds such as shorebirds, and conservation efforts directed at shorebirds often involve predator controls such as fencing or trapping. Implementing predator controls should be based on a good understanding of the dynamics of nest predation at relatively undisturbed sites. Therefore, we quantified the identity of potential predators and the frequency at which they threaten the nests of Wilson's Plovers (*Charadrius wilsonia*) at a protected and relatively undisturbed site on Cumberland Island, Georgia. We used trail cameras to photograph nests (n=6) approximately every 30 sec throughout the incubation period. Nest threats were defined as potential predators approaching within 3 m of a nest. There was an average of 16 threats per nest (range 2-35). However, only 4 of 96 threats actually resulted in loss of eggs. Nine species of potential predators threatened plover nests. An average of three predator species threatened each nest (range 2-5). Ghost crabs (*Ocypode quadrata*) were the most common nest threat (2-22 threats per nest), but did not result in egg loss (though they did move eggs out of nests). Coyotes (*Canis latrans*) were the greatest threat, with 67% of approaches resulting in egg loss. Even on a protected island, Wilson's Plover nests experience high threat rates from a diverse assemblage of predators. (ID 16296 | Poster 118)

**LeBeau, C. W.**, Western EcoSystems Technology, Inc, USA, cwlebeau@west-inc.com  
**Beck, J. L.**, University of Wyoming, USA, jlbeck@uwyo.edu  
**Johnson, G. D.**, Western EcoSystems Technology, Inc, USA, gjohnson@west-inc.com  
**Holloran, M. J.**, Wyoming Wildlife Consultants, LLC, USA, matth@wyowildlife.com

# SHORT-TERM IMPACTS OF WIND ENERGY DEVELOPMENT ON GREATER SAGE-GROUSE<sup>T</sup>

Wind energy development is increasing in rangeland habitats, prompting concerns relative to impacts to avian species including the greater sage-grouse (*Centrocercus urophasianus*). Little information exists about the impacts of wind energy development on sage-grouse; however, wind energy infrastructure is likely to directly and indirectly impact sage-grouse movements because they avoid tall structures and human activities. Changing movements may equate to different habitat selection patterns, which are



predicted to lead to reduced population fitness. The purpose of our study was to document fitness parameters associated with sage-grouse inhabiting areas in close proximity to wind turbines. In April 2009 and 2010, we captured  $n = 116$  female sage-grouse from near Medicine Bow, Wyoming. We monitored these grouse for 2 years to evaluate nest, brood, and female survival. We used Cox proportional hazards regression to model nest, brood and female survival. We considered a suite of environmental and anthropogenic features as predictor variables to model survival. Female survival was not influenced by wind infrastructure, but nest and brood survival were both negatively affected by proximity to wind turbines. This is the first study to evaluate short-term effects of wind energy infrastructure—specifically wind turbines—on sage-grouse fitness parameters. (ID 16050)

**Lehmickie, A. J.**, University of Georgia, USA, lehmicke@uga.edu  
**Nairn, C. J.**, University of Georgia, USA, nairn@uga.edu  
**Cooper, R. J.**, University of Georgia, USA, rcooper@warnell.uga.edu  
**NEST-LEVEL AND INDIVIDUAL CORRELATES OF EXTRA-PAIR PATERNITY IN THE SEASIDE SPARROW (AMMODRAMUS MARITIMUS)\***

Extra-pair paternity (EPP) is common among socially monogamous passerines, with rates varying widely among species, populations, and individuals. Much research has been focused on hypotheses attempting to explain this variation both among and within species. We collected EPP data for two breeding seasons from two populations of Seaside Sparrows (SESP) breeding in tidal marshes on the northern coast of the Gulf of Mexico in Mississippi and attempted to explain differences in EPP rates using characteristics of nests and individual adults. Thirty of 146 nestlings from 20 of 63 nests were classified as extra-pair; rates that fall at the low end of published numbers for family Emberizidae. Extra-pair young were not more genetically diverse or heavier than within-pair siblings, suggesting no indirect genetic benefits for females. No male traits, phenotypic or genetic, predicted lost paternity or differentiated between males who were cuckolded and the specific males who cuckolded them. Female mass was the only significant correlate of extra-pair paternity rates; heavier females had fewer extra-pair young. This result, when combined with the apparent lack of benefits, is difficult to explain under the assumption that female SESP are willing participants in extra-pair copulations (EPCs). We suggest that smaller females may be coerced into accepting EPCs through the use or the threat of force, adding more evidence to recent suggestions that EPP may be an example of sexual conflict in some species or populations. (ID 15912)

**Leighton, G. M.**, University of Miami, USA, gleighton@bio.miami.edu  
**Echeverri, S.**, University of Miami, USA, echeverri.sa@gmail.com  
**Heinrich, D.**, SAFRING, Namibia, photographer@afol.com.na  
**Kolberg, H.**, SAFRING, Namibia, holgerk@afol.com.na  
**Searcy, W. A.**, University of Miami, USA, wsearcy@miami.edu

#### RELATEDNESS PREDICTS MULTIPLE MEASURES OF INVESTMENT IN COOPERATIVE NEST CONSTRUCTION IN SOCIABLE WEAVERS

Although communal goods are often critical to society, they are simultaneously susceptible to exploitation, and are evolutionarily stable only if mechanisms exist to curtail exploitation. Mechanisms such as punishment and kin selection have been offered as general explanations for how communal resources can be maintained. Evidence for these mechanisms comes mostly from humans and social insects, leaving their generality in question. To assess how communal resources are maintained in a novel taxon we observed cooperative nest construction in sociable weavers (*Philetairus socius*). The communal nest of sociable weavers provides thermal benefits for all individuals but requires continual maintenance. We observed cooperative nest construction and also recorded basic morphological characteristics. We also collected blood samples, performed next-generation sequencing, and isolated 2,358 variable SNPs to estimate relatedness. We find that relatedness

predicts investment in cooperative nest construction, while no other morphological characters significantly explain cooperative output. We also find that in general male sociable weavers perform more cooperative nest construction than females, and since previous work demonstrates that males are more related to their colony of residence, we argue that indirect benefits are a critical fitness component for maintaining the cooperative behavior that maintains the communal good. (ID 15747)

**Leist, A. J.**, Great Basin Bird Observatory, USA, amyleist@yahoo.com  
**Fletcher, D. M.**, Great Basin Bird Observatory, USA, fletcher@gbbo.org  
**LOWER COLORADO RIVER RIPARIAN BIRDS PROJECT:  
 TESTING AN ASSUMPTION OF THE DOUBLE-SAMPLING METHOD**

As part of the Lower Colorado River Multi-Species Conservation Program, we conduct river-wide monitoring of riparian birds using a double-sampling area search design. One component of our project has been to test the only assumption that currently carries some uncertainty in the monitoring plan, which is that intensive area searches result in unbiased estimates of bird numbers. To address this uncertainty, we conducted three seasons of a triple-sampling effort (rapid area search (R, 2 surveys/season), intensive area search (I, 8 surveys/season), and enhanced intensive (EI, 16 surveys/season)) on 8 different plots per year (2011-2013). We found over 1600 breeding pairs in over 70 species on the EI effort surveys, and 21 species had high enough sample sizes to be included in our analyses. The overall difference between the EI and I results was only 16%, and the species that contributed most to this difference differed in their natural history from most others. The species with the largest deviations from a detection ratio of 1.0 were those that breed early, arrive late, are challenging to detect, or have poorly defined territories. The EI and I surveys were also conducted in the most difficult-to-survey plots in the project area, and it is likely that the actual detectability of most species is higher in many other areas, which are easier to survey and have lower bird densities. This project component was an important reality check for the difficult process of monitoring many species across a large landscape and over a long period of time. It confirmed that the basic approach of the double-sampling method produced the desired monitoring data, and it resulted in additional in-depth information about birds and their natural history on the Lower Colorado River that was previously unavailable. The natural history information obtained through this triple-sampling effort will help future surveys produce more accurate results and thus continue to decrease bias. (ID 15928 | Poster 67)

**Leitner, W. A.**, Sky Islands Bird Observatory, USA, wleitner@birdsci.com  
**Ralph, P. L.**, Molecular and Computational Biology University of Southern California, USA, petrel.harp@gmail.com  
**Ralph, C. J.**, US Forest Service, Redwood Sciences Laboratory and Klamath Bird Observatory, USA, cjralfph@humboldt1.com

#### ESTIMATING SHIFTS IN THE ARRIVAL TIMES OF MIGRANT BREEDING BIRDS FROM CONSTANT EFFORT MONITORING DATA

Capture data from migrating birds show that some species are currently shifting spring arrivals earlier by approximately 0.25 days per year (Cotton, 2003, Hüppop, 2003, Tøttrup et al., 2006). Here, we report a methodology to extend the analysis from shifts in arrival times at passage points to arrivals at breeding sites. Capture data from constant effort breeding bird studies (Ralph et al., 1993, Saracco et al., 2009) comprise a much larger data set, with greater spatial extent, than available from the relatively small number of migration study sites. And, this data may be used for large scale analyses for at least a few key species provided that sample design limitations can be overcome. By accounting for the effects of sampling design, we show how quantile regression (Koenker, 2005) analysis may be used to extract shape and shift rates for arrival distributions using data from the Monitoring Avian Productivity and Survivorship (Saracco et al., 2009) program, the largest bird

capture effort in North America. Following Monte Carlo characterization of the proposed method, we report shifts toward earlier arrivals from a few species studied in southeastern Arizona and northern California. We suggest guidelines for the application of these methods and provide recommendations for enhancing the monitoring of arrival distributions. (ID 16330)

**Levandoski, G. J.**, Rocky Mountain Bird Observatory, USA, greg.levandoski@rmbo.org

**Panjabi, A. O.**, Rocky Mountain Bird Observatory, USA, arvind.panjabi@rmbo.org

**Gallagher, S.**, Rocky Mountain Bird Observatory, USA, seth.gallagher@rmbo.org

**Quattrini, L.**, Rocky Mountain Bird Observatory, USA, laura.quattrini@rmbo.org

**VerCauteren, T.**, Rocky Mountain Bird Observatory, USA, tammy.vercauteren@rmbo.org

#### YES, IN YOUR BACKYARD: A MODEL FOR INCREASED PRIVATE GRASSLANDS CONSERVATION

Eighty-five percent of grasslands in the U.S. are privately owned. Although federal conservation programs are available to landowners through the Farm Bill and technical assistance through the National Resources Conservation Service (NRCS) they are not always utilized. Rocky Mountain Bird Observatory (RMBO) launched Prairie Partners in 1999 to engage landowners in voluntary and collaborative conservation, connecting them with grant opportunities and technical assistance to improve habitat conditions to benefit wildlife while protecting their economic investments. Since 1999 the program has grown considerably and now employs 11 biologists who work jointly for RMBO, NRCS and/or state agencies. Between 2008 and 2013 we have implemented 700 habitat projects improving over 500,000 acres, funded by more than 12 million Farm Bill dollars. Although grassland loss in the Great Plains has diminished, population declines of nearly all grassland bird species continue. To investigate, RMBO conducted regional monitoring from 2007-2012 in Chihuahuan Desert grasslands. Resulting information on winter grassland bird densities, spatio-temporal movements, habitat relationships and winter survival are informing a new effort to employ RMBO's outreach model in the region. Since 2012, RMBO has partnered with 11 ranches comprising nearly 250,000 acres in Valles Centrales, a Priority Conservation Area that supports the last desert-breeding Aplomado Falcons in Mexico and is critical to the survival of other priority migratory bird species. Using the model developed in the Great Plains of trust-building, bird/habitat monitoring, and collaboration on grants for habitat and infrastructure improvements, we aim to bolster the abundance and survival of wintering grassland populations in a region where grassland loss to expansion of intensive agricultural is an imminent threat. We must restore the economic sustainability of their rangelands while improving habitat for grassland birds. (ID 16379)

**Lewis, W. B.**, The University of Southern Mississippi, USA, william.b.lewis@eagles.usm.edu

**Moore, F. R.**, The University of Southern Mississippi, USA, frank.moore@usm.edu

**Wang, S.**, The University of Southern Mississippi, USA, shiao.wang@usm.edu

#### RELATIONSHIP BETWEEN THE GUT MICROBIOTA AND THE ENERGETIC DEMANDS OF LONG-DISTANCE PASSERINE MIGRATION

The gastrointestinal tract of vertebrates is home to a vast array of microbes, referred to as the gut microbiota, which are known to play an important role in pathogen defense, food digestion, and fat metabolism of the host. Little is known about the gut microbiota of passerines; furthermore no studies have investigated the relationship between migratory energetic demand and passerine gut microbiota. The condition of a bird after the non-stop flight across the Gulf of Mexico (GOM) is likely an indicator of stress and

energetic demand experienced during crossing. Birds arriving along the Northern GOM may have differing microbiota compared to birds arriving in better condition. Gray Catbirds, Wood Thrushes, and Swainson's Thrushes were captured immediately after crossing the GOM during spring migration at the University of Southern Mississippi's long-term banding site in coastal Louisiana. Fecal samples, representative of the gut microbiota, were collected and the energetic condition of each bird was assessed. Repeat fecal samples were also collected from individuals recaptured during their stopover period. The 16S rRNA gene of the bacterial genome was amplified and the microbial community structure was analyzed through Denaturing Gradient Gel Electrophoresis. DNA concentrations in all of the samples were low, potentially due to high throughput times of birds combined with physiological changes associated with migration. Analysis from recapture samples suggests that the gut microbiota undergoes restructuring during stopover. (ID 15956 | Poster 50)

**Liao, C.**, National Chiayi University, Chinese Taiwan, b\_781208@hotmail.com  
Lin, R., Endemic Species Research Institute, Chinese Taiwan, pitta.formosa@gmail.com

**Tsai, J.**, National Chiayi University, Chinese Taiwan, ross.tsai@gmail.com

#### DEVELOPING SURVEY AND MONITORING STRATEGY USING OCCUPANCY MODELING FOR AN ENDANGERED BIRD SPECIES IN TAIWAN

The population of Russet Sparrow (*Passer rutilans*) in Taiwan has been declined rapidly and was declared as endangered in 2008. However, the reasons behind the decline are still unclear. It is therefore essential to develop a systematic survey and monitoring strategy and to understand the current distribution pattern as well as its relationship with environmental variables for conservation planning. We used occupancy modeling as a framework to develop the survey method in Zengwen Reservoir region in Chiayi County, Taiwan. We applied stratified random sampling to select 60 plots based on whether there is human structures (e.g., houses and dam) or not, which is reported to associate with Russet Sparrow. Within each selected plot, we conducted two 250m transect surveys along the road and recorded both Russet Sparrow and its potential competitor, Eurasian Tree Sparrow (*Passer montana*). We repeated the survey in each plot three times within two weeks during the breeding season in April 2014. In each transect, we also used playback with male territorial singing song at two points for two minutes. The naïve occupancy estimate of Russet Sparrow was 0.30 with the overall detection probability 0.48. The model selection using Akaike Information Criterion indicated that whether there is human structure or not only had weak influence on occupancy. Moreover, 67% of the Russet Sparrow observations were detected during the playback session and among which, 73% of the individuals had responses to the playback, suggesting that playback can enhance the detection. Additional analyses will focus on how landscape-level variables influence on distribution and the relationship between Russet Sparrow and Eurasian Tree Sparrow. (ID 16366)

**Link, W. A.**, USGS Patuxent Wildlife Research Center, USA, wlink@usgs.gov  
Sauer, J. R., USGS Patuxent Wildlife Research Center, USA, jrsauer@usgs.gov

#### CRITICIZING THE BBS MODEL

Annual analysis of the North American Breeding Bird Survey is a large task, involving modeling and estimation of population trend for over 400 species of birds at multiple scales. Survey features such as range of years covers and numbers of missing years vary substantially across hundreds of strata. Models need to account for variation among observers, and need to be applicable even when species are not commonly detected Hierarchical models have provided the first real possibility for reasonable analysis of BBS data. These allow modeling of observer effects and spatial parameters as random effects, providing a rich modeling framework. These models provide

the opportunity to explore alternative patterns of population change. For instance, models currently in use treat year effects on the logarithmic scale as normally distributed with a linear trend scale. An alternative model treats the first differences of these effects as mean zero random effects, allowing greater flexibility in pattern of population change, but typically requiring greater data resources. The problem is, how do we evaluate the adequacy of data for application of various models? How do we evaluate the adequacy of specific models for description of the data? How do we discriminate among models? Is it possible or desirable to have a single model to apply at multiple scales and across species? Answering these questions is made challenging by the complex nature of BBS data. In this talk we discuss the challenges presented by these questions and propose some possible solutions. (ID 16282)

**Lituma, C. M.**, Center for Native Grasslands Management, The University of Tennessee, USA, [clituma@utk.edu](mailto:clituma@utk.edu)  
**Keyser, P. D.**, Center for Native Grasslands Management, The University of Tennessee, USA, [pkeyser@utk.edu](mailto:pkeyser@utk.edu)  
**Harper, C. A.**, The University of Tennessee, USA, [hcraig5@utk.edu](mailto:hcraig5@utk.edu)  
**Morgan, J.**, Kentucky Department of Fish and Wildlife Resources, USA  
**Holcomb, E. D.**, Center for Native Grasslands Management, The University of Tennessee, USA, [edoxon@utk.edu](mailto:edoxon@utk.edu)

#### RESTORING IMPERILED GRASSLAND BIRDS THROUGH GRAZING INNOVATION IN THE EASTERN UNITED STATES

Many grassland bird species continue to experience drastic population declines in the eastern USA. Pasturelands are a substantial landscape component but are dominated by non-native, cool-season grasses which provide poor habitat for grassland birds. Often, improving grassland bird habitat focuses on establishing native warm-season grasses (NWSG). Historically, NWSG were subjected to frequent fires and grazing by herbivores. Inclusion of fire in grazing systems has resulted in patch-burn grazing (PBG) management which can positively affect grassland bird densities, occupancies, and nest survival in the Great Plains though there is little research about PBG effects on grassland birds in the eastern USA. Use of PBG in NWSG on eastern beef and dairy production fields (<20 ha) reduces management for producers. Our objectives were to 1) foster use of NWSG in forage production in the eastern USA, 2) determine effects of PBG in NWSG pastures on cattle carrying capacity, stocking rates and dates, and weight gains, and 3) assess impacts of PBG on breeding bird density and nest survival. In 2012 we restored 15, 9-ha NWSG pastures on: Blue Grass Army Depot, Richmond, KY (n = 6); Dairy and Research Education Center, Lewisburg, TN (n = 5); and Quicksand Research and Education Center, Quicksand, KY (n = 4). In 2014, we conducted 3-minute, distance-based, avian point counts to assess pretreatment density. We surveyed points 3 times during May-July to estimate occupancy. Additionally, we used behavioral cues to search for target species' nests and assess nest survival and parasitism rates. Target species were field sparrow, grasshopper sparrow, Henslow's sparrow, eastern meadowlark, and red-winged blackbird. In 2015 we will implement PBG treatments to evaluate effects on cattle carrying capacity, stocking rates and dates, weight gains, and the avian community. Our results will provide guidance of eastern grasslands management for grassland bird conservation in production settings. (ID 16021)

**Lloyd, J. D.**, Ecostudies Institute, USA, [jilloyd@ecoinst.org](mailto:jilloyd@ecoinst.org)  
**Mullin, R. D.**, Ecostudies Institute, USA, [rmullin@ecoinst.org](mailto:rmullin@ecoinst.org)

#### NATURAL HISTORY OF MANGROVE CUCKOOS IN SOUTH FLORIDA

Mangrove Cuckoo (*Coccyzus minor*) is a West Indian species that reaches its northern limit in the mangrove forests of southern Florida. Anecdote and limited empirical information suggest that populations of this species in Florida have declined in numbers. Given concern about population declines and habitat insecurity, interest in conservation planning for Mangrove Cuckoos has increased. However, basic natural-history data that would

underpin any such effort are completely lacking. To address this gap, we are gathering information on the natural history of Mangrove Cuckoos in southwest Florida via observation and year-round radio-telemetry. Results thus far reveal a complex natural history with potentially interesting parallels to Western Yellow-billed Cuckoos. First, individuals occupy unusually large home ranges during the breeding season, with a median area of approximately 40 ha. Individuals routinely move large distances during the course of a day; one radio-tagged bird made an approximately 60-km round-trip flight between Sanibel Island, Florida and the mainland coast in a single day. Second, although requiring large areas of mangrove forest, Mangrove Cuckoos do not avoid anthropogenic edges and often occupy forests adjacent to housing and commercial developments. Whether fitness consequences accrue for individuals using such areas is unknown. Finally, although some Mangrove Cuckoos are present in Florida year-round, we have no evidence that individuals remain in the same area throughout the year. Rather, birds seem to wander widely when not breeding. Describing them as "resident" likely over-simplifies a much more complicated strategy of seasonal movement. Indeed, a more complete understanding of seasonal movements, including addressing the possibility of movement between Florida and nearby Caribbean islands is the key outstanding question that we hope to address for this species. (ID 16007)

**Lorenz, T. J.**, University of Idaho, USA, [lore5748@vandals.uidaho.edu](mailto:lore5748@vandals.uidaho.edu)  
**Vierling, K. T.**, University of Idaho, USA, [kerriv@uidaho.edu](mailto:kerriv@uidaho.edu)  
**Johnson, T. R.**, University of Idaho, USA, [trjohns@uidaho.edu](mailto:trjohns@uidaho.edu)  
**Fischer, P. C.**, Retired Civil Engineer, USA, [pcfischer@gmail.com](mailto:pcfischer@gmail.com)

#### CHOICE OR CONSTRAINT? THE ROLE OF WOOD HARDNESS IN LIMITING NEST SITE SELECTION IN NORTH AMERICAN WOODPECKERS.\*

Woodpeckers and other primary cavity excavators (PCEs) are important worldwide for excavating cavities in trees, and a large number of studies have examined their nesting preferences. However, the role of wood hardness in nest site selection has been largely ignored. Moreover, information is lacking on the excavation abilities of PCEs, and the role of wood hardness in limiting nesting opportunities. Here, we compared wood hardness at nest sites for six North American PCEs. We also examined the role of wood hardness in multi-scale nest site selection and in limiting nesting opportunities. At nest sites (n = 259), we found that wood in the tree's interior differed from exterior wood for all species ( $F(1,517) = 65.66$ ,  $P < 0.0001$ ). Among species there were no differences in interior nest wood hardness, but nests sites had softer interior wood than random sites ( $F(1,517) = 106.15$ ,  $P < 0.0001$ ). Accordingly, interior wood hardness was by far the most influential factor in our nest site selection models at both spatial scales. Moreover, regardless of hypothesized excavation ability, PCEs in our study appeared limited by interior wood hardness, and only 4-14% of measured trees were actually available for nesting. Our findings suggest past studies that did not measure wood hardness counted many sites as available that were actually unavailable, potentially biasing results. Moreover, by not accounting for nest-site limitations in PCEs, land managers may overestimate the amount of suitable habitat. Future research and management with PCEs must include quantitative measures of wood hardness at nest sites for meaningful and unbiased conclusions. (ID 15744)

**Loss, S. R.**, Oklahoma State University, USA, [scott.loss@okstate.edu](mailto:scott.loss@okstate.edu)  
**Will, T.**, U.S. Fish and Wildlife Service, USA, [tom\\_will@fws.gov](mailto:tom_will@fws.gov)  
**Marra, P. P.**, Smithsonian Conservation Biology Institute, Migratory Bird Center, USA, [marrap@si.edu](mailto:marrap@si.edu)

#### ANTHROPOGENIC BIRD MORTALITY IN THE UNITED STATES: COMPARISON OF DATA-DRIVEN ESTIMATES FOR MULTIPLE THREATS AND IDENTIFICATION OF OVER-ARCHING RESEARCH NEEDS



A tremendous number of birds are directly killed by anthropogenic mortality sources, yet there is great uncertainty about the magnitude of this mortality and the relative importance of different threats. We reviewed hundreds of studies and synthesized data to quantify annual U.S. bird mortality and to identify over-arching research needs for several threats. We estimate that domestic cats cause the greatest annual mortality (billions of birds); followed by collisions with buildings (hundreds of millions to one billion), automobiles (hundreds of millions), and power lines (tens of millions); electrocutions at power lines (1-10 million); and collisions with wind turbines (hundreds of thousands). For building collisions, estimates of species vulnerability could be generated, but many threats lack the data to inform rigorous species-specific analyses. Nonetheless, Neotropical migrants appear disproportionately vulnerable to collisions at many types of manmade structures. We identified several over-arching research needs that are crucial to an improved understanding of anthropogenic mortality, and of population-level impacts in particular, including: (1) increased focus on randomly selected study sites and structures (as opposed to focusing only on known mortality hot spots), (2) sampling and reporting all bird species potentially killed (as opposed to focusing on particular species), (3) sampling throughout the entire year (as opposed to focusing only on periods thought to have the greatest mortality), (4) quantification of biases that cause carcass counts to underestimate mortality (searcher detection, scavenger removal, and crippling rates), and (5) standardization of protocols to increase comparability of data among locations and years. Importantly, when the data allows it, an increased focus should be placed on identification of disproportionate impacts on species and locations in addition to quantifying gross mortality numbers. (ID 15852)

**Luepold, S. B.**, SUNY College of Environmental Science and Forestry, USA, shbuck01@syr.edu

Hodgman, T. P., Maine Department of Inland Fisheries and Wildlife, USA, tom.hodgman@maine.gov

McNulty, S. A., SUNY College of Environmental Science and Forestry, USA, smcnulty@esf.edu

Cohen, J., SUNY College of Environmental Science and Forestry, USA, jcohen14@esf.edu

Foss, C. R., New Hampshire Audubon, USA, cfoss@nhaudubon.org

#### A MULTI-SCALE ANALYSIS OF RUSTY BLACKBIRD NEST SURVIVAL AND NEST PREDATORS IN NEW ENGLAND

Our objectives were to identify the mechanisms by which a previously hypothesized ecological trap for Rusty Blackbirds (*Euphagus carolinus*) may be operating in New England through a multi-scale analysis of nest survival, predator identification and quantification. We monitored 65 Rusty Blackbird nests in Maine and New Hampshire in 2011 and 2012 and related nest survival to habitat characteristics at the nest patch (0.008 ha) and home range (785 ha) scale using an information-theoretic approach. At the nest patch scale, we found that nest survival increased with increasing total basal area, and we recommend land managers maintain areas of densely stocked seedling/sapling spruce (*Picea* spp.) and fir (*Abies* spp.) to enhance Rusty Blackbird nesting habitat. At the home range scale, nests that were closer to the road were less successful in 2011, but not in 2012. It was difficult to robustly assess the effect of timber management on nest survival because we had so few nests in unharvested areas ( $n = 8$ ), but we did not find clear support for an ecological trap caused by timber harvesting. We documented eight predation events and identified four predator species, including white-tailed deer (*Odocoileus virginianus*), an *Accipiter* sp., Blue Jay (*Cyanocitta cristata*) and red squirrel (*Tamiasciurus hudsonicus*). Red squirrels were the most frequent predator of Rusty Blackbird nests ( $n = 4$ ), but only in 2012, when they were generally abundant relative to 2011. Abundance of spruce and fir cones was high in 2011 and low in 2012. Fluctuating predator populations mediated through cone mast likely influence Rusty Blackbird nest survival more than timber harvesting. (ID 15919)

**Lukianchuk, K. C.**, University of Windsor, Canada, k.lukianchuk@gmail.com

Norris, D. R., University of Guelph, Canada, rnorris@uoguelph.ca

Newman, A. E., University of Guelph, Canada, newman01@uoguelph.ca

Williams, H., Williams College, USA, Heather.Williams@williams.edu

Doucet, S. M., University of Windsor, Canada, sdoucet@uwindsor.ca

Mennill, D. J., University of Windsor, Canada, dmennill@uwindsor.ca

#### SEASONAL AND DIEL VARIATION IN SINGING BEHAVIOUR IN AN ISLAND POPULATION OF SAVANNAH SPARROWS (*PASSERCULUS SANDWICHENSIS*)

Male Savannah Sparrows sing one individually distinctive song throughout their lifetime, which is used for both territory defence and mate attraction. Previous research has demonstrated that when young male Savannah Sparrows learn to sing, they are heavily influenced by adult male tutors in neighbouring territories, and that tutoring may occur during both their natal year and first breeding year. The pattern of seasonal variation in singing behaviour may reveal when young males are most heavily influenced by the tutors around them. Variation in song activity throughout the day can also reflect variation in male territorial behaviour, as well as female reproductive activities during the breeding season. Therefore, studying patterns in diel variation may help us understand how Savannah Sparrows learn to sing, and how they communicate with both male and female conspecifics. In our study population on Kent Island, New Brunswick, we used autonomous recording devices to record twenty individuals for ten 24h periods between mid-April and mid-September, with 14 day intervals between recording sessions. We analyze both seasonal and diel variation by annotating all songs produced by each male per hour during each 24h period, and performing repeated measure ANOVAs. Since young males are influenced by tutors in both natal and first breeding years and crystallize their song within the first 2 weeks after arrival in their first breeding year, this suggests that adult males produce songs during both pre-breeding and post hatching periods. We therefore predict increased song output during early arrival, when males are securing territories and attracting females, as well as after fledging their first nest. Our research will help reveal critical song learning periods for young males, as well as enhance our knowledge of how song is used for conspecific communication in birds. (ID 16309 | Poster 100)

**Lundblad, C. G.**, Idaho Cooperative Fish and Wildlife Research Unit, USA, lundblad@uidaho.edu

Conway, C. J., U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, USA, cconway@uidaho.edu

#### WHY DO SOME BUT NOT ALL BIRDS MIGRATE? TESTS OF MECHANISTIC HYPOTHESES IN YELLOW-EYED JUNCOS.\*

Despite the ubiquity and diversity of migratory behaviors, we currently know little about the causes of seasonal movements in most animals. Our ability to understand why migratory tendency often varies among and within species is limited by the logistical constraints on tracking, much less conducting manipulative experiments on, long-distance migrants. Altitudinal migrants may achieve benefits comparable to long-distance migration by making relatively-short movements up and down mountains. Short-distance altitudinal migrants provide opportunities to examine the factors that mediate individual migratory decisions within populations. We tested correlative and experimental predictions of the 1) body size, 2) dominance, and 3) arrival time hypotheses by tracking the facultative altitudinal movements of >800 uniquely marked Yellow-eyed Juncos (*Junco phaeonotus*) breeding along a 1000-meter altitudinal gradient in the Santa Catalina Mountains, Arizona. We examined what morphological, behavioral, and other condition-dependent traits were associated with the propensity of individuals to migrate. Our results suggest that: 1) females are more migratory than males, 2) all individuals breeding at the highest elevations may migrate facultatively for short periods following major snowfalls, 3) the likelihood of individual

migration is negatively associated with body size, even within sex classes, 4) individual aggressiveness is not strongly associated with migratory decisions, and more aggressive males may be more migratory than less aggressive individuals, and 5) males with higher propensities to migrate may also occupy high-quality territories and achieve higher reproductive success than less-migratory individuals (contrary to a key prediction of the arrival time hypothesis). (ID 16214)

**Luther, D. A.**, George Mason University, USA, dluther@gmu.edu  
Lipshutz, S., Tulane University, USA  
Derryberry, E., Tulane University, USA, ederrybe@tulane.edu

#### DIVERGENCE IN BILL MORPHOLOGY BETWEEN URBAN AND RURAL POPULATIONS

Cities provide one of the most extreme examples of habitat modification; whereas most native species are extirpated from these areas, some persist. Due to the heavily altered environment, strong selection pressures are predicted for populations that persist in cities. We studied museum specimens of white-crowned sparrows (*Zonotrichia leucophrys nuttali*) in San Francisco and adjacent rural areas to investigate the role of urbanization on bill morphology in a resident species that inhabits both urban and rural habitats. Male and female birds from rural populations had larger bills than urban birds. Rural females had wider bills than urban females. Rural males were larger in general than urban males, however even when controlling for body size, bills of rural males were longer, wider, and deeper with an overall larger surface area than bills of urban males. In addition, based on measurements from museum specimens from 1900 to 1980 the differences in bill size are not static. Bills have been changing over time, and bill size is getting bigger for both rural and birds. Finally, the rural populations exhibit sexual dimorphism in bill size with males having larger bills than females, whereas in the urban San Francisco population males and females have the same bill size. The findings provide compelling evidence that cities provide strong selection pressures that could lead to microevolutionary changes among urban and rural sedentary populations. (ID 16080)

**Luttrell, S. A.**, University of Maryland, Baltimore County, USA, manor.sarah@gmail.com  
Fleischer, R., Smithsonian Center for Conservation and Evolutionary Genetics, USA, fleischerr@si.edu  
Greenberg, R., Smithsonian Migratory Bird Center, USA  
Lohr, B., University of Maryland, Baltimore County, USA, blohr@umbc.edu  
MICROSATELLITE ANALYSIS OF MARSH WRENS (*CISTOTHORUS PALUSTRIS*) REVEALS SURPRISING LACK OF GENETIC DIVISION AMONG ECOLOGICALLY AND GEOGRAPHICALLY VARIABLE POPULATIONS

Understanding the extent of ecological and geographic variation is a key in conservation efforts and may provide insights into evolution and early stage speciation. The Marsh Wren (*Cistothorus palustris*) is comprised of many geographically separate subspecies that show variation in plumage, occupy different habitats, and have different migratory strategies. In order to examine geographic variation the Marsh Wren we sampled thirteen populations along the Atlantic Coast and the Great Lakes, throughout the range of four subspecies. We analyzed eight microsatellite loci for 128 individuals and then used a clustering analysis to identify groups based on genetic similarity with no prior geographic information. The clustering analysis revealed one population to be the best model of population structure. Despite a geographically wide breeding range, extreme habitat variation, plumage variation, and significant ecological variation in morphology, Marsh Wrens in eastern North America appear to be panmictic. (ID 15959)

**Luzuriaga, N. L.**, Universidad Central del Ecuador, Ecuador, nivla.luzuriaga@gmail.com  
Jiguet, F. J., Museum National d'Histoire Naturel France, France, fjiguet@mnhn.fr  
Veran, S. V., Institut National de la Recherche Agronomique, France, sophie.veran@gmail.com  
Henry, H. P., France, henry@mnhn.fr  
Tapia, W. T., Park National Galapagos, Ecuador, wtapia@dpng.gob.ec

#### HETEROGENEITY IN OBSERVER SKILLS OF NATIONAL PARK WARDENS AT COUNTING BIRDS IN THE GALÁPAGOS ISLANDS

Establishing a long term avian monitoring program for a region may be very expensive. Several countries, has been build the avian monitoring program with the volunteer observers. Since, the level of ability and training of observers can be a source of variability on collected data. This study proposes to deal with the variability of skill of volunteers to lead a monitoring survey. The context of the study is the creation of a long term survey of Galapagos terrestrial birds. This survey could have a great value for theoretical research as for practical issues. Four pairs of local gardeners were selected, after a short training. They survey two know site: one in the Dry land vegetation type, the other in the Farmland type. Results were analyzed by a General Linear Model. Variations in species abundances were predicted by the identity of the observers' pair, of the bird species and the associated interaction observer\*species. Difference between observer could be explain by the ability of detection and recognize species. Bird's species effect can be explained by density diurnal behavior, color and song traits. We suggest that the observer's effects in census birds can be reduced by an intensive learning and training. (ID 16361)

**Lyons, J. E.**, US Fish and Wildlife Service, USA, james\_lyons@fws.gov  
Nichols, J. D., US Geological Survey, USA, jnichols@usgs.gov  
McGowan, C. P., US Geological Survey, USA, cmcgowan@usgs.gov  
Smith, D. R., US Geological Survey, USA, drsmith@usgs.gov  
Sweka, J. A., US Fish and Wildlife Service, USA, john\_sweka@fws.gov  
Kalasz, K. S., Delaware Division of Fish and Wildlife, USA, kevin.kalasz@state.de.us  
Clark, N. A., British Trust for Ornithology, United Kingdom, nigel.clark@bto.org  
Dey, A. D., New Jersey Division of Fish and Wildlife, USA, amanda.dey@dep.state.nj.us  
Niles, L. J., Conserve Wildlife Foundation of NJ, USA, larry.niles@gmail.com  
STOPOVER POPULATION SIZE, MIGRATION ECOLOGY, AND ADAPTIVE MANAGEMENT OF RED KNOTS AT DELAWARE BAY, USA\*

Adaptive management of Red Knots stopping at Delaware Bay, USA requires annual estimates of stopover population size and turnover. We developed a novel mark-recapture-resight approach to estimate the number of knots stopping in Delaware Bay while accounting for turnover in the population; we also estimated arrival and departure schedules while accounting for resighting probability. We compared these mark-resight estimates to estimates from aerial surveys and ground counts. Estimation is based on 1) resighting histories of uniquely marked individuals, and 2) counts of marked and unmarked birds. We used a Bayesian analysis of the Jolly-Seber mark-recapture model, integrated with a binomial model for counts of unmarked birds, to derive estimates of stopover population size and arrival and departure probabilities in 2011-2012. Stopover duration (days) was derived from a latent state variable representing the time between arrival and departure in a state-space model. Arrival to and departure from Delaware Bay was slightly later in 2011, but in both years the stopover population peaked near 23 May. In 2011, maximum count from aerial surveys was 12,804; our mark-resight estimates peaked at 25,390. In 2012, aerial survey data were not available but maximum count from ground surveys was 25,458; our mark-resight estimates peaked at 28,970. Accounting for turnover in the population, our mark-resight estimate of stopover population

size was 43,570 (95% CI 40,880-46,570) and 44,100 (41,860-46,790) in 2011 and 2012, respectively. Early-arriving birds stayed 8-14 days and stopover durations decreased throughout the migration period. We describe how these stopover population estimates are used for state-dependent decision making for adaptive management of Red Knots and their food resources at Delaware Bay. (ID 15993)

**MacDonald, N. M.**, Trent University, Canada, nicolemacdonald22@gmail.com

Nol, E., Trent University, Canada, enol@trentu.ca

# THE EFFECTS OF ROTATIONAL GRAZING AND HAY MANAGEMENT ON THE REPRODUCTIVE SUCCESS OF BOBOLINK AND EASTERN MEADOWLARK IN EASTERN ONTARIO

We investigated the impact of beef-cattle farm management on the reproductive success of Bobolink (*Dolichonyx oryzivorus*) and Eastern Meadowlark (*Sturnella magna*) within Eastern Ontario, Canada. We monitored rotational grazing management regimes and hay cut dates while assessing breeding phenology and reproductive success of Bobolinks and Eastern Meadowlarks. In pasture paddocks the major factor determining Bobolink reproductive success was the date that cattle entered a paddock to graze, with earlier entries resulting in significantly lower nest success. On a landscape scale, within a series of paddocks grazed by a single herd, as the number of paddocks grazed during the nesting season increased, the number of Bobolinks that reproduced successfully decreased. Cattle exposed to clay pigeon targets, regardless of stocking rates, trampled the majority of targets. In hayfields associated with beef-cattle operations, grassland birds had a higher likelihood of reproductive success when cutting occurred after 1 July. The best method to improve the reproductive success of Bobolinks and Eastern Meadowlarks is to leave some hayfields and pasture paddocks undisturbed until nesting is complete. (ID 15933)

**Macfarland, L. E.**, Simon Fraser University, Canada, lma65@sfu.ca

Mahony, N. A., Environment Canada, Canada, nancy.mahony@ec.gc.ca

Harrison, M. L., Canadian Wildlife Service, Canada, megan.harrison@ec.gc.ca

Green, D. J., Simon Fraser University, Canada, djgreen@sfu.ca

# LEWIS'S WOODPECKER (MELANERPES LEWIS) HABITAT-SPECIFIC PRODUCTIVITY AND COMMUNITY DYNAMICS IN BRITISH COLUMBIA

The Lewis's Woodpecker is a threatened species in Canada and declining throughout their range in western North America. Conversion of suitable habitat to agriculture and urban development, cavity tree loss, and competition with other cavity-nesting birds are considered threats to their persistence. As weak cavity-nesters, Lewis's Woodpeckers are sensitive to loss of cavity trees. In areas with low cavity numbers and an abundance of cavity competitors such as European Starlings (*Sturnus vulgaris*), Lewis's Woodpeckers may use sub-optimal cavities, thereby reducing reproductive performance in the form of predation or consequences related to poor tree structure. In British Columbia, riparian cottonwood patches are the most productive habitat type compared with burned and live ponderosa pine forests. By documenting the abundance of cavities and cavity-nesting competitors, as well as their nest location changes between years surrounding active Lewis's Woodpecker areas, we will evaluate the role of competition on nesting success between three habitat types. Alternatively, food supply differences may influence nest success. Through nestling provisioning surveys, we will use quantifiable behavioral observations correlating directly with prey availability to determine the variation in food supply. Our overall objective is to understand the role of cavity dynamics interactions between members of the nest web and food supply on habitat-specific reproductive success in Lewis's Woodpeckers. (ID 15890 | Poster 20)

**Macias-Duarte, A.**, Universidad Estatal de Sonora, Mexico, alberto.

macias@ues.mx

Panjabi, A. O., Rocky Mountain Bird Observatory, USA, arvind.panjabi@rmbo.org

Strasser, E. H., Rocky Mountain Bird Observatory, USA, erin.strasser@rmbo.org

Levandoski, G., Rocky Mountain Bird Observatory, USA, greg.levandoski@rmbo.org

Ruvalcaba-Ortega, I., Universidad Autónoma de Nuevo León, Mexico,

iruvalca@yahoo.com.mx

Doherty, P. F., Colorado State University, USA, paul.doherty@colostate.edu

# WINTER SURVIVAL OF BAIRD'S AND GRASSHOPPER SPARROWS IN CHIHUAHUA DESERT GRASSLANDS OF MEXICO

Populations of grassland bird species are declining across North America. Most grassland birds converge in the Chihuahuan Desert of northern Mexico and southwestern United States during winter. Non-breeding survival has been shown to have a strong influence on population growth rates of migratory species. Therefore, processes in the Chihuahuan Desert affecting winter survival probably play a major role in the regulation of grassland bird populations. Nevertheless, the study of winter ecology of grassland birds in the Chihuahuan Desert has received little attention until recently. To fill this information gap, we estimated winter survival of two grassland sparrows, *Ammodramus bairdii* and *A. savannarum* using radio-telemetry. We deployed transmitters on 177 Baird's and Grasshopper Sparrows near Janos, Chihuahua, and tracked these birds from November to March during the winters of 2012-2013 and 2013-2014. We estimated daily survival probability (DSP) as implemented by the known-fate model in program MARK. We estimated a DSP=98.61% (95%CI 98.04-99.01%) for the winter of 2012-2013. DSP was significantly higher in the winter of 2013-2014, likely in response to an increased precipitation in the summer of 2013 with a DSP=99.75% (95%CI 99.49-99.88%). Our work suggests that over-winter survival varies greatly between years and that climatic conditions in the Chihuahuan Desert significantly contribute to the population regulation of North American grassland birds. (ID 15801)

**Mack, A. L.**, Indo-Pacific Conservation Alliance, USA, mack@indopacific.org

# CONSERVATION AND ECOLOGY OF SEED DISPERSAL BY THE DWARF CASSOWARY CASUARIUS BENNETTI: A SYNTHESIS OF 25 YEARS OF RESEARCH AND CONSERVATION

The Dwarf Cassowary is a large obligate frugivore, much larger than any seed disperser in montane New Guinea. Large disperser body size allows plants to evolve large seeds that can tolerate extensive (50-70%) damage by rodents and other potential seed predators. Of 400 fruiting plant species, 12-15% produce diaspores too large for any other disperser. Gut transit is fast (1-4 hours) and does not damage seeds. Dispersal, usually less than a kilometer, is preferentially uphill, countering downhill movement of fallen fruits. Plant populations would collapse downhill in the absence of dispersal. Dispersal is rarely into treefall gaps, but there is a .02-.03 probability per year that a gap will form over dispersed seedlings, and roughly 0.35 probability per year that falling debris will kill dispersed seeds. Cassowaries are heavily hunted by people in rural PNG and comprise about 27 % of animal biomass harvested. Cassowaries in New Guinea deserve conservation attention as keystone seed dispersal agents and food sources for roughly 2 million rural people. Big budget conservation projects by international NGOs with budgets in hundreds of thousands to millions have accomplished little; smaller projects by local groups have had more impact. (ID 15942)

**MacLean, S. A.**, UC Berkeley, USA, maclean@berkeley.edu

Beissinger, S. R., UC Berkeley, USA, beis@berkeley.edu

# DO SPECIES' TRAITS PREDICT VARIATION IN RANGE SHIFTS OF BIRDS?\*



Global climate change is expected to cause many species ranges to shift toward higher latitudes or elevations, but documented range shifts have been highly idiosyncratic across species, some of which show no detectable range shifts at all. A growing body of literature seeks to explain variation in observed range shifts using species-specific life history and ecological traits. We present the first comprehensive review of how range shifts relate to species' traits in eight studies of birds, and assess the degree to which these studies support the leading hypotheses that range shifts will be greater in species with greater dispersal ability, reproductive potential, and ecological generalization. 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. We also highlight inconsistencies across studies in methods for quantifying species' traits, which present potential biases that have been largely overlooked in the literature. 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. (ID 16025)

**Maderson, P. F.**, Brooklyn College of CUNY, USA, paulmaderson@verizon.net

#### REPRESENTING TIME AND SPACE IN ILLUSTRATIONS OF FEATHER REGENERATION<sup>†</sup>

Five problems in illustrating feather regeneration are: (a) identifying features of a generalized feather to which reference must be made; (b) graphically representing such in an hierarchy ranging from grossly visible to molecular levels; (c) choosing the minimal number of illustrations required to represent a temporal continuum; (d) selecting nouns and adjectives to use for labels from a plethora of synonyms -- many laden with historical and/or incorrect meaning; (e) correcting newly-revealed, long-standing misconceptions and/or generalizations. All 5 problems reflect the fact that "a mature feather" (as customarily understood) has the following characteristics: (a) it lacks a covering sheath and external pulp caps [both formed, then lost, during regeneration, but respectively rarely and never discussed in texts]; (b) it comprises two distinct types of keratin --  $\alpha$ - and  $\beta$ - [a long-known fact ignored in texts]; (c) it does not have "planar vanes" [spoon-shaped spathe may have additional compound curves]; (d) it does not possess "a hollow central shaft" [the  $\beta$ -keratogenic rachis is pith-filled -- lumen of contiguous, "tubular" calamus contains  $\alpha$ -keratogenic pulp caps]. Defining a feather as comprising distal spathe (two vanes plus rachis) and proximal "tubular" calamus, permits dividing the regenerative sequence into spathogenic and calamogenic phases which overlap as superior umbilical region forms. Viewed in the context of an introductory figure showing gross changes throughout sequence, three higher resolution diagrams of: (a) origin of spathe apex; (b) spathe deployment accompanying sheath breakdown and loss of external pulp caps; (c) pulp regression producing internal pulp caps during mid-calamogenesis, illustrate the basics of the generalized model proposed by Maderson et al., (2009) *J Morphol* 270: 1166-1208. The model accommodates all known feather morphs, including genetic mutants, and facilitates understanding of etiology of growth and fault bars. (ID 15994)

**Mahony, N. A.**, Environment Canada, Canada, nancy.mahony@ec.gc.ca  
EVIDENCE OF BARRED OWL PREDATION OF BARN SWALLOW NESTS AND ADULTS AT A DECLINING BREEDING COLONY

Barn Swallow populations in many parts of North America are declining. Many causes have been suggested including the loss and alteration of breeding habitat, including the loss of old buildings with protected interior nest sites. This may force breeding pairs to nest on the outside of newer buildings, making them more vulnerable to nest predators. From 2010-2012,

I studied breeding productivity and causes of nest failure at a Barn Swallow colony nesting on the outside of a building where anecdotal evidence suggested a decreasing number of breeding pairs. In 2010 many nests were destroyed and evidence pointed to breeding adults being depredated by a raptor. Using trail cameras, I captured video evidence of Barred Owls depredating two nests. Nest depredation rates were 72% (2010), 51% (2011) and 85% (2012). During the same period the number of breeding pairs decreased from 27 in 2010 to 14 in 2012. While there may have been other types of predators, the video evidence, dead, plucked adults and the fact that most nests disappeared over night suggests that Barred Owls, likely hunting for roosting adults, were the main predators. Barred Owls have increased in the region and did not historically breed on the BC coast, while Barn Swallows have decreased in the region by 5.64 %/year since 1970. While there are likely many causes of local and regional Barn Swallow population declines, predation in less well protected nesting sites may be a localized cause of colony decreases and disappearances. Nearby colonies inside old barns have far lower nest predation rates suggesting that nest and adult predation at the study site is responsible for the decline in colony size. (ID 15914 | Poster 60)

**Malpass, J. S.**, The Ohio State University, USA, malpass.2@osu.edu  
Rodewald, A. D., Cornell University, USA, arodewald@cornell.edu

#### NEST SURVIVAL OF URBAN-ADAPTED SONGBIRDS IN RESIDENTIAL YARDS AND ADJACENT FOREST PARKS\*

Avian conservation in urban landscapes usually emphasizes managing habitat remnants with limited human development, such as forest parks. Part of this emphasis reflects a common assumption that residential yards act as reproductive sinks due to high levels of nest predation. To evaluate this assumption, we examined daily survival rates of nests of two urban-adapted songbirds, American Robin (*Turdus migratorius*) and Northern Cardinal (*Cardinalis cardinalis*), in forest parks and adjacent residential yards. From 2011 to 2013, we monitored 529 robin nests (174 in forest parks, 355 in yards) and 956 cardinal nests (631 in forest parks, 325 in yards) across seven paired sites in Franklin County, Ohio. Daily nest survival rates were similar between paired forest ( $0.955 \pm 0.019$ ) and yard ( $0.958 \pm 0.012$ ) habitats for Northern Cardinals. In contrast, the survival rates of American Robin nests in yards ( $0.970 \pm 0.017$ ) were significantly higher than those of nests in forest parks ( $0.948 \pm 0.024$ ). Robin nests in yards were twice as likely to successfully fledge young than robin nests in adjacent forest parks. The difference in daily nest survival rates between paired yard and forest habitats increased with the proportion of robin nests on man-made structures such as gutters and pergolas in yards, suggesting that habitat attributes specific to human developments, such as buildings, may be responsible for the increased survival of robin nests in residential yards. Our results inform discussions on the value of residential areas for urban birds by demonstrating that songbirds may experience equal or enhanced reproductive success when nesting in residential yards versus in adjacent preserves. (ID 16051)

**Maness, T. J.**, Louisiana Tech University, USA, tmaness@latech.edu  
Anderson, D. J., Wake Forest University, USA, da@wfu.edu

#### PREDICTORS OF JUVENILE SURVIVAL

The survival probability of birds during the juvenile period, between the end of parental care and adulthood, is highly variable and has a major effect on population dynamics and parental fitness. As such, a large number of studies have attempted to evaluate potential predictors of juvenile survival in birds, especially predictors related to parental care. The hypothesis linking body reserves accumulated from parental care to the survival of naïve juveniles has organized much of this research, but a variety of other predictors (e.g., structural size, timing of breeding, clutch/brood size, cohort, etc.) have also been investigated. A literature review revealed methodological issues with

many of these studies, particularly statistical problems stemming from highly correlated predictors of survival. For example, a large nestling is likely to be heavy and come from a nest initiated at the optimal time of year with the optimal brood size. We used path analysis, which can accommodate correlated predictors, to test potential predictors of juvenile survival of 2631 offspring from seven annual cohorts of a seabird, the Nazca Booby (*Sula granti*). Fledging age was the most important predictor of juvenile survival: fast-growing offspring survived best. Other predictors such as offspring sex, hatching date, weight, and structural size also influenced survival probabilities to a lesser degree. More high-quality studies of juvenile survival are needed before we can interpret these predictors within a comprehensive theoretical framework. (ID 15846)

**Mangan, A. M.**, Colorado State University/USDA National Wildlife Research Center, USA, annamangan@gmail.com  
Pejchar, L., Colorado State University, USA, Liba.Pejchar@colostate.edu  
Werner, S. J., USDA National Wildlife Research Center, USA, Scott.J.Werner@aphis.usda.gov

#### ASSESSING BIRD-MEDIATED ECOSYSTEM SERVICES AND DISSERVICES IN COLORADO ORCHARDS

Birds can benefit agriculture through services such as pollination and pest control, but they also damage crops through seed and fruit depredation. Agricultural systems are essential for sustaining human populations by creating food, fiber, bioenergy and pharmaceuticals for human consumption. However, there are negative impacts from agricultural practices that effect the environment and overall human wellbeing including habitat loss, decreased biodiversity, nutrient runoff and pesticide poisoning. To achieve ecological sustainability, agriculture must be economically viable while also conserving natural biodiversity. Our goal is to investigate the ecological and economic tradeoffs of birds in Colorado's orchards by evaluating pest control and fruit depredation. Specifically, we will 1) determine the most important bird species causing damage and providing pest control services, 2) measure the rate and magnitude of these services and disservices throughout the growing season, 3) identify avian sensory cues associated with foraging, and 4) quantify costs and benefits of maintaining birds in biophysical and economic terms. Field and laboratory methods will be employed to achieve these goals. Biophysical data, along with existing economic data will be used to evaluate the role of birds in orchards under various management scenarios. Our results will contribute to the scientific understanding of birds by providing information on the relationship between foraging and visual cues. Additionally, anticipated outcomes will provide novel insights and support practical solutions for optimizing agricultural productivity and conservation benefits. (ID 15752 | Poster 29)

**Manthey, J. D.**, University of Kansas, USA, jdmanthey@gmail.com  
Moyle, R. G., University of Kansas, USA, moyle@ku.edu

#### ISOLATION BY ADAPTATION: LANDSCAPE GENOMICS OF WHITE-BREASTED NUTHATCHES (*Sitta carolinensis*) IN THE SKY ISLANDS OF ARIZONA

Understanding drivers of genetic diversity and differentiation within and among populations is a major focus of evolutionary biology. Landscape genomics, the amalgamation of ecology, geography, and population genomics, allows the simultaneous study of thousands of genetic loci to investigate genetic processes within and among populations. Here, we investigate patterns of genetic diversity and differentiation within and between sky island populations of a common montane forest bird, the White-breasted Nuthatch (*Sitta carolinensis*), using thousands of genetic loci. Few private haplotypes in mitochondrial DNA and projections of ecological niche models suggest strong connectivity of sky island populations as recently as the Last Glacial Maximum (LGM). Genetic diversity could not be explained

by sky island habitat size or environmental suitability, likely owing to recent connectivity of all populations. Using all loci, genetic differentiation among populations was highly correlated to environmental dissimilarity ( $R^2 = 0.346$ ,  $p < 0.001$ ) but not geographic distance between populations ( $p = 0.623$ ) suggesting a pattern of isolation by adaptation. Using two different tests, we identified 23 loci putatively under selection. Of these loci, seven mapped to proteins in the Zebra Finch (*Taeniopygia guttata*) and contained open reading frames. Genetic differentiation among populations using only loci putatively under selection was more strongly related to environmental dissimilarity ( $R^2 = 0.687$ ,  $p < 0.001$ ) and again not with geographic distance ( $p = 0.272$ ). These results, from thousands of genetic markers, provide a comprehensive test of the influence of isolation by adaptation, dispersal limitation, or colonization on genetic differentiation in a non-model organism. (ID 15889)

**Martell, M. S.**, Audubon Minnesota, USA, mmartell@audubon.org  
Katzner, T., West Virginia University, USA, todd.katzner@mail.wvu.edu  
Miller, T., West Virginia University, USA, Tricia.a.miller@gmail.com  
Hall, K., Audubon Minnesota, USA, khall@audubon.org  
Mehus, S., National Eagle Center, USA, scott@nationaleaglecenter.org  
Somershoe, S., Tennessee Resource Agency, USA  
Soehren, E., Alabama Dept. of Conservation and Natural Resources, USA

#### GOLDEN EAGLE MIGRATION AND WINTERING IN THE GREAT LAKES REGION

Golden Eagles are rare but regular migrants and winter residents in the Great Lakes and other portions of the eastern United States. Using GPS satellite and GSM telemetry to track nine Golden Eagles from wintering areas in Minnesota, Wisconsin, Missouri, Tennessee and Alabama we determined winter ranges, fall and spring migration routes and summer breeding areas. Birds showed fidelity to wintering areas, using the same roosting sites in multiple years. Spring migration routes tracked north around the western tip of Lake Superior, through Minnesota then into Ontario or Manitoba. One bird tracked west through the Upper Peninsula of Michigan through Ontario and Quebec and finally nesting in Newfoundland. Two birds wintering on the Cumberland Plateau migrated north through Michigan crossing between Lake Superior and Lake Huron at Sioux Saint Marie. One other bird from this region passed between Lake Huron and Lake Erie, while the fourth bird – a juvenile female made several flights north hitting Lake Erie and Lake Michigan before heading up the Appalachians by-passing the Lakes. Spring migration distances ranged from 2,700 – 3,850 km. The days spent on spring migration ranged from 43 – 80 with a mean of 57. Fall migration followed similar routes with some minor variations with the exception of one bird that made a loop migration near Detroit on its way south. Birds spent more days on fall migration than on spring migration. These birds are part of the Eastern Canadian breeding population nesting from the coast of Newfoundland to north of the Great Slave Lake 3,000 km to the west. As our research and that of others in the eastern United States reveal more about the habitat use and migration patterns of this bird we are coming to realize the vital role that the Great Lakes play in the life cycle of the eastern Golden Eagle and the serious implications for the siting of wind turbines and other structures as well as forest management practices in this region. (ID 16320)

**Martin, K.**, University of British Columbia, Canada, Kathy.Martin@ubc.ca

#### THE STATE OF ALPINE AND MONTANE ORNITHOLOGY IN THE AMERICAS: THE PROBLEMS, EMERGING ECOLOGICAL RESEARCH INSIGHTS AND WHY WE SHOULD CARE

Mountain ecosystems comprise 25% of the North American landbase, and about 35% of North American birds use temperate high elevation habitats for one or more key life history stage. A few species are alpine specialists, but most of the 62+ species known to breed in these environmentally challenging habitats are elevational generalists with wide ecological niches. Research

on fitness-related traits reveals that most birds living at high elevation are well adapted for mountain habitat conditions, and are not young or inferior individuals excluded from higher quality low elevation habitats. At high elevations, birds have less than half as much time to breed each season, and produce 50-60% fewer offspring annually than conspecifics at lower elevations. Higher annual survival of adults and juveniles at high elevations may offset partially this lower annual fecundity. Mountain habitats support stable populations for several open country songbirds that are declining rapidly at low elevations. Temperate mountains also provide important autumn stopover habitats as some latitudinal migrants gain mass faster at high elevation than at low elevation. Overall, both temperate and tropical mountains provide opportunities for seasonal altitudinal migration for a diversity of species. While birds have developed ingenious solutions to the problems of living in mountains, increases in climate warming, extreme weather and rising tree- and shrub-lines result in increasingly unreliable conditions for birds at high elevations. Since most mountain avifauna has received relatively little study, our symposium profiles research on key aspects of the ecology, energetics, genetics, connectivity and life history of high elevation bird populations and communities, and we discuss the capacity of mountain species to cope with environmental change. (ID 16045)

**Martin, T. G.**, CSIRO, Australia, Tara.Martin@csiro.au  
Nicol, S., CSIRO, Australia, Sam.Nicol@csiro.au  
Chades, I., CSIRO, Australia, Iaidne.Chades@csiro.au

#### OPTIMAL CONSERVATION STRATEGIES FOR MIGRATORY SPECIES

Designing effective conservation strategies for migratory species presents enormous challenges. Migratory birds for example, are influenced by multiple events across land and sea – regions that are often separated by thousands of kilometres and span international borders. In this talk I present two recent breakthroughs that inform better management decisions for migratory species. The first shows how failure to account for how migratory animals are spatially connected between different periods of the year (i.e. migratory connectivity) may doom some regional populations to extinction. If our conservation goal is to maintain the full range of a species, then the loss of entire sub-populations is catastrophic. By including information on how species move across the landscape throughout the year, the cost of different management actions (e.g., protecting or restoring land), the level of threat occurring in different parts of the species range and the relative abundance of species across their range, in an optimization problem, we can make more intelligent and cost-effective conservation decisions. But what happens when our assumptions about these parameters are uncertain? Under climate change, future habitat suitability is likely to change, but exactly how is unknown. Migratory shorebirds are likely to experience loss of habitat as a result of sea level rise, but how much rise? Fear of making the wrong decision limits implementation of climate adaptation actions. The second breakthrough presents an optimal adaptive management framework that can deliver decision-makers with plausible management recommendations for immediate action to protect migratory species from future threats under high levels of uncertainty. (ID 16286)

**Marzluff, J. M.**, University of Washington, USA, corvid@u.washington.edu  
DeLap, J. H., University of Washington, USA, jdelap@uw.edu  
Oleyar, M. D., University of Washington, USA, doleyar@hawkwatch.org  
SITE FIDELITY IN A CHANGING WORLD: DISPERSAL OF BREEDING ADULT SONGBIRDS DRIVEN BY SUBURBAN DEVELOPMENT

We color-banded ( $n = 3898$ ) and annually spot-mapped territories ( $n = 7099$ ) of six species from 1998-2010 in the rapidly urbanizing coniferous forest fringing Seattle, WA, USA. We compared the year-to-year movements of individuals within 26 study sites: 5 forested reserves, 10 single-family suburban developments, and 11 developing subdivisions (those under

construction during the tenure of our research). Breeders from species that declined as development proceeded (Swainson's Thrush and Pacific Wren, aka "avoiders") moved twice as far in developing landscapes (167.5m,  $n = 15$ ) than in developed (63.8m,  $n = 3$ ) or reserved (74.9,  $n = 17$ ) landscapes. Movement in developing subdivisions was often precipitated by site clearing and resulted in breeders packing into nearby less-disturbed remnant forest. Breeders from species that remained stable or increased during development (Song Sparrow, Spotted Towhee, Dark-eyed Junco, and Bewick's Wren, aka "exploiters") exhibited similar movements regardless of development type (developing: 58.2m,  $n = 205$ ; developed: 48.9m,  $n = 68$ ; reserved: 81.2m,  $n = 67$ ). The relative ease by which displaced breeders can secure productive territories influences the impact of housing development on avian conservation. (ID 15783)

**Mason, J. T.**, Boise State University, USA, tmason@peregrinefund.org  
McClure, C. J., The Peregrine Fund, USA, cmcclure@peregrinefund.org  
Barber, J. R., Boise State University, USA, jessebarber@boisestate.edu

#### THE IMPACT OF NATURAL GAS COMPRESSOR STATION NOISE ON NORTHERN SAW-WHET OWL HUNTING ABILITY\*

Anthropogenic noise has risen dramatically worldwide yet the impacts on acoustically-oriented predators have received scarce attention. Here we present evidence that natural gas compressor station noise degrades the ability of the Northern Saw-whet Owl (*Aegolius acadicus*) to detect and capture prey in the absence of light. In this experiment, we presented 27 individual wild saw-whet owls with mice inside a large flight tent under noise conditions ranging from silent (29 dB(A)) to 73 dB(A). We varied the noise treatments in intensity and spectral composition to correspond with distances between 50-800m from a compressor station. Owls were not able to capture mice at noise levels above 55 dB(A) and were not able to detect mice above 61 dB(A). At our quietest treatment level of 46 dB(A) the owls were half as successful at catching mice as in our silent control. A logistic regression of whether or not an owl tried to hunt the mouse revealed that each dB increase in noise resulted in a 5% decrease in the likelihood of a strike. Our results suggest that unmitigated natural gas compressor station noise has the potential to drastically decrease habitat suitability for acoustically-oriented owls. (ID 15821)

**Mason, N. A.**, Cornell University, USA, nicholas.albert.mason@gmail.com  
Taylor, S. A., Cornell University, USA, dr.scott.a.taylor@gmail.com

#### DIFFERENTIALLY EXPRESSED GENES UNITE PHENOTYPES AMIDST UNDIFFERENTIATED ANONYMOUS LOCI IN THE PHENOTYPICALLY DIVERSE REDPOLL FINCHES (ACANTHIS)

Understanding the patterns and processes that contribute to phenotypic diversity and speciation is a central goal of evolutionary biology. Recent developments in sequencing technology have provided unprecedented resolution of genetic differentiation in many lineages that have experienced rapid and recent diversification. The phenotypically diverse redpoll finches (Genus: *Acanthis*) are an example of one such lineage: traditional sequencing and genotyping methods have not revealed any genetic differences between currently recognized species, despite pronounced phenotypic variation within the genus. Here we examine variation among 3631 anonymous loci distributed throughout the redpoll genome in combination with gene expression data and ecological niche modeling to evaluate genetic and ecological differentiation among currently recognized species. In agreement with previous findings, we find no genetic differentiation between species or geographically isolated populations using anonymous loci; however, we find 215 differentially expressed genes between *A. flammea* and *A. hornemanni*. Moreover, *A. flammea* and *A. hornemanni* occupy similar, yet non-identical, niches in North America. The pattern of differential gene expression despite no differentiation among anonymous loci may be due to high levels of



ongoing gene flow between polymorphic populations, incomplete lineage sorting, polymorphism in cis-regulatory elements, or phenotypic plasticity. Together, these findings suggest that *A. flammea*, *A. hornemanni*, and *A. cabaret* may be better treated as polymorphic populations or subspecies within a single species. (ID 15805)

**Matsuoka, S. M.**, U.S. Fish and Wildlife Service, USA, [steve\\_matsuoka@fws.gov](mailto:steve_matsuoka@fws.gov)

Tessler, D. F., Alaska Department of Fish and Game, USA

Shaw, D., Alaska Bird Observatory, USA

Harding-Scurr, A., Humboldt State University, USA

Loomis, D., Oregon State University, USA

Cooper, E., USDA Forest Service

Hajdukovich, N., U.S. Fish and Wildlife Service, USA

#### IDENTIFYING DEMOGRAPHIC DEFICITS AMONG RUSTY BLACKBIRD BREEDING IN ALASKA: CLUES TO UNDERSTANDING POPULATION DECLINE?

Knowledge of the Rusty Blackbird's (*Euphagus carolinus*) steep and long-term population decline dates back to the mid-1990s. However, the mechanisms driving the decline remain poorly understood, as do the relative contributions of those mechanisms on the breeding versus wintering grounds. To begin to address this gap, we examined the population dynamics of Rusty Blackbirds breeding in Alaska to identify the life stages and times of year when population growth is most constrained. We first used a combination of mark-recapture and nest survival models to estimate rates of Rusty Blackbird survival, recruitment, and fecundity using data collected at 7 study sites across boreal and coastal Alaska from 2006–2012. We then used our annual and site-specific estimates of these demographic rates as input to a stochastic population matrix model to estimate population growth rates ( $\lambda$ ) and then evaluated sensitivity of  $\lambda$  to proportional changes in each demographic parameter. We hope to expand our population viability analysis in the future to include demographic data from other parts of the breeding and wintering range. (ID 16024)

**McCabe, J. D.**, University of Maine, USA, [jennifer.mccabe@maine.edu](mailto:jennifer.mccabe@maine.edu)

Olsen, B. J., University of Maine, USA, [brian.olsen@maine.edu](mailto:brian.olsen@maine.edu)

#### THE INTERACTION BETWEEN RISK AVOIDANCE AND FORAGING QUALITY ON THE STOPOVER HABITAT USE OF MIGRANT LANDBIRDS

Food acquisition and risk avoidance are fundamental components of the survival strategies of most animals. To maximize fitness, many animals make trade-offs between foraging and either predator vigilance behaviors or time spent in less risky habitats with better protective cover. In situations where animals are energetically constrained, however, they may not be able to sacrifice foraging for increased vigilance or cover. Migration may change the risk optimization strategy of animals, because the high energetic cost of long-distance flights also increases the costs of limiting energy acquisition to avoid predation. Here we examined habitat use of the entire migratory community during autumn migration within coastal Maine at two sets of stopover sites: 1) sites where a predation risk- foraging trade-off was strong (i.e. high food abundance and sufficient vegetation cover were not readily found together within the same site) and 2) sites where the trade-off was significantly reduced (i.e. high food abundance in habitats with dense cover were common at the site). Fruit resources alone predicted habitat use of the migratory community at sites where the trade-off was strong, while birds at the reduced trade-off sites chose habitat where both protection and food availability were high. Our findings suggest that on average migratory landbird species forgo predator protection when necessary, in order to satisfy their high energetic demands while on migration. (ID 15835)

**McCain, C. M.**, University of Colorado Boulder, USA, [christy.mccain@colorado.edu](mailto:christy.mccain@colorado.edu)

#### ELEVATION TRENDS IN BIRD DIVERSITY AND CONSERVATION PRIORITIES

Elevational gradients distributed across the globe are a powerful test system for understanding trends in bird biodiversity and conservation as they contain hotspots in total diversity as well as endemic and rare diversity. Birds display four distinct diversity patterns in nearly equal frequency on mountains: decreasing diversity, low elevation plateaus, low elevation plateaus with mid-peaks, and unimodal, mid-elevational peaks. Bird diversity on humid mountains is either decreasing or shows a low elevation plateau in diversity, while on arid mountains is unimodal or a broad, low elevation plateau usually with a mid-elevation maximum. Regardless of pattern, bird diversity is usually maximized within the lower half of the mountain, and the mid-elevations of which are unfortunately the least represented elevations in US and international protected areas. Protecting elevational bird diversity in the future is therefore a complex interplay between mitigating anthropogenic land conversion and climate change. The assumption that mountains represent climatic harbors against the perils of a warming climate is shown to be overly simplistic due to the discordant responses to other niche axis such as precipitation. The soundest conservation plan for imperiled, montane bird diversity is to protect complete swaths of the elevational gradient for continuous habitats that contain the maximum variability of microclimates and microhabitats. (ID 15879)

**McClung, M. R.**, Hendrix College, USA, [mcclung@hendrix.edu](mailto:mcclung@hendrix.edu)

Block, M. G., Hendrix College, USA, [blockmg@hendrix.edu](mailto:blockmg@hendrix.edu)

McFadden, M. A., Hendrix College, USA, [mcfaddenma2@hendrix.edu](mailto:mcfaddenma2@hendrix.edu)

#### EFFECTS OF CHRONIC NOISE FROM UNCONVENTIONAL GAS EXTRACTION ON BREEDING BIRD COMMUNITIES AND COMMUNICATION IN THE FAYETTEVILLE SHALE, ARKANSAS

Birds can respond to anthropogenic noise in various ways, including avoidance of noisy areas and adjustment of song characteristics to avoid masking effects. Compressor stations associated with extraction of natural gas via hydraulic fracturing produce chronic noise that changes the acoustic environment in nearby forests. The objective of our study was to investigate how this noise influences forest bird community diversity and vocal communication. In May-June 2013, we conducted point-count surveys in forest patches adjacent to noisy compressor station pads ( $n = 10$ ) and well pads ( $n = 10$ ), which have similar physical disturbance, but lack chronic noise. We also recorded singing birds of a variety of species within 300-m of the pads. Bird communities near noisy compressor stations had similar species richness compared to quieter well pads, however both the probability of local extinction ( $1 - \Phi = 0.36$ ) and species turnover ( $1 - \gamma = 0.25$ ) indicated that species composition varied between noisy and quiet sites. Spectral analysis of songs revealed species-specific responses. Songs of Red-eyed Vireo (*Vireo olivaceus*) did not differ in frequency or timing components between sites; however, songs of Tufted Titmouse (*Baeolophus bicolor*), Black-and-White Warbler (*Mniotilta varia*), and Carolina Wren (*Thryothorus ludovicianus*) were sung more slowly in noisy sites. In addition, Tufted Titmouse notes had a narrower frequency range in noisy sites. These results indicate that noise from compressors has the potential to influence both community structure and song characteristics of forest birds. Noise impacts should be taken into consideration when placing compressor stations, particularly if sensitive species are known to inhabit nearby forests. (ID 16173)

**McCormack, J. E.**, Occidental College, USA, [mccormack@oxy.edu](mailto:mccormack@oxy.edu)

Faircloth, B. C., Louisiana State University, USA, [brant@faircloth-lab.org](mailto:brant@faircloth-lab.org)

#### WHOLE-GENOME APPROACH TO SPECIATION IN SCRUB-JAYS

Reduced-representation approaches like RAD-tags and sequence capture have been important to establishing next-generation sequencing as a means to assess the genomics of divergence, but risk overlooking important regions of speciation, which may involve relatively few loci. We present results from a whole-genome approach to species divergence between two recently-evolved species, the Coastal and Interior forms of Western Scrub-Jay (*Aphelocoma californica* and *A. woodhouseii*). We indexed and sequenced whole genomes at low coverage for eight individuals, four from pure populations of each of the two species. We assembled and aligned these sequences to the newly-released crow genome. We found millions of SNPs among the eight individuals. Roughly 14,000 SNPs appeared to be fixed for different alleles between the two species. Thousands of SNPs were within or near protein-coding regions. We discuss the importance of these SNPs to speciation, their relevance to the study of a secondary contact zone, and implications to the genomic architecture of speciation. (ID 15927)

**McCracken, K. G.**, University of Miami, USA, kmccrack@iab.alaska.edu  
Natarajan, C., University of Nebraska, USA  
Moriyama, H., University of Nebraska, USA  
Weber, R. E., University of Aarhus, Denmark  
Fago, A., University of Aarhus, Denmark  
Projecto-Garcia, J., University of Nebraska, USA  
Storz, J. F., University of Nebraska, USA

#### PARALLEL ADAPTATION IN THE MAJOR HEMOGLOBIN GENES OF ANDEAN DUCKS

Theory predicts that parallel evolution should be common when the number of beneficial mutations is limited by selective constraints on protein structure. However, confirmation of this prediction is scarce in natural populations. We studied the DNA sequence and resulting functional changes of hemoglobin genes of ten high-altitude duck lineages and compared them to other waterfowl species living at both low and high elevations. One to five amino acid replacements were significantly overrepresented or derived in each highland population, and parallel substitutions were common in highland taxa. Substitutions at adjacent sites within the same functional protein region were also observed, and inter-locus contrasts incorporating the stochasticity of drift and mutation indicated that hemoglobin genes were significantly more differentiated between highland and lowland populations than unlinked alleles at other loci. In nearly all cases, the observed amino acid substitutions resulted in increased Hb-O<sub>2</sub> affinity, as a result of either increased intrinsic Hb-O<sub>2</sub> affinity or changes in anion cofactor sensitivity. The patterns of parallel evolution and function observed in these waterfowl indicate that molecular adaptation to high-altitude hypoxia has resulted from selection on unique but overlapping sets of one to five amino acid substitutions in each lineage. (ID 16311)

**McDermott, M. E.**, Ohio State University, USA, mcdermott.95@osu.edu  
Rodewald, A. D., Cornell University, USA, arodewald@cornell.edu  
Matthews, S. N., Ohio State University, USA, matthews.204@osu.edu

#### THE CONTRIBUTION OF AGROFORESTRY SYSTEMS TO CONSERVATION OF OVERWINTERING NEOTROPICAL MIGRANTS\*

Agroforestry contributes to tropical biodiversity conservation by providing habitat for a diverse avifauna including several Neotropical migrants. Unfortunately, socioeconomic pressures have favored conversion of agroforestry systems to less conservation-friendly land uses. Even where agroforestry remains, conditions vary along a gradient of land use intensification. These changing practices necessitate identifying how alternative systems can be managed for biodiversity. We studied habitat use of mixed-species flocks attended by migrants to better understand (1) relative conservation value of different agroforestry systems and (2) physiognomic

and landscape characteristics associated with habitat use. In Jan-Feb 2011-2013 we surveyed 446 flocks in shade-coffee, shade-cardamom, silvopastures, and secondary forest. Agroforestry systems differed in their ability to support migrants and mixed-species flocks. Compared to other habitats, silvopastures supported smaller, less diverse flocks with fewer Neotropical migrants and forest specialists. Structural complexity is thought to drive these differences, given that flocks and several migrant species were positively associated with canopy cover and tree density. Forest specialists and several migratory species increased with surrounding woodland cover. Further, forest connectivity was positively related to abundance of forest specialists, indicating the importance of managing at multiple spatial scales. Agroforestry's potential to contribute to overwintering migrant conservation can be improved by enhancing structural heterogeneity within farms and increasing tree cover and connectivity in the landscape. (ID 15792)

**McDonald, D. B.**, University of Wyoming, USA, dbmcd@uwyo.edu  
GENETIC ALGORITHMS FOR NON-GENETIC SOCIAL NETWORK ANALYSES OF DISEASE OR INFORMATION TRANSMISSION

Social network analyses are useful for studying social structure, disease spread and other phenomena where emergent properties arise from the structure of populations. Most analyses use binary (0/1) edges (interactions) between nodes (individuals). In many cases, though, edges have natural weights, such as the number of interaction events. I argue that studying the flow of information or disease across networks can be enriched by using existing algorithms from population genetics. In particular, I propose *effective degree* (cf., effective number of alleles) and *edge-weight diversity* (cf., heterozygosity/gene diversity) as useful new metrics for weighted networks. Consider two birds that have equal binary degree (e.g., 6 individuals with which they interact) but whose skew in edge weights differs greatly. Bird 1 with very different weights on each of its edges, has effective degree < 2, whereas Bird 2, with evenly distributed edge weights, has effective degree = 6 (= the binary degree). Depending on transmission thresholds, the differing effective degrees could dramatically affect disease spread. Low thresholds would make even-edge Bird 2 a "super-spreader," but a higher threshold could mean that none of its 6 edges sufficed for transmission; in that case, Bird 1, despite low effective degree, might actually be a better spreader. Further, other algorithms derived from genetics (e.g., *F*-statistics) provide new and useful metrics not just for assessing network flow processes (such as disease spread) but also the hierarchical structure of networks, a fundamental concern for many modeling frameworks (e.g., the evolution of cooperation). (ID 15769)

**McEntee, J. P.**, University of Arizona, USA, jaymcentee@gmail.com  
Bowie, R. C., University of California, Berkeley, USA, bowie@berkeley.edu  
SONG EVOLUTION IN SUNBIRDS OF AFRICAN SKY ISLANDS

As a trait involved in mate choice and potentially subject to rapid evolution, bird song may play a key role in bird speciation. Similar to other social traits, song may evolve in isolated populations without substantial ecological divergence, although its divergence is thought to be strongly enhanced by the accumulation of ecological differences. To test whether song could have played a role in the speciation of African sky island sunbirds, we examine correspondence of song and molecular divergence across the Eastern Double-collared Sunbird species complex of the Eastern Afromontane. Model-based clustering analyses of song phenotypes, followed by model selection, yield an inferred minimum of six song phenotype clusters. The six primary phenotypic clusters correspond tightly with an a priori taxonomic hypothesis for the species complex, with a correspondence of 92.8%. This correspondence is consistent with a role for song evolution in the speciation process across the complex. Strong phenotypic divergence in one recent

speciation event with little accompanying morphological divergence suggests that song may diverge early in the speciation process. Overall, strong divergence in song dimensions like song duration (in one sister group comparison, song duration has a greater than 3-fold difference) suggest that social selection is responsible for driving song changes. Such changes take place even where ecological niches show extremely high conservatism, consistent with social selection in the absence of ecological differences. These analyses represent one of few studies to comprehensively analyze song divergence across a species complex with extensive spatial sampling within component taxa. It has been suggested that rapid divergence in song may primarily be limited to temperate areas and driven by ecological differences among populations - this study provides evidence for rapid divergence in song in ecologically similar populations in the tropics. (ID 16333)

McFarland, K. P., Vermont Center for Ecostudies, USA, kmcfarland@vtecostudies.org  
 Rimmer, C. C., Vermont Center for Ecostudies, USA, crimmer@vtecostudies.org  
 Frey, S., Oregon State University, USA, sarah.frey@oregonstate.edu  
 Deluca, W. V., University of Massachusetts, USA, wdeluca@eco.umass.edu  
**Scarl, J. C.**, Vermont Center for Ecostudies, USA, jscarl@vtecostudies.org  
 EFFECTS OF A PULSED RESOURCE IN MONTANE FIR FORESTS OF NORTHEASTERN NORTH AMERICA

Seed masting in conifer forests causes a numeric population response in red squirrels (*Tamiasciurus hudsonicus*), and both masting and squirrel populations are synchronous over large spatial scales. Red squirrels are a major predator of passerine bird nests in some regions. Avian abundance each year is a function of recruitment of young into the population and thus relates to regional productivity the previous year. It has been hypothesized that red squirrel population fluctuations contribute to avian population fluctuations as follows: cone masting in autumn of year  $t$  leads to higher red squirrel populations by summer of year  $t+1$ , which results in lower productivity of forest songbirds that year and reduced recruitment in year  $t+2$ . Conversely, the typical lack of a cone crop in autumn of year  $t$  leads to lower red squirrel populations by summer of year  $t+1$ , which results in higher productivity of songbirds that year and higher recruitment in year  $t+2$ . We tested two assumptions of the hypothesized link between red squirrel and avian population fluctuations: 1) abundance of red squirrels relates directly to avian productivity, and 2) squirrel population fluctuations are related to avian population fluctuations at a regional scale. Our data provide strong evidence that balsam fir masting is a pulsed resource that causes a bottom-up response in red squirrel populations which, in turn, exerts top-down pressure on forest songbird populations, over regional scales. Balsam fir mast production appears to be a keystone resource in montane forests of the northeastern United States and perhaps in similar habitats in highlands of adjacent Canada and other areas in which it is the predominant tree species. (ID 15940)

**McGowan, C. P.**, U.S. Geological Survey, USA, cmcgowan@usgs.gov  
 COMPARING MODELS OF RED KNOT POPULATION DYNAMICS<sup>T</sup>

Predictive population modeling can contribute to our basic scientific understand of population dynamics but also inform management decisions by evaluating alternative actions in virtual environments. Quantitative models mathematically reflect scientific hypotheses about how a system functions. In Delaware Bay, to more effectively manage horseshoe crab (*Limulus polyphemus*) harvests and protect red knot (*Calidris canutus rufa*) populations, models are used to compare harvest actions and predict the impacts on crab and knot populations. The management has been chiefly driven by the core hypothesis that horseshoe crab egg abundance governs survival and reproduction of migrating red knots that stopover in the Bay during spring migration. However, recently hypotheses proposing that knots dynamics are

governed by cyclical lemming dynamics have emerged and garnered some support in data analyses. In the paper I present alternative models of red knot population dynamics to reflect alternative hypotheses. I project the population into the future under environmental stochasticity and parametric uncertainty with each model. I then compare the model performance to nine years of population monitoring from Delaware Bay. Using Bayes theorem and model weight updating models can accrue weight or support for one hypothesis of population dynamics or another. With four models of the red knot population dynamics and only nine years of data, no hypothesis clearly predicted population count data better than another. The collapsed lemming cycle model performed best followed closely by the horseshoe crab egg abundance model. The models that predicted no decline or stable populations were the weakest. (ID 15861)

**McGowan, K. J.**, Cornell Lab of Ornithology, USA, kjm2@cornell.edu  
 Mandelbaum, G. E., Binghamton University, USA, gmandel1@binghamton.edu  
 Clark, A. B., Binghamton University, USA, aclark@binghamton.edu  
 WHAT, ME WORRY? CHANGES OVER TIME IN MOBBING OF HUMAN “NEST PREDATORS” BY AMERICAN CROWS

Birds often drive off predators by “mobbing,” i.e., attacking and vocalizing in a group. American Crows (*Corvus brachyrhynchos*) live in family groups that cooperate with nearby families to mob avian or mammalian nest predators. In a population of rural and suburban crows studied for 26 years near Ithaca New York, researchers have climbed to nests to band young annually, often getting mobbed by the family and neighbors. We analyzed the strength of mobbing in relation to the year of study (1990-2013) as well as factors such as brood age. Although mobbing was sensitive to some other factors, the strongest pattern was a sharp decrease in mobbing in recent years. Crows may have habituated to humans in an environment with fewer predators, but unchanged mobbing after actual predation events suggests not. Our knowledge of the history of tagged crows allows us to further investigate a role for cultural transmission and the influence of researchers’ interactions with individual crow families. (ID 16326)

**McGranahan, D. A.**, North Dakota State University, USA, devan.mcgranahan@ndsu.edu  
 Kirkman, K. P., University of KwaZulu-Natal, South Africa, kirkmank@ukzn.ac.za  
 RESEARCH ON RANGELAND BIRD RESPONSES TO DISTURBANCE IN SUB-SAHARAN AFRICA LACKS ATTENTION TO SPATIAL, TEMPORAL SCALE

Sub-Saharan Africa has extraordinary avian diversity across a breadth of rangeland habitats. As ecological disturbances, fire and grazing contributed to the evolution of many African rangelands, but current regimes are shaped by human impact and global environmental change. While considerable research documents negative effects of altered disturbance regimes and land-use change on Africa’s avian diversity, relatively little work describes how fire and grazing might be managed such that biodiversity conservation and human land-use can be reconciled. We review existing literature on fire and grazing impacts on avian ecology in Sub-Saharan Africa. Specifically, we focus on the paucity of research attention to spatial and temporal scale of disturbance. We suggest considerations for future work on avian biodiversity in Sub-Saharan grassland and savanna, including 1) quantification of fire and grazing as regimes comprised of intensity and frequency, rather than qualitative categories of occurrence; 2) community-level sampling and analysis; 3) consideration of the spatial and temporal patterns of fire and grazing, with particular attention to heterogeneity and patch contrast; and 4) consideration of the interactive effects of fire and grazing, particularly at patch- and landscape-level effects on avian communities and habitat structure. (ID 16069)



**McKellar, A. E.**, Environment Canada, Canada, ann.mckellar@ec.gc.ca  
 Burger, J., Rutgers University, USA, Burger@dls.rutgers.edu  
 Niles, L. J., Conserve Wildlife, USA, larry.niles@gmail.com  
 Porter, R. R., USA, ronrporter@comcast.net  
 Smith, P. A., Environment Canada, Canada, paulallen.smith@ec.gc.ca  
**IDENTIFYING THE IMPORTANCE OF THE NELSON RIVER AREA AS A SPRING STAGING SITE FOR RED KNOT AND OTHER SHOREBIRDS**

Data from light-level geolocators deployed on Red Knots (*Calidris canutus rufa*) on the Texas Gulf coast, in Cape Cod, Massachusetts, and in Delaware Bay, New Jersey, showed that a significant proportion of birds used the area near the Nelson River Estuary in northern Manitoba for staging during migration (at least 56% in spring and 49% in fall). This area has not been previously identified as important for Red Knots and a comprehensive shorebird survey of the area has never been done. Geocator records suggest that knots reach the area after long, non-stop flights and that they spend a significant amount of time in the area. We hypothesize that birds are exploiting an important food source, possibly made available by the earlier ice break-up at the mouth of the Nelson River in comparison to nearby locations on Hudson and James Bays. In spring 2014, we performed ground and aerial shorebird surveys along 250 km of shoreline habitat on Hudson Bay between the Nelson River and Pen Islands. We also sampled benthic invertebrate prey. The Nelson River has been and continues to be the site of intensive hydroelectric development. The area's potential high use by an endangered sub-species during a critical life history stage, coupled with this development pressure, makes for a large information need. Our results will provide an improved understanding of the numbers of Red Knots and other shorebirds using the area, and the reasons for the area's importance for shorebirds, essential first steps towards understanding whether any additional management actions are necessary. (ID 15916 | Poster 49)

Mckibbin, R., Environment Canada, Canada, rene.mckibbin@ec.gc.ca  
**Bishop, C. A.**, Environment Canada, Canada, cab.bishop@ec.gc.ca  
**DOUBLE AND TRIPLE BROODS IN WESTERN YELLOW-BREASTED CHATS (ICTERIA VIRENS AURICOLLIS) AT THE NORTHERN PERIPHERY OF THEIR RANGE IN THE SOUTH OKANAGAN VALLEY, BC, CANADA**

Double brooding sometimes occurs in Yellow-breasted Chats (*Icteria virens auricollis*) but this is the first known report of triple brooding in this species. During 2007, we used color banding of adult birds to discover one instance of triple brooding of a Yellow-breasted Chat female in the south Okanagan, British Columbia (BC), Canada at the northern periphery of their breeding range. The first and second broods successfully fledged chats but the third brood failed. This triple brooding is the only known case in our study between 2005 and 2010 of 384 nesting attempts. During the same period 4.7% of banded females had double broods. Another 32 unidentified females for whom we are confident that they were the same females who initiated the first brood, also had double broods. If these females are included 13% of females had double broods. During 2002 to 2010 of 161 failed nests, 11 banded females (6.8%) re-nested for a second time. Another 32 unidentified females re-nested and if they are included 26.7% of chat females re-nested. (ID 15880 | Poster 113)

**McLeod, M. A.**, SWCA Environmental Consultants, USA, mmcleod@swca.com  
 Pellegrini, A. R., SWCA Environmental Consultants, USA, apellegrini@swca.com  
**EFFECTS OF TAMARISK DEFOLIATION ON SOUTHWESTERN WILLOW FLYCATCHERS ALONG THE VIRGIN RIVER**

Tamarisk leaf beetles (*Diorhabda* spp.) were released in the western United States as biocontrol for tamarisk (*Tamarix* spp.) beginning in 2001. Beetles became established on the Virgin River in St. George, Utah, and began defoliating large areas of tamarisk around St. George in 2008. By the end

of 2011, beetles expanded their range to encompass the entire Virgin River. The southwestern willow flycatcher (*Empidonax traillii extimus*), a federally endangered neotropical migrant passerine, breeds in dense, mesic habitats at several locations along the Virgin River. Occupied areas vary in their floristic composition — some have a significant component of native vegetation while others have extensive stands of tamarisk — and thus have been affected to varying degrees by tamarisk defoliation and subsequent mortality. Following the initial year of defoliation in St. George, flycatchers in that area moved into nearby sites that consisted primarily of native vegetation. Very little native vegetation is present farther downstream on the Virgin River, and flycatchers in downstream areas continued attempting to breed at sites that contained a significant tamarisk component; however, the number of breeding flycatchers dropped from 14 pairs to 7 pairs in the year following initial defoliation. In all cases where flycatchers attempted to breed in defoliated areas, reproductive output was poor, with an average of 0.3 young produced annually per female flycatcher. Tamarisk beetles are continuing to expand farther into the flycatcher's breeding range in both Arizona and New Mexico. Beetles are likely to arrive at several large flycatcher sites, some of which consist primarily of monotypic tamarisk, in the next few years. Active restoration of native riparian woodlands in watersheds where flycatchers currently nest primarily in tamarisk is urgently needed to provide flycatchers with alternate nesting sites. (ID 16227)

**McNeil, S. E.**, University of Arizona, USA, semcneil@email.arizona.edu  
 Culver, M., University of Arizona, USA, mculver@email.arizona.edu  
**POPULATION GENETIC DIVERSITY AND STRUCTURING OF YELLOW-BILLED CUCKOOS**

The western distinct population segment of yellow-billed cuckoo (*Coccyzus americanus*) was recently proposed as threatened due to widespread loss and degradation of western riparian forest. However, the extent of differences between the western and more abundant eastern US population remains unclear. Circumstantial evidence suggests increased inbreeding rates among western yellow-billed cuckoos; other evidence suggests wide-ranging dispersal capabilities of this long-distance Neotropical migrant, annually flying over 18,000 km between South and North America. Limited genetic comparisons of western and eastern samples have produced conflicting results, calling for improved methods and larger sample sizes. We developed and genotyped up to 16 polymorphic microsatellite loci in 200 yellow-billed cuckoos from across the breeding range, assessing east-west differences and gene flow among isolated western sites. Our results will help to inform the conservation of this population. (ID 16342)

**Megna, L. C.**, University of Wyoming, USA, lmegna@uwyo.edu  
 Carling, M. D., University of Wyoming, USA, mcarling@uwyo.edu  
**ENVIRONMENTAL NICHE DIVERGENCE FOR HYBRIDIZING AND NON-HYBRIDIZING PASSERINES\***

Identifying the factors that currently contribute to reproductive isolation is an important first step in the study of how reproductive isolation arises. In this project we determine whether environmental niche divergence is more often associated with non-hybridizing passerine species versus hybridizing passerines, and identify which environmental variables are most often associated with reproductive isolation or hybridization. In order to make meaningful comparisons between hybridizing and non-hybridizing passerines, we chose six non-hybridizing species pairs (e.g., Painted and Varied Buntings) where the species had significant range overlap and belong to the same family as one of the six hybridizing species pairs (e.g., Lazuli and Indigo Buntings). We created an environmental niche model for each species using presence/absence data from eBird and Rehfeldt climate data (e.g., mean annual temperature), in a random forests model. We then determined the degree of niche divergence for the hybridizing and non-hybridizing species

pairs using the methods of McCormack and colleagues. We also determined the degree of niche divergence for each of the environmental variables individually to determine which are most often associated with reproductive isolation versus hybridization among closely related passerine species. Although this study cannot provide a causal link between environmental parameters and reproductive isolation, consistent patterns in environmental niche divergence across a variety of bird families may point to the most likely drivers of ecological reproductive isolation. (ID 16167)

**Meine, C.**, Aldo Leopold Foundation & Center for Humans and Nature, USA, [curtmeine@gmail.com](mailto:curtmeine@gmail.com)

#### THE IMPACT OF THE PASSENGER PIGEON'S EXTINCTION ON CONSERVATION SCIENCE AND POLICY<sup>†</sup>

Virtually every commentary on the history of conservation mentions the passenger pigeon's extinction in 1914 as a signal event. In retrospect we see it as a turning point in the evolution of conservation science and policy. At the time there was no coherent field of wildlife management. The game protection movement had been gaining adherents since the 1880s, addressing issues of market hunting, excessive sport hunting, and, later, the plume trade. Early conservation laws, including especially the Lacey Act of 1900, had begun to address the causal factors behind declining populations. Theodore Roosevelt's rise to the presidency elevated the importance of "wild life" conservation, but by then the passenger pigeon was in its death spiral. With the public campaigns of organized sportsmen-conservationists, game protectors like zoologist William Temple Hornaday, and reform-minded policy-makers, the foundations for a more robust wildlife conservation movement were being put into place. The passenger pigeon thus became symbolic of the "end of the line," not only of the species, but of the old default approach of unrestrained privatization, exploitation, and marketing of wildlife, devoid of any sustained scientific attention or understanding — what Aldo Leopold called "the stringing out of the virgin supply," rather than the purposeful restoration and management of populations. The pigeon's extinction was thus unprecedented, not only in its visibility, but in the impetus it gave to the prevention of further losses. (ID 15934)

**Messmer, D. J.**, University of Saskatchewan, Canada, [dmessmer@gmail.com](mailto:dmessmer@gmail.com)  
Clark, R. G., Environment Canada/University of Saskatchewan, Canada, [bob.clark@ec.gc.ca](mailto:bob.clark@ec.gc.ca)

Slattery, S. M., Ducks Unlimited Canada, Canada, [s\\_slattery@ducks.ca](mailto:s_slattery@ducks.ca)  
Drever, M. C., Environment Canada, Canada, [Mark.Drever@ec.gc.ca](mailto:Mark.Drever@ec.gc.ca)  
Derksen, C., Environment Canada, [Chris.Derksen@ec.gc.ca](mailto:Chris.Derksen@ec.gc.ca)

#### INFLUENCE OF SPRING PHENOLOGY ON POPULATION DYNAMICS OF WESTERN BOREAL FOREST WATERBIRDS; A MULTI-SCALE AND SPECIES INVESTIGATION

Each year, the western boreal forest (WBF) of North America supports 12 to 15 million breeding ducks, including >50% of the total breeding populations of several species. Although the WBF's waterfowl habitat has traditionally been thought of as stable, this perception is being challenged in light of evidence that the region's climate, habitat, and duck populations are dynamic and exhibiting long-term changes. A trend toward warmer spring temperatures and earlier vegetative phenology may influence habitat or predator/prey communities in ways that could influence avian population dynamics. Trophic mismatch, potentially triggered by warmer springs, is one hypothesized explanation for why some duck populations have declined, while others have remained stationary or increased. We hypothesized that populations of species with limited flexibility in nest initiation dates would be more likely to decline in response to advancing spring phenology. To test this, we modeled WBF duck population responses to indices of spring phenology, while accounting for density dependence and observation error. We found evidence that species with limited flexibility in timing of breeding

had negative population responses in years following early springs (indexed by spring snow cover duration) whereas species with flexible breeding dates were unaffected. We are using finer resolution phenology data to test if this relationship persists in detrended time series, which would indicate stronger evidence for a cause-effect relationship. These results will help conservation planners understand the processes underlying population fluctuations and trends in the WBF. (ID 16147)

**Mettler, R. D.**, Black Hills State University, USA, [raeann.mettler@bhsu.edu](mailto:raeann.mettler@bhsu.edu)  
Spellman, G. M., Black Hills State University, USA, [garth.spellman@bhsu.edu](mailto:garth.spellman@bhsu.edu)  
Klicka, J., University of Nevada, Las Vegas, USA, [klicka@unlv.nevada.edu](mailto:klicka@unlv.nevada.edu)  
RADSEQ GENOTYPING-BY-SEQUENCING WITHIN THE HOUSE WREN (TROGLODYTES AEDON) COMPLEX

Delimiting species boundaries remains a challenging task for groups with poorly defined phylogenies and widespread distributions, such as with the House Wren complex (*Troglodytes aedon*). Spanning North, Central and South Americas, the numerous subspecies comprising this complex are generally clustered into 5 main groups based on geographic, morphological, and behavioral differences: 1) the aedon group, 2) the brunneicollis group, 3) the musculus group, 4) the beani group, and 5) the martinicensis group. Recent genetic studies utilizing mtDNA sequence data produce a well resolved phylogeny, while a data set including several nuclear loci produces an unresolved species tree due to a rapid burst of divergence in the middle of the tree. Therefore it remains difficult to distinguish among independent lineages within and among these groups. Furthermore, new ecological opportunities encountered during the process of niche expansion have promoted diversification within the House Wren complex. Utilizing next generation genotyping-by-sequencing (ddRADseq, Illumina), we generate large numbers of genetic markers (SNPs) to explore biogeographic hypotheses concerning diversification patterns within the House Wren complex; a particular focus is made on the recent radiation spanning the Neotropic ecozone from Central to South America. Our first approach in resolving this phylogeny incorporates the broad geographic distribution of subspecies/phylogroups in this complex, while a second approach considers an ecological transition based on elevational preference from highlands to lowlands. (ID 16390 | Poster 130)

**Michel, N. L.**, University of Saskatchewan, Canada, [Nicole.L.Michel1@gmail.com](mailto:Nicole.L.Michel1@gmail.com)  
Clark, R. G., Environment Canada, Canada, [Bob.Clark@ec.gc.ca](mailto:Bob.Clark@ec.gc.ca)  
Hobson, K. A., Environment Canada, Canada, [Keith.Hobson@ec.gc.ca](mailto:Keith.Hobson@ec.gc.ca)  
Morrissey, C. A., University of Saskatchewan, Canada, [Christy.Morrissey@usask.ca](mailto:Christy.Morrissey@usask.ca)

#### POPULATION DYNAMICS OF AERIAL INSECTIVOROUS BIRDS: OVERVIEW AND CLIMATIC DRIVERS<sup>†</sup>

Many species of aerial insectivorous birds are experiencing dramatic population declines worldwide, for reasons that remain unclear. To identify key drivers, we first need to understand the ecology and demographics of the species at risk, as well as their spatiotemporal patterns in population trends. In this opening talk of the "Ecology and Conservation of Aerial Insectivores" symposium, we will briefly review existing knowledge of aerial insectivore population trends and the ecological and life-history traits that make them particularly disturbance-sensitive. Additionally, we will present results of new analyses documenting spatiotemporal patterns and climatic drivers of population trends in five focal aerial insectivores across North America, drawn from North American Breeding Bird Survey data (1966-2011). Purple Martins, Barn Swallows, and Tree Swallows are declining across northern North America, whereas Chimney Swifts are declining across their entire breeding range, and Northern Rough-winged Swallow declines are restricted to the western US and Canada. Large-scale climate cycles (e.g., El Niño,

NAO) and migratory conditions (winds and storms during spring and fall migration) explained up to 62% of the interannual variation in population trends. Climate cycle correlation frequency was greatest in northern strata, while southern strata and South American-wintering species' trends most frequently correlated with environmental conditions during migration. Our findings highlight the need to improve our understanding of aerial insectivore life history, demographics, and migratory connectivity in order to develop appropriate species-specific management actions designed to conserve this ecologically-important guild. (ID 16011)

**Michelson, C. I.**, University of Saskatchewan, Canada, chantel.michelson@usask.ca

Morrissey, C. A., University of Saskatchewan, Canada, christy.morrissey@usask.ca

Stanton, R. L., University of Saskatchewan, Canada, rebecca.stanton@usask.ca

Clark, R. G., Environment Canada, Canada, bob.clark@ec.gc.ca

#### EFFECTS OF AGRICULTURAL INTENSIFICATION ON TREE SWALLOW (*TACHYCINETA BICOLOR*) REPRODUCTION AND NESTLING BODY CONDITION

Over the past 30-40 years many species of aerial insectivorous birds (i.e., birds that feed on flying insects) have experienced widespread declines in abundance. One hypothesis proposed to explain this trend is lower food availability due to the loss and alteration of natural, diverse habitats and pesticide use from agricultural intensification. We evaluated whether agricultural intensification affects (1) reproductive success and (2) nestling body condition in tree swallows (*Tachycineta bicolor*). Over two breeding seasons, we monitored nest box use, timing of breeding, reproductive investment and success, and measured size and body condition of nestling swallows at 3-4 sites with varying levels of agricultural intensification. Nest box occupancy and adult return rates were lower at sites dominated by cropland. Results also revealed slightly smaller clutch sizes and lower nestling body condition at sites with more intensive agriculture. However, timing of breeding and the number of young fledged per nest did not vary across study sites. Tree swallows appear to be sensitive indicators of agricultural intensification and data will aid decisions about future research and management of declining aerial insectivore populations. (ID 16066)

**Michelson, C. I.**, University of Saskatchewan, Canada, chantel.michelson@usask.ca

Clark, R. G., Environment Canada, Canada, bob.clark@ec.gc.ca

Morrissey, C. A., University of Saskatchewan, Canada, christy.morrissey@usask.ca

#### AGRICULTURAL INTENSIFICATION DOES NOT DISRUPT THE PICKY EATING HABITS OF TREE SWALLOWS (*TACHYCINETA BICOLOR*)

Abundances of many species of aerial insectivorous birds have significantly declined in the past 30-40 years. Species within this guild are linked by a strong reliance on aerial insects as their main food source. Widespread increases in agricultural intensification through wetland drainage, removal of hedge rows and trees and changes in the seeding regime has negatively impacted the abundance and diversity of aerial insects. One species, the tree swallow (*Tachycineta bicolor*), preferentially feeds on midges (e.g., order: Diptera, family: Chironomidae) and other dipteran prey over wetlands and open fields. Increased pesticide application near wetlands may reduce abundances of dipteran species. We examined potential spatiotemporal changes in the assimilated diets of adult and nestling tree swallows at 4 sites of varying agricultural intensification using stable isotope analysis ( $^{13}\text{C}$ ,  $^{15}\text{N}$ ). If agricultural intensification decreases the abundance of aerial insects, particularly the aquatic/semi-aquatic midges, then tree swallows may adjust their diet to include less preferred terrestrial prey items such as terrestrial Diptera, Coleoptera and Hemiptera. A pilot study conducted in 2012 showed that tree

swallow diets were dominated by midges at all sites. In 2013, insect sampling was completed multiple times throughout the breeding season in diverse habitats to further characterize the isotopic food web at each study site and thus to better examine potential seasonal changes in swallow diets. Using tree swallows as a study species will provide insights into how other declining aerial insectivore species may respond to potential changes in the insect community as a result of agricultural intensification. (ID 16068 | Poster 5)

**Miller, D. A.**, Pennsylvania State University, USA, dxm84@psu.edu

Smith, A. C., Environment Canada, Canada, adam.smith@ec.gc.ca

Cadman, M., Environment Canada, Canada, mike.cadman@ec.gc.ca

Russell, R., Environment Canada, Canada, rich.russell@ec.gc.ca

Weeber, R. C., Environment Canada, Canada, russ.weeber@ec.gc.ca

#### DIFFERENT FOREST BIRD POPULATION TRENDS FROM BBS AND FOREST INTERIOR MONITORING SITES

Numerous studies have shown that bird habitat sampled by the North American Breeding Bird Survey (BBS) is approximately representative of available habitat at the regional scale. Other studies have shown that the relative abundance of many species varies between the near-road areas sampled by the BBS and areas further from the road. But few studies have demonstrated differences in population trends between BBS and off-road sites in the same region. The Ontario Forest Bird Monitoring Program is a volunteer-based monitoring program that was initiated in 1987, in part, to evaluate temporal trends in abundance for birds with strong affinities for forest habitat. Using essentially identical Bayesian hierarchical models, we estimated population trends for forest birds in Ontario, doing so separately for the BBS data and the FBMP data. We compared the trends from the two programs using an additional hierarchical Bayesian model that accounted for the uncertainties associated with trend estimates. Overall, population trends from the FBMP data were more negative, indicating that for a given species, populations monitored in forest interiors (FBMP) were more likely to be in decline and/or more steeply declining than populations monitored on roadsides (BBS). That trends are different between populations monitored by the two programs may have important implications for both programs and for conclusions related to population status and trend assessment. Understanding those implications will be part of ongoing work to clarify possible mechanisms behind the differences and to evaluate the proportion of the regional bird populations represented by each program. (ID 15944)

**Miller, J. R.**, University of Illinois, USA, jrmillr@illinois.edu

Duchardt, C. J., University of Illinois, USA, cduchardt@gmail.com

Hovick, T. J., Oklahoma State University, USA, torre.hovick@gmail.com

Lyons, T. P., University of Illinois, USA, lyons22@illinois.edu

Pillsbury, F. C., New Mexico State University, USA, fcp@nmsu.edu

Debinski, D. M., Iowa State University, USA, debinski@iastate.edu

Engle, D. M., Oklahoma State University, USA, david.engle@okstate.edu

#### AVIAN RESPONSE TO THE FIRE-GRAZING INTERACTION IN GRASSLANDS OF THE UPPER MIDWEST<sup>†</sup>

Most research on the effects of the fire-grazing interaction on avian communities has been conducted in relatively extensive grasslands. We examined this phenomenon in highly fragmented grasslands of southern Iowa and northern Missouri from 2007-2013. Twelve pastures were assigned to one of three treatments: patch-burn-graze (one third burned each year, free access by cattle), graze-and-burn (one pasture-wide burn every three years, free access by cattle), and burn-only (one pasture-wide burn every three years, no grazing). The patch-burn pastures represented the fire-grazing interaction and management for habitat heterogeneity, whereas the latter two treatments represented management for homogeneity. Results from the first phase of the project (2007-2009) indicated that patch-burning was not increasing heterogeneity and that grassland birds were not responding to the



treatment as expected. This was attributed to stocking rates of cattle, which were subsequently reduced. Thereafter habitat heterogeneity increased on patch-burn pastures, as did the diversity of grassland obligate birds relative to pastures managed for homogeneity. Bird communities on patch-burn pastures were also more stable through time compared to the other treatments, reinforcing the notion that spatial heterogeneity buffers against temporal variability. Although nest survival for grassland obligates was comparable to rates reported in other studies, the predator community included at least 15 species and postfledging survival was <10%. The diversity of predator species likely stems from the prevalence of woodlands in the landscape matrix, suggesting that habitat heterogeneity at broad scales may mitigate the benefits of heterogeneity in these grassland habitats. (ID 16153)

**Miller, K. E.**, Florida Fish & Wildlife Conservation Commission, USA, karl.miller@myfwc.com

Faulhaber, C. A., Florida Fish & Wildlife Conservation Commission, USA, craig.faulhaber@myfwc.com

#### HABITAT SATURATION AND LANDSCAPE PATTERN IN THE LARGEST REMAINING POPULATION OF FLORIDA SCRUB-JAYS

Ocala National Forest (ONF) supports the largest remaining Florida Scrub-Jay (*Aphelocoma coerulescens*) population. Early successional scrub occurs in small patches (typically 20-35 ha) within a matrix of unsuitable closed canopy sand pine (*Pinus clausa*) forest. Long harvest rotations are believed to limit carrying capacity at ONF, but no empirical data exist on the relationship between demographics and forest management. In addition, the size and trend of this crucial scrub-jay population remain unknown because of monitoring limitations. To this end, we used a stratified random sampling design to develop an annual monitoring protocol for scrub-jays during the post-reproductive period. We then mapped scrub-jay territories in 2012 (n=44 stands) and 2013-2014 (n=32 stands) to assess relationships between scrub-jay density and productivity and landscape attributes such as stand size, stand age, and distance to nearest suitable stand. There was a strong curvilinear (quadratic) relationship between stand age and scrub-jay density ( $P < 0.001$ ); younger stands (<3 yrs since cutting) and older stands (>9 yrs since cutting) were suboptimal because of too little and too much vegetative cover, respectively. Stands >12 yrs were rarely occupied. Stand size and stand connectivity had no effect on density, mean group size, or productivity, possibly due to homogeneity in the landscape pattern. Relatively high densities (3.8–4.2 groups/40 ha) and low productivity (<1.0 HY birds/group) indicate that Florida Scrub-Jays in ONF occur at saturated densities with low recruitment. We revised the USFS definition of optimal scrub-jay habitat from 0-15 yrs to 3-9 yrs. Analysis of historical aerial photos revealed that the extent of scrub-jay habitat at ONF has declined by approximately 35% during the last 20 years. Findings are discussed in the context of landscape design for conservation and modeling efforts to explore the impact of forest management on scrub-jay persistence. (ID 16198)

**Miller, M. J.**, Smithsonian Tropical Research Institute, Panama, millerma@si.edu

Buitrago R., D. E., Smithsonian Tropical Research Institute, Panama, importanacional@gmail.com

Garzón V., J. L., Smithsonian Tropical Research Institute/ University of Panama, Panama, gorgevish@hotmail.com

Aguilar, C. E., INDICASAT, Panama, aguilar2587c@gmail.com

#### COMBINING MORPHOLOGY AND ULTRACONSERVED ELEMENTS (UCES) TO ESTABLISH SPECIES LIMITS IN PANAMANIAN OCHRE-BELLIED FLYCATCHERS (*MIONECTES OLEAGINEUS*)

The Neotropical region harbors one in four of the world's bird species. This fact is more impressive when one considers that a substantial portion of true Neotropical avian diversity is under-represented. Properly establishing

species limits of Neotropical birds is necessary for reconstructing the evolutionary history of diversification of the region's avifauna, as well as for understanding the processes that maintain this diversity. Previously, we demonstrated that Panamanian Ochre-bellied Flycatchers (*Mionectes oleagineus*) were comprised of three mitochondrial lineages resulting from repeated colonization out of Amazonia in the past 3 million years. Although a lack of mitochondrial (mtDNA) introgression among these phylogeographic clades hinted at the existence of as many as three species within the group, no taxonomic recommendation was provided due to uncertainty about the placement of populations from southwestern Panama, which are phenotypically similar to the assimilis clade of Bocas del Toro northward, yet have mitochondrial haplotypes belonging to the the central Panama mitochondrial phylogroup. Here, we show that a comparison of discriminant models based on morphological data provides unambiguous support for defining two species — western and central/eastern, and that contra their mtDNA, southwestern birds are best placed within the assimilis group. This result agrees with the consensus species tree generated from over 500 nuclear ultraconserved element loci (UCE). In sum, both morphometric and genomic indicate alternative species limits than those predicted by mtDNA. This *Mionectes* study provides a blueprint for the comparative study of the evolutionary history and population genomics of Panamanian lowland land bird species, an assemblage where the frequency of phylogeographic (mtDNA) structuring between western and eastern Panama approaches 25%. (ID 16375)

**Milligan, M.**, Humboldt State University, USA, mcm756@humboldt.edu

Johnson, M., Humboldt State University, USA, Matthew.Johnson@humboldt.edu

Garfinkel, M., Humboldt State University

Smith, C., Humboldt State University, USA

Njoroge, P., National Museums of Kenya, Kenya

#### QUANTIFYING PEST CONTROL SERVICES ON KENYAN COFFEE FARMS

Ecosystem services, such as pest control and pollination, are critical benefits of biodiversity necessary for agricultural production. Predators, including insectivorous birds and ants, can be important biological controls in agroecosystems, boosting yield and helping to offset the need for expensive inputs, such as pesticides. In order to better understand the relationship between predation levels and both habitat and landscape characteristics, a sentinel pest experiment was conducted to investigate predation levels in response to a novel pest outbreak on coffee farms in central Kenya. Predation levels decreased significantly with increasing distance from adjacent forest fragments and were correlated with bird species richness. Predation levels were also significantly higher on shade compared to sun coffee farms. This variation was driven primarily by the abundance of individual bird and ant species, emphasizing the importance of key species for the maintenance of ecosystem function in human-modified habitats. We conclude that a land-sharing approach, via both the integration of shade trees and the conservation of small forest fragments within a farm, can support increased levels of pest control services provided by both birds and ants. (ID 15785 | Poster 79)

**Minnich, A. N.**, Colorado State University-Pueblo, USA, an.minnich@colostate-pueblo.edu

Ramos, C. V., Colorado State University-Pueblo, USA, claire.ramos@colostate-pueblo.edu

#### MERCURY AND FLUCTUATING ASYMMETRY IN JUVENILE BIRDS ALONG FOUNTAIN CREEK, COLORADO

Mercury is a persistent pollutant of particular concern in western states because of historical mining practices and the prevalence of coal power in this region. Mercury is a threat to numerous wildlife species, including passerine birds. Mercury is known to have a greater impact on developing

individuals than on adults and may act as a strong physiological stressor during development. One measure of developmental stress is fluctuating asymmetry; therefore individuals exposed to greater amounts of mercury may be more asymmetrical. We correlated asymmetry in wing and tarsus measurements with environmental mercury exposure in juvenile passerine birds. We predicted that juvenile birds with heavier exposure to mercury exhibit a larger asymmetrical appearance than juvenile birds with lower levels of mercury. We sampled riparian birds along Fountain Creek, a watershed with known mercury contamination, between Pueblo and Woodland Park in Colorado. The asymmetry of wing and tarsus measurements will be correlated with the mercury levels determined in the blood and feather samples. Results will be discussed. If fluctuating asymmetry is associated with increasing mercury exposure, asymmetry may be used as a proxy to pollutant exposure. In addition, asymmetry is a feature that many animals use in mate choice, and increased asymmetry may represent an additional cryptic impact of mercury pollution. (ID 16210 | Poster 126)

**Moore, A. A.**, Texas State University - San Marcos, USA, am1964@txstate.edu  
Green, M. C., Texas State University - San Marcos, USA, claygreen@txstate.edu

#### THE IMPACT OF HUMAN DISTURBANCE ON THE FORAGING AND NESTING ECOLOGY OF GREEN HERONS (*BUTORIDES VIRESCENS*)

Human recreational activities in aquatic systems may influence the occurrence, abundance, and habitat use of waterbirds. Negative impacts on waterbirds from human disturbance include the reduction of feeding times, alteration of habitat use, disruption during breeding season, increased competitor density, or decreased individual quality. The objective of this study is to examine the potential influence of human recreational activity on the foraging and nesting ecology of Green Herons (*Butorides virescens*). Our study sites along the San Marcos River in Central Texas are subject to varying degrees of human activity and thereby disturbance varies across sites. In 2013, we assessed the effects of human recreational disturbance on Green Herons through the use of 20 min focal observations (n=72); we collected behavioral data to assess time budgets, as well as data on human disturbance. We also uniquely marked individuals (i.e. color bands) to determine individual foraging behavior, foraging territories and foraging habitat in relation to nesting areas. In year 2 (2014), we are examining the nesting ecology of Green Herons in relation to foraging areas and human disturbance using radio telemetry. Results from season one of this 2-year study suggest that Green Heron foraging behavior is not significantly affected by human recreational disturbance but influenced more by intraspecific behavior; presumably as a result of territorial behavior and competition for limited resources. While Green Heron foraging behavior may not be influenced by human disturbance, we hypothesize that Green Herons forage in areas spatially separate from nesting sites to minimize human disturbance at nests. (ID 16107 | Poster 6)

**Moore, F. R.**, University of Southern Mississippi, USA, frank.moore@usm.edu  
Paxton, K. L., University of Hawai'i Hilo, USA, Kristina.paxton@gmail.com  
Cohen, E. B., Smithsonian Conservation Biology Institute, USA, emlcohen@hotmail.com

Lain, E. J., University of Southern Mississippi, USA, ejlain78@gmail.com  
Paxton, E. B., US Geological Survey, Pacific Island Ecosystems Research Center, USA, epaxton@usgs.gov

Zenzal, T. J., University of Southern Mississippi, USA, tjenzal@gmail.com  
Nemeth, Z., University of California @ Davis, USA, znemeth05@gmail.com  
Diehl, R., US Geological Survey, Northern Rocky Mountain Science Center, USA, rhdiehl@usgs.gov

#### LONG TERM BANDING, ENVIRONMENTAL CHANGE AND MIGRATION BIOLOGY

The complex annual cycles of migratory birds are controlled by processes that act across multiple spatial and temporal scales. Since the late 1980s,

the stopover biology of landbird migrants has been studied along the northern coast of the Gulf of Mexico at two migration stations, one located near Johnson's Bayou, Louisiana, and the other on Ft. Morgan peninsula, Alabama. These stations sample birds originating from vast geographical areas in spring (Central and South America) and fall (much of North America). Although the spatial scale is huge, species-specific distributions and connectivity technology help us to link samples to specific areas of origin and destination. The capture and sampling of individual migrants at our spring migration station enabled us to study (1) how climatic variability across Neotropical wintering areas affects the condition of intercontinental migratory birds during migration, (2) the effects of spring resource phenology on the timing of songbird migration across the Gulf of Mexico, and (3) the impacts of hurricane induced changes in vegetation cover and distribution and abundance of resources on migrants during stopover. Long term data sets gathered during passage enable us to study large scale processes within an ecological time frame, which would not be possible from samples drawn during either stationary period of the annual cycle. Moreover, understanding the response of migrating birds to a rapidly changing world is essential to the development of truly comprehensive conservation strategies. (ID 16043)

**Morrissey, C.**, University of Saskatchewan, Canada, christy.morrissey@usask.ca

Michelson, C., University of Saskatchewan, Canada, chantel.michelson@usask.ca

Stanton, R., University of Saskatchewan, Canada, rebecca.stanton@usask.ca

Main, A., University of Saskatchewan, Canada, anson.main@usask.ca

Cavallaro, M., University of Saskatchewan, Canada, michael.cavallaro@usask.ca

Michel, N., University of Saskatchewan, Canada, nicole.michel@usask.ca

Headley, J., Environment Canada, Canada, john.headley@ec.gc.ca

Peru, K., Environment Canada, kerry.peru@ec.gc.ca

Liber, K., University of Saskatchewan, Canada, karsten.liber@usask.ca

Clark, R. G., Environment Canada, Canada, bob.clark@ec.gc.ca

#### EXPLORING THE INDIRECT LINKS BETWEEN INSECTICIDE USE AND EFFECTS TO AERIAL INSECTIVORES: A CASE STUDY FROM THE CANADIAN PRAIRIES

Rachel Carson was among the first to publicly address the problems associated with the agricultural industry's "war on insects" and potential insecticide impacts on bird populations. Insecticide applications continue to expand and directly overlap with seasonal invertebrate production and the avian breeding season. Evidence suggests these may be linked to observed declines of aerial insectivorous birds throughout North America and Europe. We hypothesize that insectivorous birds are susceptible to pesticides and particularly the widely used class of neonicotinoids, indirectly through loss of important aquatic insect prey. During a 3-year study in the Canadian Prairie Pothole region, intensive and widespread use of neonicotinoids, particularly for canola seed treatments, revealed that up to 91% (spring) and 62% (summer) of wetlands contained neonicotinoids (i.e., acetamiprid, clothianidin, imidacloprid and thiamethoxam) with maximum water concentrations as high of 3110 ng/L - well exceeding several published insect toxicity thresholds. Seasonal averages in aerial insect biomass were lower in a subset of sites with intensive agriculture and neonicotinoid use. Experimental work on important aquatic insect prey (namely Chironomidae) showed that delayed and reduced insect emergence occurred at levels below those commonly found in Prairie wetlands. The insect declines were further correlated with observed changes in growth and body condition of insectivorous tree swallows in local populations. Adult female swallows weighed 9% less and nestlings were in poorer body condition at the intensive agriculture sites relative to the more natural areas. Preliminary evidence suggests indirect effects of large scale insecticide use may have important negative consequences for aerial insectivorous birds in some regions of Canada and possibly elsewhere. (ID 16062)

**Mount, A. R.**, Green Diamond Resource Company and University of Washington, USA, amount@greendiamond.com

#### SNAG RETENTION AND HABITAT DYNAMICS FOR LARGE CAVITY NESTING BIRDS

Snag retention is an important part of forest management prescriptions and provides essential habitat for cavity nesting birds. Large snag retention in a managed forest is difficult due to safety concerns. We evaluated snag retention and recruitment in Green Diamond Resource Company's leave areas including riparian conservation reserves and wetland conservation areas on the Olympic Tree Farm at the base of the Olympic Peninsula in Washington. Pilot surveys indicated small snags (30.48- 60.96 cm Diameter at Breast Height, DBH) were common while large snags (>60.96 cm DBH) were rare. We assessed snag recruitment and retention by returning to plots established in 2000 and 2001. We found 0.69 snags per hectare (SPH) recruitment for snags 30.48-60.96 cm DBH and 1.38 SPH recruitment for snags greater than 60.96 cm. We targeted sampling to specific habitats of the cavity nesting birds covered by Green Diamond's Habitat Conservation Plan that are reported to require large snags (Common Merganser, *Mergus merganser*, Wood Duck, *Aix sponsa*, and Pileated Woodpecker, *Dryocopus pileatus*). *D. pileatus*, a Washington state candidate for ESA listing. We found *D. pileatus* evenly distributed throughout Green Diamond ownership and found evidence of *D. pileatus* (foraging excavations or cavities) in the leave areas of all forest age stands. There were 1.7 SPH in these areas. Along *A. sponsa* habitats (forested wetlands), there were 1.48 SPH. Along *M. merganser* habitats, (mainstem rivers) there were 1.7 SPH. Monitoring of *D. pileatus* habitat dynamics will be ongoing through 2015 by tracking 20 individuals with backpack telemetry. (ID 16306 | Poster 87)

**Mullin, R. D.**, Ecostudies Institute, USA, rmullin@ecoinst.org  
Lloyd, J. D., Ecostudies Institute, USA, jlloyd@ecoinst.org

#### EYE-RING COLOR IS NOT A RELIABLE INDICATOR OF AGE IN MANGROVE CUCKOOS

Soft-part coloration can be a useful method for determining the age of a bird. As part of an ongoing study of Mangrove Cuckoos (*Coccyzus minor*), we have documented plumage characteristics, molt patterns, and soft-part coloration, and have noted an important discrepancy between the patterns we have observed and widely held beliefs about age-related changes in eye-ring coloration. The commonly accepted pattern of change in eye-ring coloration among Mangrove Cuckoos is that hatch-year birds and early second-year birds exhibit a dusky-colored eye-ring, which later becomes yellow. As such, eye-ring color is believed to be a reliable criterion for separating older birds from hatch-year and second-year birds. However, our observations of both marked and unmarked individuals throughout the year reveal that changes in eye-ring coloration are not age-related but are instead seasonal. During March and April 2013 and 2014, we captured and marked three after-hatch-year birds with yellow eye-rings. In subsequent months, each of these individuals gradually developed a dusky, gray eye-ring. The change from a yellow to a gray eye-ring is not concordant with the notion that gray eye-rings are characteristic of young birds. Furthermore, observations of unmarked birds located during playback surveys revealed a decrease in the number of cuckoos exhibiting a yellow eye-ring from February to May, with zero observations of individuals with yellow eye-rings by June. Furthermore, one individual known to be early in its second year of life, based on retained juvenile plumage, showed a bright yellow eye-ring. In sum, these observations suggest that a yellow eye-ring is characteristic of non-breeding birds of all ages, and that eye-rings become gray at the onset of the breeding season. (ID 16319 | Poster 120)

**Najar, N. A.**, University of Northern Colorado, USA, nadje.najar@unco.edu  
Benedict, L., University of Northern Colorado, USA, lauryn.benedict@unco.edu

#### SIGNAL EVOLUTION AND SEXUAL SELECTION IN THE ROCK WREN (*SALPINCTES OBSOLETUS*)

Meta-analysis of the songs of hundreds of passerine species suggests a latitudinal component to song elaboration. Several hypotheses attempt to explain this phenomenon, largely in a sexual selection framework. Presumably these ideas can, on some level, apply to within-species elaboration of song as well, but within-species studies report mixed results, requiring more work to verify whether such a trend exists within species. I have set up a latitudinal transect spanning northern Montana to west Texas. I have recorded rock wren (*Salpinctes obsoletus*) song and compiled repertoire curves for 3-12 individuals from nine populations. Song can be used as a proxy measure of the strength of both inter- and intra-sexual selection, particularly in a monomorphic species like the rock wren. I predicted repertoire size would increase with increasing latitude, particularly at the migratory divide. Preliminary data from two field seasons indicates repertoire size increases with increasing latitude. Field observation suggests sedentary populations respond less often and spend less time responding to playback than migratory populations. Overall there are measurable behavioral differences between sedentary and migratory populations along a latitudinal transect within a species, as predicted by sexual selection theory. (ID 15795)

**Neiles, B. Y.**, Southern Illinois University, USA, brady.neiles@siu.edu  
Sparling, D. W., Southern Illinois University, USA, dsparl@siu.edu  
Nielsen, C. K., Southern Illinois University, USA, kezo92@siu.edu

#### AVIAN AND PREDATOR USE OF CP33 FIELD BUFFERS IN SOUTHERN ILLINOIS

In 2004, the Habitat Buffers for Upland Birds (CP33) practice was established under the federal Conservation Reserve Program (CRP) to increase native grassland bird habitat via private landowner participation. Through this program, farmers receive incentives to establish and maintain 30'-to-150'-wide strips of wildlife habitat along field margins for a period of 10-15 years. The CP33 buffer program directly addresses population recovery goals of the Northern Bobwhite Conservation Initiative by encouraging conservation practices alongside agricultural production. Although many avian species nest in these field buffers, little evidence of positive effect on populations has been reported. By surveying both CP33 buffers and larger CRP fields of southern Illinois, we intend to describe source-sink dynamics of CP33 buffers. We examined avian response, including relative abundance, density, community diversity and productivity of grassland birds to CP33 buffers. We also examined predator response to CP33 buffers using remote cameras. During May-August 2013, we sampled 47.3 ha of field buffer in 15 fields (mean size = 3.2 ha), and 55.1 ha of larger fields (mean size of 4 fields = 13.8 ha). Thirty line transects were assigned to these fields; we recorded 33 bird species using CP33 buffers, representing 15 families. Nest searches yielded 149 nests; 36 (24%) were successful, 85 (57%) failed and 27 (18%) were never used. Sixty remote cameras (2,402 trap nights) yielded 870 animal detections. Our study will provide land managers with recommendations for maximizing benefits of CP33 lands to northern bobwhite (*Colinus virginianus*) and other grassland bird species. (ID 16215 | Poster 43)

**Newbrey, J. L.**, Columbus State University, USA, newbrey\_jennifer@columbusstate.edu  
Paszowski, C. A., University of Alberta, Canada, cindy.paszowski@ualberta.ca  
McGraw, K. J., Arizona State University, USA, Kevin.McGraw@asu.edu  
Ogle, S., University of Alberta, Canada, s.ogle@live.ca

#### LAYING-SEQUENCE VARIATION IN YOLK CAROTENOIDS AND EGG CHARACTERISTICS IN THE RED-WINGED BLACKBIRD

In many bird species with asynchronous hatching, smaller, later-hatched nestlings are out-competed for food by their larger, earlier-hatched siblings and therefore suffer increased mortality via starvation. It is thought that



female birds can either maintain or reduce the survival disadvantage of later-hatched nestlings by differentially allocating maternal resources across the eggs of a clutch. Carotenoid pigments are an example of resources that female birds allocate differentially when producing a clutch, but laying sequence patterns for these pigments remain poorly studied in North American songbirds. We examined intraclutch variation in yolk carotenoids and egg metrics in 27 full clutches of red-winged blackbird *Agelaius phoeniceus* eggs collected from eight wetlands in central Alberta, Canada. We predicted that carotenoids would decrease across the laying sequence, as in this species, later-hatched, marginal nestlings suffer greater mortality than earlier-hatched, core nestlings. We found nine carotenoid pigments in red-winged blackbird egg yolks, including two that have never been described from avian yolks. As predicted, concentrations and amounts of most carotenoids decreased across the laying sequence, suggesting that female red-winged blackbirds depleted their carotenoid resources as they laid more eggs. However, egg mass and yolk mass both increased across the laying sequence, suggesting that female red-winged blackbirds may use other maternal resources to compensate for the size and survival disadvantage experienced by later-hatched, marginal nestlings. (ID 15760)

**Nielsen, L. A.**, EDM International, Inc., USA, lnielsen@edmlink.com  
Cutler, P., White Sands Missile Range, USA, patricia.l.cutler.civ@mail.mil  
Harness, R. E., EDM International, Inc., USA, rharness@edmlink.com

#### WHITE SANDS MISSILE RANGE - AVIAN PROTECTION PLAN: POWER LINE BIRD PROTECTION IN SUPPORT OF THE MILITARY MISSION<sup>†</sup>

White Sands Missile Range (WSMR) is the largest U.S. overland military installation, encompassing portions of five New Mexico counties and three rural electric service territories. The WSMR electric power grid is extensive and complex with hundreds of kilometers of distribution power lines with varying configurations. WSMR initiated a facility-wide Avian Protection Plan (APP) in 2012 to reduce bird electrocution risk and animal-caused outages, ensuring regulatory compliance with the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act. EDM International, Inc. (EDM) prepared the APP which included an avian field Risk Assessment (RA). WSMR's historic approach has been to retrofit hazardous poles and transformer banks and/or de-energize specific line spans in favorable habitat, but this can allow at-risk configurations to persist unrecognized when lines are re-energized for new missions. EDM surveyed 80% of the power line grid in 2012, resulting in over 1,000 structures and areas with retrofitting recommendations. Each RA recommendation was assigned a risk prioritization ranking (1-4) based on factors including habitat and pole configuration (Dwyer et al. 2013). Poles with equipment and exposed jumpers and antiquated ground banks were highly associated with avian incidents and received the highest RA ranking, a value of 1. Retrofitting challenges included developing strategies to mitigate remote three-phase switch structures with prominent Golden Eagle (*Aquila chrysaetos*) presence, while balancing high levels of raptor use within the more populated Main Post cantonment area. The APP was approved in 2014 and provides a short- and long-term planning tool to mitigate high-risk poles, making the power system more reliable thus supporting military mission readiness. (ID 16171)

**Niemi, G. J.**, University of Minnesota-Duluth, USA, gniemi@um.edu  
Bednar, J., University of Minnesota-Duluth, USA, bedn0050@d.umn.edu  
Brown, T., University of Minnesota-Duluth, USA, tbrown@nrri.umn.edu  
Peterson, A., University of Minnesota-Duluth, USA, pete1112@d.umn.edu  
Zlonis, E. J., University of Minnesota-Duluth, USA, zloni011@d.umn.edu  
AN ALTERNATIVE DESIGN TO SAMPLE BREEDING BIRDS FOR A STATE ATLAS

For Minnesota's first state atlas, we designed a means to systematically sample all of the 2,353 townships (9.65 x 9.65 km) with at least 50% land

throughout the state. Within each township, the northeast quadrant (typically 4.83 x 4.83 km) was randomly selected as the priority block for detection of breeding bird activity. Within each priority block, we compiled data layers for roads from the 2008 Minnesota Department of Transportation data base and land cover types from the 2001 National Land Cover Data. Non-major roads (e.g., no Interstate, United States, or State Highways) were buffered within 45 m and these buffers searched by an automated GIS procedure for appropriate land cover types. Each priority block of a township was sampled with three 10-minute, unlimited-distance point counts; generally sampled between 0500 and 1000 and within the safe nesting dates for breeding bird species in Minnesota. The first point was a randomly-selected point, the second in the predominant land cover type, and the third point in the second most common land cover type of the township. From 2009 to 2013 we successfully sampled 6,993 points in all but 5 of the 2,353 townships in Minnesota. We observed a total of 219 species and 195,475 individual birds over the five-year period. These data will allow a systematic, re-sampling of the Minnesota breeding bird atlas in future years with standard effort and an equal distribution across the state. These data allow for estimates of population size, habitat distribution, and the development of probability distribution maps for species breeding in the state. (ID 15937 | Poster 32)

**Nocera, J. J.**, Ontario Ministry of Natural Resources / Trent University, Canada, joe.nocera@ontario.ca  
Reudink, M. W., Thompson Rivers University, Canada, mreudink@tru.ca  
Campomizzi, A. J., Ontario Ministry of Natural Resources, Canada, acampomizzi@gmail.com

#### POPULATION TRENDS OF AERIAL INSECTIVORES BREEDING IN NORTH AMERICA CAN BE LINKED TO TRADE IN INSECTICIDES ON WINTERING GROUNDS IN CENTRAL AND SOUTH AMERICA

We investigated several hypotheses to explain the decline of 34 species of aerial insectivorous birds in their breeding ranges in North America. Using data from the North American Breeding Bird Survey and the Food and Agriculture Organization of the United Nations, we found that expenditures on insecticides in the non-breeding range of aerial insectivores in Central and South America was a better predictor of the index of abundance of the bird species than other hypotheses including migration distance and size of the non-breeding range. The model relating high expenditures on insecticides and aerial insectivore populations was 20 times more likely to be an appropriate model than the next-best competing model; delta AIC = 19.8. Species showing population decline from 1980-2011 were those whose over-wintering range consisted, or partially consisted, of countries with high expenditure on insecticides. Species showing stable populations from 1980-2011 were those whose over-wintering range consisted, or partially consisted, of countries with medium to low expenditures on insecticides. Although country-wide expenditure on pesticides may not directly equate to use, our results suggest that aerial insectivore populations are experiencing population-limiting effects from pesticides on the wintering grounds. Potential mechanisms for population reductions range from reduced prey availability to lethal and/or sub-lethal exposure to pesticides. (ID 15960)

**Noel, B. L.**, Bethune-Cookman University, USA, noelb@cookman.edu  
Small, A., Florida Department of Environmental Protection, USA, Andrea.Small@dep.state.fl.us  
Brush, J., Florida Fish and Wildlife Conservation Commission, USA, Janell.Brush@MyFWC.com  
Schwarzer, A., Florida Fish and Wildlife Conservation Commission, USA, Amy.Schwarzer@MyFWC.com

#### POTENTIAL TECHNIQUES FOR INCREASING AMERICAN OYSTERCATCHER HATCH SUCCESS THROUGH SHELL RAKE ENHANCEMENT

American Oystercatcher (*Haematopus palliatus*) populations are projected to decrease by at least 12% in the next decade, precipitating range-wide conservation efforts to alter this trend. Breeding oystercatchers are limited to specific coastal sites that are susceptible to anthropogenic impacts and sea level rise. Oystercatchers nest on a variety of habitats and substrates including sandy beaches and shell rakes, with shell rakes recognized as a habitat type of high importance for foraging, roosting, and breeding birds. We present data from an important breeding area in Florida from the 2012-2014 breeding seasons. In previous years (2012 and 2013), a large proportion of nests likely failed due to over wash. In an effort to test techniques for reducing over wash and increasing hatch success over time, we deployed recycled oyster shell bags along the waterward edge of an oyster rake on which a breeding pair of oystercatchers failed due to over wash in 2012 and 2013. In addition, we plan to elevate another rake within our study area during early spring 2015, testing two different shell rake enhancement techniques (i.e., wave attenuation from artificial reefs and increasing shell rake elevation). Information gathered from monitoring these two enhancement techniques combined with the evaluation of successful breeding sites, may provide resource managers with a model which they can employ to protect habitat from anthropogenic impacts and sea level rise. (ID 16165 | Poster 41)

**Oliver, K. D.**, Coker College, USA, kristen.oliver@coker.edu  
 Borgo, J. S., Coker College, USA, jborgo@coker.edu  
 Heiss, R., South Carolina Governor's School for Science and Mathematics, USA, rsh023@gmail.com

#### BACTERIAL GROWTH INHIBITION OF THE UROPYGIAL GLANDS SECRETIONS OF PASSERINES IN SOUTH CAROLINA

It is extremely important to understand the effects that the habitat has on its behavior and physiology. Different habitats, specifically dry and wet habitats, have been shown to have significant effects on the bacterial populations that exist on birds (Bisson *et al.* (2007)). This study sought to further understand how birds in differing environments may have adapted to combat the specific bacterial populations present in their environments. We examined whether secretions of the uropygial gland inhibit growth of the feather degrading bacterium *Bacillus licheniformis* or *E.coli* differently depending on environment. Birds were mistnetted at three trapping sites located near Hartsville (inland), Georgetown (coastal), and Awendaw (coastal), SC from May to August, 2013. Captured birds were identified to species, and uropygial samples were collected and stored in PBS buffer. Bacterial assays were conducted using techniques modified from French and Neuman-Lee (2012). Uropygial samples were co-incubated with each type of bacteria, *B. licheniformis* and *E.coli*, for 30 minutes, then plated on TSA and counted. Positive and negative controls were utilized to interpret percentage of growth inhibition for each sample. When birds from all habitats were included in the analysis, no statistically significant difference ( $n=18$ ,  $t=1.576$ ,  $P=0.134$ ) existed between growth inhibition of *B. licheniformis* and *E. coli*. When restricted to inland sampled birds, there was a trend found in their ability to inhibit the growth of the two species of bacteria ( $n=10$ ,  $t=2.053$ ,  $P=0.07$ ) where *B. licheniformis* was inhibited more than *E.coli*. No statistical difference in growth inhibition of bacterial species in birds sampled at coastal sites was found ( $n=8$ ,  $t=0.079$ ,  $P=0.939$ ). It is also known that *B. licheniformis* is more commonly found in soil environments, which would more likely be found in inland environments. (ID 16170 | Poster 105)

**Oliveros, C. H.**, University of Kansas, USA, oliveros@ku.edu  
 Andersen, M. J., American Museum of Natural History, USA, mandersen@amnh.org  
 Moyle, R. G., University of Kansas, USA, moyle@ku.edu

#### DISENTANGLING PHYLOGENETIC RELATIONSHIPS IN AN EXPLOSIVE BIRD RADIATION USING ULTRA CONSERVED ELEMENTS

Rapid evolutionary radiations allow tremendous insights into speciation. However, a major challenge in studies of these brief bursts of diversification has been poor resolution of species' phylogenetic relationships. As a consequence, too few robust phylogenetic hypotheses are available to document such radiations. This study aims to resolve relationships within a very rapid and diverse radiation in the passerine family of white-eyes (Zosteropidae) to illuminate underlying processes of lineage splitting. A vast majority of this lineage, which are distributed throughout much of the Old World, is estimated to have begun diversifying only in the early Pleistocene, resulting in the highest speciation rate yet documented among land vertebrates. Data from three mitochondrial genes and two nuclear introns yield a poorly-resolved phylogeny, but simulations suggest that increasing the number of loci to ~100 may improve resolution considerably. As predicted, DNA sequence data from 1,700 ultraconserved element loci provide a much better resolved estimate of phylogenetic relationships in this rapid radiation. The maximum likelihood concatenation (RAxML) and species tree (STAR) results share most strongly supported nodes. However, a few strongly supported nodes conflict with each other between the two methods. Resolution of phylogenetic relationships within Zosteropidae is vital to understanding the process of speciation in a species-rich but morphologically conserved group. More broadly, this study provides methodological insights into paths toward resolving relationships in other rapid evolutionary radiations across the tree of life. (ID 16168)

#### **Olsen, A. M.**, University of Chicago, USA, aolsen@uchicago.edu UNLOCKING THE DIET DATA OF THE PAST: A NEW R PACKAGE FOR COMPILING AND QUERYING DIET DATASETS

For many species of birds there is an enormous wealth of published diet data in the literature. However, a researcher interested in using these data to address large-scale questions is confronted with several challenges. First, many data are published in journals not included in standard library subscription services. Second, these data do not exist in a standard format that allows a user to easily perform the same query across several datasets. I present a new software package I am currently developing in the R language to perform taxonomy-based queries of compiled dietary datasets, such as how much of a species' diet is composed of the seeds of angiosperms, or larvae of Ecdysozoa. The software currently references the NCBI taxonomy, but other taxonomies can be used, including polyphyletic classifications (e.g. aquatic plants, algae). These queries require that data be in a common format and I propose a format that includes associated metadata (season, sample size, sampling method, etc.) and can be easily compiled and shared, ameliorating the limited accessibility of these data. The utility of this software extends to a broad range of analyses, such as examining seasonal variation in diet, testing for correlations between diet and morphological variables or exploring patterns of dietary evolution. I will present several examples of analyses using data compiled from over 200 different studies of diet in the bird order Anseriformes. Combined with collaborative efforts to compile these data, this software has the potential to unlock rich and scarcely utilized datasets for addressing large-scale questions in bird life history and evolution. Additionally, they allow for comprehensively assessing the limitations of currently existing data, helping to focus priorities for data collection in the future. (ID 16108)

**Olsen, B. J.**, University of Maine, USA, brian.olsen@maine.edu  
 Danner, R. M., National Zoological Park, USA, danner.ray@gmail.com  
 Shriver, W. G., University of Delaware, USA, gshriver@udel.edu  
 Walters, J. R., Virginia Tech, USA, jrwalt@vt.edu  
 Greenberg, R., National Zoological Park, USA

#### TRADEOFFS BETWEEN MIGRATION DISTANCE AND SEASONAL SURVIVAL IN MIGRATORY SONGBIRDS

Sympatrically breeding resident and migratory birds show predictable life-history differences. Migration distance is a good predictor of these differences, but causation is unclear. To explore the relationships between migration distance, life history, and annual survival, A) we present a meta-analysis of annual survival as a function of migration distance, and B) we compare the season-specific survival probabilities of a short-distance migrant (Swamp Sparrow) to previously published estimates for a long-distant migrant (Black-throated Blue Warbler). Annual survival in the two species was the same, although the warbler migrates five times as far. Monthly survival probability, however, was partitioned very differently. Adult male sparrows experienced lower survival during both migration (0.93) and the non-breeding resident period (0.91), relative to the breeding period (1.00). Adult male warblers, however, have similar survival probabilities during the breeding (1.00) and non-breeding (0.99) resident periods, but lower survival during migration (0.82). In this one comparison, migration distance appears to maintain a tradeoff between mortality risk on migration and mortality risk during non-breeding residence. These risk partitioning differences, however, do not lead to the classic life history differences among species with differing migration strategies. Both warbler and sparrow exhibit similar annual survival rates, clutch sizes, rates of double brooding, and annual fecundity. We hypothesize that reproductive strategy is driven primarily by annual survival. Migration distance, on the other hand, drives how mortality risk is partitioned across the annual cycle. (ID 16164)

**Ortega, J. C.**, Fort Lewis College, USA, ortega\_j@fortlewis.edu  
Ortega, C. P., Fort Lewis College, USA, ortega\_cp@yahoo.com

#### NEST SURVIVAL OF A TRUE HABITAT GENERALIST, THE AMERICAN ROBIN, IN SOUTHWEST COLORADO

Partially because of its large geographic distribution, the American Robin is one of the most widely-recognized avian species in North America. However, of mild concern in Colorado, and in the Southern Rocky Mountains, the Breeding Bird Survey, and the Colorado Breeding Bird Atlas II, both indicate a decline in breeding populations, or in the distribution of observed breeding activities, of this species in recent years. To further investigate these apparent decreases, from 1992 to 2004, we studied the nest success ( $n = 471$  nests) of American Robins in Southwest Colorado. Using Program MARK, we initially found that models incorporating nest height were most parsimonious. Date within the breeding season also contributed a small amount to model strength. However, the comparatively high similarity in model AICc values when examining nest site parameters such as nest age, substrate height, habitat type, grazing intensity, substrate type, and year, etc., highlight the very general nesting behavior of the American Robin. (ID 16212)

**Oswald, J. A.**, University of Florida, USA, oswaldj3@gmail.com

#### FOSSILS, MOLECULES, AND ECOLOGY: THE HISTORICAL MECHANISMS SHAPING BIRD COMMUNITIES IN NW PERU

The historical processes that drive endemism, speciation, and community composition are important in understanding the mechanisms that underlie the spatial structure of species diversity. Neotropical dry forests are characterized by their low diversity yet high endemism. I combined modern community surveys with Pleistocene songbird fossils and molecular data to evaluate the relative importance of the Neogene Andean uplift and Quaternary climate change on shaping the diversity and distributions Neotropical dry forests birds over time. This research was performed in the Marañon Valley and the Tumbesian dry forests of NW Peru; localities separated by the Andes. Fossils indicate more extensive dry forests and a non-analog community at the Tumbesian site in the recent past. Based on these results, historical climate change had a significant role in shaping distributions and community compositions. This climatic instability through time in the Tumbesian region would result in more homogeneity in community composition across space as forest fragments were either

connected by corridor habitats or species disperse more readily between fragments compared to the more stable Marañon Valley communities. I determined the betadiversity across the bird communities with both presence-absence and abundance data and compared results to expected community dissimilarity. Bird communities subjected to more climatic instability during the Pleistocene are more similar to each other than those of more climatically stable areas. Bird communities differed significantly between the Tumbesian region and the Marañon Valley, suggesting that geologic barriers have significantly structured communities. Molecular data support this finding and also suggest divergence during the Pleistocene and gene flow between populations across the Andes. Multiple mechanisms are responsible for the modern community composition and endemism in NW Peruvian dry forests. (ID 16289)

**Oyler-McCance, S. J.**, USGS, USA, soyler@usgs.gov  
Braun, C. E., Grouse Inc, USA, sgwtp66@gmail.com  
Fike, J. A., USGS, USA, fikej@usgs.gov  
Aldridge, C. L., USGS and Colorado State University, USA, aldridgec@usgs.gov  
Wann, G. T., Colorado State University, USA, greg.wann@colostate.edu  
Schroeder, M. A., Washington Department of Fish and Wildlife, USA, grouse@home.net  
Benson, D. P., Marian University, USA, dbenson@marian.edu  
Martin, K. M., University of British Columbia, Canada, kathy.martin@ubc.ca  
EXAMINING RANGE-WIDE CONNECTIVITY IN WHITE-TAILED PTARMIGAN USING GENETIC TECHNIQUES

White-tailed ptarmigan (*Lagopus leucura*) are susceptible to climate change as they spend their entire life cycle in the alpine, a habitat being reduced with upward movements of lower elevation habitats with consequent increasing isolation of remaining patches. Levels of connectivity among ptarmigan populations is unknown, yet represent an important component of population performance and persistence, particularly given that climate change may already be impacting populations in Colorado. We used microsatellites and single nucleotide polymorphisms (SNPs) to investigate connectivity and genetic structure among 7 populations across the species range including all samples from all 5 subspecies. Allelic richness was highest in Yukon (6.0) and lowest on Vancouver Island (3.7). Both microsatellite and SNPs revealed that there is significant population genetic structure throughout the range. The Colorado and Vancouver Island populations were the most isolated as both were designated as their own unique genetic cluster in STRUCTURE analyses and both were significantly different from all other populations in pairwise population FST tests. We observed limited connectivity among populations in Alaska, Yukon, Washington, and Montana as these shared patterns of cluster membership in STRUCTURE and a lower differentiation in pairwise FST tests. There is little evidence for movement from Colorado northward or from Vancouver Island eastward, raising concerns for the long term viability of two subspecies. As these areas are most impacted by climate change, this lack of connectivity to the core part of the range may have implications for the species ability to track shifting habitats. (ID 16250)

**Ozelski-McKelvy, A.**, City University of New York Graduate Center, USA, aozelski@gc.cuny.edu  
Nott, M. P., Institute for Bird Populations, USA, philipnott@gmail.com  
Manne, L. L., City University of New York - College of Staten Island, USA, lisa.manne@csi.cuny.edu

#### PREDICTING DEMOGRAPHY ACROSS LANDSCAPES AND IMPLICATIONS FOR SOURCE-SINK APPLICATIONS: AN EXAMPLE USING YELLOW WARBLERS (*SETOPHAGA PETECHIA*)

Models of habitat suitability typically utilize occurrence and abundance data. However, due to the vagile and territorial nature of many bird species, more habitat is likely occupied than is optimal for breeding. Here, we model



two demographic values using landscape-level land cover: the proportion of birds in breeding condition (PBRC) and the proportion of birds aged to be in at least their second year (PASY). We obtained demographic data for Yellow Warblers (*Setophaga petechia*) at MAPS (Monitoring Avian Survivorship and Productivity) stations in the Midwestern United States. Using habitat values derived from the National Land Cover Database (NLCD), we conducted binomial regressions of demographic variables vs. the land cover principal components. We found significant associations for both demographic measures (PBRC and ADSY) with landscape composition, supporting the hypothesis that habitat predicts demography on a level that is detectable using these data. The average number of Yellow Warblers captured per year at a site did not predict the proportion of older (after second year) individuals ( $p = 0.963$ ) or the proportion of birds in breeding condition ( $p = 0.341$ ) suggesting that abundance alone may not be a useful identifier of productive habitat. These models were then used to predict high suitability breeding habitat locations across our study landscape. The inclusion of demographic data in habitat suitability analyses will allow for better reserve design for species conservation as well as further our knowledge on spatial demography patterns. This provides us with a better visualization of "optimal" habitat (habitat with high proportions of older birds and birds in breeding condition), allowing for the most productive areas within a species range to be identified and preserved. (ID 16180)

**Pagano, T.**, Rochester Institute of Technology, USA, [tepnts@rit.edu](mailto:tepnts@rit.edu)  
Bida, M., Rochester Institute of Technology, USA  
Schroeder, S., Rochester Institute of Technology, USA  
Smith, S. B., Rochester Institute of Technology, USA, [sbssbi@rit.edu](mailto:sbssbi@rit.edu)

#### FINGERPRINTING THE BIOCHEMICAL MAKE-UP OF FRUITS AVAILABLE TO MIGRATORY BIRDS VIA MULTIDIMENSIONAL FLUORESCENCE AND CHEMOMETRICS

The fluorescence fingerprints of 13 wild fruit species available to migratory birds in Rochester, NY were obtained with multidimensional fluorescence spectroscopy coupled with chemometric analysis. Results from this novel technique provide unique spectral signatures of each fruit species based on their fluorophoric biochemical make-up and also show the potential of the fluorescence/chemometric technique to discriminate native versus invasive fruit species; and also species' taxonomy. A 5-component Parallel Factor Analysis (PARAFAC) model based on the multidimensional fluorescence matrices was found to be robust in handling both aqueous and organic extracts of the fruits. PARAFAC results were further correlated with several assays, including total phenol content and total antioxidant capacity- and proved successful in distinguishing different structural forms of these assay analytes. The model yielded two components which correlated strongly with total phenol content and antioxidant capacity, yet the observed photophysical properties indicated contributions from different forms of polyphenols. Spectral loadings further indicate protein-like, catechin-like, and anthocyanin-like contributions. Given the sensitivity and selectivity of the novel fluorescence-based method, improvements were required and implemented for the corresponding protocols of the standard microplate assays. The fluorescence/chemometric-based technique shows promise for a more specified characterization of fruit biochemical make-up over traditional/non-specific assays. The new method could be broadly applicable in assessing food quality across habitats and seasons for birds. (ID 16220 | Poster 78)

**Panjabi, A. O.**, Rocky Mountain Bird Observatory, USA, [arvind.panjabi@rmbo.org](mailto:arvind.panjabi@rmbo.org)  
Macias-Duarte, A., Universidad Estatal de Sonora, Mexico, [alberto.macias@rmbo.org](mailto:alberto.macias@rmbo.org)  
Levandoski, G. J., Rocky Mountain Bird Observatory, USA, [greg.levandoski@rmbo.org](mailto:greg.levandoski@rmbo.org)

Ruvalcaba-Ortega, I., Universidad Autonoma de Nuevo Leon, Mexico, [iruvalca@yahoo.com.mx](mailto:iruvalca@yahoo.com.mx)  
Gonzalez-Rojas, J. I., Universidad Autonoma de Nuevo Leon, Mexico, [josgonza@gmail.com](mailto:josgonza@gmail.com)

Pool, D. B., Rocky Mountain Bird Observatory, USA, [duane.pool@rmbo.org](mailto:duane.pool@rmbo.org)

#### WHERE DO GRASSLAND BIRDS OVERWINTER? DENSITY AND ABUNDANCE OF GRASSLAND BIRDS IN THE CHIHUAHUAN DESERT

Ninety percent of migratory grassland bird species in western North American overwinter in the Chihuahuan Desert. Grasslands in this region are disappearing at an alarming rate but lack of data on grassland bird non-breeding ecology hinders strategic habitat conservation. We surveyed wintering bird communities from 2007-2013 at 1,188 sites in 17 Grassland Priority Conservation Areas (GPCAs) in nine Chihuahuan Desert states in Mexico and USA. We used land cover data to estimate grassland extent in each GPCA and adjusted spatial data based on field data. We used program Distance to estimate density and population size for 12 grassland passerines in Chihuahuan Desert GPCAs. Density and abundance varied by species, GPCA and year. On average, western and southern grasslands supported the greatest numbers of most species. Some GPCAs supported a disproportionate percentage of populations, such as Cuchillas de la Zarca in Durango, Mexico which supported 42% and 24% of the total population of wintering Baird's Sparrows and Sprague's Pipits among GPCAs, respectively. Chestnut-collared Longspur had a more northerly distribution with 36% of its GPCA wintering population in The Valles Centrales of Chihuahua, Mexico. Overall, grasslands in Mexico supported larger populations of most species than grasslands in the U.S. The study highlights the importance of specific areas to individual species as well as the importance of density and abundance data for strategic conservation planning. In order to halt population declines and protect grassland conservation investments being made in breeding areas, more efforts to protect and enhance grasslands in the Chihuahuan Desert are needed, particularly in Mexico. We recommend that habitat and range specialists work with landowners to improve grassland conditions and increase productivity and viability of rangelands, while researchers focus on identifying factors limiting population growth and developing beneficial management practices. (ID 16370)

**Pansing, E. R.**, University of Colorado Denver, USA, [elizabeth.pansing@ucdenver.edu](mailto:elizabeth.pansing@ucdenver.edu)  
Tomback, D. F., University of Colorado Denver, USA, [Diana.Tomback@ucdenver.edu](mailto:Diana.Tomback@ucdenver.edu)  
Wunder, M. B., University of Colorado Denver, USA, [Michael.Wunder@ucdenver.edu](mailto:Michael.Wunder@ucdenver.edu)  
Wagner, A. C., University of Colorado Denver, USA, [Aaron.Wagner@ucdenver.edu](mailto:Aaron.Wagner@ucdenver.edu)  
French, J. P., University of Colorado Denver, USA, [Joshua.French@ucdenver.edu](mailto:Joshua.French@ucdenver.edu)

#### GERMINATION AND SEEDLING SURVIVAL OF COMMON CLARK'S NUTCRACKER CACHE LOCATIONS AND CONSEQUENCES OF CACHE PILFERAGE

By acting as seed dispersers, many scatter-hoarding birds influence plant population and spatial dynamics, community composition, and regeneration success. Cache site selection influences the regeneration process by determining both microsite type and seed pilferage risk. Clark's nutcracker (*Nucifraga columbiana*) harvests and caches the seeds of whitebark pine, acting as its primary disperser. Nutcrackers store 1-15 seeds per cache buried 2-3 cm under substrate. We determined whether cache site types generally chosen by nutcrackers 1) support germination, 2) support seedling survival, 3) are pilfered by granivorous rodents; and whether 4) rodents re-cache seeds in sites favorable for germination. In 2012, we created 735 simulated nutcracker caches in six common cache site types across the elevational

range of whitebark pine on White Calf Mountain, Glacier National Park, Montana, and Tibbs Butte, Shoshone National Forest, Wyoming. In 2013, we checked each cache for germination and seed pilferage, and tracked rodent-cached seeds using fluorescent pigments. We generated a predictive model to estimate germination success based on common cache site characteristics and pilferage. We then analyzed spatial clustering of pilferage. In 2013, at White Calf Mountain and Tibbs Butte, respectively, cache germination rates were 26 and 38%, pilferage rates were 54 and 54%, and seed coats, indicative of seed predation, were found near 22 and 66% of pilfered caches. Additionally, pilfered caches were spatially clustered at both study areas. During three nights of pigment tracking, we found seven surface caches comprising 1-3 seeds. In 2014, we will determine second year germination and seedling survival rates. Results to date suggest that sites typically chosen by nutcrackers are suitable for germination, and that cache pilferage results in either seed predation or surface caches, which are unfavorable for germination. (ID 16179)

**Parker, P. G.**, University of Missouri - St. Louis, USA, pparker@umsl.edu  
 Levin, I. I., University of Missouri - St. Louis, USA, iris.levin@gmail.com  
 Hartman, D. A., University of Missouri - St. Louis, USA, dahq8@umsl.edu  
 Jaramillo, M. C., University of Missouri - St. Louis, USA, mari.jaramillo@mail.umsl.edu

Asigau, S. S., University of Missouri - St. Louis, USA, ssacn6@mail.umsl.edu

#### PLASMODIUM IN GALAPAGOS BIRDS: DO WE KNOW ENOUGH ABOUT ITS TRANSMISSION ECOLOGY TO CONSIDER INTERVENTION? <sup>†</sup>

Plasmodium was first described in Galapagos penguins in 2009, the first finding in any Galapagos vertebrate despite considerable previous testing. Even so, we are not sure that it is a recent arrival. Since 2009, we have tested more than 3500 birds and documented infections in four endemic avian taxa, and characterized four different strains of the parasite. Three appear to have been transient infections detected in a small number of individuals in one place at one time, and two of these transients match Plasmodium variants found in migratory Bobolinks that pass through Galapagos each year. The fourth, Lineage A, is found year after year in multiple species, and is found predictably at sites we have identified as hotspots for transmission. We interpret this as evidence of establishment and regular transmission of Lineage A on the archipelago. Because no endemic birds appear to be competent hosts, we are targeting two introduced bird species, cattle egrets and smooth-billed anis, to examine their potential role as reservoirs. In addition, we are testing the three mosquito species present at the hotspots, two of which are also recent introductions. If the transmission cycle depends upon either an introduced bird, and introduced mosquito, or both, we will recommend to the Galapagos National Park that they consider eliminating either the introduced bird host or the introduced mosquito. There is little evidence of a high-elevation mosquito-free refuge as in Hawaii, emphasizing the need to understand the transmission dynamics and opportunities for intervention before changing environmental conditions lead to a major outbreak. (ID 16081)

**Parrish, C.**, Plymouth State University, USA, clinton.parrish@tetrattech.com  
 Reitsma, L., Plymouth State University, USA, leonr@plymouth.edu  
 Hunt, P., NH Audubon, USA, PHunt@nhaudubon.org  
 McFarland, K., Vermont Center for Ecostudies, USA, kmcfarland@vcecostudies.org

#### IMPACTS OF WIND DEVELOPMENT ON HIGH-ELEVATION BIRDS IN NORTHERN NEW HAMPSHIRE

Wind development at high-elevations sites across New England has caused concern for potential impact on sensitive species that inhabit these unique areas. A suite of avian species breed exclusively in high-elevation spruce-fir forests in the Northeast (including the Bicknell's Thrush) and increasing

mountaintop development presents a possible threat to the persistence of these vulnerable species. Over three years we monitored the abundance of Bicknell's Thrush and other high-elevation avian species using a grid of point counts positioned on ridge tops before, during, and post construction and onset of operation of a wind facility in northern New Hampshire. The total number of birds detected and overall species richness at all point count stations within the study area remained stable from 2010 to 2012. The abundance and species richness declined over the same time period when stations located only at turbines were included in our analyses. Higher abundance and species diversity was recorded at point count locations approximately 70 m away from turbines suggesting that turbine noise influenced detection and/or birds avoided cleared areas but were still present in forested edge habitats. Fewer observations of interior forest species such as the Black-backed Woodpecker, Golden-crowned Kinglet, Brown Creeper, and Gray Jay coincident with an increased observation of edge generalists like the American Robin indicate a measurable shift in the composition of the avian community following installation of the wind facility. (ID 16213)

**Pavlacky, D. C.**, Rocky Mountain Bird Observatory, USA, david.pavlacky@rmbo.org

Hanni, D. J., Rocky Mountain Bird Observatory, USA, david.hanni@rmbo.org  
 Gallagher, S., Rocky Mountain Bird Observatory, USA, seth.gallagher@rmbo.org

#### INTEGRATING MONITORING DATA AND ECOLOGICAL SITE DESCRIPTIONS TO ACHIEVE MULTI-SPECIES BIRD CONSERVATION IN WORKING LANDSCAPES

The apparent long-term population decline of sagebrush-dependent birds has elevated the recovery of the sagebrush avifauna to among the highest conservation priorities in North America. Because a large percentage of the sagebrush ecosystem occurs on private land, the successful recovery of the sagebrush avifauna may depend on partnerships between landowners and land managers. The failure to consider the interests of landowners and other stakeholders, and the lack of reliable knowledge about bird responses often conspire against conservation efforts in sagebrush ecosystems. The objectives of our decision support system are to maximize 1) the occurrence of sagebrush birds and 2) the sustainability grazing systems. We considered four conservation practices that are typically used by land managers to improve nesting habitat for the Greater Sage-Grouse (*Centrocercus urophasianus*). We used Structured Decision Making to integrate the objectives, conservation practices and outcomes, and a Bayesian Belief Network to determine the optimal conservation practices to achieve the objectives. We used data from the Integrated Monitoring in Bird Conservation Regions Program to model the bird responses, and Ecological Site Descriptions and State and Transition Models to inform vegetation responses to grazing management. We discovered that conservation practices for improving Greater Sage-Grouse nesting habitat increased forage production for livestock and also increased the occupancy rates of the Brewer's Sparrow (*Spizella breweri*), Sagebrush Sparrow (*Amphispiza belli*) and Sage Thrasher (*Oreoscoptes montanus*). We suggest this approach is useful for answering the "what to do" and "where to do it" questions in conservation planning, as well as for evaluating the effectiveness of management for multi-species bird conservation and sustainable land use in working landscapes. (ID 16240)

**Paxton, K. L.**, University of Hawaii Hilo, USA, kpaxton@hawaii.edu  
 Moore, F. R., University of Southern Mississippi, USA, frank.moore@usm.edu  
 REINTERPRETING MIGRATORY BEHAVIOR: MIGRATORY STRATEGIES IN THE CONTEXT OF OTHER PERIODS OF THE ANNUAL CYCLE

Our understanding of the extent to which physiological, behavioral, and ecological demands during migration limits populations has been hindered by the lack of knowledge of a bird's point of departure as well as their ultimate

destination. Moreover, documenting the influence of carry-over effects from other phases of the annual cycle while migrants are en route is complicated by the diversity of both breeding and over-wintering populations utilizing a single stopover site. At any single stopover site, populations may vary widely in their timing and overall distance of migration, factors that strongly influence migration strategies (e.g. refueling rates and stopover duration). Recent advances in the use of intrinsic markers (e.g. stable isotopes, genetics) have enhanced our ability to discern at broad scales how breeding populations are spatially distributed throughout the annual cycle, providing critical information about the timing and overall distance of migration for different breeding populations. The accumulation of studies documenting migratory connectivity for a growing number of species allows us to explore not only the strength of migratory connectivity across a species migratory route both spatially and temporally, but also the consequences of the degree of migratory connectivity. For example, if migratory connectivity is strong during migration (e.g. breeding populations use distinct migration routes) refueling rates and stopover durations may be quite divergent between stopover sites due to differences in migration strategies between populations that vary in timing and overall migration distance, not intrinsic habitat quality differences between stopover sites. Without accounting for migratory connectivity during migration we undermine our ability to interpret how factors critical for the success of migration potentially differ between stopover sites, throughout the migration season, and even between species. (ID 16380)

**Peak, R. G.**, U. S. Army Garrison-Fort Hood, USA, rpeak1969@gmail.com  
Thompson III, F. R., USDA Forest Service Northern Research Station, USA, frthompson@fs.fed.us

#### SEASONAL PRODUCTIVITY AND NEST SURVIVAL OF GOLDEN-CHEEKED WARBLERS VARY WITH FOREST TYPE AND EDGE DENSITY

The Golden-cheeked Warbler is a federally endangered Neotropical migratory songbird and knowledge of its habitat requirements is needed for recovery. We determined its breeding phenology and demography and determined relationships between habitat and temporal variables with nest survival and seasonal productivity in Fort Hood, Texas. Males arrived on the breeding grounds in early March, females laid the first egg of the first clutch in early April, made up to five nesting attempts, and completed nesting by mid-June. We monitored 834 nests from 2003-2013 and the most-supported nest survival model included cubic effect of day of year, proportion of juniper and juniper-oak woodland within a 100-m radius of each nest, and the interactive effect of year and woodland edge density within a 100-m radius. We monitored every nesting attempt in 423 territories from 2006-2013 and used a generalized linear mixed model to estimate seasonal productivity. The most supported seasonal productivity model included proportion of juniper woodland, proportion of juniper-oak woodland, and the interactive effect of year and woodland edge density. Seasonal productivity increased from 1.38 to 3.96 fledglings per territory and from 1.38 to 2.40 fledglings per territory across the observed ranges of proportion of juniper and juniper-oak woodland, respectively. Seasonal productivity ranged from 1.86 fledglings per territory in 2010 to 3.12 fledglings per territory in 2004. We believe it is important to conserve landscapes with a high proportion of juniper and juniper-oak woodland and a low amount of woodland edge density to conserve the Golden-cheeked Warbler. (ID 16150)

**Peele, A. M.**, Tulane University, USA, ashpeele25@gmail.com

#### A FLOATER INVASION: THE OCCURRENCE AND IMPACT OF NON-TERRITORIAL INDIVIDUALS ON WINTERING POPULATIONS OF A MIGRATORY PASSERINE

Many migratory species are classified as territorial in the non-breeding season, distributing across a landscape according to habitat quality. This is well established in species like the American redstart, however evidence

from the Caribbean has shown some individuals using a non-territorial strategy, roaming a habitat or region in search of food, never settling into a territory. The occurrence and abundance of these non-territorial redstarts is poorly documented, and their potential impact on overwintering territorial populations could be substantial. I tested the hypothesis that territorial redstarts experience increased food limitation and decreased survival in habitats with high abundances of non-territorial (NT) individuals. Focusing on three habitat types in Jamaica, I tested this using density-estimation and mark-recapture-resight methods, as well as arthropod sampling. Density-estimation efforts showed surprisingly high numbers of NT redstarts in two of the three habitat types, representing 30-50% of the banded population from 2009-2012. These two habitats, mangrove and scrub, had the highest overall population densities, as well as the lowest annual mean survival probabilities of territorial individuals, 0.40 and 0.33 respectively. Very few NT birds occurred in the third habitat, wet limestone forest, which had the highest mean survival probability, 0.55. Arthropod sampling data showed that habitats with the greatest abundances of NT redstarts also have the lowest availability of arthropod prey per individual redstart. This suggests a mechanism by which NT birds may directly limit territorial redstart populations occupying a given habitat and explain their decreased survival probability. These data provide the first evidence that NT birds are abundant in some habitats and influence non-breeding Neotropical migrant population dynamics. (ID 16246)

**Peer, B. D.**, Western Illinois University, USA, BD-Peer@wiu.edu  
Arns, R. M., Western Illinois University, USA, RM-Arns@wiu.edu  
Holt, S. M., Western Illinois University, USA, SM-Holt@wiu.edu

#### COWBIRD PARASITISM AND BACTERIAL CONTAMINATION OF HOST EGGS

Brown-headed Cowbird (*Molothrus ater*) parasitism reduces host fitness because female cowbirds remove host eggs when they parasitize nests, and cowbird young hatch sooner and out-compete host nestlings. An additional potential cost is that female cowbirds and their eggs may introduce harmful bacterial into host nests during laying. Bacteria can penetrate eggs through their pores causing infection, thereby possibly decreasing host fitness. These bacteria could account for the high percentage of unhatched eggs in parasitized nests and could also affect host nestling growth rates. We examined whether cowbirds transfer harmful bacteria to the eggs of the Red-winged Blackbird (*Agelaius phoeniceus*). Bacterial samples were taken from cowbird and Red-winged Blackbird eggs. We discuss our findings and the cowbird's role as a vector for bacterial infection of host eggs. (ID 16259 | Poster 117)

**Peiman, K. S.**, UCLA Dept of EEB, USA, kpeiman@ucla.edu  
Grether, G. F., UCLA Dept of EEB, USA, ggrether@ucla.edu

#### INTERFERENCE AND EXPLOITATIVE COMPETITION BETWEEN A MIGRANT AND RESIDENT PASSERINE DURING THE NON-BREEDING SEASON\*

Competition occurs through defense of resources (interference) and/or acquisition of food (exploitation). The migrant White-eyed Vireo (*Vireo griseus*) and resident Thick-billed Vireo (*V. crassirostris*) only coexist during the non-breeding season. Their populations may be limited by environmental conditions during the winter and thus subject to strong selection. I used the evolutionary contrast of sympatry and allopatry to test for the effects of heterospecific presence, and the ecological contrasts of low- vs high-quality habitats and seasonal changes in rainfall to test for the effects of resource abundance on competition. I found that despite very high levels of aggression by *V. crassirostris* towards *V. griseus*, heterospecific territories overlapped. *V. griseus* spent less time close to *V. crassirostris* in sympatry than allopatry, indicating that they may be actively avoiding the aggressive *V. crassirostris*.



To investigate exploitative competition, I used stable isotopes from claw tips. Preliminary analyses indicate seasonal effects: both species fed higher on the food chain in the winter than the fall, yet individuals maintained their rank order differences in diet, implying specialization. This seasonal switch did not match changes in resource abundance. Since baseline prey isotopes varied due to location, season, and habitat, ongoing analyses are using mixing models to characterize prey contribution to vireo diet. This is the first study to simultaneously investigate evolutionary and ecological effects during the non-breeding season, and will result in the most comprehensive examination of the individual-level consequences of interspecific interactions to date. (ID 15796)

**Pejchar, L.**, Colorado State University, USA, liba.pejchar@colostate.edu  
Culliney, S., Lewis and Clark Law School, USA, sculliney@lclark.edu  
Kaushik, M., Wildlife Institute of India, India, monikakaushik05@gmail.com  
Crampton, L., Kauai Forest Bird Recovery Project, USA, cali@kauaiforestbirds.org

#### SEED DISPERSAL AND THE DECLINE OF HAWAII'S FRUIT-EATING BIRDS

The decline and loss of island birds can lead to cascading effects on communities, including the disruption of ecological processes such as seed dispersal. The Alala (*Corvus hawaiiensis*), the largest remaining native Hawaiian forest bird, was once common on the Island of Hawaii, but today exists solely in captivity. Similarly, the Puaiohi (*Myadestes palmeri*), the only extant frugivore on Kauai, is critically endangered and restricted to a narrow portion of its former range. Prior to their decline, the Alala and Puaiohi may have helped establish and maintain plant communities via seed dispersal. In the near absence of Alala and Puaiohi, the structure and composition of Hawaii's forests may be changing; some plants may be dispersal limited and Hawaii's forests may increasingly be dominated by small-seeded species dispersed by small-bodied exotic birds. We fed captive Alala a variety of native fruits, documented seed dispersal behavior, and measured germination success of seeds that passed through the gut of Alala relative to control groups. Alala ate and carried fourteen native fruits, and Alala ingestion was critical for the germination of several species. In a second ongoing study, we compare diet of Puaiohi and non-native birds and measure seed rain in the presence and absence of Puaiohi. Preliminary results demonstrate substantial differences in diet with important implications for seed dispersal dynamics. These studies demonstrate that rare native birds could play a vital role in maintaining diverse fruiting plants through enhanced seed dispersal and germination, thus adding urgency to efforts to restore these species to island ecosystems. (ID 16266)

**Peterson, A.**, Western State Colorado University, USA, apeterson@western.edu  
Niemi, G., NRRI, University of Minnesota Duluth, USA, gniemi@d.umn.edu  
Johnson, D., USGS, USA, douglas\_h\_johnson@usgs.gov

#### PATTERNS IN DIURNAL AIRSPACE USE BY MIGRATORY LANDBIRDS ALONG AN ECOLOGICAL BARRIER

Conditions during landbird migration periods affect populations and survival, yet a disproportionate number of studies and conservation and management efforts focus on terrestrial stoppage and staging areas. The aerial environment through which migrants move is also subjected to anthropogenic impacts with potential impacts on avian migratory movement and survival. During autumn migration, the northern coastline of Lake Superior acts as an ecological barrier for many landbirds migrating out of the boreal forests of Canada and Alaska. From 24 observation points, we assessed the diurnal movements of birds throughout autumn migration, 2008-2010, within a 10 km by 210 km coastal region along the northern coast of Lake Superior. Several raptor species showed patterns in airspace associated with topographic features such as proximity to the coastline and presence of ridgelines. Funneling

movement, commonly used to describe the concentration of raptors along a migratory diversion line that either prevents or enhances migration progress, occurred only for Bald and Golden Eagles. This suggests a "leaky" migration funnel for most migratory raptors. Passerines migrating during the late-season showed more spatial and temporal structure in airspace distribution than raptors, including funneling and an association with airspace near the coast. We conclude that a) the diurnal use of airspace by migratory landbirds is patterned in space and time, b) autumn count sites situated along ecological barriers substantially underestimate the number of raptors due to 'leakage' out of these concentration areas, and c) the magnitude and structure of diurnal passerine movements in airspace has been overlooked. The heavy and patterned use of airspace associated with anthropogenic development (e.g., buildings, towers, turbines) by migratory landbirds necessitates management and conservation attention. (ID 15978)

**Phillips, J. L.**, University of California, Davis, USA, jphillips@ucdavis.edu  
Kelley, J. P., University of British Columbia, Canada, jpkelley@ucdavis.edu  
Patricelli, G. L., University of California, Davis, USA, GPatricelli@ucdavis.edu  
SO WHAT IS GLOGER'S RULE? NO ONE DEFINITION IS SUPPORTED BY FIVE AVIAN SPECIES THAT FOLLOW IT\*

Ecogeographic rules have long been studied for their potential to reflect common selective pressures across wide geographic ranges and among diverse taxa. While Bergmann's and Allen's Rules have been extensively studied, Gloger's Rule has remained poorly understood. Originally, Gloger's Rule was defined as the pattern of organisms being darker in wet, warm, tropical habitats. More recently, more specific relationships have been proposed between climatic variables and coloration under the umbrella of Gloger's Rule, including precipitation, temperature, humidity, latitude, sun exposure, dew point, visibility and evapotranspiration. In this study, we examined how these geographic and climatic variables relate to spectral reflectance in five species described to follow Gloger's Rule: Hairy Woodpecker (*Picoides villosus*), Red-eyed Vireo (*Vireo olivaceus*), Gray Jay (*Perisoreus canadensis*), House Wren (*Troglodytes aedon*) and Song Sparrow (*Melospiza melodia*). For each species, we measured reflectance of 75-950 museum specimens and used climate records for the locations of collection. Preliminary results suggest that no single "definition" of Gloger's Rule is supported by all of the species. Instead, all variables explain plumage variation to different extents in the different species. While there is variation in the top model and effect sizes among the species, the direction of relationships is largely consistent, with birds being darker in areas of higher humidity, temperature, precipitation and lower visibility, latitude, sun exposure. We suggest Gloger's Rule should be reformulated to include all climatic variables, as this pattern is likely the result of climate as a whole. (ID 15974)

**Phillips, J. N.**, Tulane University, USA, jphill1@tulane.edu  
Luther, D., George Mason University, USA, dluther@gmu.edu  
Derryberry, E. P., Tulane University, USA, ederry1@tulane.edu

#### THE EFFECTS OF SONG URBANIZATION ON MALE-MALE INTERACTIONS: DO HIGH FREQUENCIES MATTER?\*

Urban conservation efforts require a better understanding of how anthropogenic development affects animal populations. Acoustic communication in animals may be especially susceptible to urban selection pressures because of anthropogenic noise. Alteration of the ambient noise environment can mask signal content, affecting the perception of acoustic mating signals. Despite extensive research on selection pressures on acoustic mating signals in urban environments, we still know relatively little about whether song adjustments to noise have functional consequences. Culturally transmitted communication behaviors, such as song in oscines, can respond quickly to new selective forces, making bird song a particularly tractable trait

to study organismal response to selection pressures in urban environments. Here we use the model species, Nuttall's white-crowned sparrow (*Zonotrichia leucophrys nuttalli*), to investigate how urbanization of songs affects signal salience in male-male competition. We conducted playback experiments using a balanced pairwise design with song minimum frequency upshifted by 500 Hz or downshifted by 500 Hz relative to focal males' songs. Experiments took place on territories representing a noise gradient in San Francisco and Point Reyes, California. Urban males respond more strongly to songs of their own minimum frequency ('standard') than to upshifted songs. Urban males did not respond differently to standard vs. downshifted songs. Rural birds on quiet territories also did not discriminate between standard and upshifted songs. Background noise levels collected during playbacks show that response to upshifted song increases as noise levels increase. These results suggest that higher frequency songs may elicit less aggressive responses from neighbors at certain noise levels, but at the noisiest sites small frequency shifts may increase the salience of song to neighbors. (ID 16278 | Poster 99)

**Pierce, A. K.**, University of Colorado Denver, USA, allison.pierce@ucdenver.edu  
Dinsmore, S. J., Iowa State University, USA, cootjr@iastate.edu  
Jorgensen, D., World Wildlife Fund, Northern Great Plains, Dennis.  
Jorgensen@wwf.us  
Wunder, M. B., University of Colorado Denver, USA, Michael.Wunder@ucdenver.edu

#### MOUNTAIN PLOVERS MIGRATE SHORT DISTANCES AND USE STOPOVER SITES

Mountain plovers winter from southern California, across northern Mexico into southern Texas; however, little is known about migratory paths between breeding and wintering grounds, including potential stopover sites. To study the migratory tracks and connectivity of plovers, we deployed 35 light-level archive tags on adult birds breeding in north central Montana over the course of three years (2010-2012). We recovered six tags, five of which contained data for estimating migratory tracks. Tracks of four individuals revealed migration to wintering grounds in east Texas, and the fifth individual migrated to a site in southern Arizona. None of the individuals migrated to California, where the majority of plovers range wide are thought to winter. Among all of the tracks analyzed, only two birds used a fall stopover site, one in east Colorado and the other in north Texas. Stopover periods ranged from approximately 1-2 months. Birds who did not use stopover sites traveled on relatively fixed paths between wintering and breeding grounds during both fall and spring travel periods. These findings help to elucidate the space-time dependency on specific locations and habitats used by this species of concern (ID 16351 | Poster 57)

**Pinney, T. A.**, Baylor University, USA, tracy\_pinney@baylor.edu  
Gutzwiller, K. J., Baylor University, USA, kevin\_gutzwiller@baylor.edu  
White, J. D., Baylor University, USA, joseph\_d\_white@baylor.edu

#### THE RELATIVE IMPORTANCE OF NICHE AND NEUTRAL PROCESSES IN GUILD-LEVEL BIRD COMMUNITY ASSEMBLY

The relative importance of niche and neutral processes in community assembly has received much attention. We hypothesized that niche processes were more important than were neutral processes in structuring assemblages of Texas birds, which we sampled using point counts at 270 sites. To account for niche processes, habitat variables were measured using remotely-sensed landcover data. We also included niche variables representing interspecific interactions (avian nest predator abundance and the abundance of a brood parasite). Spatial eigenvectors were used to account for dispersal-based neutral processes. We used multiple regression and variance partitioning to assess evidence for niche and neutral processes during 2008 for birds in grassland and woodland habitat guilds. For both guilds, habitat variables and nest predator abundance accounted for more of the variation in species

composition than did spatial variables, suggesting that niche processes were more important than were neutral processes in structuring these assemblages. However, spatial variables were also significant for both guilds, suggesting that neutral processes played a role in community assembly. Understanding the relative importance of niche and neutral processes can inform conservation decisions for guild-level assemblages. (ID 16352)

**Pletsch, S. M.**, homespun-webs.com, USA, spletschet@gmail.com  
Kelly, J. F., University of Oklahoma, USA, jkelly@ou.edu  
Fagin, T., University of Oklahoma, USA, tfagin@ou.edu  
Bridge, E. S., University of Oklahoma, USA, ebridge@ou.edu  
Chilson, P. B., University of Oklahoma, USA, chilson@ou.edu

#### BIOGEOGRAPHY AND PHENOLOGY OF A MIGRANT SONGBIRD IN NORTH AMERICA QUANTIFIED VIA WEATHER SURVEILLANCE RADAR

Ground based weather surveillance radars (WSRs) have unique potential for ecological monitoring because they directly detect the presence of airborne animals. We evaluated whether WSRs could be used to monitor the phenology and persistence of roosts of a common migrant bird in eastern North America, the Purple Martin (*Progne subis*). Purple Martins are unusual among migrant songbirds in their habit of forming large nocturnal roosts during the non-breeding season. These roosts are identifiable in WSR as birds leave roosts en masse near sunrise. Using continentally mosaicked radar reflectivity data from June through August of 2009 through 2013, we located 221 roosts that were active in this period. Of these roosts, 101 were used in at least 4 of 5 years. National Land Cover Database indicated that the dominant land cover surrounding roosts was herbaceous agricultural (within 1km and 5km radii of the roosts). However, for 44 roosts for which we knew the exact locations, the dominant land cover at the roost site was urban and developed. For one year (2011) we quantified start and end dates for each active roost. We found strong positive latitudinal trends in both day that roosts first became active and day roosts were last active. We document a negative trend in total length of the active season with latitude. These results demonstrate the potential value of using WSR data to monitor the phenology and dynamics of Purple Martin Roosts in eastern North America. No continentally distributed consumer population is currently monitored with remote sensing at this spatial scale. The 20 year archive of WSR data could be used to document the phenology and dynamics of martin roosts retrospectively back to the mid 1990s. (ID 16013)

**Plumb, R. T.**, Kansas State University, USA, rtplumb@ksu.edu  
Lautenbach, J., Kansas State University, USA  
Robinson, S. G., Kansas State University, USA  
Kraft, J., Kansas State University, USA  
Sullins, D., Kansas State University, USA  
Haukos, D. A., U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, USA, dhaukos@ksu.edu  
Pitman, J. C., Kansas Department of Wildlife, Parks, and Tourism, USA  
Dahlgren, D., Utah State University, Department of Wildland Resources, USA  
BREEDING SEASON HABITAT PATCH USE BY FEMALE LESSER PRAIRIE-CHICKENS IN KANSAS AND COLORADO

Fragmentation and habitat loss have been identified as the primary causes of consistent declines in lesser prairie-chicken (*Tympanuchus pallidicinctus*; LEPC) populations. Landscapes of the Southern Great Plains have been altered extensively due to conversion of native grasslands to row-crop agriculture; creating a heterogeneous landscape interspersed with a mosaic of habitat patches. Understanding the relationships among characteristics of habitat patches and use by lesser prairie-chickens is a necessary prerequisite to conservation planning and management. We used VHF and satellite GPS radio transmitters on female LEPCs in Kansas and eastern Colorado to identify the effects of different habitat patch types and patch sizes at multiple

spatial scales on use. Point data derived from locations of individual birds were used to quantify movement and space use of female LEPC. Habitat patches within their home-range were delineated using ArcGIS 10.0. Habitat composition and structure were characterized using the point-step method and visual obstruction readings (VOR). Resource Utilization Functions were used to relate habitat resources to a probabilistic measure of space use. Larger and more contiguous patches of habitat had a greater degree of use than smaller patches of the same type. Habitat patch use varied during the breeding season with selection of grassland habitats with greater VOR. With land-use changes continually affecting the composition and availability of habitat on the landscape, understanding the inter-relatedness between lesser prairie-chicken use and availability of habitat patches could improve the process of prioritizing conservation decisions and directing management actions for lesser prairie-chickens. (ID 16128)

**Plumb, R. T.**, Kansas State University, USA, [rtplumb@ksu.edu](mailto:rtplumb@ksu.edu)  
 Lautenbach, J., Kansas State University, USA  
 Robinson, S. G., Kansas State University, USA  
 Kraft, J., Kansas State University, USA  
 Sullins, D., Kansas State University, USA  
 Haukos, D. A., U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, USA, [dhaukos@ksu.edu](mailto:dhaukos@ksu.edu)  
 Pitman, J. C., Kansas Department of Wildlife, Parks, and Tourism, USA  
 Dahlgren, D., Utah State University, Department of Wildland Resources, USA  
**EFFECTS OF HABITAT PATCH USE ON BREEDING SEASON SURVIVORSHIP OF LESSER PRAIRIE-CHICKENS IN KANSAS AND COLORADO**

Habitat fragmentation and loss have been identified as the primary causes of precipitous declines in lesser prairie-chicken (*Tympanuchus pallidicinctus*) populations. Changes in land use patterns have created a mosaic landscape of interspersed habitat patches. Identifying species-habitat patch relationships and their effects on demographic parameters have become increasingly important dynamics that have not yet been adequately addressed. The goal of this study was to assess the influence of habitat patch use on breeding season survival rates of female lesser prairie-chickens. Habitat use was measured using data from VHF and satellite GPS radio-marked females captured during the lekking season of 2013 and 2014. Beta estimates were derived using Resource Utilization Functions relating use to habitat variables. Survival rates of marked individuals were derived using known-fate modeling in program MARK. RUF estimates indicating use and other aspects of habitat patches were used as individual covariates to determine their influence on survival within individual periods and across the breeding season. Preliminary estimates indicate that survival varies temporally with nesting (May-June) having the lowest (0.57 + 0.93) estimate. Birds that used patches with taller vegetation more frequently appeared to have greater survival than those birds that utilized patches with reduced vegetation cover. Use of larger patches has a positive influence on survival. Fragmentation of landscape results in a different pattern of habitat use compared to unfragmented landscapes, which influences survival during the breeding season. Understanding the effects of habitat patch use on survival and other aspects of population demography could improve the process of prioritizing conservation decisions and directing management actions for lesser prairie-chickens. (ID 16129)

**Pollock, H. S.**, University of Illinois at Urbana-Champaign, USA, [hpollock@illinois.edu](mailto:hpollock@illinois.edu)  
 Cheviron, Z. A., University of Illinois at Urbana-Champaign, USA, [cheviron@illinois.edu](mailto:cheviron@illinois.edu)  
 Brawn, J. D., University of Illinois at Urbana-Champaign, USA, [jbrawn@illinois.edu](mailto:jbrawn@illinois.edu)

**TESTING JANZEN'S HYPOTHESIS: VARIATION IN AVIAN THERMAL TOLERANCES ACROSS LATITUDE**

Understanding the influence of abiotic environments on physiological traits has been a long-standing goal in evolutionary physiology. Janzen's hypothesis predicts that organisms from relatively seasonal environments (e.g. temperate latitudes) will evolve comparatively broad thermal tolerances to cope with greater environmental variation. In contrast, organisms from less seasonal environments (e.g. tropical latitudes) are expected to have narrower thermal tolerances, which may make less tolerant of environmental variation. Understanding how thermal tolerances vary across latitude is crucial in predicting whether tropical organisms have narrower tolerances and thus, greater susceptibility to climate change than their temperate-zone counterparts. We used the breadth of the thermoneutral zone (TNZ) to assay thermal tolerances in suites of tropical and temperate-zone resident bird species using flow-through respirometry. Temperate-zone species had significantly broader thermal tolerances than their tropical counterparts. The mechanism for variation in thermal tolerance breadth was driven by variation at the lower end of the TNZ (Lower Critical Temperature: LCT), which was significantly lower in temperate-zone species. The upper end of the TNZ (Upper Critical Temperature: UCT) was not significantly different between tropical and temperate-zone species. Both UCT and LCT values were independent of body size and were consistent among individuals of the same species. Thermal tolerance (i.e. TNZ breadth) thus varies predictably with latitude and appears to be driven by exposure to cold temperatures. Our data confirm Janzen's hypothesis and suggest that environmental variation (i.e. past selective regimes and/or current environmental conditions) influences avian thermal tolerances. (ID 15988)

**Pope, T. L.**, Utah Division of Wildlife Resources, USA, [tpope@utah.gov](mailto:tpope@utah.gov)  
**20-YEAR TRENDS FOR RIPARIAN BIRDS IN UTAH**

Riparian systems make up < 1% of land area in Utah, but riparian systems are arguably the habitat in greatest conservation need. Over 70% of Utah's birds use riparian habitat, yet little was known about population status and trends of these species when Utah DWR initiated a 20-year riparian monitoring project. To get baseline data and evaluate trends, Utah DWR conducted point counts at 37 riparian sites across Utah from 1992 to 2011. I estimated statewide density of 38 species for each year of the study using the Conventional Distance Sampling and Multiple Covariate Distance Sampling (MCDS) engines in DISTANCE. We estimated trends using a Bayesian framework that provides estimated probability of a 25% change in density over 25 years. The variable affecting detection that appeared most often in the best-supported MCDS models was 'Year.' Yellow warbler (*Setophaga petechia*) had the greatest density with 4.5/ha (95% CI: 4.3 - 4.6), followed by Spotted Towhee (*Pipilo maculatus*) with 1.6/ha (95% CI: 1.6 - 1.7) and Warbling Vireo (*Vireo gilvus*) with 1.6/ha (95% CI: 1.6 - 1.7). Although there were annual fluctuations in density, Bayesian trend analyses indicated only 4 species had strong ( $0.7 < P < 0.9$ ) or very strong ( $P \geq 0.9$ ) evidence of a 25% decline over 25 years; whereas 9 species had evidence of an increasing trend. Species with declining trends were Black-billed Magpie (*Pica hudsonia*), American Goldfinch (*Spinus tristis*), American Robin (*Turdus migratorius*), and House Wren (*Troglodytes aedon*). These trends were consistent with Breeding Bird Survey trends for Utah during the same time period. It is encouraging that riparian bird populations in Utah are not declining at alarming rates, as was expected. Nonetheless, protecting and restoring riparian systems remains important for keeping population trends steady in the face of drought, fire, exotic species, and human activity, all of which may be exacerbated by climate change. (ID 15911)

**Porzig, E. L.**, HT Harvey & Associates, USA, [elizabeth.porzig@gmail.com](mailto:elizabeth.porzig@gmail.com)  
 Seavy, N. E., Point Blue Conservation Science, USA, [nseavy@pointblue.org](mailto:nseavy@pointblue.org)  
 Eadie, J. M., University of California Davis, USA, [jmeadie@ucdavis.edu](mailto:jmeadie@ucdavis.edu)  
 Humple, D. L., Point Blue Conservation Science, USA, [dhumble@pointblue.org](mailto:dhumble@pointblue.org)  
 Geupel, G. R., Point Blue Conservation Science, USA, [ggeupel@pointblue.org](mailto:ggeupel@pointblue.org)  
 Gardali, T., Point Blue Conservation Science, USA, [tgardali@pointblue.org](mailto:tgardali@pointblue.org)



# INTERSPECIFIC INTERACTIONS, POPULATION VARIATION, AND ENVIRONMENTAL FORCING IN THE CONTEXT OF THE COMMUNITY

While population dynamics are often modeled on a species by species basis, changes are typically nested within the context of a community, yet the degree to which multispecies interactions influence long-term population dynamics is unresolved. Furthermore, because competition can affect a species' ability to track its niche across space and time, quantifying the contribution of interspecific interactions is an important step to improving model projections and consequently conservation. Here, we evaluate the contribution of interspecific interactions, intraspecific processes, and environmental forcing to variation in species' abundance in a habitat undergoing rapid successional change. Using data collected at the Palomarin Field Station operated by Point Blue Conservation Science, we applied a Bayesian hierarchical approach to a 29-year time series of territory density of seven landbird species. We found that interspecific interactions were the least important driver in our system, explaining between 0 and 5% of variation. Environmental forcing, both explained and unexplained, was the most important driver of species dynamics in our system, with 6 to 30% of variation attributed to explained environmental forcing and 27 to 90% attributed to unexplained environmental variation. Intraspecific processes explained between 0 and 39% of variation. Our results demonstrate that environmental variation (including vegetation change) is the primary driver of population change in this study, and interspecific interactions among landbirds are relatively unimportant in the system studied. These results suggest that in some cases it may be valid to project individual populations to predict community responses to future conditions; however, this conclusion should be interpreted with caution because interspecific interactions in our community did not include novel interactions that could result from distributional shifts in species ranges. (ID 15853)

**Pourtless, J. A.**, Florida State University, USA, [jpourtless@bio.fsu.edu](mailto:jpourtless@bio.fsu.edu)  
James, F. C., Florida State University, USA, [james@bio.fsu.edu](mailto:james@bio.fsu.edu)

# CONFLICTING INTERPRETATIONS OF THE "THERMOPOLIS" *ARCHAEOPTERYX* AND THE COMPLEX PROBLEM OF BIRD ORIGINS

The recently described tenth "Thermopolis" specimen of *Archaeopteryx lithographica* has reinvigorated debates about the morphology and paleobiology of this taxon, long considered to be the oldest and most primitive bird. Gerald Mayr and his coauthors as well as Oliver Rauhut have argued that the specimen provides additional support for the theropod affinities of *Archaeopteryx* and further demonstrates that it was primarily a terrestrial cursor. Our examination of the specimen, focusing on several character suites across the skeleton, fails to support that view and instead affirms that *Archaeopteryx* was an arboreal, flying bird. *Archaeopteryx* and maniraptorans do share many similarities, but all currently proposed models for the origin and early evolution of birds are compatible with that fact and at least some maniraptorans may be members of avian lineages that were more derived toward modern birds than *Archaeopteryx*, albeit at various stages of flight and flight loss. Although *Archaeopteryx* remains important to understanding the origin and early evolution of birds, the many recent fossil discoveries have been revealing a more complex picture of this important evolutionary transition than most workers have previously envisioned. Given the persistent concerns about the strength of the hypothesis that birds are derived from theropod dinosaurs, we believe that a more critical examination of competing models and a willingness to be open to novel hypotheses is required. (ID 16019)

**Powell, L. L.**, Smithsonian Migratory Bird Center, USA, [Luke.L.Powell@gmail.com](mailto:Luke.L.Powell@gmail.com)  
AN INTRODUCTION TO THE RUSTY BLACKBIRD SYMPOSIUM:  
BUILDING ON THE FOUNDATION BUILT BY RUSS GREENBERG.  
In 1999, Russ Greenberg and Sam Droege published their landmark paper

quantifying a steep decline in Rusty Blackbird populations (85-95% since the 1960s), and qualitatively showing that this wetland species has been in decline since at least 1900. Russ formed the International Rusty Blackbird Technical Group in 2005, an organization dedicated to cross-seasonal and comprehensive research programs aimed at understanding the causes and ecological significance of the Rusty Blackbirds' decline. A flurry of research followed, including many publications, four conferences, two symposia, seven theses/dissertations, and field research in 12 states and provinces. Although we have made great progress in understanding the species' biology, we have found no "silver bullet" that fits the timing and severity of declines. Further, nest success studies across the boreal, and body condition research in the southeast show no red flags. One potential next step is working towards a full life cycle population model: a cross-seasonal approach designed to determine the life cycle phase limiting populations. A major challenge to building this model is that individuals often show little inter-annual site fidelity. A meaningful full life cycle model must account for low inter-annual site fidelity by incorporating the probability of emigration, thus avoiding low-biased estimates of survival. By pooling cross-seasonal research and using new transmitter technology to tease apart emigration vs. mortality, we could build full cycle population model that can not only help us determine what is limiting Rusty Blackbird populations, but can have a broad applicability to other migratory systems. (ID 16162)

**Powell, L. L.**, Smithsonian Migratory Bird Center, USA, [Luke.L.Powell@gmail.com](mailto:Luke.L.Powell@gmail.com)

Cooper, N. W., Smithsonian Migratory Bird Center, USA, [nathanwands@gmail.com](mailto:nathanwands@gmail.com)

Marra, P. P., Smithsonian Migratory Bird Center, USA, [marrap@si.edu](mailto:marrap@si.edu)

# COMPETITION EXPERIMENTS BETWEEN WINTERING AMERICAN REDSTARTS AND RESIDENT YELLOW WARBLERS IN JAMAICAN MANGROVE FOREST

In the Caribbean, the winter influx of billions of migrant birds coincides with food shortages that not only limit populations of wintering songbirds, but probably those of ecologically similar year-round residents as well. We sought to experimentally demonstrate interspecific competition for food between a resident (Yellow Warbler; *Setophaga petechia*; hereafter "yellows") and a wintering migrant (American Redstart; *Setophaga ruticilla*). We ran two experiments in Jamaican mangroves: 1) a removal experiment in which we 3D-mapped yellow territories ( $n = 14$ ) and overlapping redstart territories ( $n = 24$ ) before and after removal of yellows, and 2) a natural experiment in which we compared redstart presence with and without territorial yellow pairs ( $n = 10$ ). In the removal experiment, we found little evidence that redstarts expanded their 3D territories (i.e. spatial niches) into those of removed yellows; however, due to the large floater population, yellow territories could only be kept vacant for 24-hrs, so redstarts may not have had enough time to respond. In the natural experiment, redstarts were 2.3 times more likely to be detected with yellows absent than with yellows present, indicating that yellows exclude redstarts from space, but that the space they are excluded from varies spatiotemporally based on the yellow's location. This resource exclusion likely has population-level consequences over an ~7 month winter; thus we predict redstarts wintering without yellows will show: 1) increased density, 2) improved body condition and 3) earlier departure date. By understanding interspecific competition, we quantify challenges to migrants throughout the annual cycle. (ID 16184 | Poster 63)

**Power, H. W.**, Bluebird Hill Ranch, USA, [harrypower@mac.com](mailto:harrypower@mac.com)

# PARENTAL ALLOCATION AND NESTLING SEX RATIOS IN MOUNTAIN BLUEBIRDS

1115 nestlings in 239 broods were sexed over 13 years. 666 were measured for mass, tarsus and wing length. The sex ratio (SR) for all chicks was 45:55,

the average brood SR for all years was 0.447, and the average brood SR for 11 of 13 years was <0.5, implying a female bias in SR. Males had greater mass, and longer tarsi and wings. Scott Johnson (pers.comm.) has shown that chicks with longer wings fledge first and that the order of fledging reflects the competitiveness of chicks. In combination with my data, this suggests males fledge earlier and are more competitive. O'Brien and Dawson (2012) have shown that female chicks are more susceptible to blow fly parasitism, implying parasitized females need more food to achieve a specified goal of development. Given that parents are favored for equal allocation in each sex, parents must either (a) adjust the brood SR, or (b) vary their behavior to attempt equal allocation. They appear to do both but with imperfect results. Brood SR's can't be finely adjusted to compensate for small differences in competitive ability. Parents can provide extra feedings to sate more competitive chicks, allowing less competitive chicks to get sufficient food, but more competitive chicks will get proportionately more. It may be impossible to simultaneously meet the twin goals of giving all chicks their necessary minimum, and allocating equally between male and female chicks. (ID 16207)

**Preston, P. J.**, University of Regina, Canada, ppreston00@gmail.com  
Brigham, R. M., University of Regina, Canada, mark.brigham@uregina.ca

#### THE INFLUENCE OF PREY AVAILABILITY ON THE THERMOREGULATORY BEHAVIOUR OF THE COMMON POORWILL (*PHALAEOPTILUS NUTTALLII*)

Torpor is an energy saving mechanism used by many birds and mammals during times of resource shortages or inclement weather conditions. Common Poorwills (*Phalaeoptilus nuttallii*) have been found to use torpor extensively during their non-breeding season. In this study I will investigate how torpor use is influenced by prey abundance and availability. To experimentally increase potential prey availability and therefore energy intake, I will attract phototactic insect prey by erecting lights in foraging areas and visually monitor foraging behaviour. In addition, I will equip birds with temperature sensitive radio transmitters and remotely monitor skin temperature to assess torpor use. The goal of this project is to not only determine what effects these manipulations have on the thermoregulatory behavior of the birds but also how changes in torpor use influence other behaviors such as foraging and reproduction. With this knowledge we can begin to understand exactly why torpor is used and more importantly, at what threshold torpor is necessary. (ID 15726)

**Prevost, S. C.**, University of Tennessee, Knoxville, USA, sprevo@utk.edu  
Buehler, D. A., University of Tennessee, Knoxville, USA, dbuehler@utk.edu  
Hockman, E. V., University of Tennessee, Knoxville, USA, ehockman@utk.edu  
Fischer, R. A., US Army Engineer Research and Development Center, Environmental Laboratory, USA, richard.a.fischer@erdc.dren.mil  
Wilkerson, J. B., University of Tennessee, Knoxville, USA, wilkerj@utk.edu  
Smith, D. R., University of Tennessee, Knoxville, USA, dsmith23@utk.edu

#### USE OF AUTOMATED RECORDING DEVICES FOR MONITORING SONGBIRDS: CAN SONG RATES BE USED AS A MEASURE OF RELATIVE ABUNDANCE?

The use of automated audio recording technology for documenting avian song behavior and monitoring populations has increased greatly as recording devices have become highly portable and affordable. This technology affords many benefits, such as extensive documentation of song behavior, elimination of observer bias, and data collection efficiency. Automated recorders have been used for validation of observer-based monitoring techniques (e.g., point counts) or to estimate species occupancy and species richness. More advanced uses of recording technology have attempted to use microphone arrays to spatially correlate vocalizations and derive abundance estimates. We used automated recording devices to document breeding season song behavior for five focal species: Prairie Warbler (*Setophaga*

*discolor*), Bachman's Sparrow (*Peucaea aestivalis*), Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow (*Ammodramus saviannarum*), and Henslow's Sparrow (*Ammodramus henslowii*). We documented variability in species song rates based on various temporal and environmental parameters. Finally, we evaluated the ability to estimate relative abundance from song-rate data based on our audio recordings. We employed automated recording units, observer-based song counts, and territory mapping to measure and validate singing rates and to estimate relative abundance. For our focal species, we found strong linear or curvilinear relationships between the number of songs recorded per hour during peak song rates and the number of individual males occupying territories within the auditory range of the microphones. In some cases, the song rates of individuals of a given species varied with changes in the number of conspecifics nearby. In addition to providing new information on avian vocal behavior, our approach has potential application in the growing field of avian acoustic monitoring. (ID 16318)

**Prince, K.**, University of Wisconsin-Madison, USA, karine.prince@gmail.com  
Chipault, J., USGS National Wildlife Health Center, USA, jchipault@usgs.gov  
White, L., USGS National Wildlife Health Center, USA, clwhite@usgs.gov  
Zuckerberg, B., University of Wisconsin-Madison, USA, bzuckerberg@wisc.edu

#### USING CITIZEN SCIENCE TO EXPLORE SPATIOTEMPORAL PATTERNS OF AVIAN BOTULISM MORTALITY EVENTS IN LAKE MICHIGAN

Since the 1960s, periodic outbreaks of type E botulism have resulted in die-offs of fish-eating birds in the Great Lakes. But in recent years, outbreaks have become more common and widespread. This recent resurgence of outbreaks increases the concern for wildlife health issue and waterfowl conservation. While botulism outbreaks demonstrate a high degree of inter-annual variability that correlate with specific environmental conditions (e.g., water level, surface water temperature), less is known regarding within-season variation of mortality events. Using data generated from a 4-year citizen science initiative, the Avian Monitoring for Botulism Lakeshore Events (AMBLE) program, our objectives were to 1) quantify the spatial and temporal autocorrelation in mortality events within the AMBLE sampling region across species and foraging guilds, and 2) explore the role of environmental drivers influencing the magnitude and periodicity of these synchronized mortality events. After accounting for variation in sampling effort, we found significant intra-seasonal spatial synchrony in the detection of bird carcasses. We found a high local autocorrelation ( $\rho(0)$ ) in pulses of mortality events for all species (2010:  $\rho(0) = 0.41$ , CI95% = [0.17, 0.62]). The spatial extent of local autocorrelation in abundance of carcasses is approximately 40 km. We found significant positive interspecific synchrony of within-year fluctuations for several species, such as Common Loon, Long-tailed Duck, and White-winged Scoter. We also found evidence of positive temporal synchrony between shorebirds and diving birds. We conclude that quantifying spatiotemporal characteristics of mortality events is critical for identifying the potential environmental mechanisms of botulism transmission and achieving better conservation targets. (ID 16323)

**Pringle, H. E.**, Imperial College, London, United Kingdom, henrietta.pringle09@imperial.ac.uk  
Leather, S. R., Harper Adams University, United Kingdom, simonleather@harper-adams.ac.uk  
Crawley, M. J., Imperial College, London, United Kingdom, m.crawley@imperial.ac.uk  
Sage, R. B., Game and Wildlife Conservation Trust, United Kingdom, rsage@gwct.org.uk

#### THE BREEDING ECOLOGY OF LAPWINGS IN ENERGY CROPS

Reaching the EU target for renewable energy is likely to encourage a rapid expansion of energy-crop production in the UK. These crops differ significantly from arable crops in terms of their management and structure,

and thus will bring about changes to the farming landscape. Given their vulnerability to changing land-use, this expansion could pose a considerable threat to ground-nesting birds. I therefore considered the suitability of *Miscanthus* energy-crops as a nesting habitat for lapwings, a priority conservation species in the UK. Although there was no evidence of lapwings avoiding nesting in *Miscanthus* fields, clutches laid in this crop experienced lower hatch success than those laid in arable crops. This result was mainly influenced by increased losses in 2012, a particularly wet breeding season. This suggests in years of already unfavourable breeding conditions, nests in *Miscanthus* may be more vulnerable than those in traditional crops. Higher predation rates facilitated by the change in crop structure are discussed as a likely cause of reduced hatch success in *Miscanthus*. Long-term monitoring is required to account for inter-year variation and to determine the risk posed by energy-crop expansion to ground-nesters, but this is the first evidence of reduced breeding success in these crops. (ID 16384)

Pruett, H. L., Texas A&M University, USA, hannah.pruett@gmail.com  
Mathewson, H. A., Institute of Renewable Natural Resources, Texas A&M University, USA, hamathewson@ag.tamu.edu  
Morrison, M. L., Texas A&M University, USA, mlmorrison@tamu.edu  
**Davis, K. P.**, Texas A&M University, USA, kristin.p.davis@gmail.com  
Newnam, C., Texas Department of Transportation, Cal.Newnam@txdot.gov  
STUDY OF THE POTENTIAL IMPACTS OF HIGHWAY CONSTRUCTION ON SELECTED BIRDS WITH EMPHASIS ON THE GOLDEN-CHEEKED WARBLER

Roadways fragment landscapes and generate noise, which can negatively affect songbirds by changing vegetation, altering predator-prey assemblages, influencing species movement and obstructing avian vocalizations. Increased activity and noise due to roadway construction can intensify these pressures. As such, understanding the impact of roadway construction on songbirds is essential for mitigating negative impacts on sensitive populations. From 2008-2014, we conducted an impact assessment on part of Highway 71 located near Austin, Texas to study the potential effects of construction noise and activity on the reproductive success of the federally endangered Golden-cheeked Warbler (*Setophaga chrysoparia*; hereafter warbler). Our objectives were to quantify warbler productivity and behavioral responses to construction activity and noise, which included response to experimental playback of construction noise and territorial male vocalizations. Data analyzed through 2013 indicate construction activity does not significantly impact warbler productivity. We found no main effect or interaction of year and study site type on pairing, nesting or fledging success. Experimental playback of construction noise also did not impact warbler behavior. We found multiple significant interactions and main effects of site and year on male warbler vocalizations, however the direction of these effects did not fit trends indicative of impact found by other researchers. Data collected during the 2014 breeding season will be used to examine our objectives during the post-construction period. There is currently little evidence to suggest a negative effect of construction noise and activity on the warbler and we anticipate similar results in our post-construction phase of monitoring. Results from our research will be used to inform management decisions on our study site and to design future impact assessments for birds along roadways. (ID 16185)

**Pruett, M. S.**, Archbold Biological Station, USA, spruett@archbold-station.org  
Bowman, R., Archbold Biological Station, USA, rbowman@archbold-station.org  
Fitzpatrick, J. W., Cornell University Lab of Ornithology, USA, jwf7@cornell.edu  
Dent, M., Archbold Biological Station, USA, mdent@archbold-station.org  
POPULATION-SPECIFIC PATTERNS OF PARTIAL BROOD LOSS  
HIGHLIGHT DIFFERENCES IN ENVIRONMENTAL CONSTRAINTS ON PRODUCTIVITY

Population growth may be influenced by both bottom-up (resource limitation) and top-down (predation) processes. Assessing the relative importance of each across various landscapes may illuminate key differences underlying population persistence. Habitat fragmentation and suburbanization may influence productivity by altering resource availability and the overall community composition (e.g. competitors, predators) and interspecific interactions. The Florida Scrub-Jay (*Aphelocoma coerulescens*) is a habitat specialist of Florida oak scrub communities. Productivity varies across years and geographically. Here, we compare patterns of whole and partial nest losses over 17 years in three landscapes (suburban, wild fragmented, and wild contiguous) to determine whether the influence of top-down and bottom-up constraints on fledgling production is similar. Suburban nests experience greater complete nest failure during the nestling stage due to intense predation, but also incur greater partial losses from otherwise successful nests than either wild population. Productivity in the two wild populations is similar, but the contiguous population experiences greater early-season nest failure, while the fragmented population has greater late-season nest failure and suffers higher intensity partial losses. Initial results suggest partial losses largely result from different processes in wild and suburban contexts. Thus, the three populations operate under very different landscape-induced constraints. Our data highlights the importance of understanding local constraints on productivity when the goal is predicting population growth or persistence. (ID 16000)

Quick, D. E., Oregon State University, USA, quickd@science.oregonstate.edu  
**Ruben, J. A.**, Oregon State University, USA, rubenj@science.oregonstate.edu

#### THE DISTINCTLY UN-BIRDLIKE LUNGS OF THEROPOD DINOSAURS<sup>†</sup>

Recent analyses suggest that some supposed theropod dinosaurs may actually have been secondarily flightless birds, and the so-called feathers of many other theropods are likely to have been seriously misinterpreted. Here, we discuss the evidence for the structure and function of the supposedly bird-like lung of theropod dinosaurs. Based on firsthand review of superb, but often unpublicized fossil specimens, as well as new physiological data, we demonstrate that theropod ribcage and visceral anatomy was distinctly different from that of birds and almost certainly could not have been consistent with the presence of an avian-style, flow-through lung. Although a unidirectional lung may be ancestral in archosaurs and present in theropods, we conclude that the theropod lung was most likely ventilated, in part, by a hepatic piston-style diaphragm. Accordingly, lung structure in theropod dinosaurs should not be cited as evidence in support of a seamless ancestor-descendant relationship between theropods and birds. (ID 16110)

**Ralph, C. J.**, Humboldt University, USA, cjralph@humboldt1.com  
INTRODUCTION TO SYMPOSIUM S19

The basic understanding of a species' full life cycle depends upon understanding of much more than just trends of abundance. It requires knowledge of the factors contributing to the success or failure of individuals and populations, through the many demographic and related measures of a population. Capture and banding of birds historically have largely been used to determine the location of birds during all seasons, based on band recoveries, resightings, transmitters, and geolocators. In contrast, value-added metrics, such as physical measurements and physiological estimates, as well as the calculation of demographic information, have become common and add a great deal of value to abundance information. Value-added metrics and give an idea of why the species is at a site and these metrics help us understand the species' age and sex composition, breeding and migratory status, molt strategies, complexities of body condition, and the trends over time of all metrics. These papers will focus mostly on landbird examples and demonstrate how these data, with a variety of spatial (e.g. networks),



or temporal (e.g., long-term) stations, inform science and conservation. Investigation of these data allows us to form hypotheses that begin to explain the causes of population abundance and trends, as well as behavior and seasonal movements. The intent is to publish these papers as a separate monograph elucidating the value of this approach and the efficient ways of getting these critical data. (ID 16401)

Ramsdell, C. P., Virginia Polytechnic Institute and State University, USA, paxton.ramsdell@gmail.com

**Dwyer, A. M.**, Rocky Mountain Bird Observatory, USA, angela.dwyer@rmbo.org  
Snyder, L. H., Rocky Mountain Bird Observatory, USA, larry.snyder@rmbo.org  
Sorce, M. G., Virginia Polytechnic Institute and State University, USA, msorce@vt.edu

#### WHAT MOTIVATES PRIVATE LANDOWNERS TO PARTICIPATE IN A CONSERVATION PROGRAM TO PROTECT MOUNTAIN PLOVER NESTS?

Self-Determination Theory (SDT) posits that individuals are driven by intrinsic and extrinsic motivation. Intrinsic motivation is aligned with an individual's values, whereas extrinsic motivation is aligned with attaining a separable outcome. Financial incentives can change behavior to achieve goals such as wildlife conservation. SDT states that individuals require autonomy, competence, and relatedness. I collaborated with the Rocky Mountain Bird Observatory (RMBO) and designed a survey for all (n=77) landowners in an incentive program focused on protecting the Mountain Plover (*Charadrius montanus*). A shortgrass obligate species, considered for listing under the U.S. Endangered Species Act, nests in cultivated crop fields with a risk of nest mortality from farm machinery. RMBO has compensated farmers (\$100–\$200) per nest protected since 2006 and was interested in understanding landowner motivations for continued participation. Information regarding landowner perceptions, motivations, and willingness to continue without an incentive was included in the survey. Forty-one respondents completed the survey. Overall, respondents indicated the program allowed for a high degree of autonomy, a moderate degree of competence and organizational relatedness, and a low degree of inter-personal relatedness. The majority (65%) indicated a low level of effort to protect the plover, while 71% indicated they would continue to protect the plover without an incentive. Results of this study support previous findings that under certain circumstances financial incentives increase willingness to complete a behavior. (ID 16032)

**Randall, C. A.**, Sam Houston State University, USA, car055@shsu.edu  
Neudorf, D., Sam Houston State, USA, bio\_dln@shsu.edu

#### THE FUNCTION AND STRUCTURE OF SONG DELIVERED BY MALE CAROLINA WRENS (THRYOTHORUS LUDOVICIANUS) DURING NESTLING PROVISIONING IN URBAN AND RURAL HABITATS\*

Male Carolina Wrens often sing at the nest when feeding their nestlings. We tested the hypotheses that male song at the nest serves as a communication tool to both the female and also the nestlings. We quantified the incidence of male song during nestling provisioning by video recording and direct observation in both urban and rural environments. We observed female responses (latency) and recorded nestling begging responses to male song at the nest to test our hypotheses. Results from the first season showed that there is a significant effect between male song at the nest and nestling begging. No significant difference was found with female latency in regards to male song at the nest, however females tended to wait longer to return if the male sang. More data is being gathered this field season. Recordings of male song at the nest were collected during observational periods with a lapel microphone in the nest box. Male songs given during female incubation were also collected with a Marantz® recorder prior to the nestlings hatching for general song comparison. We used Raven Sound Analysis® software to compare the structure of these song recordings by measuring the duration of the song, the maximum and minimum frequency, the number of phrases

in the song, and the delivery rate. Background noise measurements were also taken in both habitats in an attempt to relate this to the structure of male song. We found that there is a significant difference in the low frequency and delivery rate of incubation songs between the habitats, which could be potential urbanization effects. We will discuss the possible functions of male song during provisioning, as well as variation in structure among male song in both an urban and rural habitat. (ID 15989)

**Randall, J. A.**, University of Northern British Columbia, Canada, randallj@unbc.ca

Dawson, R. D., University of Northern British Columbia, Canada, russ.dawson@unbc.ca

#### PRELIMINARY INVESTIGATIONS INTO THE CAUSES AND CONSEQUENCES OF VARIATION IN EGG COLOR OF MOUNTAIN BLUEBIRDS: AN EXPERIMENTAL APPROACH\*

The function of conspicuous egg color has been the subject of much recent interest. In particular, based on the possibility that the pigment used to color blue-green eggs is limited and potentially costly to allocate to eggshells, blue-green color has been proposed as a signal of female quality and investment, with potential to influence male provisioning behavior. Before investigating the signalling properties of egg color it is necessary to determine if patterns of color variation support the idea that pigment is limited, and the potential of egg color to be informative to males. Using mountain bluebirds (*Sialia currucoides*) as a model, we measured egg color with a spectrometer and investigated natural patterns of variation and the effect of food availability on color by providing supplemental food during nest building and egg laying. Within clutches, blue-green chroma generally declined after the first-laid egg. The least colorful eggs occurred midway through the laying sequence, with last-laid eggs showing a slight increase in blue-green chroma. Supplemented females laid eggs with higher blue-green chroma than control females, and although overall color did not depend on clutch initiation date, second clutches had lower blue-green chroma than first clutches within females. There were, however, no consistent relationships between egg color and egg mass or female condition. In addition, egg color did not predict the probability of nestling survival or nestling characteristics at fledging in control nests, but there was a negative correlation between blue-green chroma and both nestling mass and structural size for broods where the female was supplemented. These findings suggest that pigment may be limited and sensitive to food availability, but only some of the patterns of color variation followed predictions of color being a reflection of female quality and investment; further study is needed to determine if egg color is a truly informative signal. (ID 16040 | Poster 115)

**Raynor, E. J.**, Kansas State University, USA, ejraynor@ksu.edu

Cable, T. T., Kansas State University, USA, tcable@ksu.edu

Sandercok, B. K., Kansas State University, USA, bsanderc@ksu.edu

#### EFFECTS OF TAMARIX REMOVAL ON COMMUNITY DYNAMICS OF RIPARIAN BIRDS

Estimates of community vital rates and structure such as probability of local extinction, species richness and diversity are critical when evaluating ecological restoration efforts. In southwest Kansas, resource managers have initiated efforts to thwart the invasion of Tamarix (salt cedar) along the Cimarron River. We quantified the effects of Tamarix removal on riparian bird communities using robust design mark-recapture models to account for imperfect detection in estimation of community vital rates. We estimated community structure indices and other community vital rates for replicated sites with Tamarix-present (untreated), Tamarix-removal (treated), and reference sites with cottonwoods (reference). Estimates of species richness at untreated sites were marginally greater than sites where Tamarix was removed (18.22±0.5 species per site vs. 17.08±0.5), but species persistence,

species emigration, and species turnover were unaffected by Tamarix removal. The number of colonizing species at reference sites was greater than untreated ( $3.4 \pm 2.8$  species per plot vs.  $1.2 \pm 0.5$ ). We examined changes in abundance of birds in four nesting guilds and two migratory guilds, and concluded that reference sites supported the greatest bird abundance. Assessment of nesting guild and migratory guild abundance indicated canopy-nesters and breeding migrants were more abundant than any other nesting guild and permanent residents, respectively. Evenness of all bird species indicated treated and untreated sites had higher evenness than reference sites, while species diversity did not differ between habitat types. Observed species richness of canopy-nesters at untreated sites was greater than reference sites and treated sites. Our results suggest riparian sites where Tamarix is present provide nesting habitat for a wide variety of bird species in comparable abundances and diversity to remnant riparian sites. (ID 15867)

**Reddy, S.**, Loyola University Chicago, USA, sreddy6@luc.edu

# ONE STEP FORWARD, TWO STEPS BACK: TAXONOMIC CONFUSION IN TROPICAL ASIA<sup>T</sup>

Timaliidae (babblers) is the poster-child of bad taxonomy, with molecular studies discovering numerous inaccuracies resulting in dramatic rearrangements of taxa traditionally placed in this family. While there is overall consensus that the current taxonomy is inaccurate and polytypic species grossly underestimate Timaliid diversity, ornithologists differ in strategies in response to the urgent need to revise classification. This has profound impacts, especially in understudied regions like Asia. Taxonomists writing handbooks and field guides, in their race against molecular systematists to revise classifications, have developed morphological scoring systems emphasizing major over minor differences to decide which subspecies are distinct enough to be elevated to new species. I contend that these methods, while attempting to bring objectivity into species delimitation, are still arbitrary in several ways and suffer from the same pitfalls of assumptions that created the current taxonomic mess. Their revisions often result in some subspecies being elevated to species and other subspecies remaining as forms of nominate species, which is then rendered paraphyletic. I will use babblers to show that traditional subspecies and revisions based on morphological scoring create taxonomic, phylogenetic, and biogeographic confusion because they do not account for cryptic or low rates of morphological diversification. Systematic analysis using multiple types of characters and biogeographic information is the most evolutionarily appropriate method for delineating distinct species. In absence of DNA evidence, taxonomists should treat all morphological (major and minor) differences as equally relevant and distinguish geographically distinct subspecies as tentative species that can be further tested with genetic and other data when available. (ID 16195)

**Reichert, A.**, Andrews University, USA, ashleyareichert@gmail.com

Hayward, J. L., Andrews University, USA, hayward@andrews.edu

Henson, S. M., Andrews University, USA, henson@andrews.edu

# THE BEHAVIOR OF GLAUCOUS-WINGED GULL EGG CANNIBALS

We recently demonstrated that egg cannibalism in Glaucous-winged Gulls increases with sea surface temperature associated with El Niño events. Higher sea surface temperatures deepen ocean thermoclines and weaken upwellings, changes that lead to decreased productivity of surface waters and movement of surviving forage fish to deeper water. In response, surface feeders such as gulls become food-stressed and egg cannibalism becomes more advantageous. Although egg cannibalism in gulls is well known and accounts for a large proportion of egg failure, the behavior of cannibalistic gulls has been minimally described. Egg cannibal specialists accumulate large deposits of broken eggshell in their nesting territories making these territories easy to locate. Here we characterize the behavior and reproductive success of egg cannibal specialists, which account for less than 1% of colony residents. (ID 16075 | Poster 75)

**Reidy, J. L.**, University of Missouri, USA, jennifer.reidy@gmail.com

Thompson, F. R., U.S. Forest Service, USA, frthompson@fs.fed.us

O'Donnell, L., City of Austin, USA, Lisa.ODonnell@austintexas.gov

# HABITAT AND LANDSCAPE FACTORS AFFECTING DENSITY OF GOLDEN-CHEEKED WARBLERS ON THE BALCONES CANYONLANDS PRESERVE, TEXAS

The Balcones Canyonlands Preserve was created to mitigate effects of increasing habitat loss and fragmentation in western Travis County, Texas on endangered species, including the Golden-cheeked Warbler. Our objective was to develop models based on point- and landscape-level habitat measures to evaluate habitat relationships and predict bird densities across the Preserve. We completed point counts at 1122 points and detected 621 males from 2011-2013. We developed hierarchical density models with detection functions based on distance sampling that allowed us to consider covariate effects on density and simultaneously estimated detection probability and density. We found support for observer, day of year, and woodland type on detectability. Average predicted density was 0.14 (0.12-0.17). Predicted density increased with higher canopy cover, taller average oak height, and more large junipers at a point; greater canopy cover and canopy height in a 100-m radius around the point; and greater proportions of juniper woodland and mixed woodland in a 1-km radius around the point; and decreased with more small stems of live oaks and exotics. Our model-based estimates compared favorably ( $R^2 = 0.51$ ) to estimates from 18 plots on which color marked birds were intensively spot-mapped. The ability to predict densities at landscape scales will greatly facilitate conservation planning and efforts to assess species viability. (ID 16096 | Poster 61)

**Reudink, M. W.**, Thompson, Canada, mreudink@tru.ca

McKellar, A. E., Environment Canada, Canada

Marini, K. L., Thompson Rivers University, Canada

McArthur, S., Thompson Rivers University, Canada

Marra, P. P., Smithsonian Conservation Biology Institute, USA

Ratcliffe, L. M., Queen's University

# INTER-ANNUAL VARIATION IN AMERICAN REDSTART (SETOPHAGA RUTICILLA) PLUMAGE COLOUR IS ASSOCIATED WITH RAINFALL AND TEMPERATURE DURING MOULT: AN 11-YEAR STUDY

Carotenoid-based colouration plays an important role in sexual signaling in animals as an honest indicator of individual quality during mate choice and competitive interactions. However, few studies have examined how natural variation in weather conditions influences inter-annual variation in the expression of ornamentation. In birds, environmental variation in carotenoid availability during feather moult may affect an individuals' uptake of carotenoids with subsequent effects on feather colouration. In this study, we examine variation in the expression of carotenoid-based plumage colouration in relation to weather (temperature and rainfall) during the pre-mouling and moulting period over 11 years in a population of American redstarts, *Setophaga ruticilla*, breeding in eastern Canada. We used reflectance spectrometry of tail feathers collected from male and female redstarts to relate feather colour with weather conditions the previous breeding season during the months over which redstarts are likely to moult (June, July, August, and September). Individuals expressed feathers with higher red chroma and lower brightness in years following high July rainfall. The pattern was stronger in males, but was generally consistent across ages and sexes. We suggest that higher rainfall during the moulting period may increase insect abundance and the availability of dietary carotenoids. This is among the first studies to show population-level effects of weather conditions on a sexual signaling trait, which may have important consequences for sexual selection, mate choice, and the reliability of putative signals. (ID 15819)

**Rice, M. B.**, Colorado Parks and Wildlife, USA, mindy.rice@state.co.us  
 Rossi, L., Colorado Parks and Wildlife, USA, liza.rossi@state.co.us  
 Apa, A. D., Colorado Parks and Wildlife, USA, tony.apa@state.co.us

#### REFINING SEASONAL RESOURCE SELECTION MODELS FOR THE MANAGEMENT OF GREATER SAGE-GROUSE IN NORTH PARK, COLORADO

Rangewide declines of greater sage-grouse and recent energy development within sagebrush habitat has led to concern for conservation of greater sage-grouse (GRSG) populations across Colorado, including the North Park population, which supports approximately 20% of the state's GRSG. Seasonal variations to habitat use by GRSG can provide important information for biologists and these seasonal habitats have been mapped at the statewide level in Colorado, but at the time, there were no data available for the North Park population. Therefore, we used telemetry data collected from April 2010-February 2012 to map habitat specific to the North Park GRSG population. Close to 4,000 locations were used to map breeding, winter, and summer habitat using a generalized linear mixed model logistic regression in program R. Variables were chosen based on vegetation, topography, and oil/road development across North Park. Results indicated that sagebrush was higher in the winter and breeding seasons whereas there was more vegetation classes used in the summer. In all 3 seasons there was little effect of road and oil development. The breeding and winter model tend to be more similar focusing on large expanses of sagebrush and little to no probability in riparian areas, whereas the summer model shows more use in the riparian areas. Compared to the statewide model, the specific North Park model defined more specific areas of quality habitat in all seasons. These seasonal models provide a data-driven, small-scale distribution map that can be used for identification and exploration when investigating GRSG issues specific to North Park especially if oil and gas exploration expand. (ID 15746)

**Ricono, A.**, Florida Institute of Technology, USA, aricono2011@my.fit.edu  
 Sperrn, C., Florida Institute of Technology, USA, csperrn2013@my.fit.edu  
 Winker, K., University of Alaska Museum, USA, kevin.winker@alaska.edu  
 Pruett, C. L., Florida Institute of Technology, USA, cpruett@fit.edu

#### EFFECTS OF COLONIZATION AND ISOLATION ON THE POPULATION GENETICS OF PACIFIC WRENS

The ability of birds to colonize remote islands accounts for some of the most spectacular diversifications in the class Aves. However, many of the patterns we observe are far removed from the colonization event and thus the initial effects of those events are not well understood. Several species of landbirds successfully colonized the Aleutian Islands in Alaska during the late Pleistocene and have evolved subspecies-level differences in plumage and body size. To understand the patterns of colonization and isolation during the initial stages of population divergence, we studied the genetics of one of these colonist species, Pacific Wren (*Troglodytes pacificus*). We examined 10 populations (N=170) of Pacific Wren in Alaska and British Columbia using 9 microsatellite loci. We discovered that birds found on the most remote islands were the most divergent (pairwise  $F_{ST} = 0.3 - 0.8$ ), showing a signal of isolation-by-distance ( $r = 0.68$ ;  $P = 0.001$ ). These divergent populations also differ morphologically and are described subspecies. We found a substantial loss of genetic diversity during colonization (e.g., mainland,  $H_e = 0.72$  versus Attu Island,  $H_e = 0.27$  and the Pribilof Islands  $H_e = 0.34$ ), suggesting genetic founder events during or following colonization. We compare these results with genetic patterns found in two other taxa of Aleutian birds, Rock Ptarmigan (*Lagopus muta*) and Song Sparrow (*Melospiza melodia*), to provide a cohesive description of the early stages of divergence after island colonization in this unique system. (ID 15779 | Poster 23)

**Rigby, E. A.**, University of Minnesota, USA, rigby007@umn.edu  
 Johnson, D. H., USGS Northern Prairie Wildlife Research Center, USA, douglas\_h\_johnson@usgs.gov

#### MODELING DETECTABILITY IN BIRD SURVEYS: A NEW, EXTENSIVE SIMULATION

Bird surveys are commonly used to assess species' population status and assess biodiversity. Birds vary in their detectability, however, and not accounting for detectability results in biased estimates of abundance. Several survey methods have been developed to estimate probability of detection as well as abundance, but all require collecting additional data during surveys, and estimates are not always comparable among methods. We constructed a model including 3 components of detectability: spatial arrangement of birds, availability (the probability that a bird vocalizes during a survey), and perceptibility (the probability that a bird is observed, given that it is available). We modeled each component of detection, including variation due to environment, bird behavior, and human presence. The model was parameterized with species-specific biological and environmental information, and perceptibility information from previous field experiments using recorded bird songs. Five survey methods (index to relative abundance, distance sampling, time of detection, double observer, and replicated counts) were used to analyze simulated counts. Estimated abundance from each survey method was then compared to the true abundance. We simulated surveys using the Black-Throated Blue Warbler (*Setophaga caerulescens*) as an example. We examined 4 combinations of 2 scenarios: stable population versus declining population, and a broad, range-wide survey versus a targeted survey on a subset of high-density sites. Results varied by analysis method. By extending this model under a wide range of conditions, we expect to provide guidelines for choosing an effective survey method. (ID 15809)

**Ringelman, K. M.**, University of Delaware, USA, kmringel@udel.edu  
 Eadie, J. M., University of California - Davis, USA, jmeadie@ucdavis.edu  
 Ackerman, J. T., United States Geological Survey, USA, jackerman@usgs.gov  
 Sih, A., University of California - Davis, USA, asih@ucdavis.edu  
 Loughman, D., California Waterfowl Association (ret.), USA  
 Yarris, G., California Waterfowl Association (ret.), USA  
 Oldenburger, S. L., University of California - Davis (fmr.), USA  
 McLandress, M. R., California Waterfowl Association (ret.), USA

#### SHIFTING PATTERNS OF NEST DENSITY AND PREDATION RISK: A SPATIAL ANALYSIS OF 15 YEARS OF DUCK NESTING DATA FROM CALIFORNIA

One of the best known adaptive habitat selection rules is the win-stay, lose-shift strategy that many bird species appear to use to select nest sites in consecutive years. Although this is an individual behavior, it may be possible to detect shifting patterns of nest density and predation risk at a population level. Here, we conducted a spatial analysis using 15 years of duck nesting data to assess whether there were areas of consistently high or low predation risk, and whether ducks used prior risk landscapes to make current habitat selection decisions. We created kernel density maps of successful and unsuccessful nests in consecutive years, and found no spatio-temporal correlation in predation risk and no evidence for win-stay, lose-shift dynamics. We also examined between-year correlations in nest success and nest density at three smaller spatial scales: individual nesting fields (10-28 ha in size), 16 ha grid cells, and 4 ha grid cells. We found no evidence for year-to-year correlation in nest success at the field and 4 ha scale, and no evidence for win-stay lose-shift behavior. At the 16 ha scale, we found positive between-year correlations in nest success, but no evidence of win-stay, lose-shift. Finally, using banding data from individual birds, we found a weak relationship between nest survival and dispersal distance in the following year. Taken together, our results indicate that there was relatively little year-to-year spatial correlation in nest predation risk, and therefore suggest that there was little advantage to win-stay, lose-shift behavior. Despite little temporal correlation in predation risk, we found strong spatial correlations between nest density in consecutive years at all spatial scales but not at longer



temporal scales, suggesting that birds use short-term cues to select nest sites. In unpredictable environments, current cues, such as the presence of active conspecific nests, may be especially useful in selecting nest sites. (ID 15899)

**Rivera-Cáceres, K. D.**, University of Miami, USA, krivera@bio.miami.edu  
 Quirós Guerrero, E., University of St. Andrews, United Kingdom, esme\_q@hotmail.com

#### DUET COORDINATION AND DUET CODE IN JUVENILE PLAIN WRENS\*

Duets are defined as coordinated vocalizations produced by two or more individuals. Two key properties of duets arise from the relationships between these vocalizations: precise song coordination and non-random association of song types (duet codes). Little attention has been directed to the proximate mechanisms driving these behaviors. However, because both behaviors are achieved in a complex and dynamic way, it is suggested that they require learning. As juveniles of some duetting species duet with adults during the sub-song stage, juveniles could potentially learn both proper coordination and specific duet codes during this stage. Regarding duet coordination, the learning hypothesis predicts that juveniles a) should perform duets with poorer coordination than adults and b) should improve their coordination with time. Regarding duet codes, this hypothesis predicts that juveniles a) use the same code as the adults they are singing with, b) break the code more often than adults and c) break the code less as time progresses. In this study I performed recordings of adult and juvenile plain wrens (*Cantorchilus modestus zeledoni*) to determine whether precise coordination and duet codes are acquired through learning during early development. I found that juveniles a) exhibit poorer coordination than adults while duetting, b) do not seem to improve their coordination within the timeframe measured, c) use fewer song types to answer a duet as time progresses. Additionally I found that juveniles d) most of the time use the same song types as adults to answer a duet, and e) use fewer song types when they duet with both adults than when they duet only with the adult of the opposite sex. Both results indicate that juveniles copy the song type from the adult of the same sex to answer the adult of the opposite sex (i.e. follow the adult's duet code). Overall, results suggest that juveniles learn coordination and a duet code from the territorial adults they duet with. (ID 16103)

**Rivers, J. W.**, Oregon State University, USA, jim.rivers@oregonstate.edu  
 Betts, M. G., Oregon State University, USA, matt.betts@oregonstate.edu

#### INTENSIVE FOREST MANAGEMENT PRACTICES REDUCE NEST SURVIVAL AND OFFSPRING PRODUCTION: EVIDENCE FROM A LANDSCAPE-SCALE EXPERIMENT

Production forests are subjected to intensive management practices that enhance growth and survival of commercial plant species by chemical control of competing vegetation. Assessments of how intensive forest management impacts native biodiversity have been limited largely to descriptive studies, making it difficult to provide strong inference regarding how demographic measures are influenced by such practices. Here we use a landscape-scale experiment to assess the demographic response of the White-crowned Sparrow (*Zonotrichia leucophrys*) to varying levels of herbicide intensity in regenerating Douglas-fir (*Pseudotsuga menziesii*) stands. We quantified nest survival and offspring production of >300 nests across 24 stands to which 4 distinct treatments were applied (i.e., light herbicide, intermediate herbicide, intensive herbicide, and no-herbicide control). We found the odds of daily nest survival in the control treatment group was 1.71x greater than the intermediate herbicide group, leading to a near doubling of per-capita offspring production in stands subject to this treatment. Our findings suggest that lower nest survival and reduced offspring production are associated with a reduction in vegetation cover due to herbicide application. (ID 15891)

**Robertson, G. J.**, Wildlife Research Division, Environment Canada, Canada, greg.robertson@ec.gc.ca

Whitney, H. G., Animal Health Division, Province of Newfoundland and Labrador, Canada, hughwhitney@gov.nl.ca

Lang, A. S., Department of Biology, Memorial University of Newfoundland, Canada, aslang@mun.ca

#### THE ROLE OF MARINE BIRDS IN THE TRANS-ATLANTIC MOVEMENT OF AVIAN INFLUENZA VIRUSES

With the emergence of highly pathogenic forms of avian influenza virus (AIV), surveillance efforts of wild bird populations have increased. For North America, intercontinental movement of AIV is possible through a direct link between waterfowl breeding in Alaska and wintering in Asia. A trans-Atlantic route to connect Eurasia to the Americas is also possible, because millions of pelagic seabirds migrate east-west across the North Atlantic. We studied the prevalence, seroprevalence, and virus genetics of AIV found in seabirds, gulls and waterfowl at the eastern edge of North America in Newfoundland and Labrador. Prevalence was generally low in gulls (1.8%) and seabirds (2.2%) but seroprevalence was much higher in Common Murres, Atlantic Puffins and large gulls (22-50%). AIVs isolated from murres were intercontinental reassortants, with gene segments mainly from avian lineages but also containing some gull lineage segments. In 2011, we detected an outbreak of H1N2 viruses at a small sub-colony of murres (60 of 67 positive individuals sampled on a single day) and identified at least 4 genotypes amongst these viruses, showing the rapid viral evolution as the outbreak unfolded. Large gulls showed a wide diversity of AIVs, including intercontinental reassortants and both gull and avian lineage gene segments, and the first purely Eurasian AIV found in North America. In contrast, waterfowl (mainly Black Ducks) sampled in urban areas, where large numbers of gulls congregate, showed AIV strains typical of North American waterfowl. Taken together our results show that pelagic seabirds are potentially important reservoirs of AIV and the AIVs found in gulls are highly diverse and reassorted, whereas the local waterfowl population did not appear to contract any of these chimeric AIVs from the gulls. More work is needed to understand the dynamics of AIV in gulls and seabirds, as these species may be the main source of intercontinental reassortment across the Atlantic. (ID 16078)

**Robinson, S. G.**, Kansas State University, USA, robinsonsg@k-state.edu  
 Plumb, R. T., Kansas State University, USA, rtplumb@k-state.edu  
 Lautenbach, J. M., Kansas State University, USA, lautenba@k-state.edu  
 Kraft, J. D., Kansas State University, USA, jdkraft@k-state.edu  
 Sullins, D. S., Kansas State University, USA, sullins@k-state.edu  
 Haukos, D. A., U.S. Geological Survey, Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University, USA, dhaukos@k-state.edu  
 Pitman, J. C., Kansas Department of Wildlife, Parks and Tourism, USA, jim.pitman@ksoutdoors.com

#### NONBREEDING SEASON MOVEMENT AND HABITAT USE OF LESSER PRAIRIE-CHICKENS IN KANSAS

Wintering ecology of Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*) has not been studied as extensively as breeding season demographic rates and habitat use. This is especially true for the contemporary northern range of the species, where they have expanded since the 1980s. As a non-migratory species of concern, annual life-cycle movements need to be understood to inform management decisions. Females were captured during the spring lekking season using drop-nets and walk-in drift traps. Each captured female was fitted with a VHF radio transmitter or a GPS Satellite Transmitter. Nonbreeding movements and habitat use were estimated for Lesser Prairie-Chickens in two ecoregions within Kansas, the northwestern High Plains and the south-central Red Hills, from 15 Sept 2013 to 15 Mar 2014. Movements were averaged weekly and seasonally. Movements in the Red Hills region were less than that of the birds in northwest Kansas, and

their utilized habitat was nearly all grassland. Average weekly movements in NW Kansas increased overwinter, with the majority of time was spent in Conservation Reserve Program land and grassland, but row-crop fields were occasionally used for foraging. Greater movements occurred in the early fall and the late winter, as birds were dispersing or forming winter flocks and transitioning into the breeding season by localizing around leks, respectively. Differences between regions and seasons are crucial to understanding this species at a landscape scale. (ID 15728)

**Rodewald, A. D.**, Cornell University, USA, arodewald@cornell.edu  
EXPERIMENTAL REMOVAL OF HONEYSUCKLE AND CONSEQUENCES FOR PLANT-BIRD-PREDATOR COMMUNITIES.

Although eradication or control of non-native species is a common restoration goal of heavily invaded sites, the extent to which native communities can be successfully restored remains poorly understood. This study examined the response of understory-nesting birds and nest predators to the experimental removal of the non-native and invasive shrub, Amur honeysuckle (*Lonicera maackii*). Bird, plant, and predator communities were studied in 19 mature riparian forests in central Ohio from 2005-2013. In four 2-ha plots, all honeysuckle was removed in 2007-2008 so that understory stem density resembled that found in uninvaded forests. Understory-nesting birds declined following honeysuckle removal. Ecological networks comprised of breeding birds and the plants in which they nested also were sensitive to the presence of honeysuckle, such that networks were less compartmentalized and characterized by interaction strengths that were highly asymmetric (i.e., low evenness) in invaded sites. Nevertheless, network structure following removal of honeysuckle was not restored to that found in uninvaded sites. Unexpectedly, nest survival rates declined on removal sites, though survival was best explained by network evenness, not treatment per se. Despite being limited in temporal (6 years post-treatment) and spatial (2 ha) scale, these findings show that eradication and control of honeysuckle may have some, but not all, desired restoration outcomes. (ID 15896)

**Rodriguez, M. D.**, Colorado State University, USA, mdrodriguez10@gmail.com  
Huyvaert, K. P., Colorado State University, USA, kate.huyvaert@colostate.edu  
Doherty, Jr., P. F., Colorado State University, USA, paul.doherty@colostate.edu  
THE EFFECT OF CALCIUM SUPPLEMENTATION ON NESTING TREE SWALLOWS

Understanding the role that critical nutrients, such as calcium, play in the reproduction and fitness of organisms is vital to conservation efforts and management. Calcium is crucial to avian egg production and chick growth, and has been shown to be a limiting factor in many systems. We utilized calcium supplementation as a means of assessing the extent to which calcium availability affects Tree Swallow (*Tachycineta bicolor*) reproduction in a high altitude, non-acidic environment. At the start of nest construction, nest boxes at the study site were randomly assigned to either a calcium treatment or a control treatment. Calcium treated nests were supplemented with crushed oyster shell in a tray above the nest box, while control nests had the same tray and were instead supplemented with sand. Reproductive parameters such as clutch initiation date, clutch size, egg volume, and hatching and fledging success were measured. Larger reproduction parameters for the calcium treated nests may imply that calcium is a limiting factor for Tree Swallow reproduction, especially in a high-altitude environment where effects of calcium availability may be amplified by the harsh environment and short growing season. Knowing that higher calcium availability increases reproductive success and fitness of this population can aid in the conservation for this, or similar, species. (ID 16191 | Poster 116)

**Rodriguez-Contreras, V.**, CONABIO, Mexico, vrodrig@conabio.gob.mx  
Berlanga, H., CONABIO, Mexico, hberlang@conabio.gob.mx  
Pardieck, K., USGS PWRC, USA, kpardieck@usgs.gov

EXPANSION OF THE BREEDING BIRD SURVEY TO NORTHERN MEXICO: WORTH THE EFFORT

This year will be the seventh field year of the expansion of the Breeding Bird Survey Program to the northern states of Mexico. This long term, large scale effort to assess bird populations in North America has provided the main data input on population trends for multiple purposes in Canada and the United states, from decision making support on conservation, to develop conservation strategies and plans at different scales, among other uses. In Mexico, A previous pilot project on expansion of this program in 1996 suggested the viability of the program, but also pointed out a possible lack of volunteers for the program. With the support of NMBCA among several partners, NABCI coordination in Mexico started the actual expansion of the program to Mexico in 2007. Despite adverse situations on northern Mexico, numbers of volunteers/run routes have been constantly growing, allowing preliminary analyses to be performed in some states by the end of this year. In order to consolidate the program in other regions and continue gathering valuable information on more sampled areas as well, a compromise from some institutions is required. (ID 15855)

Rogers, A. M., EDM International, Inc., USA, a.munro.rogers@gmail.com  
Gibson, M. R., University of Durham, United Kingdom, mishka.r.g@gmail.com  
Pockette, T., EDM International, Inc., USA, tylerpockette4@gmail.com  
Alexander, J. L., EDM International, Inc., USA, alexand.jl@gmail.com  
Dwyer, J. F., EDM International, Inc., USA, jdwyer@edmlink.com  
**Dwyer, A. M.**, Rocky Mountain Bird Observatory, USA, angela.dwyer@rmbo.org

SCAVENGING OF MIGRATORY BIRD CARCASSES IN THE SONORAN DESERT<sup>†</sup>

Avian survival during migration can be low compared to non-migratory periods. Because migration occurs over great distances, little is known of the timing or location of mortality during migration or the fate of the carcasses of dead migrants. In this study we report avian and mammalian scavengers foraging on migratory bird carcasses in the Sonoran Desert. We walked the same transects repeatedly through our study area while observing foraging behaviors of potential scavengers and documenting carcasses of migratory birds. We used remote cameras to monitor carcasses we found. In 26 instances we observed a common raven (*Corvus corax*) in flight with nothing in its feet or beak, drop to the ground and then immediately fly up again with a migratory bird carcass. We could not identify all of these scavenged birds to species, but most of those that could be identified were warblers (Parulidae). We used remote cameras to monitor 25 migratory bird carcasses. We documented four species scavenging 10 carcasses (kit fox, *Vulpes macrotis*, n = 4; coyote, *Canis latrans*, n = 3; common raven, n = 2, and greater roadrunner, *Geococcyx californianus*, n = 1), and recorded coyote tracks at 3 additional carcasses. Neither remote cameras nor tracks indicated the scavenger species of the remaining carcasses. Our data suggest migrant birds may provide an important food source for resident scavengers, particularly in desert habitats where food can be scarce. Our study also supports prior assertions that failure to account for removal of carcasses by scavengers may cause errors in estimates of mortality. (ID 16006)

**Rolland, V.**, Arkansas State University, USA, vrolland@astate.edu  
Fowler, J. A., Arkansas State University, USA, jessica@trioaks.com  
WINTER ROOSTING BIOLOGY OF EASTERN BLUEBIRDS IN NE ARKANSAS  
Winter roosting behavior in Eastern Bluebirds has only been anecdotally documented, despite historic population declines associated with severe

winter weather. We monitored 69 nest boxes in Northeast Arkansas during winters 2012-2013 and 2013-14 to determine (1) whether temperature and the presence of nest material drives the decision to roost in a nest box, and (2) the social and genetic relationships among roost-mates. Not only the probability of a bird roosting in a box increased as the windchill at sunset decreased, but so did roost group size (which varied from 1 to 15 birds roosting together). Also, boxes with nest material were chosen significantly more over empty boxes even though they did not provide more heat insulation. Finally, banding data and blood samples revealed predominantly family-based roosting groups, with 90% of all relationships being family relationships (parent-offspring, siblings, mate pairs, or extended). Among hatch/second-year birds roosting with their parents, significantly more were from late clutches than first clutches. Surprisingly (or maybe because of unusual weather in the second season), not only the level of relatedness of a roosting group did not decrease as the nesting season approached but the juvenile sex-ratio remained balanced. This may suggest that natal dispersal and mate bonding may occur later than previously thought. (ID 15794)

**Rose, A. P.**, University of Colorado Museum of Natural History, USA, alexandra.rose@colorado.edu  
**Shizuka, D.**, University of Nebraska Lincoln, USA, dshizuka2@unl.edu  
**Bakker, V. J.**, Montana State University, USA  
**Brandt, J.**, Hopper Mountain National Wildlife Refuge Complex, USA  
**Burnett, J.**, Ventana Wilderness Society, USA  
**Doak, D. F.**, University of Colorado, USA  
**Finkelstein, M. E.**, University of California, Santa Cruz, USA  
**Jones, J. K.**, Pinnacles National Park, USA  
**Pryor, D.**, Santa Barbara Zoo, USA  
**Welch, A. T.**, Pinnacles National Park, USA

#### CONDOR WATCH: HOW CITIZEN SCIENTISTS ARE HELPING IMPROVE MANAGEMENT OF ONE OF THE WORLD'S MOST ENDANGERED SPECIES

The California condor is one of the most endangered species in the world. In the 1980s there were only 22 individual birds, but, as a result of an intensive recovery effort, there are now over 400 birds. Despite the continuing success of their conservation, condors are threatened by problems such as lead poisoning from ingestion of lead shot in hunter-killed carcasses and other anthropogenic impacts. Condors congregate at feeding sites, and a better understanding of the social dynamics there could provide valuable clues into how and why lead poisoning remains a persistent problem. We have launched a citizen science project to gain insights into the social dynamics of condors. This program, Condor Watch ([www.condorwatch.org](http://www.condorwatch.org)), asks volunteers to look at photos taken by motion-activated cameras at sites where condors are fed as part of regular management activities. By identifying the tag number of each condor and describing its behavior in over 150,000 photos taken over ~8 years, citizen scientists will help researchers understand how condor social networks may be related to lead poisoning or other problems. Ultimately, we hope the project will improve the ability of condor biologists to identify high risk birds and develop better strategies for ensuring the species' successful survival. Photo classification started in Spring 2014. We will present preliminary results on several features of the data including: understanding the social interactions of this highly manipulated population of birds; how these data may be used for management; and the benefits and challenges of using volunteers to deal with the flood of data that can defy traditional analysis approaches. Behavioral data from this program are also being tied to other sources of individual-level data, including movement patterns, diet, and contamination levels from multiple environmental pollutants to create a comprehensive understanding of the risks and best management strategies for this imperiled species. (ID 16335 | Poster 110)

**Rose, E. T.**, North Carolina Cooperative Fish and wildlife Research Unit, Department of Applied Ecology, NCSU, USA, EliTRose2@gmail.com  
**Simons, T. R.**, U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, USA, tsimons@ncsu.edu

#### UNDERSTANDING LONG-TERM TRENDS IN BIRD OCCURRENCE FOLLOWING AN INCREASE IN THE PREVALENCE OF FIRE ON A SOUTHERN APPALACHIAN LANDSCAPE

The long-term effects of fire on bird assemblages in the xeric pine-oak forests of the southern Appalachian region have received little study, and as a result are poorly understood. Following recent changes in fire management within Great Smoky Mountains National Park, we took advantage of a unique opportunity to identify species occurrence patterns across a heterogeneous landscape subject to a wide variety of fire effects. Using 300 avian point counts and a hierarchical modeling approach, we quantify differences in species occurrence for sites that burned within the past 5, 10, 15, and 30 years for both high and low severity fires. We contrast species occurrence during each time interval with those in areas that have not burned for more than 70 years. We report patterns of species persistence following fire for two species adapted to early succession habitats (Prairie Warbler and Yellow-breasted Chat), and explore the temporal patterns of colonization for two species that are sensitive to forest fragmentation (Ovenbird, Blue-headed Vireo). To identify the structural characteristics of the vegetation that best explain observed species occurrence patterns, we evaluate tree basal area, vegetation cover (shrub, midstory, overstory), and the vertical distribution of vegetation using both field collected and remotely sensed (LIDAR) habitat characteristics. (ID 16223)

**Rosenberg, K. V.**, Cornell Lab of Ornithology, USA, kvr2@cornell.edu  
**Marra, P. P.**, 2Migratory Bird Center, Smithsonian Conservation Biology Institute, USA, marrap@si.edu

#### NEW INSIGHTS INTO WINTER DISTRIBUTION AND NATURAL HISTORY OF NEOTROPICAL MIGRATORY BIRDS

A major impediment to full life-cycle conservation planning for Neotropical migratory birds is the lack of precise data on non-breeding distributions for many species, as well as fundamental natural history information from the non-breeding period including data on migratory connectivity, habitat use, social behavior (e.g. territoriality vs. flocking), and foraging ecology. We are currently compiling all available data on distribution and natural history for 140 species that winter primarily south of the U.S., using specimen (e.g. ORNIS) and observational databases (e.g. eBird), and other published and unpublished sources. New winter distribution maps reveal rich contours of relative abundance within previously large, "flat" range maps, changing our concept of "winter range" for many species. Data are still very sparse for some species, especially cuckoos, thrushes, and some warblers that virtually disappear into South American forests in winter (e.g., Black-billed Cuckoo is represented by only 4 Dec-Feb specimens and 2-3 Dec-Feb observations in eBird). Emerging evidence also suggests that some species may move between widely separated regions to exploit the seasonal flush in resources during the rainy seasons. Our compilation of species-level data from the non-breeding season when combined with a rapidly growing dataset on individual movements using new tracking technologies, is ushering in a new era of knowledge about the biology of long-distance migratory birds during their full annual cycle. (ID 16243 | Poster 45)

**Ross, E. J.**, University of Wisconsin-Madison, USA, ejross3@wisc.edu  
**Princé, K.**, University of Wisconsin-Madison, USA, prince3@wisc.edu  
**Zuckerberg, B.**, University of Wisconsin-Madison, USA, bzuckerberg@wisc.edu

#### CLIMATE CONDITIONS ON OVERWINTERING GROUNDS INFLUENCE THE PHENOLOGY AND SPEED OF SPRING MIGRATION FOR TEMPERATE MIGRANTS IN THE UPPER MIDWEST



The timing of many springtime events throughout the world is shifting due to climate change. Spring arrival dates of many migratory birds have been getting earlier since the late 1930's, but many of past studies rely on observations from a limited number of sites or banding stations. Using data from Project FeederWatch, a continental-scale citizen science program focused on wintering birds, we analyzed observations from hundreds of feeder stations over a twenty-three year period (1990-2012) to capture the migratory front and speed for five temperate migratory birds. After calculating the difference between two threshold-based metrics of arrival (first and median arrival dates), we correlated both arrival timing and migration speed in relation to a suite of climate and environmental variables on their overwintering grounds using a moving window analysis. We found support for the importance of multiple climate and ecological conditions on first arrival times, the combinations of which varied by species, but commonly included: minimum temperature during the week immediately preceding arrival, total precipitation over the month preceding arrival, and the normalized difference vegetation index of the wintering grounds. During spring migration, we found that the pace of migration proceeded more steadily over a longer period of time during years with an early first arrival. Conversely, during years of delayed spring arrival, the pace of migration was more abrupt and characterized by a reduced temporal window between the first and median arrival dates. Our findings suggest that many studies on avian migration phenology ignore critical information on the influence of overwintering climate conditions and their subsequent effect on the entire migratory front, not just first arrival dates. We predict that migratory fronts of short-distance migratory birds will arrive earlier and become less pronounced under projected climate change. (ID 16186)

**Ross, J. D.**, University of Oklahoma, USA, rossjd@ou.edu  
 Kelly, J. F., University of Oklahoma, USA, jkelly@ou.edu  
 Bridge, E. S., University of Oklahoma, USA, ebridge@ou.edu  
 Boyle, W. A., Kansas State University, USA, aboyle@ksu.edu

#### SEVERE WEATHER, FAULT BARS, AND STABLE ISOTOPE SIGNATURES OF STRESS

Grassland birds of the American Great Plains regularly face severe weather. Beyond anecdotes, the impact of these events on breeding birds remains unknown. On May 31, 2013 near El Reno, Oklahoma an historic storm spawned a 4.2km-wide tornado and hailstones exceeding 4cm diameter. During August, we captured fledgling Grasshopper Sparrows (*Ammodrammus savannarum*) in the area impacted by these hailstones and found a very high incidence (66.7%) of synchronous fault bars across the rectrices, usually a rare find within the species. We sampled a single rectrix from each individual and analyzed the  $\delta N_{15}$  and  $\delta C_{13}$  stable isotope ratios within four 0.25-0.40mg feather sections from the tip, rootward. The fault bar, if present, was wholly contained within only one section. Carbon stable isotopes did not significantly differ among sections regardless of fault bar presence. However, after accounting for consistent, natural  $\delta N_{15}$  variation across sections, we found: 1) residuals from feather sections containing or immediately downstream of the fault bar showed significantly higher  $\delta N_{15}$  than outside the fault bar region ( $t=-2.24$ ,  $p=0.015$ ); though 2) feathers containing fault bars had collectively-lower  $\delta N_{15}$  than feathers without fault bars ( $F=10.34$ ;  $p<0.001$ ). We propose that these findings suggest an abrupt starvation/stressor event that widely affected Grasshopper Sparrow chicks of various ages. Furthermore, elevated  $\delta N_{15}$  among fledglings lacking fault bars suggests trophic progression potentially consistent with these individuals hatching after the May 31 severe weather event. Severe hail events may represent major stressors to ground-nesting birds and, therefore, should be monitored opportunistically during avian breeding studies. (ID 16056)

**Ruben, J.**, Oregon State University, Department of Zoology, USA, rubenj@science.oregonstate.edu

#### OVERLOOKED SPECIMENS, OVERLOOKED ANALYSES: AVIAN ORIGINS RECONSIDERED

The widespread and popular notion that birds are merely "flying dinosaurs" is based largely on cladograms that have been reinforced by the discovery of many supposedly feathered dinosaurs from Chinese Mesozoic Era deposits. Nevertheless, a number of often overlooked, but exceedingly well-preserved fossils, as well as sophisticated cladistic analyses, suggest the issue of avian origins has yet to reach the level of "settled science." Thus, for example, the morphology of several European and Chinese fossils indicates that the "feathers" of many specimens from China may well be misidentified collagenous connective tissue fibers. Similarly, recent cladistic analyses suggest that a number of the most birdlike theropod dinosaurs may actually have been secondarily flightless birds. The question of avian origins remains open. (ID 16404)

**Rueda-Hernández, R.**, Universidad Nacional Autónoma de México, Mexico, rafael.ruedahernandez@gmail.com  
 MacGregor-Fors, I., Instituto de Ecología, A.C., Mexico, ian.macgregor@inecol.mx  
 Renton, K., Universidad Nacional Autónoma de México, Mexico, krenton@ib.unam.mx

#### SHIFTS IN RESIDENT BIRD COMMUNITIES ASSOCIATED WITH CLOUD FOREST PATCH SIZE IN CENTRAL VERACRUZ, MEXICO

Avian communities in cloud forests maintain high levels of endemism, but are at major risk given the accelerated loss of land cover resulting in habitat fragmentation. Nevertheless, the response of these avian communities to changes in fragment size remains poorly known. We assessed changes in four aspects of avian communities: species richness, bird density, community evenness and composition, in association with different size categories of cloud-forest fragments. Contrary to expectation, we found a higher statistical species richness and more even communities in medium-sized fragments, which may reflect the intermediate disturbance hypothesis where medium-sized fragments are exploited by both forest and disturbance species. Bird density also reached an asymptote in medium-sized fragments, and may indicate a carrying capacity in this habitat. Nevertheless, large cloud-forest fragments maintained a functionally distinct composition of avian communities, which were dominated by either endemic or protected species, and with a greater composition of understory insectivores and canopy frugivores. These results highlight the conservation value of large cloud-forest remnants for maintaining ecologically and functionally distinct communities of threatened and endemic bird species. We also highlight the importance of considering all attributes of avian communities, not just species richness, when evaluating the influence of fragmentation on avian communities influence of fragmentation on avian communities. (ID 16291)

**Ruegg, K. C.**, University of California, Los Angeles, USA, kruegg@ucla.edu  
 Anderson, E. C., National Marine Fisheries, USA, eric.anderson@noaa.gov  
 Paxton, K., University of Southern Mississippi, USA, kristina.paxton@gmail.com  
 Apkenas, V., National Marine Fisheries Service, USA, vanessa.apkenas@noaa.gov  
 Lao, S., University of California, Los Angeles, USA, sirenalao@ucla.edu  
 Siegel, R. B., Institute for Bird Populations, USA, rsiegel@birdpop.org  
 Moore, F. M., University of Southern Mississippi, USA, Frank.Moore@usm.edu  
 Smith, T. B., University of California, Los Angeles, USA, tbsmith@ucla.edu

#### MAPPING MIGRATION IN A SONGBIRD USING HIGH-RESOLUTION GENETIC TAGS

Neotropical migratory birds are declining across the Western Hemisphere, but conservation efforts have been hampered by the inability to assess

where migrants are most limited – the breeding grounds, migratory stopover points, or tropical wintering areas. A major challenge has been the lack of an efficient, reliable, and broadly applicable method for connecting populations across the annual cycle. Here we show how high-resolution genetic tags can be used to identify populations of a Neotropical migratory bird, the Wilson's warbler (*Cardinella pusilla*), at fine enough spatial scales to facilitate assessing regional drivers of demographic trends. By screening 1509 samples from across the range using 96 single nucleotide polymorphisms (SNPs) selected from a large pool of candidates (~450,000), we identify strong, previously unreported connections between breeding and wintering areas, population-specific flyway use, and timetables of migration along the Pacific Flyway. We illustrate how the resulting information can be applied to assess where migrants are most limited and help inform studies of migrant stopover ecology. Our results illustrate that high-resolution genetic tags are more reliable, accurate, and amenable to high throughput screening than all previously described intrinsic marking techniques, making them broadly applicable towards large-scale monitoring and conservation efforts. (ID 15954)

**Ruegg, K. C.**, University of California, Santa Cruz, Santa Cruz, USA, kruegg@ucsc.edu

#### INTEGRATION OF GENETIC AND BANDING DATA TO INFORM MIGRANT ECOLOGY, EVOLUTION AND CONSERVATION

Feathers collected from bird monitoring stations across the Western Hemisphere provide an invaluable source of biological material that can be used to help inform landbird conservation. Genetic and isotopic material contained within the feathers can be used to help track long distance movements, identify potential disease transmission routes, and provide a more in depth understanding of the ecology and evolutionary history of a species. The Swainson's thrush, a long distance Neotropical migrant with a wide spread distribution, has become a model migratory system in the Western Hemisphere. Here we review the ways in which feathers collected in collaboration with banding stations in North, Central and South America have provided a new insights into the ecology and evolutionary history of this and other Neotropical migrant bird species. In addition, we explore the ways in which genetic and isotopic information can be integrated with estimates of survivorship and data on migration timing and physiology attained from constant-effort misting station in order to improve our understanding of migrant ecology across the annual cycle. (ID 16392)

**Ruiz-Gutierrez, V.**, Rocky Mountain Bird Observatory, USA, vruizg@colostate.edu  
Kendall, W. L., U.S. Geological Survey, Colorado Cooperative Fish and Wildlife Research Unit, USA, William.Kendall@colostate.edu  
Saracco, F. S., Institute for Bird Population Studies, USA, jsaracco@birdpop.org  
OVERWINTERING DYNAMICS OF MIGRATORY BIRDS: HOW TO INFER MOVEMENT PATTERNS USING OPEN MULTI-STATE MODELS<sup>T</sup>

Patterns of movement in bird populations make up the core foundation of much of our current ecological knowledge. Direct measures of movement can be made using marked individuals, but this requires a spatial allocation of capture effort that is not feasible for most studies. Capture effort is most often restricted to a single site, limiting our ability to make inferences on the timing and nature of how individuals are associated with a given site. We demonstrate how movements can be monitored indirectly by accounting for permanent and temporary emigration, as well as transience, using the multistate open robust design with state uncertainty model (MSORD-SU). We applied the MSORD-SU to eight species of Neotropical migrants to examine overwintering movement patterns, using a data set of captures from 14 countries collected in 2002-2011. We estimated within-season dynamics of probabilities of entry for residents and transients, the probability of persisting

at a site for residents, the ratio of residents to transients using the study area, and residence time. Our results identified overwintering movement patterns which were largely independent of prior categorization of territoriality for each species. Residents of all species were likely to enter a site early in the season, but on average, individuals did not remain at sites for the full duration of the overwintering period. The MSORD-SU model is a useful tool to correct for and estimate dynamics of both residents and transients, and allows us to estimate the proportion of individuals that reside in the study area, which is a useful metric for determining the ecological importance or conservation value of an area. (ID 15788)

**Ruiz-Gutiérrez, V.**, Colorado State University, USA, vruizg@colostate.edu  
Saracco, J. F., The Institute for Bird Populations, USA, jsaracco@birdpop.org  
DeSante, D. F., The Institute for Bird Populations, USA, ddesante@birdpop.org

#### BROAD-SCALE BIRD-BANDING TO INFORM THE DYNAMICS, DEMOGRAPHY, AND MIGRATORY CONNECTIVITY OF LANDBIRDS

The earliest bird-banding studies were concerned with site fidelity and migration. Attention soon shifted to estimation of population size, and later, demographic rates. Methods for studying these parameters have evolved rapidly, and continental-scale bird-banding programs have both driven and benefited from methodological innovations. We discuss aspects of study design that can enhance the utility of banding data in the context of available analytical tools. In addition, we present recent results from a broad-scale cooperative bird-banding network in North America operated during the breeding season, the Monitoring Avian Productivity and Survivorship (MAPS) program; and from a complimentary program aimed at studying migrants during the non-breeding season, the Monitoreo de Sobrevivencia Invernal (MoSI) program. MAPS cooperators have contributed data from > 1,000 banding stations since 1992. MoSI cooperators have submitted data from 130+ stations in 14 countries since 2003. Results highlight spatial and temporal patterns in demographic rates and links to environmental covariates. In addition, capture-recapture analyses that capitalize on repeat visits within breeding or non-breeding seasons lend insight into the timing and extent of within-season movements. These analyses further allow for estimation of proportions of captured individuals that are resident on study areas. We also show how measurements and tissue samples are being used to inform patterns of migratory connectivity. Lastly, we discuss the importance of maintaining and improving these broad-scale monitoring programs to meet information needs for developing full life-cycle conservation. (ID 16276)

**Ruiz-Sanchez, A.**, UNAM, Mexico, angelina.ruizsanchez@gmail.com  
Rueda-Hernandez, R., UNAM, Mexico, rafael.ruedahernandez@gmail.com  
Renton, K., UNAM, Mexico, krenton@ib.unam.mx

#### BIRDS AND DISTURBANCE: EFFECT OF HABITAT MODIFICATION ON WILSON'S WARBLER DENSITY, TERRITORY SIZE AND BODY CONDITION.\*

Migratory birds face population declines attributed to habitat loss and modification in the wintering grounds. Habitat quality and body condition on the wintering grounds influence the time of arrival to breeding grounds, affecting birds breeding. Despite the influence wintering grounds have on migratory birds there is few information on habitat use, territoriality and body condition. In particular in the Neotropics where land conversion rate has increased in the last decades. From 2011 to 2014, during three wintering seasons, we used unlimited distance point counts to assess Wilson's Warbler density in three sites with different degrees of disturbance and area covered by cloud forests, the preserved site is protected. In addition, we color-banded, measure, re-sighted and followed 80 territorial birds along the wintering season, to assess body condition and individual territory size. We found higher bird density in the preserved site, almost twice the density of disturbed areas. We also found differences in territory size, it was smaller in the preserved

site compared to the site with higher disturbance, where we found the largest territories. On the other hand body condition showed no differences among the sites with distinct degrees of forest disturbance. Nevertheless body condition was less variable where forest was preserved. The same happened with territory size that was consistent in the preserved site, whereas it varied greatly among years in the disturbed sites. Apparently territorial birds show similar body condition regardless of forest disturbance, but the defended area is larger where disturbance is higher, implicating higher energy cost, and smaller density of birds. Considering the higher bird density, the smaller territory size and the lack of variation of territory size among years on the preserved site, we propose that protected and preserved cloud forests represent a higher quality habitat than the disturbed and unprotected cloud forests. (ID 16371)

**Rushing, C. S.**, Smithsonian Conservation Biology Institute, USA, [crushing05@gmail.com](mailto:crushing05@gmail.com)

Hostetler, J. A., Smithsonian Conservation Biology Institute, USA  
Marra, P. P., Smithsonian Conservation Biology Institute, USA

#### THE ROLE OF DISPERSAL IN DETERMINING MIGRATORY CONNECTIVITY PATTERNS

By mixing individuals from different populations, dispersal between is expected to weaken migratory connectivity. However, the degree to which dispersal influences connectivity will depend on the frequency, magnitude, and direction of these movements and how they interact with forces that act to strengthen connectivity. We used theoretical models and empirical data to investigate how dispersal between breeding and non-breeding populations influences the patterns of migratory connectivity and show that long-distance dispersal movements of both young individuals and adults can significantly influence the strength of connectivity. We also present empirical data on long-distance dispersal in American redstarts and show that annual variation in environmental conditions can produce extreme biases in the direction of long-distance dispersal. These results suggest that the weakening force of dispersal may play a significant role in shaping observed patterns of migratory connectivity and also that connectivity may be dynamic over relatively short timescales, which could buffer populations against environmental degradation throughout the annual cycle. (ID 16099)

**Ruskin, K. J.**, University of Maine, USA, [katharine.ruskin@maine.edu](mailto:katharine.ruskin@maine.edu)  
Etterson, M. A., Environmental Protection Agency, USA, [Etterson.Matthew@epa.gov](mailto:Etterson.Matthew@epa.gov)

Olsen, B. J., University of Maine, USA, [brian.olsen@maine.edu](mailto:brian.olsen@maine.edu)  
Hodgman, T. p., Maine Department of Inland Fisheries and Wildlife, USA, [tom.hodgman@maine.gov](mailto:tom.hodgman@maine.gov)  
Elphick, C. S., University of Connecticut, USA, [chris.elphick@uconn.edu](mailto:chris.elphick@uconn.edu)  
Kovach, A. I., University of New Hampshire, USA, [adrienne.kovach@unh.edu](mailto:adrienne.kovach@unh.edu)  
Shriver, W. G., University of Delaware, USA, [gshriver@udel.edu](mailto:gshriver@udel.edu)  
King, E., United States Fish and Wildlife Service, USA, [Erin\\_King@fws.gov](mailto:Erin_King@fws.gov)  
LATITUDINAL TRENDS IN SALTMARSH SPARROW (*AMMODRAMUS CAUDACUTUS*) NEST FAILURE FROM COMPETING RISKS\*

Saltmarsh Sparrows (*Ammodramus caudacutus*) are endemic to tidal marshes and breed exclusively in the northeastern United States. They are considered globally threatened due to declining populations, habitat loss, and sea level rise. Saltmarsh Sparrows are named on the National Audubon Society's current WatchList as a species of global conservation concern and on the International Union for Conservation of Nature's Red List as vulnerable. Working toward an assessment of the Saltmarsh Sparrow's global population status, we estimated the fecundity of populations across the majority of the species' range. From 2011-2013, we conducted intensive demographic surveys of breeding Saltmarsh Sparrow populations in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, and New Jersey.

We calculated average probabilities of nest failure for each population via MCEstimate, a program created by the Environmental Protection Agency to estimate failure probabilities of competing risks by using a Markov Chain framework. We found that Saltmarsh Sparrow nest survival ranged from 2-42% across all sites. We also found distinctive latitudinal gradients for different modes of nest failure; specifically, nest failure due to depredation decreased with increasing latitude, while nest failure due to flooding increased with increasing latitude. (ID 16194)

**Rylander, R. J.**, Texas State University, USA, [rebekah.j.rylander@gmail.com](mailto:rebekah.j.rylander@gmail.com)  
Green, M. C., Texas State University, USA

#### AN EXAMINATION OF FLOCK DYNAMICS OF THE BLACK-CRESTED TITMOUSE (*BAEOLOPHUS ATRICRISTATUS*) IN THE EDWARDS PLATEAU OF TEXAS

The prolonged brood care hypothesis states that avian adults should be more tolerant of their own young versus unrelated individuals when it comes to resource sharing. This phenomenon is particularly apparent in species that show delayed dispersal of young, where nepotistic parents and their offspring benefit by keeping families together in "home" territories for an extended period of time. The Black-crested Titmouse (*Baeolophus atricristatus*, hereafter BCTI) of central Texas is a resident species that displays delayed natal dispersal and fluid family flock dynamics throughout the year, though the mechanisms by which it does so is largely unknown. During the spring of 2013 and 2014, all members within 24 family flocks of BCTI (breeding pairs and their broods) were marked with color bands at the Freeman Research Center, located 10 miles west of San Marcos, Texas. Observations were conducted as to how nepotism and the prolonged brood care hypothesis pertain to the life history of this species. Our results showed that BCTI tend to stay in relatively complete family flocks anywhere between seven to ten months, with a handful of juveniles failing to disperse all together. These second-year individuals either become helpers at their parents' nest the following year, or form territories directly next to their father's. The dominating sex that fails to disperse is usually male, with floating, unrelated females loosely joining the family flocks in late winter to early spring. Further investigation in regards to the potential role of resource limitation (habitat, food abundance) on BCTI juvenile dispersal is ongoing. (ID 15918 | Poster 114)

**Safran, R. J.**, University of Colorado, Boulder, USA, [rebecca.safran@colorado.edu](mailto:rebecca.safran@colorado.edu)

Wilkins, M. R., USA  
Albrecht, T., Czech Republic  
Chan, S., Chinese Taiwan  
Evans, M. R., United Kingdom  
Flaxman, S. M., USA  
Karaardıç, H., Turkey  
Lotem, A., Israel  
Nosil, P., United Kingdom  
Buerkle, C. A., USA

#### ISOLATION BY DISTANCE OR ADAPTATION? THE ROLE OF SEXUAL SELECTION IN GENOME WIDE DIVERGENCE

It is now well understood that during speciation genetic divergence causes gene flow to become reduced between populations. Less well understood are the mechanisms that reduce gene flow. Natural and sexual selection may act against immigrants and hybrids leading to reduced gene flow, and thus stronger genetic divergence, among pairs of increasingly adaptively-divergent populations, a pattern referred to as 'Isolation by Adaptation' ('IBA'). IBA is analogous, and complementary, to the well-known pattern of 'Isolation by Distance' ('IBD'), in which gene flow is reduced between populations due to geographic isolation. The barn swallow *Hirundo rustica* species complex is comprised of six closely related subspecies where divergent sexual selection



is important in phenotype differentiation among allopatric populations. To investigate whether sexual selection is important in genome wide differentiation, we generated DNA sequence data from 352 individual barn swallows sampled across eight populations from four different subspecies of barn swallow. We obtained a set of 62,411 SNPs for analyses; 18,860 of the sequences containing these SNPs mapped to scaffolds from the whole genome assembly that could be placed onto chromosomes in the *Hirundo rustica* draft genome. We based analyses on the 26,421 SNPs occurring in these sequenced regions. Here, we provide genome-wide evidence for a pattern of IBA controlling for IBD, with information on the general importance of sexual selection and adaptation for population genomic divergence among closely related populations of barn swallows, revealing mate choice selection as a likely critical mechanism for reduced gene flow in this system. (ID 15732)

**Salter, J. F.**, Occidental College, USA, jessie.salter@gmail.com  
**Maley, J. M.**, Occidental College, USA, jmaley@oxy.edu  
**McCormack, J. E.**, Occidental College, USA, mccormack@oxy.edu

#### SEQUENCING DNA FROM MUSEUM SPECIMENS ELUCIDATES DISPUTED LOCALITIES IN THE FULVOUS OWL (*STRIX FULVESCENS*)

In 1942, professional collector Mario Del Toro Aviles collected four specimens initially identified as *Strix fulvescens* in Totontepec, Oaxaca, Mexico. These are housed at the Moore Laboratory of Zoology (MLZ) at Occidental College. This species was not thought to occur on the west side of the Isthmus of Tehuantepec. In his 1989 publication, A Distributional Survey of the Birds of the Mexican State of Oaxaca, Laurence C. Binford cast doubt on the accuracy and reliability of Aviles' entire body of collection data. He specifically cited the locality where Aviles claimed to have collected these specimens, concluding, "all [his data] must be questioned." In recent years, however, birders have reported sightings of *S. fulvescens* in the same region of Oaxaca on eBird. Using toepads from fourteen *Strix* specimens in the MLZ, including Aviles' original four, we amplified mitochondrial genes cytochrome c oxidase subunit III (CO3) and NADH dehydrogenase 6 (ND6). Our findings elucidate Aviles' original locality information, the eBird sightings, and the question of a population of *S. fulvescens* west of the isthmus in the Oaxacan highlands. (ID 16127)

**Samuel, M. D.**, U.S. Geological Survey, USA, mdsamuel@wisc.edu  
**Atkinson, C. T.**, U.S. Geological Survey, USA, carter\_atkinson@usgs.gov  
**LaPointe, D. A.**, U.S. Geological Survey, USA, Dennis\_Lapointe@usgs.gov  
**Woodworth, B. L.**, University of New England, USA, BWoodworth@une.edu  
**Liao, W.**, University of Wisconsin - Madison, USA, wliao27@wisc.edu  
**Hart, P. J.**, University of Hawaii - Hilo, USA, pjhart@hawaii.edu

#### DISEASE IN HAWAIIAN FOREST BIRDS: CURRENT PATTERNS AND FUTURE THREATS<sup>†</sup>

The introduction of exotic organisms, including pathogens, is one of the most important factors contributing to avian extinctions on island ecosystems. Several key features have been blamed for the vulnerability of naive island populations to disease emergence including small host population size, limited genetic diversity, and reduced selection pressure from impoverished parasite communities. In addition, island systems may severely limit a species ability to respond or adapt to emerging diseases or increased disease threats caused by anthropogenic changes. In particular, better understanding disease dynamics and how ecological and environmental factors affect prevalence are crucial to assessing conservation needs and development of future management options. The introduction of mosquito vectors, avian pox, and avian malaria to the Hawaiian Islands provides a strategic example of the potentially devastating effects of exotic disease on island ecosystems. We will discuss factors driving similar transmission of these two pathogens in Hawaiian birds and the impacts of both diseases on bird populations.

Understanding disease dynamics and key drivers facilitates the future prediction of disease risk resulting from climate change and allows proactive evaluation of alternative conservation strategies. (ID 15848)

**Sanchez, C. C.**, National Audubon Society, USA, csanchez@audubon.org  
**Auer, M. T.**, National Audubon Society, USA, tauer@audubon.org  
**Wilsey, C. B.**, National Audubon Society, USA, cwilsey@audubon.org

#### DEVELOPING STRATEGIES FOR CONSERVING PRIORITY SITES FOR BIRD CONSERVATION: AN ANALYSIS OF THE U.S. IMPORTANT BIRD AREAS NETWORK

As part of a global initiative led by BirdLife International, the National Audubon Society and partners have identified over 2,600 Important Bird Areas, encompassing over 380 million acres across the United States representing focal sites for bird conservation. Sites have been identified using a standardized criteria framework for determining areas that support significant numbers of individual species. Over 230 stewardship groups are active at close to 400 sites, taking local action to protect and restore these places. Additional efforts are underway, focused on multiple sites at a regional scale. To further facilitate the development of conservation strategies and recommendations, we conducted a series of analyses aimed at increasing our understanding of this Important Bird Areas network at a national scale. We summarized target species, significance of sites, as well as habitats reported across the network. We determined the protection status and summarized ownership across the network and looked at threats reported across sites. In addition, to increase focus on an overarching threat, we estimated exposure to climate change at these priority sites based on output from multiple general circulation models downscaled to 10km resolution. Preliminary analyses of protected status and threats reveal that approximately 75 million acres of the Important Bird Areas network remains unprotected, with the top reported threats to the network in the general categories of invasive species, urbanization, and natural events. While many Important Bird Areas encompass a mix of ownerships, state and federally owned lands were reported with the highest rates across the network. (ID 16226 | Poster 44)

**Sanchez-Clavijo, L. M.**, University of Central Florida, Colombia, lina.sanchez@knights.ucf.edu  
**Hearn, J.**, University of Central Florida, USA, hearnj@knights.ucf.edu  
**Quintana-Ascencio, P. F.**, University of Central Florida, Mexico, Pedro.Quintana-Ascencio@ucf.edu

#### ECOLOGICAL TRAPS: MODELING HABITAT SELECTION FOR BIRDS IN HETEROGENEOUS LANDSCAPES.

Tropical agroforestry systems such as shade coffee plantations retain important portions of native forest biodiversity. However, novel habitats in heterogeneous landscapes can become ecological traps for breeding birds. We created a spatially-explicit, individually-based simulation model to predict effects of landscape structure on population dynamics under different types of habitat selection. This work complements five years of bird banding, surveys, nest monitoring, and landscape and vegetation characterizations in the Sierra Nevada de Santa Marta, Colombia. Simulations are initialized by generating a landscape which is colonized by a bird population, followed by yearly cycles of breeding, death, dispersal, census and sampling before reaching a stable population size. Besides manipulating landscape composition and configuration, we define habitat selection either as a categorical process with adaptive, neutral or maladaptive outcomes, or as a threshold of continuous canopy cover. The strongest determinant of population size was forest cover, but both landscape configuration and type of habitat selection affected the time it took for the population to stabilize. When birds preferred habitats with the highest offspring productivity, populations stabilized much faster than when they preferred those with the lowest. Due to differences in distances between preferred patches, populations stabilized

slower in landscapes with patchy rather than random configurations. Floater individuals and detectability differences between habitats may obscure detection of maladaptive habitat selection in the field. Our results suggest that negative impacts of ecological traps can be buffered by landscape structure. It is therefore important to determine conditions under which they may arise. Our model is highly adaptable, so findings can be applied to bird conservation in shade coffee and to general cases of mobile animals in heterogeneous landscapes. (ID 16305 | Poster 71)

**Sandercock, B. K.**, Kansas State University, USA, bsanderc@ksu.edu  
Winder, V. L., Benedictine College, USA, vwinder@benedictine.edu  
Casey, A. E., Kansas State University, USA, caseyae@gmail.com  
Mong, T. W., Wyoming Game and Fish Department, USA, twmong@wfg.state.wy.us  
Johnson, T. N., University of Wyoming, USA, tjohns67@uwyo.edu  
Odom, K. J., University of Maryland, USA, kjodom@gmail.com  
Strum, K. M., Point Blue, USA, kstrum@pointblue.org  
Alfaro, M., Universidad de la Republica, Uruguay, matilde.alfaro@gmail.com

#### BLAZING AND GRAZING FOR CONSERVATION: HABITAT USE BY UPLAND SANDPIPERS IN AN EXPERIMENTAL LANDSCAPE

Upland Sandpipers (*Bartramia longicauda*) are a terrestrial species of migratory shorebird that require native grasslands for breeding and migration. Intensification of grazing management for cattle production may impact habitat quality and reproductive success. We investigated space use and habitat-specific demography of sandpipers in an experimental landscape with different fire and grazing treatments in northeast Kansas. To investigate space use, we radio-tracked 37 sandpipers with intensive daily monitoring for a 2-year period. Resource utilization functions (RUF) based on individual home ranges showed preferences for higher elevation, recently burned areas, high stocking rates, and habitat edges. To investigate nest placement and nest survival, we monitored an average of 30 nests per year for a 9-year period. The strongest predictor of nest placement was burn treatment with preference for sites not recently burned. Nest placement affected reproductive success because the highest rates of nest survival were in unburned and ungrazed sites. Our demographic results indicate that conservation of Upland Sandpipers and other grassland birds will require partnerships with private landowners to reduce use of prescribed fire and grazing intensity. (ID 15849)

**Sandercock, B. K.**, Kansas State University, USA, bsanderc@ksu.edu  
Winder, V. L., Benedictine College, USA, vwinder@benedictine.edu  
Hagen, C. A., Oregon State University, USA, christian.hagen@oregonstate.edu  
Haukos, D. A., Kansas State University, USA, dhaukos@ksu.edu  
Kesler, D. C., University of Missouri at Columbia, USA, keslerd@missouri.edu  
Patten, M. A., University of Oklahoma, USA, mpatten@ou.edu  
Powell, L. A., University of Nebraska at Lincoln, USA, lpowell2@unl.edu

#### REGIONAL VARIATION IN THE SEASONAL SURVIVAL OF PRAIRIE CHICKENS\*

One challenge for managing harvest and other anthropogenic sources of mortality is understanding whether demographic impacts on bird populations will include compensatory or additive mortality. Models predict that anthropogenic mortality is likely to be additive in periods when natural mortality is low, but seasonal variation in survival has rarely been studied in birds. Nevertheless, most gamebird populations in North America are managed with autumn hunting seasons and set bag limits for daily harvest and possession. Current regulations assume that fall harvest is compensated by density-dependent competition that leads to overwinter mortality. Under this scenario, harvest of the 'doomed surplus' results in compensatory mortality. We used known fate models and hazard functions to investigate

seasonal patterns of mortality of radio-marked females in ten populations of Greater and Lesser Prairie-Chickens (*Tympanuchus* spp.). Predation was usually the main cause of death, and seasonal risk of mortality was greatest during incubation and brood-rearing when females were attending eggs or young. Unexpectedly, risk of mortality was often low during the nonbreeding season despite inclement weather, reduced food availability, and exposure to harvest. Seasonal patterns of mortality in prairie-chickens suggest that harvest is likely to be additive for most populations, particularly toward the end of the hunting season. Options for management could include shorter seasons, reduced bag limits for late season harvest, or use of proportional quotas. In the future, our modeling framework could be adapted to other problems in bird conservation such as mortality losses to energy development, commercial fishing, or collisions with anthropogenic structures. (ID 15854)

**Sandler, A. G.**, Andrews University, USA, sandler@andrews.edu  
Megna, L. C., University of Wyoming, USA, lmegna@uwyo.edu  
Henson, S. M., Andrews University, USA, henson@andrews.edu  
Hayward, J. L., Andrews University, USA, hayward@andrews.edu

#### EVERY-OTHER-DAY OVULATION SYNCHRONY, HIGH NESTING DENSITY, AND EGG LOSS IN A COLONY OF RING-BILLED GULLS (LARUS DELAWARENSIS)

Recently, every-other-day ovulation synchrony was demonstrated in Glaucous-winged Gulls (*Larus glaucescens*), the first known case of socially induced ovulation synchrony on a daily time scale in non-mammals. Here we report a second case of every-other-day ovulation synchrony, this time in a colony of Ring-billed Gulls (*Larus delawarensis*). As in Glaucous-winged Gulls, the level of synchrony increased with nest density, raising the possibility that ovulation synchrony may confer a selective advantage on gulls nesting at high densities. However, the probability of egg loss in the Ring-bill Gull colony also increased with nest density, complicating any simple adaptive interpretation. (ID 15872)

**Sandoval, L.**, Universidad de Costa Rica, Costa Rica, biosandoval@hotmail.com  
Méndez, C., Universidad de Costa Rica, Costa Rica, caritomendvasq@gmail.com

#### WHITE-EARED GROUND-SPARROW (MELOZONE LEUCOTIS) CALL IS A DOUBLE FUNCTION SIGNAL: THE IMPORTANCE OF THE CALL RATE\*

Two main mechanisms have been proposed to encode information into vocalizations, variation in the structure of the vocalization frequency or time domain characteristics and variation in the rate of the vocalization production. How important is each mechanism to encode information inside bird vocalizations is still in debate. We analyze the effect of rate variation on the double function of chip calls (contact and alarm function) produced by White-eared Ground-sparrows (*Melospiza leucotis*). We conducted an acoustic playback experiment in 38 territories in Costa Rica. We played back four chip call rates 12, 36, 60, and 84 calls/minute; and measured the response of the territorial pairs using behavioral responses and fine structural features of their vocal responses. White-eared Ground-sparrows showed more intense behavioral response to highest call rates (60 and 84 calls per minute) than they did to lowest call rates (12 and 36 calls per minute), showing that receivers respond according to the urgency of the signal. The characteristics of vocalizations produced in response to the playbacks (e.g., calls) were not influenced by the call rates, showing that these species are not varying the structure of the vocalization to encode different information. In conclusion, our results support the call rate as the main mechanisms to encode the dual function inside calls in this species. (ID 15759)

**Sardell, J. M.**, University of Miami, USA, jsardell@bio.miami.edu  
 Uy, J. A., University of Miami, USA, uy@bio.miami.edu

ASYMMETRIC GENETIC AND PHENOTYPIC INTROGRESSION  
 IN A RECENTLY-ESTABLISHED HYBRID ZONE  
 BETWEEN *MYZOMELA* HONEYEATERS\*

Hybridization and genomic introgression have important consequences for evolution and conservation, with several recent studies revealing evidence of historical introgression between currently reproductively-isolated taxa. However, few studies have directly observed genetic introgression during the early stages of natural secondary contact, likely due to the scarcity of such events. An example of such recent secondary contact is the two species of *Myzomela* honeyeaters, *M. tristrami* and *M. cardinalis*, on Makira in the Solomon Islands, the latter of which colonized from nearby satellite islands in the late 19th-century. Despite high levels of mtDNA divergence, hybridization between species is ongoing in sympatry. We collected 203 total individuals from 2 allopatric and 2 sympatric populations of each species and sequenced each at 1 mitochondrial and 6 nuclear markers. Mitochondrial introgression is unidirectional and extensive: 22% of sympatric *M. tristrami* and all phenotypic hybrids possessed *M. cardinalis* mtDNA haplotypes, while all sympatric *M. cardinalis* possessed conspecific haplotypes. This result is consistent with asymmetric mate preferences, as predicted by the Kaneshiro hypothesis, as well as with asymmetric hybrid viability. In contrast, shared DNA haplotypes and a population assignment analysis both reveal extensive bidirectional nuclear introgression within the hybrid zone. Intriguingly, 57% of phenotypic hybrids and 6% of sympatric *M. tristrami* strongly clustered with *M. cardinalis*, suggesting introgression of plumage-related alleles from the native to the invading species, a result that potentially poses important complications for many species concepts. (ID 16193)

**Sauer, J. R.**, USGS Patuxent Wildlife Research Center, USA, jrsauer@usgs.gov  
 Zimmerman, G. S., USFWS - Division of Migratory Bird Management, USA,  
 guthrie\_zimmerman@fws.gov

USING BBS AND THE ATLANTIC FLYWAY BREEDING WATERFOWL  
 SURVEY TO ESTIMATE COMPOSITE TRENDS OF WOOD DUCK IN  
 EASTERN NORTH AMERICA

The North American Breeding Bird Survey (BBS) provides extensive information on population change for >420 species of birds. It is a count-based omnibus survey; however, results among species vary widely in precision of estimates, and the population index provided by the analysis is not readily interpretable as a population size. A variety of additional regional surveys have been established in North America to ensure that reliable information exists for species of management interest. Combining information from these regional surveys with BBS data can provide more precise estimates of population change and provide a means of deriving population estimates for the BBS range. We describe a hierarchical modeling approach for combining BBS results with results from the regional Atlantic Flyway Breeding Waterfowl Survey (AFBWS), and scale BBS index to a population estimate. We implement this analysis for Wood Ducks in the Atlantic Flyway. The AFBWS uses 1 km square plots as its sample units, and was initiated in 1989 to provide population estimates for waterfowl in the Northeastern United States. We analyze both surveys using log-linear hierarchical models, controlling for factors influencing detection in both surveys, and adjust combined results to the level of the AFBWS. Both surveys indicate increasing populations, and the AFBWS results are more precise than BBS results for comparable time intervals. Regional abundances vary by physiographic regions, and we use those regions as the geographic scale for adjustment of the BBS. Initial results from the AFBWS indicate that the Wood Duck population in the Northeastern US has increased from approximately 900,000 birds in 1993 to 1.2 million in 2013. Scaling the BBS data in the

southeastern US and combining it with the AFBWS data, the model indicated that Flyway-wide population estimates were approximately 2 to 5 times greater than the estimate based only on the AFBWS survey area. (ID 16228)

**Saunders, S. P.**, University of Minnesota Twin Cities, USA, saund196@umn.edu  
 Cuthbert, F. J., University of Minnesota Twin Cities, USA, cuthb001@umn.edu

GENETIC AND ENVIRONMENTAL INFLUENCES ON FITNESS-RELATED  
 TRAITS IN AN ENDANGERED SHOREBIRD POPULATION\*

Adaptation depends on the additive genetic variance for fitness and its component traits. Yet few estimates of additive genetic variance and heritability are available for wild populations because determining relatedness of individuals is difficult. We used 20 years (1994-2013) of phenotypic records from mark-recapture data and a multi-generational pedigree to estimate quantitative genetic variation in three fitness-related traits in Great Lakes piping plovers (*Charadrius melodus*), an endangered wild shorebird population. Genetic and environmental components of variance as well as heritabilities were estimated using Bayesian inference for animal models. Phenotypic variation in chick body condition was composed of a significant additive genetic component ( $h^2 = 0.27$ ; 95% credible interval: 0.16 – 0.38), and hatch year, common maternal environment, and hatch site effects. Conversely, natal dispersal distance and female breeding time were not significantly heritable ( $h^2 = 0.03$ ; 95% CI: 0.0 – 0.11;  $h^2 = 0.08$ , 95% CI: 0.0 – 0.22, respectively). Rather, environmental factors (e.g., breeding site) are the main sources of variation in these two traits. Variation in female breeding time was minimally influenced by her mate and was moderately repeatable. The low potential for natal dispersal and breeding time to evolve may limit the ability of this population to adapt to climate change long-term. However, trait alteration could occur by a phenotypically plastic response, allowing rapid adjustment to novel environmental conditions and short-term persistence. Future studies should use quantitative genetic parameters estimated from wild populations to better understand the demographic consequences of climate change on population persistence, especially for those already endangered. (ID 15866)

**Sausner, J. S.**, California State University Northridge, USA, josh.  
 sausner.259@my.csun.edu

Hertel, F., California State University Northridge, USA, fritz.hertel@csun.edu  
 ECOMORPHOLOGY OF STORM-PETRELS ALONG THE PACIFIC COAST  
 OF THE AMERICAS

Storm-petrels are among the smallest seabirds and exhibit high levels of taxonomic diversity in the eastern Pacific Ocean. The storm-petrel family (Hydrobatidae) is currently split into two subfamilies that may represent a paraphyletic assemblage. Some storm-petrels exhibit a unique foraging behavior, known as pattering, in which they appear to walk on the surface of the water. This behavior is used to a varying degree among species, ranging from those that patter exclusively to those that do not. It is unclear if the use of this foraging strategy is ancestral or if other selective pressures have caused it to evolve multiple times. This study compares aspects of morphology in storm-petrels that breed in the eastern Pacific and are related to this unique foraging behavior. We contrasted wing loading and aspect ratio to compare wing size and shape, respectively. We also calculated foot loading as an indicator of the amount of drag generated by the feet during pattering. Lastly, thin-plate spline analysis was used to compare relative warps of wings and discriminate any minor differences among species. Morphological differences were found between patterers and non-patterers. Morphology associated with optimal pattering performance was found mainly in one of the two subfamilies, but morphological data for the remaining species are still pending. (ID 15823)



**Scarl, J. C.**, Vermont Center for Ecostudies, USA, jscarl@vtecostudies.org  
 Foss, C., New Hampshire Audubon, USA, cfoss@nhaudubon.org  
 Demarest, D., U.S. Fish and Wildlife Service, USA, dean\_demarest@fws.gov  
 Heyden, K., Kentucky Department of Fish and Wildlife Resources, USA, kathryn.heyden@ky.gov  
 Sinclair, P., Canadian Wildlife Service, USA, pam.sinclair@ec.gc.ca

#### MOBILIZING TWO COUNTRIES FOR CONSERVATION: RUSTY BLACKBIRD SPRING MIGRATION BLITZ

Effective conservation of migratory species demands a full life-cycle approach that considers all phases of a species' ecology. While our understanding of Rusty Blackbird breeding and wintering ecology has increased dramatically over the past two decades, knowledge of basic migratory biology lags behind. The International Rusty Blackbird Working Group launched a three-year Rusty Blackbird Spring Migration Blitz in 2014 to determine important migratory stopover sites for Rusty Blackbirds and assess consistency of numbers and timing of stopover occurrence. In addition, the Blitz aims to engage the birding community to create increased awareness of Rusty Blackbirds as well as strengthen relationships between state, federal, and private organizations to promote Rusty Blackbird conservation. 38 states, 9 Canadian provinces, 3 Canadian territories, and the District of Columbia participated in the 2014 Blitz between 1 March and 15 June, with staggered target observation windows based on peak migration dates for each region. Outreach efforts focused on encouraging birders to search for Rusty Blackbirds and report their sightings to eBird. During March 2014, birders submitted 3613 eBird checklists with Rusty Blackbird observations, a 52% increase over the same period in 2013. April showed similar increases; birders submitted 6281 checklists containing Rusty Blackbirds, a 41% increase from April 2013. In 2015, our efforts will focus on revisiting areas where Rusties congregated in 2014 to evaluate consistency and timing of site use; we will also continue to increase our outreach efforts to raise the profile of this vulnerable species. Ultimately, these data will be used to target conservation efforts that will benefit Rusty Blackbirds during their northward migration. (ID 16137)

**Schaming, T. D.**, Cornell University, USA, tds55@cornell.edu

#### CLARK'S NUTCRACKER DEMOGRAPHY AND HABITAT SELECTION IN THE FACE OF HABITAT DECLINE\*

To understand processes underlying forest decline and potential for recovery, I am evaluating whether Clark's nutcrackers (*Nucifraga columbiana*), and hence their functional role as seed dispersers, can persist in the Greater Yellowstone Ecosystem in the face of habitat decline. Over five years, through radio tracking and conducting occupancy surveys, I documented nutcracker reproductive success, habitat selection, foraging ecology and occupancy in areas with variable whitebark pine (*Pinus albicaulis*) mortality. No breeding was observed to occur population-wide during two years: both of these nonbreeding years followed an autumn with a low regional whitebark pine cone crop, and occurred during springs with high snowpack. I examined how whitebark pine cone crop density, local conifer composition, and regional landscape composition correlated with nutcracker occupancy. After correcting for detectability, model results suggested that nutcrackers track the whitebark pine cone crop during the autumn harvest season, and there is a strong positive influence of local whitebark pine importance value and landscape scale proportion of whitebark pine on nutcracker occupancy throughout the year. This suggests nutcrackers select areas with greater healthy whitebark pine habitat, though radio-tracking data (n = 76 nutcrackers) show a strong relationship between daily movements and ephemeral food availability. With habitat suitability models, I predicted which forest communities surviving within the nutcracker range will be sufficient to support nutcrackers populations, and the threshold at which stability of the Clark's nutcracker - whitebark pine mutualism will begin to break down (i.e. when nutcrackers avoid stands and thus do not disperse seeds). This

study informs conservation efforts, and is a rare opportunity to understand both mutualism breakdown potential and the capacity of a bird population to respond via habitat selection. (ID 16161)

**Schofield, L. N.**, Eastern Illinois University, USA, schofield.lynn@gmail.com  
 Deppe, J. L., Eastern Illinois University, USA, jldeppe@eiu.edu  
 Smolinsky, J., University of Delaware, USA, jacs3@optonline.net  
 Bolus, R., U.S. Geological Survey, USA, rbolus@usgs.gov  
 Ward, M., University of Illinois, USA, mpward@illinois.edu  
 Diehl, R., U.S. Geological Survey, USA, rhdiehl@usgs.gov  
 Moore, F., University of Southern Mississippi, Frank.Moore@usm.edu  
 Zenzal, T., University of Southern Mississippi, USA, tjzenzal@gmail.com

#### SMALL-SCALE MOVEMENT STRATEGIES OF MIGRATORY SONGBIRDS AT A STAGING AREA ALONG THE GULF OF MEXICO

Every autumn, millions of songbirds cross the Gulf of Mexico to reach their tropical wintering grounds. How birds prepare for this journey is presumed to have a major influence on migratory success. Using automated radio-telemetry systems on both sides of the Gulf of Mexico (Coastal Alabama and the Yucatan Peninsula), this study is the first that has been able to track individual songbirds at both side of such a large geographic barrier. This makes it possible to directly link behaviors of individual birds as they prepare to cross the gulf to their probability of arriving on the other side. At a coastal site on the Fort Morgan peninsula in Alabama we monitored small-scale movements, an estimation of foraging activity, in five focal species of trans-gulf migrants, each with different flight behaviors, wing morphologies, and final wintering destinations. The overall amount of movement and the timing of activity varied between species, revealing a common pre-migration strategy shared by individuals of each species we tracked. Unexpectedly, within a species movement behavior was not observed to be altered in response to differences in the age or body condition of the individual, nor were activity rates found to impact a bird's probability of arrival in Yucatan. Rather than adjusting their movement behavior, individuals in poor condition instead returned to the north. This indicates that such coastal locations may not necessarily act as refueling sites for many species, but instead as staging areas. (ID 16035 | Poster 52)

**Schondube, J. E.**, Universidad Nacional Autónoma de México, Mexico, chon@cieco.unam.mx  
 Maya-Gracia, O., Universidad Nacional Autónoma de México, Mexico, bonham\_maya@yahoo.com.mx

#### HIGH ELEVATION HUMMINGBIRD PHYSIOLOGY: SOLVING THE CHALLENGES OF MEETING HIGH ENERGY REQUIREMENTS AT LOW TEMPERATURES

The digestive capacities of organisms limit their food intake, restraining the amount of nutrients and energy they can obtain. Hummingbirds have high digestive capacities to assimilate the sugars present in the floral nectar they use as food. They also have high metabolic costs. As a result they live on the verge of a negative energy balance, a situation in which fat reserves are crucial to survive harsh environmental conditions. Here we used enzymatic activity and enzyme kinetics to describe the digestive capacity of the members of a high elevation hummingbird community (3400 masl) in West Mexico. We related digestive capacity with the hummingbirds' ability to build fat reserves. Additionally we related digestive capacity with use of torpor, feeding strategies, behavioral dominance, and hummingbird abundance. We found a clear relationship between digestive capacity and the ability to build fat. Additionally, the use of torpor was negatively related to the ability to build fat. We found that hummingbirds presented two types of strategies: 1) to be dominant and aggressive, defending high energy territories and presenting intermediate to low densities; and 2) to be non aggressive, non territorial and presenting high densities. These strategies were closely related to their capacities to build body fat and use torpor. (ID 16332)

**Schrage, A.**, University of California, Museum of Vertebrate Zoology, USA, alma.schrage@berkeley.edu

Cicero, C., University of California, Department of Integrative Biology, Museum of Vertebrate Zoology, USA, ccicero@berkeley.edu

Bowie, R., University of California, Department of Integrative Biology, Museum of Vertebrate Zoology, USA, bowie@berkeley.edu

#### GEOGRAPHIC AND TEMPORAL VARIATION IN SONGS OF BAEOLOPHUS INORNATUS AND B. RIDGWAYI

We studied song variation within and between populations of the Oak Titmouse (*Baeolophus inornatus*) and Juniper Titmouse (*Baeolophus ridgwayi*) in western North America, as well as temporal song variation in *B. inornatus* at the Hastings Natural History Reservation, Monterey County, California. These two sibling species occupy different ecoregions, with *B. inornatus* occurring in oak woodlands along the Pacific slope and *B. ridgwayi* preferring pinyon-juniper woodland in the interior. The range of *B. inornatus* is more continuous than that of *B. ridgwayi*, where isolation of suitable habitat has resulted in disjunct populations. The distributions of the two species are separate except for a narrow contact zone in northern California. We analyzed over 17,000 songs from more than 200 individuals, and measured a number of variables on sound spectrographs to quantify the frequency and temporal characteristics of songs. Our comparison of songs identified at least 381 unique types. *Baeolophus inornatus* has a larger repertoire of song types at the population and species level compared to *B. ridgwayi*. Although populations of *Baeolophus ridgwayi* are more isolated geographically compared to *B. inornatus*, they had a higher occurrence of song sharing. Temporal comparison of *B. inornatus* songs from two time periods (1965 versus 2000) revealed a high level of turnover in song types over time, but with conservation of certain song types. (ID 15825)

**Schroeder, M. A.**, Washington Department of Fish and Wildlife, USA, michael.schroeder@dfw.wa.gov

Shirk, A. J., University of Washington, USA, ashirk@uw.edu

Robb, L. A., USA, robblar@homenetnw.net

#### LONG TERM CHANGES IN DISTRIBUTION, ABUNDANCE AND ELEVATION OF GROUSE IN WESTERN NORTH AMERICA: IS CLIMATE CHANGE A FACTOR?

Ten of the 12 grouse species in North America are found in montane regions, from the basins to the alpine. These grouse offer a unique opportunity to examine long-term anthropogenic impacts, including climate change, because they occupy a broad range of native ecosystems across many elevational gradients. Grouse are also non-migratory on a regional scale, thus making them dependent on connections between areas of potential occupancy. We focus on the distribution and abundance of 3 species including greater sage-grouse (*Centrocercus urophasianus*), Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*), and Franklin's spruce grouse (*Falcipecten canadensis franklinii*). The greater sage-grouse, first described in print by Meriwether Lewis as the cock of the mountains, has encountered a dramatic reduction in both distribution and abundance with populations being lost disproportionately in the south and/or in relatively low elevation ecosystems. Similar trends/losses have been noted for the sharp-tailed grouse, despite the fact that it was historically adapted to higher elevational habitats than sage-grouse. For example, in the state of Washington, both species are increasingly found in isolated pockets of relatively high elevation habitat, often separated from each other by further distances than their usual dispersal movements. Franklin's spruce grouse is found in high elevation conifer forests in portions of S British Columbia, SW Alberta, and NW USA. Populations have been dramatically impacted by the combined effects of pine beetles, intensive forestry practices, and wildfire. Although it is difficult to be certain that any of these effects is directly related to climate change, habitat degradation at low elevations has resulted in an upshifting in the remaining habitat for all 3 species. (ID 16369)

**Scopel, L. C.**, University of New Brunswick, Canada, l.c.scopel@gmail.com

Diamond, A. W., University of New Brunswick, Canada, diamond@unb.ca

#### COLONY COLLAPSE IN AN ARCTIC TERN METAPOPULATION: FOOD, WEATHER, OR PREDATION?

Machias Seal Island (MSI) once held the largest colony of Arctic Terns (*Sterna paradisaea*) in North America (~2,800 pairs). MSI accounted for at least 50% of the regional Arctic Tern metapopulation in the Gulf of Maine (GOM) in the 1990s and early 2000s, when the metapopulation was increasing. In 2006, however, the MSI colony abandoned breeding mid-season, following two consecutive years of low breeding success; they have abandoned breeding in every year since. Only two chicks have hatched between 2007-2013, and none have fledged. The metapopulation has since experienced rapid declines, totaling 42% since 2007 (Gulf of Maine Seabird Working Group, unpublished data). This crash has caused much speculation regarding Arctic Tern nesting success in the GOM, including concern over the sustainability of the metapopulation. The collapse of the MSI colony was the first indication of metapopulation instability, and may have been a cause of its subsequent decline, yet the cause of MSI's collapse was unclear. We analyzed trends in Arctic Tern nesting success on MSI in 1995-2005 using logistic regression, focusing on predictors of food, weather, and predation. Contrary to our expectation, there was no support for a role of herring, a high-quality food, as a predictor of nest success on MSI. Predation and weather, especially rain during the first week of a chick's life, were the best supported predictors of nesting success. The high rate of predation at MSI is unique in this region, where lethal control is employed on Herring (*Larus argentatus*) and Great Black-backed Gulls (*L. marinus*) in all other major seabird colonies. Without a drastic change in predator management on MSI, recovery of this tern colony is unlikely. (ID 16292)

**Scordato, E.**, The University of Colorado, USA, elizabeth.scordato@colorado.edu

Wilkins, M., The University of Colorado, USA

Semenov, G., Institute for systematics and ecology of animals, Russian Federation

Rubtsov, A., State Darwin Museum, Russian Federation

Kane, N., The University of Colorado, USA

Parchman, T., The University of Nevada, USA

Buerkle, A., The University of Wyoming, USA

Safran, R., The University of Colorado, USA

#### PHENOTYPIC AND GENOMIC CLINES IN TWO BARN SWALLOW CONTACT ZONES

During the early stages of speciation, gene flow is restricted among populations, leading to the formation of barriers to reproduction. However, it is increasingly clear that reproductive barriers can arise among groups that exchange genes, particularly in phenotypically divergent populations where selection opposes the homogenizing effects of gene flow. Hybrid zones, where two divergent groups come into contact with each other, are thus useful for studying interactions between selection and gene flow in the formation and maintenance of reproductive barriers. The barn swallow complex (*Hirundo rustica*), comprised of six globally distributed subspecies, is a recent radiation that is believed to have diverged in the last 27,000 to 100,000 years. Five of the six named subspecies share range borders, resulting in the opportunity for hybridization and ongoing gene flow. Despite recent divergence and shared range borders, there is extensive variation in sexually selected traits (plumage color and tail streamer length) and body size among populations, suggesting that these traits may contribute to assortative mating population divergence. However, the degree of reproductive isolation among subspecies is unknown. To examine potential evidence for hybridization (or lack thereof) among subspecies, we conducted a >10,000 km transect across Russia, bisecting the ranges of three subspecies (H.

r. rustica, H. r. tyleri, and H. r. gutturalis), and two contact zones (rustica-tyleri, and tyleri - gutturalis). We present data on genetic structure and patterns of gene flow based on analysis of >11,000 SNPs, which reveal evidence for hybridization across both contact areas. We analyze both phenotypic and genomic clines and consider a potential role for sexual selection in the maintenance of reproductive isolation. (ID 15858)

**Seavy, N. E.**, Point Blue Conservation Science, USA, nseavy@pointblue.org  
 Cormier, R. L., Point Blue Conservation Science, USA  
 Golet, G., The Nature Conservancy, USA  
 Kelsey, R., The Nature Conservancy, USA  
 Gardali, T., Point Blue Conservation Science, USA

#### HOW DO WE DESIGN RESTORATION FOR RIPARIAN BIRDS? CHALLENGES AND OPPORTUNITIES

Restoration design is the process of decision making that guides investments in restoration. These investments may range anywhere from allowing vegetation to recover by excluding livestock to returning hydrological function to a river bed by removing a dam or levee. The challenge is to match the restoration design to the project goals. In California, one goal of riparian restoration design is to create habitat for riparian birds. Traditionally, the design of these projects has been informed by correlative studies of habitat associations. Our recent work to evaluate habitat associations of birds that winter in riparian scrub and riparian grassland systems is extending this information beyond the riparian forest context that has been the focus of most wildlife habitat restoration. Additionally, we are increasingly able to use large-scale experiments to test the hypotheses generated by correlational habitat associations. On the Cosumnes River, we have established experimental plots where three different restoration designs (passive, low planting investment, and high planting investment) will be applied. In aggregate, this body of work is allowing us to design tools for quantifying the expected habitat value of restored riparian areas for birds. These tools are being used to develop a market-based mechanism, the Central Valley Habitat Exchange, which will provide landowners with incentives for creating riparian bird habitat. (ID 16272)

**Sechrist, J. D.**, Bureau of Reclamation, Technical Service Center, USA, jsechrist@usbr.gov  
 Ahlers, D. D., Bureau of Reclamation, Technical Service Center, USA, dahlers@usbr.gov  
 Paxton, E. H., United States Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, USA, epaxton@usgs.gov  
 Doster, R. H., United States Fish and Wildlife Service, Pacific Southwest Region Migratory Bird Program, USA, rob\_doster@fws.gov  
 Ryan, V. M., United States Bureau of Reclamation, Albuquerque Area Office, vryan@usbr.gov

#### HOME RANGE AND MIGRATION STUDIES OF THE YELLOW-BILLED CUCKOO IN NEW MEXICO

The Bureau of Reclamation (Reclamation) has documented movement, home range, and migration strategies of Yellow-billed Cuckoos (*Coccyzus americanus*) on the Middle Rio Grande (MRG) and Pecos Rivers (PR) in New Mexico (NM). Within the MRG, Reclamation studied home range and habitat use of cuckoos in 2007 and 2008. Nine of 13 cuckoos were tracked for sufficient time to generate home range estimates. Overall size of home ranges for the two years was 91 ha (100% MCP) and 62 ha (95% KHR). Home ranges varied among individuals and use of habitat differed between core areas and overall home ranges, but the differences were non-significant. Home ranges calculated for Western Yellow-billed Cuckoos on the MRG are larger than those in other southwestern riparian areas. In 2009, Reclamation studied cuckoo migration by capturing 13 birds within the MRG, attaching a 1.5g geolocator to each. In 2010, one of the cuckoos was recaptured. The cuckoo flew approximately 9,500 km during its southward migration, traveling

through Central America to winter in Bolivia, Brazil, Paraguay, and Argentina. The spring migration route differed from the fall, with the cuckoo bypassing Central America to migrate through the Caribbean. During the migration, the cuckoo appeared to use portions of the PR in NM. It is believed that the distributional range of the two recognized subspecies of cuckoo (*C. a. occidentalis* Western and *C. a. americanus* or Eastern) are roughly bounded by the PR; therefore, questions arose regarding the migration pattern of cuckoos within the PR Basin. In 2011, Reclamation implemented a migration study for this species along the PR between Brantley Dam and Lake Avalon, NM. Nine cuckoos were instrumented with 2.8g geolocator and released over two years, resulting in one recapture. The geolocator provided an incomplete data-set, thus the migration strategies of Yellow-billed Cuckoos within the PR Basin of NM remains unknown. (ID 15900)

#### **Sehgal, R. N.**, San Francisco State University, USA, sehgal@sfsu.edu MANIFOLD HABITAT EFFECTS ON THE PREVALENCE AND DIVERSITY OF AVIAN HEMATOZOA<sup>†</sup>

The effects of rapid global environmental changes on parasite distributions are diverse and despite potential consequences to ecosystem health, large-scale studies involving wildlife have been scarce. Here we present data of the effects of deforestation and global climate change on the prevalence and diversity of blood parasites in birds ranging from the tropics to the arctic. Using complementary techniques of blood smear analysis and molecular biology, samples are assayed for species of *Plasmodium*, *Haemoproteus*, *Leucocytozoon* and *Trypanosoma*. We have obtained results regarding the host-specificity, prevalence and lineage diversity of these parasites in several communities of birds from Africa, Central and South America, California and Alaska. We find that habitat degradation leads to altered patterns of parasite prevalence and disruptions in parasite species dominance. We also present data on how habitat and climatic conditions may affect the evolution of specialist vs. generalist strategies in avian malaria. Our work incorporates satellite imagery and bioclimatic data to quantify differences among the collection sites, and predict how habitat changes may affect the spread of infections. We have also initiated studies on genes involved in host specificity, with the characterization of erythrocyte invasion genes from the chicken parasite *P. gallinaceum*. With our long-term agenda to discern the interplay between habitat, vector ecology, and genetics on the host-specificity of parasites, we emphasize that influences of land use changes on parasite prevalence are complex, and will require the detailed study of the vector ecology, and the further quantification of fine-scale habitat effects. Through time, our multidisciplinary approach will aid in predicting how habitat changes will influence future scenarios of host-parasite interactions. (ID 16177)

**Semenov, G.**, Institute of Systematics and Ecology of Animals of Siberian Branch of Russian Academy of Sciences, Russian Federation, motacilla@bk.ru  
 Drovetski, S. V., Department of Natural History, Tromsø University Museum, University of Tromsø, Norway, sdrovetski@gmail.com  
 Gay, L., INRA UMR AGAP, France, gayl@supagro.inra.fr  
 Derryberry, G., Museum of Natural Science, Louisiana State University, USA, g.derryberry@gmail.com  
 Khaydarov, D. R., Institute of Systematics and Ecology of Animals of Siberian Branch of Russian Academy of Sciences, Russian Federation, davidson\_avis@yahoo.com  
 Malykh, I. M., Institute of Cytology and Genetics of Siberian Branch of Russian Academy of Sciences, Russian Federation

#### WHEN WAGTAILS GET UNMASKED: HYBRIDIZATION, INTROGRESSION AND INCOMPLETE LINEAGE SORTING BETWEEN THE WHITE AND THE MASKED WAGTAILS

The nominative white wagtail (*Motacilla alba alba*) and the masked wagtail (*M. a. personata*) are considered subspecies, but their taxonomic status is



debated. The predominance of parental phenotypes across their hybrid zone suggests partial reproductive isolation; however, the geographic pattern of mitochondrial DNA (mtDNA) variation indicates either a lack of reproductive isolation or incomplete lineage sorting. This study aimed to test the hypothesis that a bimodal phenotype distribution is a good predictor of reproductive isolation in the alba-personata hybrid zone. We compared patterns of genetic introgression in one mtDNA gene and 19 microsatellite loci with clines in plumage coloration and morphometric data from 294 individuals collected along a transect across a hybrid zone in southern Siberia. The hybrid zone was only 54 km wide for plumage coloration but nearly an order of magnitude wider for molecular markers and morphometry. Analysis of the phenotypic scores revealed that the coloration features that mainly distinguish the subspecies are controlled by a single locus with partially dominant inheritance of the alba allele. The cline analyses revealed asymmetric gene flow towards personata in morphometry, mtDNA and one of the Z-linked MS. Analysis of linkage disequilibrium detected a strong reproductive barrier in plumage coloration but only a weak barrier in the molecular markers. Thus, the strong selection on plumage patterns restricts gene flow only for some genomic regions because these patterns are encoded by a single partially dominant locus with large phenotypic effect, whereas a substantial part of the genome undergoes extensive asymmetric introgression. (ID 15774)

Sesnie, S. E., USFWS, USA, [steven\\_sesnie@fws.gov](mailto:steven_sesnie@fws.gov)  
Mueller, J. M., USFWS, USA, [jim\\_mueller@fws.gov](mailto:jim_mueller@fws.gov)  
**Lehnen, S. E.**, USFWS, USA, [sarah\\_lehnen@fws.gov](mailto:sarah_lehnen@fws.gov)  
Rowin, S. M., USFWS, USA, [scott\\_rowin@fws.gov](mailto:scott_rowin@fws.gov)

#### CHARACTERIZING GOLDEN-CHEEKED WARBLER HABITAT USING LIDAR AND NAIP-CIR IMAGERY

The endangered Golden-cheeked Warbler (*Setophaga chrysoparia*) nests exclusively in late successional stages of oak and Ashe juniper woodland habitat in Central Texas, including remnant habitat at the 10,000 ha Balcones Canyonlands National Wildlife Refuge (BCNWR). We combined point count data (n=250) collected at BCNWR during the 2012 breeding season with fine-scale habitat information derived from light detection and ranging (LiDAR) data and high-resolution National Agriculture Imagery Program color infrared (NAIP-CIR) aerial photography to develop distance sampling-based models of warbler density. We developed competing models of warbler detection and density containing features such as successional stage, ratio of juniper to broadleaf canopy cover, and measures of woodland complexity and then compared these models using the 'distsamp' function from the 'unmarked' package in program R. Detection probability was negatively related to canopy cover (trees above 1 m) and positively related to more rugged terrain. The density model with the greatest support indicated that warbler density peaked in areas of high canopy cover, 70:30 ratios of juniper to broadleaf cover, and lower solar radiation areas characteristic of steep canyon slopes with late successional oak-juniper woodlands. Maps of warbler density estimated a total of 785 (95% CI 578, 1080) male warblers on BCNWR during 2012. These maps are also being used to prioritize conservation and habitat restoration activities. LiDAR, in combination with other high-resolution remotely-sensed data, can characterize fine-scale avian habitat relationships at the local-to-regional level. (ID 16208)

**Shah, S. S.**, Cornell University, USA, [sss253@cornell.edu](mailto:sss253@cornell.edu)  
Bonter, D. N., Cornell University, USA, [dnb23@cornell.edu](mailto:dnb23@cornell.edu)  
MacLean, S. A., University of California Berkeley, USA, [maclean@berkeley.edu](mailto:maclean@berkeley.edu)  
Greig, E. I., Cornell University, USA, [eig9@cornell.edu](mailto:eig9@cornell.edu)

#### RISK-BASED ALARM CALLING IN HERRING GULLS

Recent studies have demonstrated the presence of referential and risk-based variation in alarm calling in many vertebrate species. Most of the studies

on birds, however, have focused on passerine systems. This is perhaps due to the traditional view that passerine vocalizations are more complex, since passerines have a more developed syrinx and the ability to sing complex songs. I investigated the presence of a risk-based alarm calling system in a non-passerine and found that herring gulls communicate threat urgency in their alarm calls using frequency and time parameters. Sound recordings indicated that herring gulls increase the peak and center frequency of their alarm calls, as well as the rate of calling with increase in perceived threat level. Playback experiments showed that conspecifics pay attention to both parameters and respond most urgently to playbacks of high frequency calls at a high call rate. A less urgent response to high frequency calls at a low call rate and low frequency calls at a high call rate suggests that herring gulls threat urgency information must be reinforced by both call type and call rate in this system. (ID 15778)

**Shapiro, B.**, University of California, Santa Cruz - Dept. of Ecology and Evolutionary Biology, Santa Cruz, USA, [bashapir@ucsc.edu](mailto:bashapir@ucsc.edu)  
Green, R. E., University of California, Santa Cruz - Biomolecular Engineering, Santa Cruz, USA, [ed@soe.ucsc.edu](mailto:ed@soe.ucsc.edu)  
Rodrigues Soares, A. E., University of California, Santa Cruz - Dept. of Ecology and Evolutionary Biology, Santa Cruz, USA, [aersoares@gmail.com](mailto:aersoares@gmail.com)  
Novak, B., University of California, Santa Cruz - Dept. of Ecology and Evolutionary Biology, Santa Cruz, [raphus.bjn@gmail.com](mailto:raphus.bjn@gmail.com)

#### THE GENOMICS OF EXTINCTION: USING ANCIENT DNA TO UNDERSTAND THE RISE AND FALL OF THE PASSENGER PIGEON<sup>†</sup>

Passenger Pigeon populations declined from billions of individuals to extinction within only a few decades. The reasons for their ultimate extinction remain a matter of some debate, but it seems clear that overexploitation by humans was the most important driver of their rapid decline. It is less clear, however, why Passenger Pigeon populations were as large as they were when Europeans first arrived in North America. One way to address why the population was so large is to better understand when the growth leading to their enormous flocks began. Using ancient DNA and next-generation sequencing technologies, we sequenced and assembled complete genome sequence from two Passenger Pigeons and from a Band-Tailed Pigeon, which is the closest living relative to the Passenger Pigeon. These data indicated that Passenger Pigeon populations were not always extremely large, but instead fluctuated considerably in size, several times, over geological time, with the most recent increase in size occurring within the last 50,000 years. In this presentation, we present a new analysis of these genomic data and of complete mitochondrial genome sequences from 25 Passenger Pigeons. We explore alternate hypotheses about when Passenger Pigeon populations began to increase. For example, did populations increase at the transition into the Holocene? Or, did populations begin to increase much later, perhaps when parts of eastern North America were converted into agricultural land? We discuss our results in the context of ecological changes and changes in available habitat throughout the last 50,000 years. Finally, we compare the genome sequences of the Passenger Pigeon and Band-Tailed Pigeon with other bird genomes to better understand how Passenger Pigeons may have been shaped by natural selection. (ID 16337)

**Shave, M. E.**, Michigan State University, USA, [shavemeg@msu.edu](mailto:shavemeg@msu.edu)  
Lindell, C. A., Michigan State University, USA, [lindellc@msu.edu](mailto:lindellc@msu.edu)  
DIET AND PROVISIONING BEHAVIOR OF AMERICAN KESTRELS IN AN ORCHARD NEST BOX SYSTEM

Biological control of crop-damaging species via a native predator is an appealing management strategy that concurrently addresses agricultural and conservation needs. The American Kestrel (*Falco sparverius*) is a potentially important predator that has shown long-term population declines. Kestrels hunt in open habitats, including agricultural fields and orchards that often

lack natural nest cavities, but they will occupy nest boxes in these areas. Many potential kestrel prey species cause damage in orchards; however, kestrel diet composition varies seasonally and geographically. As part of an investigation of the potential for kestrels to limit prey activity in orchards, this study assessed the diets and provisioning behavior of kestrels occupying nest boxes in Michigan cherry and apple orchards. In 2013, prey deliveries to eight nests were recorded using nest box video cameras. Approximately 125 total hours of video were recorded between days 0 and 22 of the nestling period. The average provisioning rate was 5.7 deliveries per hour, and females made 83.2% of recorded deliveries. The most common prey types were terrestrial arthropods, mammals, and birds (93.6%, 3.1%, and 2.1% of total deliveries, respectively). A preliminary mixed effects model suggests that the number of deliveries increased with nestling age. The videos, along with collected pellet and prey remains, show that the kestrels captured prey known to damage orchards, including grasshoppers, voles, and passerine birds such as the European Starling and American Robin. Additional data will be collected in 2014 to assess whether diet composition changes with nestling age, year, or timing of the nestling period. (ID 16189 | Poster 76)

**Shew, J. J.**, Southern Illinois University Carbondale, USA, justin.shew@siu.edu  
Sparling, D. W., Southern Illinois University Carbondale, USA, dsparl@siu.edu  
Nielsen, C. K., Southern Illinois University Carbondale, USA, kezo92@siu.edu

#### GRASSLAND BIRD RESPONSE TO MID-CONTRACT MANAGEMENT AND MULTI-SCALE FACTORS ON PRIVATE CONSERVATION RESERVE PROGRAM LANDS

Many avian conservationists anticipated that the establishment of the Conservation Reserve Program (CRP) in 1985 would alleviate grassland bird population declines. However, despite the advantage of additional habitat, without disturbance, grasslands quickly degrade through secondary succession. In 2003, the USDA mandated that all new CRP contracts require mid-contract management (MCM) to improve CRP for early-successional wildlife. We are examining avian response, including relative species density, species richness, nest richness, and nest daily survival, to 3 MCM practices and multi-scale factors on 30 smooth brome (*Bromus inermis*) and 24 native grass fields in northwestern Illinois. Treatments include idle (control), light disking, herbicidal spraying, and spraying with forb interseeding. Using generalized linear models to assess the explanatory variables of field size and grass type, field size ( $\beta = 0.64 \pm 0.16$  SE; 0.33, 0.95 CI 95%) was a significant predictor of species richness. Other avian responses were not predicted by field size or grass type for 2011, a pre-MCM year. Combining all field seasons at present (2011-2013), there was only a difference in means between year and grass type for relative density but not for the two-way interaction term between year and grass type ( $1 \leq df \leq 2$ ;  $0.66 \leq F \leq 19.89$ ;  $0.01 \leq P \leq 0.52$ ). Mean nest richness differed among years, but not between grass types or within the two-way interaction ( $1 \leq df \leq 2$ ;  $0.55 \leq F \leq 4.62$ ;  $0.01 \leq P \leq 0.58$ ). Avian species richness and daily nest survival were not predicted by field size or grass types. When treatment was added to the analysis, a treatment effect was only significant in the two-way interaction with grass type for relative density. ( $df = 2$ ,  $F = 4.22$ ,  $P = 0.01$ ). Future analyses will assess between-field variation and detection probability with mixed-effects models and help elucidate effects of MCM and multi-scale factors on avian response. (ID 16101)

**Shizuka, D.**, University of Nebraska-Lincoln, USA, dshizuka2@unl.edu  
Chaine, A. S., CNRS-Moulis, France, alexis.chaine@ecoex-moulis.cnrs.fr  
Anderson, J., USA, jka@cruzio.com  
Johnson, O., USA, henicorhina@yahoo.com  
Laursen, I. M., USA, iml@jaredphoto.com  
Lyon, B. E., University of California, Santa Cruz, USA, lyon@biology.ucsc.edu

#### WITHIN- AND ACROSS-YEAR SOCIAL COHESION IN WINTERING MIGRANT SPARROWS REVEALED BY SOCIAL NETWORK ANALYSIS

Migratory birds often form flocks on their wintering grounds, but important details of social structure such as the patterns of association between individuals are virtually unknown. We analyzed networks of co-membership in short-term flocks for wintering golden-crowned sparrows (*Zonotrichia atricapilla*) across three years and discovered social complexity unsuspected for migratory songbirds. The population was consistently clustered into distinct social communities within a relatively small area (~7ha). Birds returned to the same community across years, with mortality and recruitment leading to some degree of turnover in membership. These spatiotemporal patterns were explained by the combination of space use and social preference—birds that flocked together in one year flocked together again in the subsequent year more often than were expected based on degrees of home range overlap. Our results suggest that a surprising level of social fidelity across years leads to repeatable patterns of social network structure in migratory populations. Our work has potential implications for the ecology of social structure in migrant populations as well as evolution of social communication, recognition systems and long-term memory in migrant birds. (ID 15807)

**Shouse, R. A.**, Georgia Southern University, USA, rs04209@georgiasouthern.edu  
Chandler, C. R., Georgia Southern University, USA, chandler@georgiasouthern.edu

#### EFFECTS OF HABITAT FRAGMENTATION ON AVIAN MOBBING BEHAVIOR

Mobbing, the behavior used to deter predators, could potentially be affected by habitat loss. The objectives of my study are to see how a group behavior will be affected by fragmented forests and whether the size of the forest will correspondingly affect the time in which birds respond. Group behavior, specifically the intensity in which the birds will mob, will presumably vary depending on the size of the habitat. There are two predictions. First, birds in a smaller fragment, which provide a limited habitat size, may have more at risk if a predator decides to start foraging and living in their area. Therefore, one prediction is that smaller fragments will have a high intensity of mobbing behavior in response to a predator. However, compared to larger fragments, smaller fragments will produce a lower population and diversity of birds possibly causing a lack of potency when mobbing, due to much mobbing behavior being induced or led by certain species. Whereas birds in a larger fragment have more space to spread out and can potentially avoid a new threat that settles in their territory. This leads to the contrasting prediction that smaller fragments will lack an intense group behavior when mobbing. I have used a recording of an Eastern Screech-Owl (*Megascops asio*) and a realistic mount to elicit mobbing behavior in various sized forests around Bulloch County in the state of Georgia. As the size of the sites increased, the latency, number of birds, and number of species slightly increased, but was not significant. This research provides valuable information regarding population decline caused by habitat loss. (ID 16159 | Poster 7)

**Shriner, S. A.**, National Wildlife Research Center, USDA/APHIS/WS/NWRC, USA, susan.a.schriner@aphis.usda.gov  
Root, J. J., National Wildlife Research Center, USDA/APHIS/WS/NWRC, USA  
Ellis, J. W., National Wildlife Research Center, USDA/APHIS/WS/NWRC, USA  
Sullivan, H. J., National Wildlife Research Center, USDA/APHIS/WS/NWRC, USA  
VanDalen, K. K., National Wildlife Research Center, USDA/APHIS/WS/NWRC, USA  
Bentler, K. T., National Wildlife Research Center, USDA/APHIS/WS/NWRC  
Mooers, N. L., National Wildlife Research Center, USDA/APHIS/WS/NWRC, USA  
Franklin, A. B., National Wildlife Research Center, USDA/APHIS/WS/NWRC  
LONG-TERM ANTIBODY PERSISTENCE FOR LOW PATHOGENIC AVIAN INFLUENZA VIRUS IN MALLARDS

Information on long-term antibody persistence in waterfowl is critical to understanding factors associated with avian influenza strain dynamics and

appropriately interpreting serology-based surveillance studies. However, very limited experimental information is available on long-term immunity in natural hosts, such as mallards. Therefore, we infected 40 mallards with an H6N2 avian influenza virus to investigate long-term humoral immunity. We collected blood samples from 37 of those individuals for more than 18 months, testing for antibodies to influenza A viruses via ELISA at approximately 4 week intervals. We re-infected the same individuals with the same virus and dose after a year to investigate long-term homosubtypic immunity. After the initial infection, more than half of the ducks exhibited detectable antibodies on day 7 and all ducks were positive on day 10 and remained so through day 28. By day 56, only 39% of ducks were positive by ELISA. Only 3 individuals had detectable antibodies throughout the year. After the re-challenge, most ducks were antibody positive on day 4, all were positive by day 10, and nearly 70% still showed detectable antibodies on day 140. These results are consistent with an anamnestic response (i.e., a more rapid production of antibodies in greater titers and persistent over a longer time period). Female mallards consistently showed a stronger ELISA response compared to males, but this difference was minor with respect to the percent of positive individuals. Overall, these results indicate antibodies may only be detectable in the short-term in many individuals, but a strong humoral memory may be present. These results have important implications for interpreting surveillance schemes based on serology and shed light on seasonal strain dynamics in mallards. (ID 16410)

**Sierzega, K. P.**, Southern Illinois University Carbondale, USA, ksierzega@siu.edu

Eichholz, M. W., Southern Illinois University Carbondale, USA, eichholz@siu.edu

#### FACTORS INFLUENCING AVIAN HABITAT SELECTION BETWEEN OAK-HICKORY AND MESIC FOREST TYPES IN SOUTHERN ILLINOIS

Oak regeneration has declined over the past century due to decreased fire disturbance and mesophication. Oaks are a keystone species and provide many resources for forest birds; the ability of mesic species to provide similar resources is untested. To determine whether patches of distinct oak or mesic forest provide comparable resources, we examined two non-exclusive habitat selection hypotheses that determine avian abundance and distribution: (1) Habitat heterogeneity and (2) Availability and distribution of food resources. We predicted oak dominated patches would provide greater heterogeneity and more food resources than mesic patches. We conducted spring migration and breeding season bird surveys from 15-April to 15-July 2013-2014 across a gradient of oak (n=13 sites) to mesic (n=9 sites) dominance in the Shawnee National Forest, Illinois. At each site, we collected microhabitat data and used the branch clipping method to sample arthropods. In 2013, the eastern wood-pewee and Acadian flycatcher had support for greater densities in oak sites of our five focal, regionally-sensitive species. The worm-eating warbler showed a positive relationship with oak relative basal area (RBA) whereas the Kentucky warbler showed a positive relationship with mesic species RBA, though additional microhabitat need be considered. Species richness and diversity were higher in oak sites during migration and similar to mesic sites during the breeding season. Total site visits were 24 and 60 during migration in 2013 and 2014, respectively, thus community metrics will be reexamined. Densities of transient management species (e.g., bay-breasted warbler) will be estimated between forest types. (ID 16290 | Poster 86)

**Silverio, C. A.**, York University, Canada, cassang@yorku.ca  
Stutchbury, B. J., York University, Canada, bstutch@yorku.ca

#### FITNESS COSTS OF MALARIA PARASITES IN A DECLINING SWALLOW SPECIES

Malaria parasites are highly prevalent among avian hosts, despite this being a well studied system the fitness costs if infections are not well established. It is suspected infected individuals allocate fewer resources towards reproduction

and survival as a trade-off to increase immune function, resulting in reduced fitness. It is important to understand these costs because they may result in parasite mediated selection that will further influence population dynamics and evolutionary outcomes. This research investigates the potential fitness costs of malaria parasite infections in a declining swallow species the purple martin (*Progne subis*). It is predicted that birds with higher parasitemia have reduced annual survival probability and lower reproductive success. Additionally, due to resource tradeoffs increased parasitemia is predicted to influence migration parameters including departure date, distance and pace resulting in carryover effects. This study was conducted at two purple martin colonies in northwestern Pennsylvania, U.S.A. over a seven-year period (2006-2012). Prevalence and parasitemia were determined for over 700 birds using sequencing and quantitative PCR methods. Migration data was collected from tracking with geolocators. This comprehensive study will address the fitness costs of malaria infections in an avian host species and provide further understanding of parasite mediated selection in this highly relevant host-parasite system. (ID 16083)

**Sinnott, E. A.**, Oklahoma State University, USA, emily.sinnott@okstate.edu  
O'Connell, T. J., Oklahoma State University, USA, tim.oconnell@okstate.edu

#### PATTERNS OF EASTERN SONGBIRD DISTRIBUTION IN CENTRAL OKLAHOMA'S CROSS TIMBERS FORESTS

**ABSTRACT**—The Cross Timbers is a semi-arid transitional landscape between the eastern temperate deciduous forests and the grasslands of the Central Great Plains. Here many eastern forest birds reach the western edge of their breeding ranges. Differences between riparian and upland forests may influence bird community composition and species distributions in this drier climate. We conducted paired upland-riparian surveys for a total of 160 point counts across central Oklahoma. Ordination techniques were used to investigate if riparian versus upland forest type explains variation in forest bird community composition. Most eastern species, including the Kentucky Warbler and Red-eyed Vireo, were more common in riparian than upland forests. Riparian forests were characterized by taller, denser canopies compared to adjacent uplands and included riparian-associated trees such as elm, sugarberry, and cottonwood. We also assessed the significance of stream order and distance to reservoir on riparian bird community composition. Eastern forest species had mixed responses to stream-reservoir patterns, but stream order and distance to reservoir significantly explained variation among riparian forest bird communities. Stream order was positively associated with Northern Parula presence; distance to reservoir was negatively associated with the presence of Prothonotary Warblers. Some eastern species, such as Acadian Flycatcher and Yellow-throated Vireo, were detected in the eastern region of the Cross Timbers, but not in the western-most sites. Riparian forests along streams and reservoirs may create refuges suitable for eastern birds in this water-limited environment. (ID 16140)

**Skeen, H. R.**, Loyola University Chicago, USA, hskeen@fieldmuseum.org  
Weckstein, J. D., The Field Museum of Natural History, USA, jweckstein@fieldmuseum.org

Hackett, S. J., The Field Museum of Natural History, USA, shackett@fieldmuseum.org

Reddy, S., Loyola University Chicago, USA, sreddy6@luc.edu

#### ORIGIN AND DIVERSIFICATION OF AFRICAN *LEUCOCYTOZON* IN A GLOBAL CONTEXT

Understanding geographic variation of host-parasite relationships is a critical part of untangling their evolutionary histories. We examined the biogeographic history of Haemosporidian blood parasites *Leucocytozoon*, a close relative of *Haemoproteus* and *Plasmodium*. Unlike its relatives, *Leucocytozoon* are exclusively found in birds and believed to be globally abundant. We conducted a survey of the diversity



of *Leucocytozoon* from sub-Saharan birds. We screened 230 different species from 12 sampling locations in three different countries for a total number of 1903 screened birds. From this over 200 unique mtDNA lineages of cytochrome b were discovered. There are currently 375 unique lineages from across the globe available on MalAvi which were included in this study. We analyzed all lineages in a phylogenetic context in order to (i) investigate the origin(s) of *Leucocytozoon* in Africa, (ii) determine the amount of known diversity within Africa, and (iii) identify the biogeographical patterns of *Leucocytozoon* on a global scale. In our preliminary analysis of genotypes from across the globe we found African *Leucocytozoon* to cluster in multiple independent clades. These clades appear to have dispersed into Africa from multiple regions. Our analysis shows that in a broader context *Leucocytozoon* do appear to form clades that are specific to larger geographic regions. Our study has more than tripled the number of known lineages from Africa and is a substantial contribution to the knowledge of *Leucocytozoon* diversity. Through this, we demonstrate that there are patterns of *Leucocytozoon* diversification that can be inferred from a global biogeographic comparison. (ID 16209)

**Slager, D. L.**, University of Washington, USA, slager@uw.edu  
 Battey, C. J., University of Washington, USA  
 Bryson, Jr., R. W., University of Washington, USA  
 Voelker, G., Texas A&M University, USA  
 Klicka, J., University of Washington, USA

#### A MULTILOCUS PHYLOGENY OF A MAJOR NEW WORLD AVIAN RADIATION: THE VIREONIDAE\*

Vireonidae is a widespread and well-known New World avian radiation, but a robust species-level phylogeny of the family is lacking. We inferred a multilocus phylogeny of the family using DNA sequences representing 46 of 52 vireonid species. We sequenced the mitochondrial ND2 gene for 222 samples and three Z-linked nuclear genes for a subset of 34 samples. Our results show a monophyletic Vireonidae closely related to Asian genera *Erpornis* and *Pteruthius*, consistent with a single colonization of the New World. *Cyclarhis* and *Vireolanius* are each monophyletic and diverged early from the rest of Vireonidae, but gene trees conflict in their relative placement. *Hylophilus* is polyphyletic, representing three deeply divergent clades concordant with differences in eye color, habitat, and voice. The poorly known *Hylophilus sclateri* of the Guianan shield region is embedded within the genus *Vireo*. *Vireo*, in turn, consists of several well-supported intrageneric clades. Both ND2 and nuclear analyses recover a sister relationship between a monophyletic “eye-ringed” *Vireo* clade containing mostly Caribbean and shrub-inhabiting species and a monophyletic “spectacled” *Vireo* clade containing mostly North American species. ND2 analysis shows *Vireo plumbeus* to be polyphyletic across the Isthmus of Tehuantepec, with birds south of the Isthmus sister to the rest of the *Vireo solitarius* clade including northern *plumbeus*; analysis of additional loci is needed to assess this potential cryptic species. An “eye-lined” clade contains two sister groups representing the *Vireo gilvus* complex (including *Hylophilus sclateri*) and the *Vireo olivaceus* complex, respectively. Tropical vireonid species tend to exhibit overall more intraspecific genetic structure than temperate species, and several contain potential cryptic species. We are now using next generation sequence capture to resolve poorly supported nodes and enable quantitative analysis of trait evolution and biogeography. (ID 16199)

**Slater, S. J.**, HawkWatch International, Inc., USA, sslater@hawkwatch.org  
 Frye, K. W., Ecosphere Environmental Services, USA, kfrye@ecosphere-services.com  
 Knight, R. N., U.S. Army Dugway Proving Ground, USA, robert.n.knight.civ@mail.mil

#### GOLDEN EAGLE TERRITORY OCCUPANCY AND EGG LAYING DEPRESSION IN RELATION TO FIRE AND PREY ABUNDANCE IN THE WEST DESERT OF UTAH

Fire frequency and shrub loss have increased with the spread of invasive cheatgrass (*Bromus tectorum*) in the Great Basin. Widespread fire in the West Desert of Utah in 2007 coincided with a decline in area Golden Eagle (*Aquila chrysaetos*) territory occupancy and egg laying. Nesting data compiled from 196 territories revealed territory occupancy and egg laying rates were 38% and 50% lower, respectively, during the period 2008–2012 relative to 1998–2007 rates. Additionally, we found that territories experiencing higher long-term occupancy and egg laying rates experienced significantly ( $P < 0.05$ ) fewer fires and contained less burned area and greater shrub cover within 4 km of nests compared to territories with lower rates. Rates did not differ in relation to elevation or region within the study area, suggesting the declines were study area-wide. Prey surveys conducted in 2011 and 2012 suggested black-tailed jackrabbit (*Lepus californicus*) abundance was very low relative to historic census data compiled for the years 1962–2001 and no rabbits were observed on transects ( $n = 128$ ) in areas with >40% cheatgrass cover. Small mammal abundance and diversity were significantly reduced in areas of high cheatgrass cover. We also highlight dispersal data from 157 banded nestlings subsequently re-encountered, genetic data from feathers collected at 58 nests, and first-year survival and movement data from 19 GPS tracking units deployed on nestlings in 2013. Overall, our results suggest concern is warranted for Golden Eagles in western Utah given sustained declines in breeding activity and minimal dispersal that appear related to fire, shrub loss, and concomitant prey declines. (ID 16027)

**Slowinski, S. P.**, Indiana University, USA, sslowins@indiana.edu  
 Whittaker, D. J., Michigan State University, USA, djwhitta@msu.edu  
 Soini, H. A., Indiana University, USA, hsoini@indiana.edu  
 Novotny, M. V., Indiana University, USA, novotny@indiana.edu  
 Mettler, R., Black Hills State University, USA, raeann.mettler@bhsu.edu  
 Spellman, G. M., Black Hills State University, USA, garth.spellman@bhsu.edu  
 Ketterson, E. D., Indiana University, USA, ketterso@indiana.edu

#### THE EFFECT OF HAEMOSPORIDIAN INFECTIONS ON THE PRODUCTION OF VOLATILE COMPOUNDS IN THE AVIAN PREEN GLAND

Many parasites have evolved strategies to enhance their own transmission, for example by manipulating the behavior of their hosts or vectors. Recent work has shown that domestic canaries (*Serinus canaria*) experimentally infected with the haemosporidian parasite *Plasmodium relictum* are more attractive than uninfected canaries to the mosquito vector *Culex pipiens*. This result suggests that haemosporidian parasites can influence the physiology of their avian hosts to make them more attractive to vectors. We tested the hypothesis that *Plasmodium* parasites increase the attractiveness of their avian hosts to mosquitoes by altering the production of volatile compounds in the preen gland. We used gas chromatography-mass spectrometry to identify and measure the abundance of 16 volatile compounds in preen oil samples collected from dark-eyed juncos (*Junco hyemalis*) at the Mountain Lake Biological Station in Virginia. We compared the composition of preen oil volatiles in uninfected and infected birds in the wild. Additionally, we treated captive juncos with the anti-malarial drug Malarone in order to assess the effect of experimental clearance of *Plasmodium* on the production of preen oil volatile compounds. Preliminary data suggest that *Plasmodium* may suppress the production of the junco preen oil volatiles 1-tridecanol and 1-pentadecanol. Future work will assess whether mosquito vectors are more attracted to preen oil samples collected from infected birds than uninfected birds. (ID 15938 | Poster 93)

**Sly, N. D.**, Dept. of Animal Biology, University of Illinois, Urbana-Champaign, USA, ndsly2@illinois.edu

Cheviron, Z. A., Dept. of Animal Biology, University of Illinois, Urbana-Champaign, USA, cheviron@illinois.edu

#### GENE EXPRESSION PATTERNS REGULATING MELANIN-BASED FEATHER PIGMENTATION IN THE ZEBRA FINCH\*

Avian coloration has a long history of study, yet knowledge of the developmental and genetic mechanisms underlying feather color remains incomplete. Melanins, the most common class of pigments in feathers, produce a range of browns and blacks. During feather development, melanocyte precursors in the base of the feather follicle migrate to the growing feather barbs, mature and deposit melanin into the barbs. Some melanocyte precursors remain in place in the base of the follicle across repeated molt cycles and respond to circulating hormone levels to produce different feather patterns across different molts. By regulating gene expression at these various steps, birds change the type and amount of melanin in feathers to create a diversity of colors and patterns. To better understand these regulatory mechanisms, we use Zebra Finches as a model, due in part to their sequenced, well-annotated genome and discrete melanin-based plumage patches. We sequenced the transcriptomes of developing Zebra Finch feather tissues using RNA-seq to: a) characterize the transcriptomic responses associated with pigmentation variation; and b) determine where in the feather follicle pigmentation-related expression differences occur. We describe differential expression among a phaeomelanin-based orange patch, gray and black eumelanin-based patches, and amelanin white patches. We also subdivided feather tissues to test whether differential expression among these colors occurs in the follicle base or in the developing feather barbs. Together, these results make important inroads towards understanding the mechanisms that underlie the tremendous diversity in avian plumage color and patterns. (ID 16251)

**Smith, A. C.**, Environment Canada, Canada, adam.smith@ec.gc.ca  
Hudson, M. A., Environment Canada, Canada, marie-anne.hudson@ec.gc.ca  
Francis, C. M., Environment Canada, Canada, charles.francis@ec.gc.ca

#### WHAT HAPPENED IN THE '80S? NORTH AMERICAN AERIAL INSECTIVORE SPECIES SHARE COMMON CHANGE POINTS IN THEIR POPULATION TRENDS.

North American populations of swallows, swifts, nightjars, and flycatchers (avian aerial insectivores, hereafter "AI") are declining. Previous work has suggested that population trends of AI changed for the worse in the 1980s. We were interested in testing whether a more rigorous analysis would support these apparent group-level change points (i.e., change points shared by many or all species in the group). Group-level change points could represent a common response to environmental change. Published annual indices from the North American Breeding Bird Survey (BBS), derived from hierarchical Bayes methods, are not suitable for this type of analysis because they are based on a model that assumes a continuous long-term trend. Instead, we generated annual indices of abundance from BBS data using a Bayesian, spatially explicit, conditional autoregressive model. We used these indices in a Bayesian, penalized regression spline model to estimate group-level change points for 22 AI species. We found evidence for group-level change points. Change points in Flycatcher (FC) populations are distinct from those for Swallows, Swifts and Nightjars (SSN) across North America, except in the Northeast, where there is evidence that FC and SSN share the same group-level change points. Change points for SSN indicate a downturn in the mid-1980s across most of North America. Change points for FC are more geographically variable, and in many regions, there are two: an upturn followed by a downturn. By supplying all annual indices and models, we hope to encourage further analyses, which may identify covariates that explain these change points and shed light on the causes of AI declines. (ID 15945)

**Smith, A. C.**, Canadian Wildlife Service, Canada, adam.smith@ec.gc.ca

#### GO NORTH YOUNG BIRDER! THE BBS FRONTIER HIGHLIGHTS THE NEED FOR A DISCUSSION ON WHAT WE WANT FROM PUBLISHED ESTIMATES OF STATUS AND TREND (AND THE NEED FOR MORE DATA!).

The sparsely surveyed northern edge of the BBS presents particular challenges for status and trend assessment in Canada. For example, estimating stratum-level trends as fixed effects allows trends to vary regionally, but can result in spurious and extreme trend estimates in the sparsely surveyed, northern strata. Modifications to the hierarchical structure of the BBS model could retain the regional variability in trend estimates and reduce extreme estimates, but require additional assumptions. I will briefly compare trend estimates from models with added hierarchical structure on trends to estimates from the standard model. I will use this comparison as a starting-point for a broader discussion on the most appropriate combinations of "reasonable" assumptions and model structures. BBS estimates are used in status and trend assessments and as data in further modeling studies, but the estimates vary depending on the model used to produce them, and particularly for sparsely surveyed strata. The structure and assumptions of a given model are more or less appropriate for different species and regions. However, practical and computational considerations limit the fine-tuning of the analysis to particular situations, so the published estimates are not always an optimal assessment of a species' status and trend, even for relatively common types of inference that users of BBS estimates require. By demonstrating some aspects of this variability and some alternative models, I hope to contribute to a broader discussion on the types of model structures and assumptions that are most appropriate for the estimates published annually by the CWS and the USGS. (ID 15897)

**Smith, C. J.**, Humboldt State University, USA, cscsmith805@gmail.com  
Johnson, M. J., Humboldt State University, USA  
Milligan, M. C., Humboldt State University  
Wendt, C., Humboldt State University  
Gichuiki, P., Kenya National Museums, Kenya  
MacDonald, S.

#### BIRD COMMUNITY DYNAMICS ON KENYAN COFFEE FARMS

Coffee is one of the most important agricultural crops in the world, grown mostly in tropical countries where most of the world's biodiversity resides. Traditionally, coffee is grown under shade trees; however, management is shifting towards coffee grown in direct sun with high levels of pesticide and fertilizer inputs. Shade coffee in central and South America has been well documented to support higher bird diversity and abundance than sun coffee. However, no studies have documented bird species richness or abundance on coffee plantations in Africa, even though it makes up 20% of the world's land under coffee cultivation. We mist-netted on six large-scale coffee plantations sites in central Kenya to quantify the bird community in relation to proximity to forest fragment and sun or shade management strategies. We used a Bayesian hierarchical model to correct for capture probability and found sun coffee had higher bird abundance and species richness, and that understory biomass was the most important predictor of bird abundance. Proximity to fragment and landscape variables were only examined on sun farms. Only granivores were associated (negatively) with distance to forest fragment. Landscape variables were also only important for granivores, with higher numbers associated with smaller fragment sizes and a higher proportion of coffee cover. Arthropod size was an important predictor of species richness and insectivore abundance. Our results suggest that in Kenya, bird community dynamics on coffee farms are very different than those in the Neotropics, highlighting the need for further research in this little-studied system. (ID 15786 | Poster 19)

**Smith, J. P.**, H. T. Harvey & Associates, USA, jsmith@harveyecology.com  
 Seay, J. L., H. T. Harvey & Associates, USA, jseay@harveyecology.com  
 Zirpoli, J. A., H. T. Harvey & Associates, USA, jzirpoli@harveyecology.com  
 Terrill, S. B., H. T. Harvey & Associates, USA, sterrill@harveyecology.com  
 Boroski, B. B., H. T. Harvey & Associates, USA, bboroski@harveyecology.com  
 INITIAL RESPONSES OF RAPTORS AND OTHER BIRDS TO  
 DEVELOPMENT OF A UTILITY-SCALE PHOTOVOLTAIC SOLAR  
 FACILITY IN GRASSLAND HABITAT IN CALIFORNIA<sup>T</sup>

The California Valley Solar Ranch is a 250 MW power plant consisting of nine discrete solar arrays and related infrastructure, located on 642 ha of primarily degraded, largely treeless, grassland habitat in south-central California. To investigate possible effects of project development on avian activity rates, we are conducting monthly activity counts (800-m-radius point counts) on the project site and in adjacent control plots. Construction began in October 2011, the first arrays were operational in winter 2012, and the project was fully operational in October 2013. The surveys began with construction and will continue through October 2014. Through Year 2, we recorded 55 species, including 11 species of raptors. To describe temporal, spatial, and construction-related variation in avian activity rates (sightings per hour), we fit generalized linear models to group-level data for raptors, corvids, columbids, icterids, and other small birds. With pronounced seasonal and interannual influences accounted for, modeling based on the first two years of data revealed that overall raptor activity tended to decline progressively as arrays moved from preconstruction to construction to operational status, whereas raptors responded positively to installation of a new transmission line that provided perch substrates in an area otherwise devoid of elevated perches. In contrast to the raptor response, construction activity in the arrays generally had a positive effect on the activity rates of other species groups. For corvids and columbids, activity rates remained high in operational arrays, whereas activity rates of icterids and other small birds tended to decline again post-construction. Further insight about species-specific and operation-phase responses will be possible with three years data. (ID 16312)

**Smith, J. A.**, University of Nebraska-Lincoln, USA, jsmith60@unl.edu  
 Olney, J. A., University of Nebraska-Lincoln, USA, jocelyn.olney@gmail.com  
 Whalen, C., University of Nebraska-Lincoln, USA, carawhalen@gmail.com  
 Brown, M. B., University of Nebraska-Lincoln, USA, mbrown9@unl.edu  
 Powell, L. A., University of Nebraska-Lincoln, USA, lpowell3@unl.edu  
 INDIRECT EFFECTS OF A WIND FARM ON PREDATION RISK AND  
 SURVIVAL OF GREATER PRAIRIE-CHICKENS<sup>T</sup>

There is increasing evidence that suggests wind farms may indirectly impact avian survival. However, the mechanisms underlying such effects are poorly understood. Here we simultaneously investigate the indirect effects of a wind farm on the survival of Greater Prairie-Chickens (*Tympanuchus cupido pinnatus*) and on a possible mechanism, predation risk, that is an important predictor of survival in this species. Between April and July of 2013 we began to assess spatial variation in daily survival rates of radio-marked hens breeding along a 15km gradient directed away from a wind farm near Ainsworth, Nebraska. During the same period we assessed spatial variation in predation risk by estimating both mammalian and avian predator occupancy along the same gradient. We monitored a total of 32 radio-collared hens and identified eight avian predator species and five mammalian predator species. Daily survival rates were high throughout the study ( $\hat{S}=0.993$ , 95% CI: 0.988–0.996); our analyses did not show any evidence of an effect of 'distance to turbine'. We found weak evidence for an effect of proximity to turbine on mammalian predator occupancy with mammalian predator occupancy lowest at sites closest to the turbines ( $\Psi=0.83$ , 95% CI: 0.31–0.98), and highest ( $\Psi=1.00$ , 95% CI: 0.00–1.00) at sites greater than 1 km away from the turbines. In contrast, we found no evidence for a similar effect on avian predator occupancy. Our preliminary results from the first year of our 2 year

study will aid in the development of decision support tools for siting wind farms that minimize disturbance to these prairie grouse and other species of conservation concern. (ID 16160)

**Smith, P. A.**, Environment Canada, Canada, paulallen.smith@ec.gc.ca  
 Pollock, L., Canada, lisapoll@gmail.com  
 Bart, J., USA, jonbart@gmail.com

CORRELATES OF GLOBAL SHOREBIRD POPULATION DECLINE AND  
 IMPLICATIONS FOR ARCTIC BREEDERS

To better understand the status of shorebird populations around the globe, we obtained the most current available population trend estimates and determined the intrinsic and extrinsic correlates of these trends. For 514 taxa in 7 regions, we estimated the magnitude and extent of anthropogenic threats facing populations using a standardized methodology, and developed a set of variables describing life history (e.g., clutch size, mating system), biogeography (e.g., population size, breeding range), migration strategy (e.g., migration distance, routes taken), and habitat use (e.g., coast, grassland, agricultural fields). We also developed a set of variables to represent natural risk factors, such as wing-loading (a determinant of risk of predation by raptors) or overlap in timing of migration and hurricane seasons. Results suggest that, among 303 populations around the globe with known trends, 43% are declining. Contrary to expectations, populations using coastal habitats during migration were not found to be exhibiting a disproportionate number of declines. However, long-distance migrants were much more likely to be declining (46 of 83 populations or 55%) versus short distance migrants or resident species (38/127; 30%). Because the vast majority of arctic-breeding species are long distance migrants, this translates into a disproportionate number of declines for species breeding in the Arctic biome; in the North American Arctic 62% are believed to be declining. Analyses are ongoing to identify more specific correlates of decline and guide the development of targeted research to understand and address the causes. (ID 16387)

**Smith, S. B.**, Rochester Institute of Technology, USA, sbssbi@rit.edu  
 Merchant, C. R., Rochester Institute of Technology, USA  
 Saleess, R. E., Rochester Institute of Technology, USA  
 Sood, H., Rochester Institute of Technology, USA  
 Pagano, T., Rochester Institute of Technology, USA

NUTRITIONAL COMPOSITION OF NATIVE AND INVASIVE FRUITS  
 CONSUMED BY MIGRATING BIRDS AT STOPOVER SITES IN THE  
 WESTERN FINGER LAKES REGION OF NEW YORK

The nutritional make-up of fruit supplies are critical to migratory birds in eastern North America and vary among plant species- and these differences may impact the quality of food resources available to refueling birds. We investigated the nutritional composition of common native and invasive fruits from locally-occurring shrubs in the western Finger Lakes region of NY. Fruits of invasive plants had significantly lower energy density and fat content than native fruits. Total nitrogen content, percent acid detergent fiber, and percent sucrose did not show clear patterns among native and invasive fruits. However, energy density and fat content coupled with measurements of other biochemical features, including monomeric anthocyanins, total phenol content, and total antioxidant capacity revealed that certain native fruits, namely Arrowwood *Viburnum*, may provide superior energetic and antioxidant benefits for migrating birds that consume them. Further, a novel fluorescence spectroscopy technique (coupled with chemometric analysis) showed spectral groupings based on the molecular make-up of fruits that differentiate between native and invasive plant species. Preliminary analyses of annual differences in fruit nutritional composition show that some fruit species may be flexible in their response to growing season conditions by adjusting their allocation of certain nutrients or biochemical composition in



autumn ripening fruit. Future work will continue to examine the link between growing season conditions and autumn fruit quality across upcoming seasons and at different locations that serve as important bird migration stopover sites in the region. (ID 16219 | Poster 77)

**Smith, S. H.**, Boise State University, USA, shawnsmith3@u.boisestate.edu  
Urban, E. H., Boise State University, USA, urbanhawk137@gmail.com  
Heath, J. A., Boise State University, USA, julieheath@boisestate.edu

#### THE EFFECT OF CLIMATE CHANGE ON AVAILABLE RESOURCES FOR AMERICAN KESTRELS (FALCO SPARVERIUS) IN SOUTHWESTERN IDAHO.

Climate change is likely to affect the relative costs and benefits of different migratory strategies. For partial migrant populations, warmer winters may facilitate resident behavior, early readiness to breed, and advanced nesting phenology. A potential consequence of earlier nesting phenology may be that nesting no longer coincides with optimal levels of prey availability. In southwestern Idaho, a partially migratory population of American kestrels (*Falco sparverius*) has advanced the timing of nesting by 28 days over the last 27 years and these changes are associated with winter warming, not spring temperatures. We monitored seasonal changes in small mammals and insects to test the hypothesis that earlier nesting by kestrels may have created a decoupling from peak prey availability. In addition, we compared prey abundance with seasonal changes in Normalized Difference Vegetation Index (NDVI), to create a proxy for prey availability and used NDVI values from the past 27 years to examine evidence of whether the timing and magnitude of spring has changed. Prey abundance peaked in May and coincided with peak NDVI values. Preliminary NDVI analyses suggest that the timing and magnitude of spring has not changed over the past 27 years. Finally, there is no significant relationship between kestrel nesting phenology and NDVI from 1987-2014, suggesting that kestrel phenology has not responded to changes in spring vegetation growth. Individual-based models that will allow for hindcasting are in development. Results from this study will contribute to understanding how kestrels respond to climate change if a decoupling in peak prey abundance has occurred in response to advanced nesting phenology. (ID 15970 | Poster 13)

**Sofaer, H. R.**, Colorado State University, USA, helen@rams.colostate.edu  
Steen, V. A., Colorado State University, USA, valerie.steen@gmail.com  
Skagen, S. K., USGS, USA, skagens@usgs.gov  
Hoeting, J. A., Colorado State University, USA, jah@rams.colostate.edu  
Noon, B. R., Colorado State University, USA, Barry.Noon@colostate.edu

#### PROJECTED EFFECTS OF CLIMATE CHANGE ON THE UTILITY OF SURROGATE SPECIES APPROACHES IN THE PRAIRIE POTHOLE REGION

Species differ in their vulnerability to climate change because of variation in their habitat requirements and in their sensitivity to changing environments. This implies that management approaches based on surrogate relationships between species will also be sensitive to climate change. However, despite the formal incorporation of surrogate-based management by multiple federal agencies, the effects of climate change on the effectiveness of surrogate approaches remains largely unknown. Here, we tested the strength of surrogate relationships for wetland-dependent birds in the Prairie Pothole Region and evaluated their projected sensitivity to climate change. We projected the effects of climate change on the distribution and abundance of wetlands and used results from species distribution models to compare current and future distributional overlap between species. We show that our results are sensitive to the spatial resolution of distributional data, with the strength of surrogate relationships likely to be overestimated at a coarse spatial scale. Finally, we evaluated whether responses to previous droughts varied with species' natural history and life history traits to assess whether

incorporating these traits in the selection of surrogate species could make surrogate-based management more robust to climate change. (ID 16237)

**Solymos, P.**, University of Alberta, Canada, solymos@ualberta.ca  
Bayne, E. M., University of Alberta, Canada, bayne@ualberta.ca  
Mahon, C. L., Environment Canada, Canada, lisa.mahon@ec.gc.ca  
Hache, S., Environment Canada, Canada, Samuel.Hache@ec.gc.ca  
Fontaine, P., University of Alberta, Canada, trish.fontaine@ualberta.ca  
Cumming, S. G., Universite Laval, Canada, stevec.boreal@gmail.com  
Stralberg, D., University of Alberta, Canada, stralber@ualberta.ca  
Schmiegelow, F., University of Alberta, Canada, fschmie@ualberta.ca  
Song, S., Environment Canada, Canada, samantha.song@ec.gc.ca

#### UNDERSTANDING THE SOURCES OF BIASES IN POPULATION SIZE ESTIMATES BASED ON ROADSIDE SURVEYS IN CANADA

Bird point-counts from the North American Breeding Bird Survey (BBS) have been used to estimate population sizes of landbird species by Partners in Flight (PIF). Their estimates relied on three key assumptions: (A1) roadside surveys sample habitats in proportion to their availability; (A2) roadside counts are similar to off-road counts; and (A3) their adjustments for timing and detection ranges accounted for imperfect detection. We used a combination of roadside and off-road surveys from the Boreal Avian Modelling Project (BAM) and BBS to test these assumptions. We used model-based techniques with covariates for local habitat conditions and regional factors to relax A1. We estimated an effect size for roadside surveys as such, thus further relaxing A2. We used a combination of removal and distance sampling to adjust for unequal sampling effort and other factors affecting availability and detectability (testing A3). We found that our Canadian (2 species) and Alberta specific (77 species) population estimates were on average 6 (range 0.2 to 20.0) times higher than corresponding PIF estimates. We attributed the inter-specific variation to consequences of the 3 assumptions. Effects related to A1 and A2 varied greatly among species but without significant bias as between methods. The effects of A3 were less variable and consistently positive. Our findings indicate that habitat-sampling and roadside biases can affect ranking of species based on population sizes estimated from roadside surveys, while effects of detectability markedly bias population estimates for most species. (ID 16111)

**Sousa, B. F.**, H. T. Harvey & Associates, USA, bsousa@harveyecology.com  
Peterson, S. L., H. T. Harvey & Associates, USA, speterson@harveyecology.com

#### AVIAN USE OF A SOLAR PHOTOVOLTAIC ENERGY FACILITY

Alternative energy development has become a major focus of energy policy, with solar leading the way in new energy production. While wind energy facilities have been studied extensively, little is known about avian use of solar facilities. We recorded avian use of a solar energy facility located on the Carrizo Plain of California. The California Valley Solar Ranch (CVSR) is a 250 MW photovoltaic system with solar arrays occupying ~1200 acres. We examined avian activities and nesting in operational solar arrays and adjacent mitigation lands at CVSR. Observations were made opportunistically during regular fatality surveys in operational arrays and nesting deterrence in active construction areas. Shading and moisture retention associated with the solar panels resulted in greater vegetative heterogeneity and persistence in solar arrays during drought conditions. Large flocks of house finches, horned larks, and mourning doves were observed foraging and sheltering in the arrays from fall through early spring. Several species, including lark sparrows and western meadowlarks, were regularly observed in operational arrays in the non-breeding season, but were not observed there in the breeding season. Mourning doves, horned larks, house finches, and loggerhead shrikes regularly nested within the solar arrays. Our observations indicate that a number of native birds utilize solar arrays to shelter, forage, and breed. (ID 16126 | Poster 82)

**Sparks, R. A.**, Rocky Mountain Bird Observatory, USA, rob.sparks@rmbo.org  
 Pavlacky, D. C., Rocky Mountain Bird Observatory, USA, David.Pavlacky@rmbo.org  
 Hanni, D. J., Rocky Mountain Bird Observatory, USA, David.Hanni@rmbo.org  
 Panjabi, A. O., Rocky Mountain Bird Observatory, USA, Arvind.Panjabi@rmbo.org

#### A MULTISCALE VIEW OF SHORTGRASS PRAIRIE BIRD ABUNDANCE AND DISTRIBUTION

Addressing the population declines of grassland bird species is among the highest conservation priorities in North America. We studied multi-scale habitat relationships for the McCown's Longspur (*Rhynchophanes mccownii*) and Loggerhead Shrike (*Lanius ludovicianus*), two species of conservation concern in the Shortgrass Prairie Bird Conservation Region (BCR) of eastern Colorado. Our objectives were to 1) investigate habitat effects on population density at the landscape-scale, 2) determine habitat effects on occupancy at the local scale and 3) predict the abundance distribution of the species. We extended the previously developed generalized multinomial mixture model to estimate abundance, occupancy and detection probability using 4 years of data from the Integrated Monitoring in Bird Conservation Regions program. At the landscape scale, there was strong support for percent grass cover in the top model for both species. However, the relationship between percent grass cover and abundance was linear for Loggerhead Shrike ( $\beta = 3.28$ ,  $SE = 1.21$ ) and quadratic for McCown's Longspur ( $\beta = -7.85$ ,  $SE = 4.49$ ). At the local scale the top model for McCown's Longspur occupancy showed strong support for a negative effect of shrub cover ( $\beta = -118.79$ ,  $SE = 59.02$ ) and grass height ( $\beta = -99.45$ ,  $SE = 20.63$ ). The top model for Loggerhead Shrike occupancy supported a positive effect for shrub cover ( $\beta = 122.88$ ,  $SE = 25.83$ ) at the local scale. The top model for detection probability was constant for McCown's Longspur and varied by year for Loggerhead Shrike. These results suggest that multiple scales are important to consider when developing habitat relationship and distribution models. The distribution map can be used by managers to create abundance summaries for any area of management interest within the BCR. (ID 16178)

**Spaul, R. J.**, Boise State University, USA, robspaul@u.boisestate.edu  
 Heath, J. A., Boise State University, USA, julieheath@boisestate.edu

#### THE EFFECTS OF OFF-HIGHWAY RECREATION ON THE BREEDING ECOLOGY OF A SHRUB-STEPPE RAPTOR\*

With the rapid increase in Off-Highway Vehicle use and backcountry recreation, wildlife and recreation managers need better information on the potential impact to breeding raptors and their habitat. In Southwest Idaho, reduced golden eagle (*Aquila chrysaetos*) nest productivity is associated with off highway recreation (Steenhof et al. in press), but the mechanisms for this are not fully understood. We monitored recreation volume and nest survival at 23 historical golden eagle territories in the Owyhee Front of southwest Idaho, from January 15- July 6 of 2013 and 2014. We used trail cameras to record road vehicle, all-terrain vehicle, dirt bike, rock crawler, equestrian, mountain bike and pedestrian trail use over an 8-12 day period, once every 5 weeks, at each territory. During 4-hour behavioral and reproductive surveys we documented all vehicular and non-vehicular traffic within 1 km of each territory's focal nest, and flushing distance of any nesting or perched eagles. We assessed trail density (km/km<sup>2</sup>) and vegetative habitat associations on the territory scale, using ArcGIS 10.1. Recreation traffic was greater on weekends and increased through the early portion of the eagle breeding season. Eagles flushed in response to human activity at a mean distance of 301 m ( $\pm 206$  m,  $n = 16$ ). Most recreationists and vehicles passed with no discernible response by eagles, unless they stopped and lingered near the bird or nest. Models suggest eagle nest survival is influenced by proximity to nearest trail, trail density, pedestrian use, OHV use and proportion of sagebrush within a territory. Results contribute to an adaptive management

plan for trail management in golden eagle habitat. Works Cited: Steenhof, K., J.L. Brown, and M.N. Kochert. in press. Temporal and Spatial Changes in Golden Eagle Reproduction in Relation to Increased Off Highway Vehicle Activity. Wildlife Society Bulletin. (ID 15972 | Poster 34)

**Specht, H. M.**, University of Minnesota, USA, spech030@umn.edu  
 Arnold, T. W., University of Minnesota, USA, arnol065@umn.edu  
 Trosen, C., USFWS St. Croix Wetland Management District, USA, chris\_trosen@usfws.gov

#### ADAPTING ROADSIDE SURVEY METHODS TO ENHANCE GREAT LAKES WATERFOWL MANAGEMENT

Information on abundance and habitat preferences of breeding waterfowl is critical for efficient and effective waterfowl management; however differences in survey methodologies in Minnesota, Wisconsin and Michigan render regional estimates difficult. We developed a roadside survey protocol in Minnesota and Wisconsin for breeding waterfowl that could be scaled up to the entire Great Lakes Region. We sampled visible wetlands within 400m of the road along 25-mile roadside transects, conducting a 3 minute survey, similar to the Breeding Bird Survey. We employed removal methods to account for calculate detection probabilities when determining wetland occupancy. We observed 1801 breeding pairs of Canada geese, mallards, wood ducks, and blue-winged teal at 2,113 individual wetlands. All four species exhibited highest occupancy on semi-permanent wetlands, but species differed in their relative use of deep water and temporary habitats. Flood level and edge complexity had positive effects on occupancy across species. Wetland area however, only exhibited a positive effect on the occupancy rates of mallards and Canada geese suggesting that the number, rather than the size of basins, creates more habitat for some species. Wetland cover in the surrounding landscape had no effect on wetland occupancy, while grass cover was only positive for some species. By providing basin-specific habitat data, this survey method has the capacity to support strategic habitat conservation maps specific to the Midwest landscape where quality wetland data can support such analyses. (ID 15822)

**Spellmeyer, A. J.**, Wichita State University, USA, aspellmeyer@gmail.com  
 Rogers, C. M., Wichita State University, USA, chris.rogers@wichita.edu

#### REVERSING SONBIRD DECLINE: OVERWINTER FOOD SUPPLEMENTATION INCREASES SURVIVAL OF THE DARK-EYED JUNCO

Decline of songbirds is widespread in North America. Habitat loss, fragmentation, and degradation are hypothesized to be a primary cause of avian decline. The Dark-eyed Junco (*Junco hyemalis*), a granivorous, migratory sparrow, has declined annually since 1966. Juncos nest in the boreal region; boreal species have become particularly imperiled in recent decades. Decline of this ubiquitous bird is alarming and important, as it indicates widespread habitat degradation. It is possible that lessened food availability during the nonbreeding season can limit junco populations. We introduce an experiment that indicates supplemental feeding increases the survival of juncos during the overwinter period. Using mark-resight methods, we captured and uniquely color-banded 208 juncos, and found that supplemental feeding significantly increased site fidelity in three winters (2011, 2012, and 2013). This effect was exacerbated in cold winters with high average daily snow-accumulation. However, it was unclear whether juncos absent from unsupplemented sites represented within-winter dispersal or mortality. In the winter of 2014, we attached VHF radio-transmitters to 29 unsupplemented juncos to ascertain the fate of birds absent during resighting periods. Utilizing the mark-resight methods employed in previous years, and the addition of radio-transmitters, we found that movement beyond the study area was minimal. Juncos occupied the home range previously described by literature. Of the radio-tagged birds, 27.5% were not resighted during

observation periods, but located and confirmed alive via radiotelemetry. A correction factor was applied to previous years data and the effect of food supplementation remained significant. Supplemental feeding during the wintering period may elevate population recruitment by increasing winter survival, migratory fitness, and reproductive success. Therefore, large-scale overwinter food supplementation may reverse decline. (ID 15963)

**Stager, M.**, University of Illinois at Urbana-Champaign, USA, stager2@illinois.edu

Pollock, H. S., University of Illinois at Urbana-Champaign, USA  
Benham, P. M., University of Illinois at Urbana-Champaign, USA  
Sly, N. D., University of Illinois at Urbana-Champaign, USA  
Brawn, J. J., University of Illinois at Urbana-Champaign, USA  
Cheviron, Z. A., University of Illinois at Urbana-Champaign, chevion@illinois.edu

#### CLIMATIC INDICES UNDERLYING LATITUDINAL PATTERNS IN AVIAN METABOLIC SCOPE\*

An organism's ability to adjust metabolic performance in response to current selective pressures has clear implications for fitness and adaptation. At the lower limit, basal metabolic rate is the energy expenditure required for self-maintenance at rest; while at the upper limit, peak metabolic rate is an individual's maximum aerobic performance under conditions of physical exertion. The difference between the two, metabolic scope, is an instantaneous measure of an individual's flexibility to cope with the many energetic demands posed by its environment. Metabolic scope has been shown to linearly increase with increasing absolute latitude across fishes and mammals. This pattern has largely been attributed to underlying trends in climatic variability, such that individuals in variable temperate zones are likely to exhibit greater flexibility in their physiological response than do those in the less variable tropics. Alternatively, climatic extremes could themselves drive variation in scope via selective pressure on thermogenic performance. To differentiate between these two hypotheses, we characterized patterns in avian metabolic scope using data from the literature and tested for associations with climatic variables using both conventional and phylogenetically informed analyses. We found that climatic extremes (i.e. minimum temperature), not climatic variability, are driving interspecific patterns in avian scope. Moreover, we found a tight correlation between scope and peak metabolic rate, indicating that selection is acting on the upper limits of performance. This represents an important step towards illuminating the mechanisms underlying patterns in avian macrophysiology. (ID 16233)

**Stanek, J. R.**, Southern Sierra Research Station, USA, jrstanek.ssrs@gmail.com  
McNeil, S. E., Southern Sierra Research Station, USA, sem.ssrs@gmail.com  
Tracy, D. D., Southern Sierra Research Station, USA, dtracy.ssrs@gmail.com

#### FACTORS AFFECTING DETECTION OF YELLOW-BILLED CUCKOOS DURING STANDARDIZED SURVEYS

The western yellow-billed cuckoo (*Coccyzus americanus*) population has declined dramatically over the past century following extensive riparian habitat loss. Identifying causes of decline and evaluating habitat management actions requires accurate estimates of cuckoo abundance and population trends. Yet, cuckoos are notoriously difficult to monitor. They are furtive by nature, call infrequently, and often evade detection. Surveyors use call broadcasts to increase cuckoo detection probability. At the fine spatial scale of the survey point, we used logistic regression mixed effects models to evaluate factors that could potentially affect the probability of a cuckoo to respond to broadcast calls and of a surveyor to detect responsive cuckoos. Cuckoo response probability was inversely related to surveyor distance and affected by breeding stage. The probability to detect a cuckoo was affected by distance, and response type. At the habitat patch scale, we used Program Presence to examine three factors that could potentially affect the

probability of detecting breeding cuckoos within the habitat patch. Cuckoo detection was highest during the nesting period and increased with density and asynchronous breeding. At patches with nesting cuckoos, on average, cuckoos were detected on three of the five survey visits. The results of this study can aid in future survey design. While additional data from other regions are needed, it appears that optimal timing of surveys will vary with regional differences in breeding phenology and nest stage. (ID 16304)

**Stanley, T. R.**, USGS, Fort Collins Science Center, USA, stanleyt@usgs.gov  
GUNNISON SAGE-GROUSE NEST SURVIVAL: ASSESSING LOCAL- AND LANDSCAPE-SCALE DRIVERS

The Gunnison Sage-grouse (*Centrocercus minimus*) is a species of conservation concern and is a candidate for listing under the U.S. Endangered Species Act due to substantial declines in breeding populations from historic levels. It is thought that loss, fragmentation and deterioration of sagebrush habitat have contributed to the precipitous decline and isolation of this species into seven geographically distinct populations. Although nest survival is known to be a primary driver of sage-grouse demography, there are currently no unbiased estimates of nest survival for Gunnison Sage-grouse or published studies identifying factors that influence nest survival. Our objective in this study was to estimate Gunnison Sage-grouse nest survival for the western portion of Colorado's Gunnison Basin population, and to assess the effects and relative importance of local- and landscape-scale habitat characteristics on nest survival. We found in a priori model analyses that the most important local-scale factor influencing nest survival was grass height; the most important landscape-scale factors influencing nest survival were distance to roads and residential developments; and we found local-scale variables more strongly affected nest survival than landscape-scale variables. In post hoc exploratory analyses we found percent cover of tall grasses and sagebrush cover (at larger scales) was an important predictor of nest survival rates. We conclude that if land managers are seeking to improve Gunnison Sage-grouse nest survival rates, they could undertake management activities that increase grass height and percent cover of tall grasses, minimize disturbances such as roads and residential developments, and maintain large contiguous patches of sagebrush habitat. (ID 16397 | Poster 90)

**Stanton, R. A.**, University of Missouri, USA, richardastanton@ufl.edu  
Thompson III, F. R., USDA Forest Service, USA, frthompson@fs.fed.us  
Kesler, D. C., University of Missouri, USA, KeslerD@missouri.edu

#### UNDERSTANDING LANDSCAPE FOREST COVER AND BIRD OCCUPANCY IN MANAGED SAVANNAS AND WOODLANDS

Landscape scale forest cover can affect avian site occupancy in ways that are not well understood, posing challenges for restoration planning. We studied patch occupancy of six savanna and woodland species in sites managed with stand thinning, prescribed fire and snag retention in Arkansas, USA. High tree stocking levels reduced occupancy probability for all species (mean odds ratio: 0.38, range: 0.29-0.58) whereas ground cover composition, years since prescribed fire and snag density had varied effects (odds ratio range: 0.21-5.89). Forest cover within 10 km was positively associated with one species and negatively associated with three others. However, these relationships did not conform to predictions based on expected variation in nest and fledgling survival between nesting types. Cavity nesting birds typically have higher nest success and fledgling survival than open-nesting species, and should be less sensitive to reduced landscape forest cover. Yet, results indicated a relationship between landscape forest cover and occupancy in two of three cavity nesting species and only two of three open nesters. Our results show that habitat restoration increased occupancy for several species, but the relationship between forest cover and occupancy was complex. We also found that landscape forest cover affected bird occupancy even in a highly-forested region (mean 86%, range 59-97%). We suggest that a meta-analytic



synthesis of observational and experimental research is needed to determine how life history traits interact with habitat and landscape factors to generate patterns of bird occupancy. (ID 16095)

**Stanton, R. L.**, University of Saskatchewan, Canada, res536@mail.usask.ca  
Morrissey, C. A., University of Saskatchewan, Canada, christy.morrissey@usask.ca

Clark, R. G., University of Saskatchewan/Environment Canada, Canada, Bob.Clark@EC.GC.CA

#### INDIRECT EFFECTS OF AGRICULTURAL INTENSIFICATION ON COMPONENTS OF TREE SWALLOW (*TACHYCNETA BICOLOR*) STRESS PHYSIOLOGY

In several regions of North America, aerial insectivorous birds have exhibited sharp declines, with tree swallows (*Tachycineta bicolor*) experiencing a 2.8% annual decline in Canada over the past few decades. The timing of these declines coincides with major changes in agriculture, which may signal a potential causal link. Agricultural intensification (AI) could reduce the abundance and diversity of the aerial insects that comprise the majority of a swallow's diet, resulting in increased foraging effort and potential effects on adult and nestling physiology. Physiological effects were determined through measurements of oxidative damage (OD) and total antioxidant counts (OXY) in both adults and nestlings to determine overall oxidative stress in swallows nesting in artificial nest-boxes at multiple sites with varying levels of AI in south-central Saskatchewan, 2012-2014. Feather corticosterone was also quantified in nestlings. In both years, males had higher levels of OD ( $p < 0.001$ ), while OD in nestlings was found to decrease with date ( $p = 0.008$ ). OXY in adults also decreased with date ( $p < 0.001$ ) in 2012, as would be expected with declining preferred insect abundance near the end of the season, while in 2013 OXY was higher on reference sites ( $p = 0.02$ ). In nestlings, it was found that OXY was higher on sites with higher AI ( $p = 0.007$ ) in both years, while oxidative stress was higher on the reference site ( $p = 0.004$ ) and in older nestlings ( $p < 0.001$ ), but decreased with date ( $p = 0.04$ ). Nestling feather corticosterone was unrelated to AI, but showed strong box-type effects in 2012 ( $p = 0.004$ ), while in 2013 it was primarily influenced by nestling age, increasing in older nestlings ( $p = 0.03$ ). The results of this study may provide information on the impact of AI on swallow stress physiology. (ID 15907)

**Stanton, R. L.**, University of Saskatchewan, Canada, res536@mail.usask.ca  
Morrissey, C. A., University of Saskatchewan, Canada, christy.morrissey@usask.ca

Clark, R. G., University of Saskatchewan/Environment Canada, Canada, Bob.Clark@EC.GC.CA

#### INDIRECT EFFECTS OF AGRICULTURAL INTENSIFICATION ON TREE SWALLOW (*TACHYCNETA BICOLOR*) FORAGING AND DISPERSAL BEHAVIOURS

In several regions of North America, aerial insectivorous birds have exhibited sharp declines, with tree swallows (*Tachycineta bicolor*) experiencing a 2.8% annual decline in Canada over the past few decades. The timing of these declines coincides with major changes in agriculture, which may signal a potential causal link. Agricultural intensification (AI) could reduce the abundance and diversity of the aerial insects which make up the majority of a swallow's diet, resulting in altered parental foraging strategies, higher foraging times and costs, and hence increased absences from the nest-box. Costs associated with increased foraging can include nestling starvation, reduced brood size, and reduced overwinter survival for both adults and nestlings. Previous work has indicated that birds on sites with higher AI exhibit shorter parental feeding durations to the nest-box per visit. My objectives are to determine how aerial insect abundance and biomass vary with AI, and relate differences to tree swallow (i) body condition, (ii) dispersal rates, and

(iii) foraging behavior. Responses in individually-marked tree swallows were measured through morphological measurements, mark-recapture and use of radio-frequency identification (RFID) for determining foraging effort in swallows nesting in artificial nest-boxes at multiple sites with varying levels of AI in south-central Saskatchewan, 2012-2014. Preliminary results indicate that adult mass was significantly lower on sites with higher AI for both sexes in 2012 and 2013 ( $p < 0.05$ ), and the number of previously banded individuals was higher on the reference site compared to sites characterized by higher levels of AI. The results of this study may provide information on the impact of AI on swallow foraging and dispersal behaviours. (ID 15908 | Poster 74)

**Steen, V. A.**, Colorado State University, USA, valerie.steen@gmail.com  
Skagen, S. K., U.S. Geological Survey, USA, skagens@usgs.gov  
Noon, B. R., Colorado State University, USA, barry.noon@colostate.edu

#### CLIMATIC IMPACTS ON THE HABITAT RELATIONSHIPS AND DISTRIBUTION PATTERNS OF MIGRATING SHOREBIRDS IN THE PRAIRIE POTHOLE REGION

The Prairie Pothole Region (PPR) in mid-continental North America contains extensive, diverse wetlands necessary to sustain the populations of many shorebird species. During migration, ~7.3 million shorebirds find essential food resources and habitat in the U.S. Prairie Potholes. Suitable habitats, including shallow water, mudflats, and shoreline areas, are abundant in wet years but may be limiting in dry years. Wetland availability in any given year is uncertain, a result of the highly variable climate of this temperate region. Climate change is adding to this uncertainty, but current climate projections suggest increased drying of wetlands, which would restrict habitats to the more permanent but less common large, deep wetlands. As a proxy for future climate change conditions, we evaluated the dynamics of broad-scale, historic distribution patterns and local and landscape scale patterns of habitat use by comparing years that ranged from wet to dry. We found pronounced shifts in distributional and habitat use patterns between climatically different years—however, we did not detect significant declines in abundance for most species comparing wet to dry years. We believe our retrospective analyses will provide useful insights to help guide conservation decisions to mitigate the impacts of climate change on migrating shorebirds. (ID 16284)

**Strasser, E. H.**, Rocky Mountain Bird Observatory, USA, erin.strasser@rmbo.org  
Panjabi, A. O., Rocky Mountain Bird Observatory, USA, arvind.panjabi@rmbo.org  
Macias-Duarte, A., Rocky Mountain Bird Observatory, Mexico, alberto.macias@rmbo.org

#### INFLUENCE AND CONSEQUENCES OF HABITAT CHARACTERISTICS ON SPACE USE STRATEGIES AND BODY CONDITION IN WINTERING BAIRD'S AND GRASSHOPPER SPARROWS

Grassland birds are declining at a greater rate than any other guild of North American birds yet there is little information on their winter movements and habitat preferences. An understanding of relationships among spatial and temporal patterns of space use and habitat attributes as well as implications for body condition are needed to assess how grassland birds will respond to changing conditions on the wintering grounds. We used radio-telemetry to characterize home ranges, movement patterns, and habitat selection for two declining grassland birds, Baird's ( $n = 24$ ) and Grasshopper Sparrows ( $n = 75$ ) on the wintering grounds in northern Chihuahua, Mexico. We used kernel density estimators of the utilization distribution to estimate home range size and overlap over two winters (2012-13 and 2013-14). We compared habitat characteristics between foraging sites and systematically placed points throughout core use areas and examined temporal changes in habitat preferences. Grasshopper Sparrow home range size was larger in 2013-14 than 2012-13 ( $115.76 \pm 46.43$  ha vs.  $52.65 \pm 22.11$  ha). Sparrow space use

was highly variable between individuals. For both seasons, most birds (72.7% and 58.2% for 2012-13 and 2013-14 respectively) were sedentary and used a contiguous area over the winter. Fewer birds made home range shifts from one disjunct location to another in 2012-13 than 2013-14 (27.2% and 41.8%) and results suggest that increased pre-winter precipitation in 2013 played a role. We discuss how vegetation structure and composition influence sparrow space use strategies, examine seasonal changes in body condition, and provide insightful visualizations of movement patterns. (ID 16060)

**Strozier, L. S.**, Loyola University Chicago, USA, lstrozier@luc.edu  
Reddy, S., Loyola University Chicago, USA, sreddy6@luc.edu  
Goodman, S., The Field Museum of Natural History and Association  
Vahatra, Antananarivo 101, Madagascar, USA, sgoodman@fieldmuseum.org  
Raherilalao, M. J., The Field Museum of Natural History, USA

#### CRYPTIC DIVERSIFICATION ON WIDESPREAD SPECIES IN MADAGASCAR

Madagascar is known for its rich biodiversity and high level of endemic species that are found nowhere else. Despite the overall species diversity, there are fewer bird species than one would predict on Madagascar given the size of the island. Cryptic diversification, when genetically distinct species are hard to detect because they are morphologically undifferentiated, has been hypothesized to occur in some groups on Madagascar. Currently it is unclear to what extent this occurs in birds because only a few studies have been conducted. This study aims to understand the phylogenetic and phylogeographic patterns within members of a Madagascar endemic songbird genus, *Newtonia*. We conducted a phylogenetic analysis using multiple molecular markers in order to examine the evolutionary relationships and diversification patterns among these species. We further examined phylogeographic structure within two widespread species to assess the potential for cryptic species. Preliminary evidence shows substantial genetic differentiation both within and among species of *Newtonia*. We conducted additional analyses to determine whether distinct lineages are associated with habitat type or geographic area. Our study shows the importance of phylogenetic analyses for uncovering the hidden diversity of Madagascar. (ID 16052)

**Stryjewski, K. F.**, Boston University, USA, katiefs@bu.edu  
Sorenson, M. D., Boston University, USA, msoren@bu.edu

#### ISLANDS OF DIVERGENCE IN AN EXTRAORDINARY RADIATION OF FINCHES (LONCHURA SPP.) FROM PAPUA NEW GUINEA\*

Recent studies have shown that speciation can proceed in the face of significant gene flow, and that only small portions of the genome may be responsible for the phenotypic differences between closely related species. Recently evolved species and/or those with "porous" genomes provide the opportunity to identify and characterize genomic regions diverging early in the speciation process. Our research has revealed an extraordinary radiation of 12 estrildid finch species in the genus *Lonchura*. Eight of these species live in broad sympatry with one or two other members of the radiation in different parts of New Guinea and Australia. Analysis of 7,537 restriction-site associated DNA (RAD-seq) loci reveals broad similarity across the genome (mean pairwise  $\Phi_{ST} = 0.185$ ). Mitochondrial and autosomal loci reveal significant population structure between some sympatric species, but not others, whereas Z-linked loci are the most successful at separating populations by species rather than geographic location. These results suggest that significant introgression has occurred. However, these species maintain their unique phenotypes, and current rates of hybridization appear to be low. Quantitative analysis of coloration reveals little evidence of character displacement in sympatric populations. Whole-genome sequencing of the two Australian species in the radiation reveals 14 highly differentiated regions on eight chromosomes, ranging in size from ~2,000 to ~1 million base pairs.

Two of these regions overlap the melanocortin-1 receptor (MC1R) and Agouti genes, and four are located on the Z-chromosome. We are currently obtaining whole-genome sequence data for several more populations. (ID 16031)

**Studds, C. E.**, University of Maryland Baltimore County, USA, studdsc@umbc.edu  
McFarland, K. P., Vermont Center for Ecostudies, USA, kmcfarland@vtecostudies.org  
Aubry, Y., Environment Canada, Canada, yves.aubry@ec.gc.ca  
Rimmer, C. C., Vermont Center for Ecostudies, Canada, crimmer@vtecostudies.org  
Hobson, K. A., Environment Canada, Canada, keith.hobson@ec.gc.ca  
Marra, P. P., Smithsonian Conservation Biology Institute, USA, marrap@si.edu  
Wassenaar, L. I., Environment Canada, len.wassenaar@ec.gc.ca

#### STABLE-HYDROGEN ISOTOPE MEASURES OF NATAL DISPERSAL REFLECT OBSERVED POPULATION DECLINES IN A THREATENED MIGRATORY SONGBIRD

Measuring dispersal is crucial for estimating demographic rates that inform conservation plans for rare and threatened species. We evaluated natal dispersal patterns in Bicknell's thrush (*Catharus bicknelli*) across most of the breeding range by using a 10-year data set of stable-hydrogen isotope ratios in feathers ( $\delta^2\text{HF}$ ) grown on the natal area and sampled one year later at the first breeding site. We used  $\delta^2\text{HF}$  values of adult thrushes sampled at 25 breeding sites as prior information for assigning first-time breeders to their natal site. We calculated the minimum distance birds moved from their natal to first breeding site and fit these data to three statistical distributions for characterizing long-distance dispersal: the exponential, Weibull, and half-Cauchy. Finally, we assessed differences in the probability of dispersal across the breeding range and through time in order to understand spatio-temporal variation in demographic connectivity. The  $\delta^2\text{HF}$  values of first-time breeders were lower compared to those of adults, a difference that was greater at the southern compared to northern breeding range extreme. Assignment tests accounting for age differences in  $\delta^2\text{HF}$  suggested that most birds dispersed less than 200 km from their natal area and within the centre of the breeding range, whereas comparatively few individuals dispersed up to 700 km. A Weibull distribution provided the best fit to these data. Two of three corrections for age differences in  $\delta^2\text{HF}$  indicated that natal dispersal probability declined by 30–38 % from 1996–2005. Our findings suggest that estimating natal dispersal with  $\delta^2\text{HF}$  measurements may contribute to understanding resilience of geographically isolated Bicknell's thrush populations. Declining natal dispersal may be symptomatic of observed population declines and could compound this trend by limiting demographic exchange between habitat patches predicted to be increasingly isolated by natural and anthropogenic habitat changes. (ID 16200)

**Sullivan, S. M.**, The Chicago Academy of Sciences and its Peggy Notebaert Nature Museum, USA, ssullivan@naturemuseum.org  
Greenberg, J., The Chicago Academy of Sciences and its Peggy Notebaert Nature Museum, USA, joelgreenberg@gmail.com

#### PROJECT PASSENGER PIGEON: RESOURCES FOR INSTITUTIONS AND INDIVIDUALS THAT PROMOTE LEARNING FROM THE PAST FOR A SUSTAINABLE FUTURE<sup>T</sup>

2014 is the centenary of the extinction of the Passenger Pigeon, a species that once darkened the skies with its billions yet was extinct due to a mere five decades of human persecution. Though the loss of this species awakened humanity to the impact of our actions, the story of the Passenger Pigeon continues in this era of the sixth great extinction as anthropogenic activity persists in unsustainable uses of habitats and species. Project Passenger Pigeon (P3) is an international effort to commemorate this centenary in a way that familiarizes people with the Passenger Pigeon and its story, then

uses that story as a portal into consideration of current issues regarding extinction, the connections between humans and the natural world, and the need to build sustainable relationships with all of the inhabitants of Earth. To further these goals, we have created a wide range of products: a web site [www.PassengerPigeon.org](http://www.PassengerPigeon.org) and social media outlets, a acclaimed book and a documentary film (that will be shown at these meetings), standards-based lesson plans for diverse ages, a speakers bureau, a children's play, downloadable information panels that allow anyone to create a local museum-style exhibit, a 5,000sq ft traveling exhibit, and digitized access to a variety of passenger pigeon-related data, including Schorger's notes. Our website also hosts a calendar where local Passenger Pigeon-related events can be posted. We hope that the story of the Passenger Pigeon can be utilized to unify the conservation efforts of all biologists in 2014 and to stimulate a renewed interest in the public in conserving species and their habitats. (ID 16048)

**Sweet, A. D.**, University of Illinois, USA, [adsweet2@illinois.edu](mailto:adsweet2@illinois.edu)  
**Johnson, K. P.**, University of Illinois, USA, [kpjohnso@illinois.edu](mailto:kpjohnso@illinois.edu)

#### PATTERNS OF DIVERSIFICATION IN SMALL NEW WORLD GROUND DOVES ARE CONSISTENT WITH MAJOR NEW WORLD GEOLOGIC EVENTS

Small New World ground doves are a monophyletic clade within Columbidae, and include the genera *Claravis*, *Columbina*, *Metriopelia*, and *Uropelia*. Species in these genera are distributed throughout South America and southern North America. This broad distribution makes the clade ideal for studying the impact of geologic events on speciation and diversification patterns of birds in the New World. New World ground doves could be particularly useful in addressing biogeographic questions related to Andean uplift and the Panamanian Land Bridge formation, since they are dispersed across both continents and across the Andean mountain range. Using complete taxon sampling for the clade (barring two possibly extinct species), we inferred a well-supported phylogenetic tree based on four mitochondrial loci and one nuclear locus. For historical biogeographic analyses focused on Andean uplift and land bridge formation, we estimated divergence times and reconstructed ancestral ranges. Our estimates indicate a South American origin for the clade, with several speciation events coinciding with either Andean uplift events or the land bridge formation. These results indicate how two major New World geologic events impacted the diversification of small New World ground doves, leading to a broader understanding of the impact of these events on patterns of speciation in New World birds. (ID 15965)

**Swift, K. N.**, University of Washington, USA, [kaeli.swift@gmail.com](mailto:kaeli.swift@gmail.com)  
**Marzluff, J. M.**, University of Washington, USA, [corvid@uw.edu](mailto:corvid@uw.edu)  
 AMERICAN CROW "FUNERALS" SERVE AS MECHANISM OF DANGER LEARNING\*

Previous work has demonstrated that some corvids respond to dead conspecifics through cacophonous aggregations and subsequently reduce foraging in associated areas for 24 hours. However, little work has been done to show what may be learned during these events or if the threat level of predators and/or dead conspecifics is treated uniformly. Here we show that cacophonous aggregations following the discovery of a dead conspecific and/or predator are one mechanism by which wild American Crows (*Corvus brachyrhynchos*) learn about dangerous places and humans and subsequently respond with risk reducing behaviors. We provided nesting pairs food in a consistent location for 3 days prior to stimulus exposure. On 4th day crows were presented either 1) a human holding a dead crow, 2) a human 2m from an upright hawk, 3) a human 2m from an upright hawk with a dead crow 4) human only control, or 5) food only control. In the following 3 days, crows were either presented the food alone (Trial Type I) or the food with dangerous human seen on stimulus day (Trial Type II). On stimulus day crows scolded stimuli presented in 34 of 35 trials, compared with only 2 of 18 controls.

Following exposure to danger, latency to approach food significantly increased over subsequent 72 hours in Trial Type I ( $F_{4,25}=6.759$ ,  $P<0.05$ ), and to a lesser extent in Trial Type II ( $F_{4,25}=3.2$ ,  $P<0.87$ ). Across trials types this trend was weakest if only the hawk was present. When presented the human accomplice a week following the dangerous event, 64% of birds responded by scolding or completely avoiding the area. This suite of responses would be adaptive for crows, which inhabit year-round territories. (ID 16364)

**Tamura, E. K.**, Sítio Paineira, Brazil, [ektamura@yahoo.com.br](mailto:ektamura@yahoo.com.br)  
**Iartelli, R.**, Sítio Paineira, Brazil, [iartelli@yahoo.com.br](mailto:iartelli@yahoo.com.br)  
**Nakashima, F.**, Sítio Paineira, Brazil, [contato@sitiopaineira.com](mailto:contato@sitiopaineira.com)

#### CHRONOBIOLOGY APPROACH IN THE REPRODUCTION OF CANARIES (SERINUS CANARIUS)

The domestic canary has been bred for hundreds of years to improve the quality of its plumage and its song. Reproduction in this species is seasonal, influenced by photoperiod. In Brazil, under natural photoperiod, breeding occurs between August and December, stimulated by gradual increase in daylength (between late winter and early spring). Despite the fact that seasonal breeding by canaries is well-known, the ability of breeders to manipulate reproduction in canaries is still untested. Seasonal reproductive behavior restricts breeding to one part of the year. The objective of our study was to determine the conditions in captivity that would enable canaries to reproduce outside of the natural breeding season. The first step was to evaluate whether it was possible to inhibit the natural onset of reproduction by manipulating the photoperiod and the temperature cycles in controlled captive conditions. Initially, all birds were housed together in outdoor aviaries under ambient conditions. Thirty days before the natural breeding season, the animals were randomly assigned into pairs and separated into three groups: CONTROL 1 (maintained outdoor under ambient conditions); CONTROL 2 (housed artificially following the same external conditions); TEST (housed artificially during the test period on short days 10L:14D, 20 °C). After five months (at the end of breeding season), the results indicated that the test group remained non-reproductive in contrast to both control groups. Therefore, breeders may be able to induce artificially the breeding of canaries in different times of the year. This work opens new possibilities for aviculture, without negatively affecting animal welfare. Financial support: FAPESP (2012/51365-6) (ID 15922 | Poster 104)

**Taylor, C. M.**, Tulane University, USA, [caz@tulane.edu](mailto:caz@tulane.edu)  
**Laughlin, A. J.**, Tulane University, USA, [alaughli@tulane.edu](mailto:alaughli@tulane.edu)  
**Hall, R. J.**, University of Georgia, USA, [rjhall@uga.edu](mailto:rjhall@uga.edu)

#### MIGRATORY FLOW NETWORK MODELS: PREDICTING THE MOVEMENTS AND POPULATION DYNAMICS OF AN AERIAL INSECTIVORE.<sup>†</sup>

Changes to the environment and climate can lead to alterations in migration patterns of bird populations, including change in timing and duration of migration, choice of stopover locations, frequency of stopovers, and migratory connectivity. There is an urgent need to understand how these alterations affect population dynamics. In this work, we present a novel type of network model, the Migratory Flow Network (MFN), in which breeding, stopover, and wintering areas (nodes) are connected by the seasonal movements (flow) of individuals between them. The seasonal changes in suitability of nodes drive the rate and timing of movement. Habitat loss and climate change can alter the suitability of nodes and thus the movements and the MFN model allows us to predict the consequences of such changes. The MFN model also allows us to model what happens to the population in the case when birds are able to adapt to phenological changes compared to the case when they are not able to adapt. We apply this model to Tree Swallows (*Tachycineta bicolor*) to explore potential drivers of observed declines, such as mismatch where climate changes cause peak of resource availability in the



breeding grounds to shift earlier than the arrival date of the birds. We also test whether observed declines at traditional sites could be a result of population redistribution rather than actual population declines. (ID 15947)

**Taylor, C. M.**, Tulane University, USA, caz@tulane.edu  
Stutchbury, B., York University, Canada, bstuch@yorku.ca

#### MODELING THE EFFECTS OF BREEDING VERSUS WINTER HABITAT LOSS ON THE POPULATION DYNAMICS OF A NEOTROPICAL MIGRATORY SONGBIRD

Populations of many migratory North American breeding songbirds are declining and the reasons are not understood because it is generally not known whether populations are limited primarily by events during the non-breeding seasons versus the breeding season. Our study species, the wood thrush, *Hylocichla mustelina*, has declined by more than 50% since the mid-1960s. Estimates from the large scale breeding bird survey (BBS) show that these declines are not evenly distributed across the breeding range and recent tracking of ~100 of individual birds with geolocators reveals an overall pattern of parallel leapfrog migration with moderate migratory connectivity such that breeding regions have different core wintering areas but most breeding populations are connected to most wintering areas. We apply a migratory network model, to wood thrush to explain the pattern of declines and to predict future population trends. We used an integrated approach to estimate demographic parameters by maximizing the likelihood of the observations from geolocator data as well as observations of patterns of declines from BBS. We show that tropical deforestation, especially in eastern Central America, has a bigger impact on species-level declines than breeding ground forest loss. However, protection of breeding habitat, especially in the central-east breeding region, is also necessary in order to prevent shifts in the migratory network and to sustain both that region and adjacent regions. Stabilizing the wood thrush population will require a targeted approach of protecting tropical forest in the eastern winter region and temperate forest in the central-east breeding region. (ID 15948)

**Taylor, D. R.**, USGS, USA, dan.taylor419@gmail.com  
Fike, J. A., USGS, USA, FikeJ@usgs.gov  
Brauch, J., Colorado State University, USA, JBrauch@rams.colostate.edu  
Oyler-McCance, S. J., USGS, USA, Soyler@usgs.gov

#### EVALUATING DNA EXTRACTION METHODS FOR GREATER SAGE-GROUSE FECAL DNA

Greater Sage-grouse (*Centrocercus urophasianus*) is a species of conservation concern. Many studies now use non-invasively collected DNA from Greater Sage-grouse to address important management issues. While non-invasively collected DNA may have advantages from a field collection standpoint, the quantity and quality of DNA collected this way can be problematic, particularly from fecal DNA. The isolation of DNA is an integral first step, yet can be a time consuming part of a study. Fecal DNA is commonly extracted using Qiagen's QiAmp Stool kit. The disadvantage of this kit is the time needed to process samples (3 hours for 12 samples). Other extraction methods are available that allow for high throughput sample processing. One such method is Qiagen's DNeasy 96 Blood and Tissue kit where samples are processed in plates resulting in 192 extractions in approximately 10 hours. This kit is not specifically designed for scat but has been used on numerous other sample types, including feathers, hair, and nails. The objective of our study was to determine whether the Qiagen's DNeasy 96 Blood and Tissue kit was as effective in extracting DNA from Sage-grouse fecal pellets as is the Qiagen QiAmp Stool kit. We extracted DNA from 92 Greater Sage-grouse fecal pellets using both extraction kits. The results of the comparative study show that DNA can successfully be extracted using both the Qiagen QiAmp Stool kit method and the Qiagen DNeasy 96 Blood and Tissue kit method. However, the difference in time and cost per sample both favor the Qiagen DNeasy 96 Blood and Tissue kit method,

making this the more efficient and preferred method for future Sage-Grouse fecal DNA studies. (ID 16151 | Poster 70)

Taylor, R. L., US Geological Survey, Alaska Science Center, USA, rebeccataylor@usgs.gov  
**Tack, J. D.**, Colorado State University, USA, jasontack@gmail.com  
Naugle, D. E., University of Montana, USA, dave.naugle@umontana.edu  
Mills, L. S., North Carolina State University, USA, scott\_mills@ncsu.edu  
COMBINED EFFECTS OF ENERGY DEVELOPMENT AND DISEASE ON GREATER SAGE-GROUSE

Greater sage-grouse are highly susceptible to the impacts of two anthropogenic stressors which are outside their evolutionary experience: oil and gas (energy) development and West Nile virus (WNV). We used lek counts across a landscape encompassing extensive local and regional variation in the intensity of energy development to quantify effects of energy development on lek counts, in years with widespread WNV outbreaks and in years without widespread outbreaks. We then predicted the effects of well density and WNV outbreak years on sage-grouse in northeast Wyoming. Absent an outbreak year, drilling an undeveloped landscape to a high permitting level (3.1 wells/km<sup>2</sup>) resulted in a 61% reduction in the total number of males counted in northeast Wyoming (total count). This was similar in magnitude to the 55% total count reduction that resulted from an outbreak year alone. However, energy-associated reductions in the total count resulted from a decrease in the mean count at active leks, whereas outbreak-associated reductions resulted from a near doubling of the lek inactivity rate (proportion of leks with a last count = 0). Lek inactivity quadrupled when 3.1 wells/km<sup>2</sup> was combined with an outbreak year, compared to no energy development and no outbreak. Conservation measures should maintain sagebrush landscapes large and intact enough so leks are not chronically reduced in size due to energy development, and therefore vulnerable to becoming inactive due to additional stressors. (ID 15773)

**Taylor, S. A.**, Cornell Lab of Ornithology, USA, dr.scott.a.taylor@gmail.com  
Curry, R. L., Villanova University, USA, robert.curry@villanova.edu  
White, T. A., University of Bern, Switzerland, tawhite201@gmail.com  
Ferretti, V., Villanova University, USA, valentina.ferretti@villanova.edu  
Lovette, I. J., Cornell Lab of Ornithology, USA, ijl2@cornell.edu

#### CONSISTENT GENOMIC SIGNATURES OF REPRODUCTIVE ISOLATION IN A MOVING AVIAN HYBRID ZONE

Studies of hybrid zone dynamics often investigate a single sampling period and draw conclusions from that temporal snapshot, but stochasticity can result in loci with patterns that differ from neutral expectations. Comparing admixed populations from different geographic regions is one way to detect consistently divergent regions potentially involved in reproductive isolation. Temporal comparisons address the same problem, but have not been investigated. In North America, black-capped (Poecile atricapillus) and Carolina (P. carolinensis) chickadees hybridize in a contact zone extending from New Jersey to Kansas. The hybrid zone is likely maintained by strong intrinsic selection against hybrids, and it is moving north in response to climate change. We used a reduced representation genomic approach and temporally spaced sampling—two samples of ~80 individuals separated by a decade—to determine the pattern and consistency of selection and introgression in the chickadee hybrid zone. We report consistently low introgression for highly divergent loci between P. atricapillus and P. carolinensis in this moving hybrid zone. This is strong evidence that these loci are linked to genomic regions involved in reproductive isolation between chickadees. This spatiotemporal genomic analysis highlights the benefits of examining hybrid zones at multiple time points, and in different geographic contexts, when investigating reproductive isolation between closely related species. (ID 15734)

**Taylor, S. A.**, dr.scott.a.taylor@gmail.com

#### INTRODUCTION TO SYMPOSIUM S04

Understanding the patterns and processes behind the generation and maintenance of avian biodiversity has been a central goal of avian evolutionary biology for decades. The advent of Sanger sequencing revolutionized the field and thousands of studies utilizing traditional sequencing methods have provided important insights into avian speciation. Advances in sequencing technology over the past decade are making genomic resources increasingly available for non-model organisms and are facilitating the investigation of adaptive divergence and reproductive isolation in numerous taxa. Previously intractable questions in avian speciation research can now be addressed, and multiple research programs are providing new insight. The objective of this symposium is to provide a venue for disseminating cutting edge genomic research that include multiple approaches to understanding avian diversification in the context of recent radiations and incipient species, hybrid zone dynamics and the maintenance of reproductive isolation, and the role of geography in speciation. We hope that this symposium will facilitate collaborations and knowledge transfer as genomic tools become increasingly available and utilized by avian biologists. (ID 16399)

**Temple, S. A.**, University of Wisconsin-Madison, USA, satemple@wisc.edu  
Zuckerberg, B., University of Wisconsin-Madison, USA, bzuckerberg@wisc.edu  
Stanton, J. C., USGS Upper Midwest Environmental Services Center, USA, jcstanton@usgs.gov

#### REVISITING HISTORICAL PASSENGER PIGEON DATA: REINFORCING SOME INTERPRETATIONS AND QUESTIONING OTHERS\*

The late A. W. [Bill] Schorger spent some 15 years accumulating and analyzing over 9,000 firsthand accounts of Passenger Pigeons (*Ectopistes migratorius*). His interpretations of these data were published as the Brewster Medal-winning 1955 book, *The Passenger Pigeon: Its Natural History and Extinction*, and in a series of journal articles. Using analytical tools not available in Schorger's time, we have reexamined his original data, which have been preserved at the University of Wisconsin, and we use them to address both conventional wisdom about the species (mostly from Schorger's interpretations) and ideas that have been proposed more recently. In general we were able to reinforce many of Schorger's interpretations about the extent of and movements within the species' geographic range, the estimates of the size of the species population, the dynamics of the population, the trajectory of the population's decline, and the causes of its extinction. Newer ideas about how the expanding telegraph system and railroad network contributed to the species decline and extinction are largely consistent with and reinforce Schorger's earlier interpretations. On the other hand, we found little support for several newer ideas concerning the population's status prior to European arrival, the role of exotic diseases in the decline and the need for a high population size or density to stimulate breeding. (ID 16012)

**Terrill, R. s.**, Louisiana State University, USA, rterri2@tigers.lsu.edu  
NEOTENOUS FEATHER REPLACEMENT FACILITATES LOSS OF FLIGHT IN BIRDS\*

Biologists have long been interested in how life history affects trait evolution, and recent advances in systematics and evolutionary analysis allow for tests of correlated evolution between traits. I examined the physiological context for loss of flight in birds. Stem birds were volant, so all crown non-volant birds have lost flight. The ability to fly is costly because of the energy required to maintain structures such as an enlarged pectoralis muscle, and flight has been lost many times in avian lineages. However, some lineages are more prone to loss of flight than others. Many of these lineages exhibit a molt strategy

where they retain a juvenile-like simultaneous remige molt into adulthood, rendering them flightless during the molting period. I hypothesize that these groups lose flight rapidly and commonly because of pre-adaptions to a non-volant lifestyle facilitated by the need to escape predators and forage for resources without flying. Neoteny has been implicated as a facilitator of rapid morphological and ecological evolution in other groups because change in developmental timing can result in profound life-history alteration with relatively few physiological and morphological changes. I used a Bayesian approach to test the hypothesis that simultaneous molt has facilitated loss of flight in birds by implementing a reverse-jump Markov-Chain Monte Carlo method over a pseudo-posterior distribution of super trees of all birds to test whether a model in which the loss of flight is dependent upon simultaneous molt is more likely than a model of independent evolution. I also used taxonomy to simulate phylogenetic position of recently extinct birds by including species in a random position within their genus over the set of trees to account for a potential bias towards flightless species in human-mediated extinction. My results with both tree sets support a model of dependent evolution, in which a simultaneous molt strategy facilitates loss of flight. (ID 15840)

**Tessler, D. F.**, Alaska Department of Fish and Game, Wildlife Diversity Program, USA, david.tessler@alaska.gov  
Johnson, J. A., U.S. Fish and Wildlife Service, Migratory Bird Management, USA, james\_a\_johnson@fws.gov  
Matsuoka, S. A., U.S. Fish and Wildlife Service, Migratory Bird Management, USA, steve\_matsuoka@fws.gov  
Greenberg, R. S., Smithsonian Migratory Bird Center, USA, deceased  
Foss, A. R., Audubon Society of New Hampshire, USA, cfoss@nhaudubon.org  
Hobson, K. A., Environment Canada, Canadian Wildlife Service, Canada, keith.hobson@ec.gc.ca  
Newell, P. J., Audubon Society of New Hampshire, USA, pattijean.newell@gmail.com  
DiCicco, L. H., U.S. Fish and Wildlife Service, Migratory Bird Management, USA, Lucas\_DeCicco@fws.gov

#### INVESTIGATING MIGRATION PATTERNS OF THE RUSTY BLACKBIRD USING LIGHT-LEVEL GEOLOCATORS AND STABLE ISOTOPES.

We fitted 17 Rusty Blackbirds (*Euphagus carolinus*) with geolocators in 2009 to track migration between nest sites in Anchorage, Alaska, and wintering grounds in the conterminous United States. We recaptured three of these birds in 2010. Each took similar Central Flyway routes not previously described for this species on both southward and northward migrations, and used a series of stopover sites across the prairie region from southern Saskatchewan to Iowa on their southward migration. Wintering areas spanned South Dakota to northern Louisiana. Upon retrieval, we found the geolocator attachments had loosened and abraded away the surrounding feathers on the three birds. Despite the continuing need to understand migratory connectivity in the context of this species' decline and the novel results from these birds, the abrasion coupled with the low return rate for instrumented birds (18%) prompted us to curtail geolocator studies until a smaller device and better harness was developed. Since then, improvements have shrunk the total instrument package by 50% to 1.0g (1.7% of blackbird mass), and added a degree of harness elasticity with a much finer material. In 2014 we are deploying geolocators at nest sites in Anchorage, Alaska, and Wentworth, New Hampshire, and pairing the movement study with concurrent analyses of stable isotope (deuterium) signatures from feathers grown in wintering grounds following prealternate molt. We will use geolocator data to calibrate isotopic signatures of feathers collected during the recapture year and will compare those to isotopic signatures from feathers collected at deployment to determine if birds wintered in the same locations each year. (ID 16065 | Poster 129)

Thomas, E. H., Pennsylvania State University, Dubois, USA, eht5002@hotmail.com

**Stoleson, S. H.**, USFS Northern Research Station, USA, sstoleson@fs.fed.us  
Brittingham, M. C., Pennsylvania State University, USA, mxb21@psu.edu

# CONVENTIONAL OIL AND GAS DEVELOPMENT ALTERS COMMUNITY STRUCTURE AND PRODUCTIVITY OF FOREST BIRDS IN EASTERN DECIDUOUS FORESTS.

Concurrent with the ongoing rapid exploitation of deep shale gas in North America, development of more conventional gas and oil plays continues to increase. Conventional plays do not employ the horizontal drilling technology used to access deep shale, so wells are increasingly drilled at high densities across landscapes. When placed in forested areas, wells and their infrastructure create significant changes in forest structure and continuity; how those changes affect forest birds remains unexplored. We examined the effects of conventional oil and gas development on the abundance, community structure, and nest success of forest songbirds in an extensively forested landscape in northwestern Pennsylvania, USA. In 2009-2010, we conducted standardized point counts in 72, 25-ha blocks, stratified equally by forest type (northern hardwood vs. mixed oak) and well density class (none, low [4 – 20 wells / km<sup>2</sup>], and high [40 – 60 wells/km<sup>2</sup>]). From 2011 to 2013 we used spot-mapping and nest monitoring to assess density and nest success at a subset of those 25-ha blocks (n=4 no-well, 4 high-density). We found the abundance of forest interior species declined with increasing well density. In contrast, early successional species and synanthropic species increased with well density, which resulted in overall abundance and diversity increasing with well density. Avian communities differed significantly between northern hardwood and mixed oak forest types at reference sites and low well-density sites, but did not differ significantly at high well densities, suggesting biotic homogenization of the avian community occurred. In contrast, we detected no effect of wells on nest success, suggesting the changes to forests induced by dense gas development do not necessarily increase numbers of predators or brood parasites. (ID 16181)

**Thompson, S. J.**, USGS Northern Prairie Wildlife Research Center, USA, sjthompson@usgs.gov

Johnson, D. H., USGS Northern Prairie Wildlife Research Center, USA, douglas\_h\_johnson@usgs.gov

Niemuth, N. D., US Fish and Wildlife Service, USA, neal\_niemuth@fws.gov

Ribic, C. A., USGS Wisconsin Cooperative Wildlife Research Unit, USA, caribic@usgs.gov

# ASSESSING THE IMPACT OF OIL DEVELOPMENT ON GRASSLAND BIRDS

New oil-extraction technologies have driven a rapid increase in oil development in the northern Great Plains. Experts predict that between 2005 and 2035 North Dakota will see 80,000 oil wells constructed, many of which will be located on native grasslands. Our research examines how grassland birds react to oil development. We conducted spot-mapping surveys to examine patterns of bird distribution in relation to oil wells and associated roads during 2012-2014. Species varied in their tolerance of oil development. Some species, like Clay-colored Sparrow (*Spizella pallida*), were relatively tolerant of oil development, avoiding areas only within 50 m of well pads. Other species such as Savannah Sparrow (*Passerculus sandwichensis*) avoided habitat within 100 m of well pads. Grasshopper Sparrows (*Ammodramus savannarum*), Sprague's Pipits (*Anthus spragueii*), and Baird's Sparrows (*Ammodramus bairdii*) showed the greatest aversion by avoiding habitat within 200 m of well pads. All grassland species combined avoided habitat within 100 m of secondary roads (gravel roads with moderately heavy oil-related traffic). Including a 200-m buffer around a well pad increased the average impacted area from 2.2 ha to 25 ha or approximately 11 times the footprint of a well pad alone. Similarly, average secondary roads in North Dakota are 10 m wide; the addition of 100 m on each side increases

the affected area to 21 times that of the actual road. Understanding these indirect impacts on habitat will allow us to better predict the effects of oil development on grassland birds. (ID 15882)

# **Thorup, K.**, University of Copenhagen, Denmark, kthorup@snm.ku.dk USING SATELLITE TELEMETRY TO STUDY MIGRATORY ORIENTATION

The capabilities and underlying basis of orientation and navigation in migratory in birds has proven difficult to establish. Thus, it is still controversial whether young birds are able to use simple navigation during their first outward flight as are the cues used by experienced migrants for navigation. In general, the most effective way of studying navigation is through displacement experiments. Because of difficulties in following small birds over longer distances, the extraordinary long travels in migratory birds have long prevented proper investigation of the response to such experiments in the smaller solitary, nocturnal migrants where the social influence of conspecifics can be ruled out. Here, I present the first attempts to study orientation and navigation in common cuckoos travelling from Europe to Africa using satellite telemetry to establish their spatio-temporal migration schedule as well their response to displacements. Common cuckoo chicks are brought up by foster parents of other species and the first migration must be initiated by their internal program. (ID 15992 | Poster 51)

**Tigano, A.**, Queen's University, Canada, anna.tigano@queensu.ca  
Shultz, A. J., Harvard University, USA, ashultz@fas.harvard.edu  
Edwards, S. V., Harvard University, USA, sedwards@fas.harvard.edu  
Friesen, V. L., Queen's University, Canada, vlf@queensu.ca

# TESTS OF LOCAL ADAPTATION ALONG A LATITUDINAL CLINE: A STUDY OF AN ARCTIC SEABIRD.\*

From an evolutionary perspective the investigation of local adaptation is crucial to understand the mechanisms leading to speciation. It is also important to understand how populations have adapted to current environmental conditions and to help predict how they may respond to anthropogenic changes. One method to study local adaptation in natural populations is by screening phenotypic and/or genetic differentiation across environmental gradients, and investigating the factors driving selection. We tested whether an arctic seabird, the thick-billed murre (*Uria lomvia*), showed evidence of local adaptation along a 20° latitudinal gradient. Important differences among thick-billed murres from different colonies, such as body size, migratory behavior and breeding phenology, could be a result of local adaptation. We screened variation at more than 2,000 loci using a reduced representation approach (restriction site-associated DNA sequencing) and performed outlier analyses to detect loci under selection using the programs Lositan and Bayescan. We used multivariate statistical approaches (DAPC) and Bayesian clustering algorithms to test whether colonies grouped differently when all markers or only outlier loci were included in the analyses. Lositan detected few loci as candidates for positive selection, and Bayescan detected none. We found low differentiation among colonies overall, but also some loci putatively under selection. DAPC showed the two southernmost colonies to be distinct and more differentiated from the rest when only outlier loci were included. Further sampling of the genome will help identify more genomic regions under selection that may code for key adaptations. (ID 15834)

**Title, P. O.**, University of Michigan, USA, ptile@umich.edu  
Burns, K. J., San Diego State University, USA, kburns@mail.sdsu.edu  
NICHE EVOLUTION AND ITS ROLE IN THE DIVERSIFICATION OF TANAGERS\*

The increasing availability of species occurrence data, together with sophistication of niche modeling techniques, has made it possible to quantify ecological niches based on large-scale environmental data. Coupled with



advances in phylogenetics, studies can now address broad questions regarding the interplay between ecology and evolution across space and time. Specifically, questions regarding species' climatic niches can be framed in an evolutionary context to examine the role of ecology in diversification. We address these questions using climatic niche data in conjunction with a recently inferred phylogeny for the largest family of songbirds, the tanagers (Thraupidae). Tanagers are ecologically diverse and are found in most terrestrial habitats in the Neotropics from lowland rainforests to high altitude grasslands. In this study, we test whether differences in species numbers in the major clades of tanagers can be explained by differences in rate of climatic niche evolution, and link this hypothesized connection to geographic and environmental space availability. We find that clade richness and climatic niche rate are positively correlated, and that this is also correlated with the amount of environmental space occupied by each clade. Additionally, we find that tanagers have partitioned climatic niche space relatively early on in their evolutionary history, and that more recent climatic niche evolution has shifted towards convergence. Our results suggest clades in which species are more successful at diversifying across climatic gradients have greater potential for speciation or, alternatively, are more buffered from the risk of extinction. (ID 15813)

**Toews, D. P.**, University of British Columbia, Canada, toews@zoology.ubc.ca  
Brelsford, A., University of Lausanne, Switzerland, Alan.Brelsford@unil.ch  
Grossen, C., University of British Columbia, Canada, christine.grossen@gmail.com

Mila, B., Museo Nacional de Ciencias Naturales, Spain, borjamila@gmail.com  
Irwin, D. E., University of British Columbia, Canada, irwin@zoology.ubc.ca

#### GENOMIC VARIATION IN YELLOW-RUMPED WARBLERS

Contact zones between previously isolated taxa provide natural systems for studying the processes involved in divergence, adaptation and reproductive isolation. In particular, studying rates of introgression between different genetic markers can reveal important insights into historical evolutionary dynamics. Here we use variation in tens of thousands of nuclear genetic markers to assay nuclear genetic variation across the yellow-rumped warbler species complex. We find strong evidence of discordance between patterns in the nuclear genome and the mitochondrial genome, suggesting an important role for historical gene flow in shaping the distribution of mitochondrial DNA. Using these data we also find that differentiation is heterogenous across a number of the comparisons between divergent groups in the system. We interpret this as evidence of the unique evolutionary history experienced by birds inhabiting different past selective environments. More generally, this large dataset sheds light on the relevant species boundaries in this group with a tortuous taxonomic history. (ID 16121)

**Tomasevic, J. A.**, University of Washington, USA, tomasevi@uw.edu  
Marzluff, J. M., University of Washington, USA, corvid@uw.edu

#### SUCCESSFUL EXPLOITATION OF SUBURBAN LANDSCAPES BY THE PILEATED WOODPECKER\*

As cities keep growing, more natural habitat is transformed changing the resources available for native birds. We studied how a purported sensitive species, the Pileated Woodpecker (*Dryocopus pileatus*), responds to rapid and extensive land cover change as urbanization reduces and isolates forest. Between 2009 and 2013, we radiotracked 15 birds in 9 suburbs on a gradient of urbanization (5–90% forest) east of Seattle, WA. We estimated home range size, resource use, productivity and survivorship. Using a subset of individuals (n=9 males), we calculated concentration of use and resource utilization functions to examine use of vegetative features at landscape and local levels. The average home range size was  $232 \pm 47.7$  ha (MCP, mean  $\pm$  SE), a three-fold difference with nearby sites and significantly smaller than expected by latitudinal trends. The home ranges were comprised of over a third forest cover (35.6%) and half developed land (54.6%). However, use

of these landscapes differed. They concentrated their use in forested and lightly developed lands, but not intensely developed lands (ANOVA,  $F=2.7$ ,  $df=6$ ,  $p=0.02$ ). As expected based our previous work, they intensively used coniferous and broadleaved forests, but they also included a large proportion of suburban areas where trees were retained. Fitness of suburban birds (reproduction and survivorship) was similar or even higher than reported for natural areas elsewhere (2.08 birds/nest, 80% survival/year), suggesting that this species is adapting to these novel conditions. To retain Pileated Woodpeckers in developed regions, planners should design subdivisions with forested reserves and retain native trees in yards. (ID 16373)

**Tombback, D. F.**, University of Colorado Denver, USA, diana.tombback@ucdenver.edu

Scott, J. D., University of Colorado Denver, USA, jdscott90@hotmail.com

Wunder, M. B., University of Colorado Denver, USA, Michael.Wunder@ucdenver.edu

McKinney, S. T., U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, USA, Shawn.McKinney@maine.edu

#### WHITEBARK PINE CONE PRODUCTION AND THE PROBABILITY OF STAND VISITATION BY CLARK'S NUTCRACKER: ASSESSMENTS FROM GLACIER AND WATERTON LAKES NATIONAL PARKS

Mutualistic interactions increase the evolutionary fitness of participating species, but these interactions may be disrupted by pathogens and pests. Clark's Nutcracker (*Nucifraga columbiana*) is a coevolved mutualist and primary seed disperser for whitebark pine, a subalpine conifer widely distributed across western North America but declining from white pine blister rust and outbreaks of mountain pine beetles. Beginning in 2001, we examined the relationship between whitebark pine cone production and the likelihood of nutcracker visitation from early July to late September—the time of cone ripening and seed dispersal—in several Rocky Mountain regions. Our previous surveys in the Northern Divide Ecosystem, which has the highest known whitebark pine blister rust infection rates and mortality, indicated low nutcracker visitation probabilities. Here, we focus on five study areas in the Northern Divide across the trans-boundary national parks Glacier and Waterton Lakes. Transect length for nutcracker counts ranged from 450 to 1550 m per study area and totaled 5.3 km. For each transect, we assessed whitebark pine stand health and counted cones on two 10 m x 50 m plots. Transects were surveyed for nutcrackers three times in the first year and seven times in the second year. We found blister rust infection rates from 33% to 80% per transect with a mean of 64%. Cone production varied from 0 to 470 cones per ha, an order of magnitude lower than in regions with healthier whitebark pine. The mean proportion of total observation hours in which at least one nutcracker was sighted was 0.128 (SD 0.179)—3.5 times less than mean nutcracker visitation in two previous studies, which included regions with healthier whitebark pine. We conclude that an invasive pathogen has disrupted the nutcracker-pine interaction in the Northern Divide Ecosystem, which will impact whitebark pine regeneration and prevent the spread of blister rust-resistant genotypes. (ID 16204)

Toms, J. D., Eco-Logic Consulting, Canada, judith.toms@zoho.com

**Faaborg, J.**, University of Missouri, USA, faaborgj@missouri.edu

Arendt, W. J., International Institute of Tropical Forestry, USA, waynearendt@gmail.com

Cox, W. A., Florida Fish & Wildlife Research Institute, USA, wacox@mail.missouri.edu

#### BANDING ADDS VALUE TO LONG-TERM MONITORING STUDIES IN PUERTO RICO

We have been monitoring birds using constant-effort mistnetting in January for over 40 years in the Guanica Forest of southwest Puerto Rico. Many residents and all migrants are mostly silent at this time of year, so mist

nets are the only method that can be used to get an index of abundance. Banding birds also adds tremendous value to our research: 1. The high quality demographic data produced by banding studies allow us to determine whether changes in capture rates result from changes in survival, recruitment or detectability. 2. Basic measurements of captured birds can provide measures of body condition, allowing us to determine how seasonal changes in environmental conditions affect individuals. 3. The age class of captured individuals can be determined using molt patterns, and sex can be determined using plumage patterns or with genetic methods. This allows examination of whether age and sex influence survival, behavior and other traits. 4. Tissue samples can be collected during handling, allowing us to address additional questions, such as determining migratory connectivity using stable isotopes in feathers. 5. Banding throughout the year allows us to examine seasonal dependence of breeding and molt, and describe previously unknown molt patterns of resident species. 6. Banding operations also allow us to efficiently support additional studies, such as by placing color bands or geolocators onto selected study species. While some of these activities could be done without banding, all require capturing individuals; by banding these individuals, their value compounds with each future recapture. (ID 16274)

**Toms, J. D.**, Eco-Logic Consulting, Canada, judith.toms@zoho.com  
 Millsbaugh, J. J., University of Missouri, USA, MillsbaughJ@missouri.edu  
 Belant, J. L., Mississippi State University, USA, jbelant@CFR.MsState.Edu  
 Washburn, B. E., USDA APHIS, USA, Brian.E.Washburn@aphis.usda.gov

#### ESTIMATING SPACE USE IN THREE DIMENSIONS: THE IMPORTANCE OF ACCOUNTING FOR BARRIERS TO MOVEMENT<sup>T</sup>

Incorporating the vertical dimension of space use into home range estimation is potentially critical for understanding avian ecology, but three-dimensional models have rarely been applied to such data. However, extending space-use models to three spatial dimensions is complicated by the presence of physical barriers to movement (boundaries), such as the ground or ocean surface. We have developed a new method that can be used with all types of boundaries, the trivariate linear boundary kernel. In this talk, I will review basic kernel density estimation methods, demonstrate why it is so important to examine space use in three dimensions, and show how our new method can provide superior performance in two real-life situations. In the first example, we examined three dimensional space use of a pair of osprey with almost identical height use profiles. This analysis indicates that they use different heights in areas where they share two dimensional space use, thereby reducing overlap. In the second example, we examine territories of two species of warblers, which showed a high degree of overlap in two-dimensional space use and height profiles. Overlap among territories was reduced when examined in three dimensions, indicating that individuals may be partitioning space in a way that cannot be observed using standard two-dimensional metrics. In both cases, the new method correctly limited space use to occur only at or above ground level, while standard methods estimated substantial use of space below ground level. (ID 15844)

**Tonra, C. M.**, Migratory Bird Center, Smithsonian Conservation Biology Institute, USA, cm.tonra@gmail.com  
 Sager-Fradkin, K., Lower Elwha Klallam Tribe, USA, kim.sager@elwha.org  
 Marra, P. P., Migratory Bird Center, Smithsonian Conservation Biology Institute, USA, MarraP@si.edu

#### TRACKING THE RETURN OF CRITICAL NUTRIENT SUBSIDIES TO WESTERN RIPARIAN ECOSYSTEMS FOLLOWING DAM REMOVAL: THE VALUE OF SONGBIRDS AS BIO-INDICATORS

In the United States, it is estimated that fluvial processes in every watershed greater than 2 000 km<sup>2</sup> have been affected by dams. Ecologically, dams can disrupt food-webs, alter/obstruct critical habitat, fragment populations, and alter species life history. Along with safety concerns, this has led to the

removal of over 1 000 dams to date in the US. In western North America, one of the main drivers of dam removal is opening spawning habitat to anadromous Pacific salmon (*Oncorhynchus* spp.). In addition to the conservation status and cultural/commercial importance of many salmon populations, these species can have profound effects on western riparian ecosystems as vectors for marine derived nutrients (MDN; e.g. nitrogen and phosphorus). Salmon deposit large amounts of MDN into these often oligotrophic (i.e. nutrient poor) freshwater systems when they return to natal streams, spawn and die. MDN crosses the aquatic-terrestrial boundary to benefit riparian plants and animals. We will review how songbird systems represent a valuable opportunity to track the recovery of riparian food-webs following dam removal, as indicators of MDN. We will present results from a case study examining the effects of obstructions to salmon migration on a riparian songbird, the American Dipper (*Cinclus mexicanus*), and changes in this population following the largest dam removal in history on the Elwha River, WA, USA. We have found that dippers exhibit substantial life history and demographic variation based on the presence or absence of MDN subsidies. Further, we have documented a rapid return of MDN following dam removal and salmon re-colonization. We will also discuss potential short-term deleterious impacts on dipper populations due to increased sediment loads in the Elwha. These findings highlight the dramatic beneficial effects removal of large dams can have, and the immense value of riparian birds as bio-indicators of watershed recovery. (ID 16042)

**Trahan, K. J.**, Louisiana State University, Canada, kallitrahani1119@gmail.com  
 Cuervo, A. M., Louisiana State University, USA, amcuervo@gmail.com

#### LATITUDINAL GEOGRAPHICAL VARIATION IN SEXUAL DIMORPHISM IN A TROPICAL MONTANE BIRD (FURNARIIDAE: *PSEUDOCOLAPTES BOISSONNEAUTII*)

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. I evaluated the extent of geographical variation in bill size and sexual size dimorphism across the range of an Andean montane bird, *Pseudocolaptes boissonneautii*, the Streaked Tuftedcheek. I also examined whether geographic variation in this species follows Bergman's Rule and Rensch's Rule. I measured bill shape in a 152 specimens, and I analyzed wing length for another set of 149 specimens. I found sexual dimorphism in both bill morphology and wing length, but males have longer wings, whereas females have 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. (ID 16310 | Poster 27)

**Tremblay, J. A.**, Environment Canada, Canada, junior.tremblay@ec.gc.ca  
 Ibarzabal, J., Université du Québec à Chicoutimi, Canada, jacques\_ibrzabal@uqac.ca  
 Savard, J. P., Environment Canada, Canada, jean-pierre.savard@ec.gc.ca  
**DEMOGRAPHY OF THE BLACK-BACKED WOODPECKER IN UNBURNED BOREAL FOREST STANDS IN EASTERN CANADA**

The Black-backed Woodpecker (*Picoides arcticus*) occurs at higher densities in recently burned boreal forest stands than in unburned ones,

which has led to the hypothesis that unburned stands act as a population sink for this species. The present study was conducted in central Quebec within coniferous forests shaped largely by timber harvest and wildfire, and compares the breeding ecology of Black-backed Woodpeckers in both unburned and burned stands. Furthermore, it evaluates the role of unburned stands in the general population demographics of this species. Nests were monitored in both unburned and burned stands, and the influence of biotic, abiotic and temporal variables on daily nest survival rates was investigated. The age-class structure of breeders was also compared between both habitats. Nest age influenced daily survival rate of nests, and a higher number of nestlings fledged from successful nests in burned than in unburned stands. In contrast to what might be expected, the breeding population in resource-rich burned stands contained a higher proportion of younger individuals and the apparently resource-poor unburned stands contained a higher proportion of older experienced birds. Results suggest that Black-backed Woodpeckers maintain breeding populations in unburned mature or old-growth forests. (ID 15833)

**Trevelline, B. K.**, Duquesne University, USA, trevlineb@duq.edu  
Porter, B. A., Duquesne University, USA, porterb@duq.edu  
Latta, S. C., National Aviary, USA, steven.latta@aviary.org

#### DNA BARCODING AS A NON-INVASIVE STRATEGY FOR THE IDENTIFICATION OF PREY FROM THE FECES OF LOUISIANA WATERTHRUSH (*PARUSIA MOTACILLA*)

Diet studies provide ornithologists with vital information regarding the environmental needs of avian species, which may improve the outcome of conservation efforts. The molecular approach of DNA barcoding offers researchers an accurate and non-invasive alternative to the antiquated techniques often utilized in avian diet studies. For insectivorous taxa, the fecal sacs of developing nestlings contain residual DNA from digested prey, which can be identified via molecular techniques. In this study, we developed a non-invasive technique for analyzing the diet of the Louisiana Waterthrush from collections of nestling fecal sacs. The fecal sacs were collected from multiple Waterthrush nests within the Carnegie Museum of Natural History's Powdermill Nature Reserve near Rector, Pennsylvania. The fecal sacs were rich in undigested insect remains and residual DNA, which were amplified with insect-specific primers using Polymerase Chain Reaction (PCR). Due to environmental exposure, the DNA was highly degraded, and thus, necessitated the use of primers capable of amplifying short segments of DNA (157 bp) within the Cytochrome C Oxidase Subunit I (COI) gene. The resulting DNA amplicons were TA cloned, sequenced and identified using the Barcode of Life Database (BOLD). In our preliminary findings, we successfully identified three unique arthropod genera, all of which are known to naturally occur at our study site: Epeorus (Mayfly), Heptagenia (Mayfly) and Nigronia (Hellgrammite). In all cases, the amplicon obtained from fecal sac DNA matched the published sequences by greater than 95%. (ID 15770 | Poster 66)

**Tsai, J.**, National Chiayi University, Chinese Taiwan, ross.tsai@gmail.com  
Chang, K., National Chiayi University, Chinese Taiwan, kaechyuan16@gmail.com  
Hsu, F., National Chiayi University, Chinese Taiwan, richbear@mail.ncyu.edu.tw  
AVIAN COMMUNITY COMPOSITION OF BETEL NUT PLANTATIONS AND SECONDARY FOREST: THE INFLUENCES OF VEGETATION STRUCTURE ON FORAGING GUILDS

Betel nut tree (*Areca catechu*) is a tropical plant with high economic value and the betel nut plantation has become one of the most important industries in lowland and hillside areas in Taiwan. However, betel nut plantations have caused serious soil erosion and it is not clear how the conversion from secondary forest to betel nut plantation affects the avian communities. We selected 30 betel nut and 30 forest plots in Chiayi County, which contributes

approximately one-fifth of the total betel nut production in Taiwan. We conducted three point count surveys in each plot and recorded all the species seen or heard in March 2014. Species richness in forest was marginally higher than betel nut plots (11.5 vs. 10.1;  $p < 0.04$ ), but there was no difference in overall abundance. While the avian community compositions between forest and betel nut plantation did not differ significantly, some species in certain foraging guilds showed differences in densities between forest and betel nut plots. For aerial-insectivores and ground-insectivores, the overall densities were higher in forest than in betel nut plots. For tree-insectivores, we found more White-eared Sibia (*Heterophasia auricularis*) in forest than in betel nut plots, while Light-vented Bulbul (*Pycnonotus sinensis*) had higher density in betel nut than forest plots. The differences in density for various foraging guilds between betel nut and forest plots suggest that the vegetation structure have an effect on avian communities. Additional analyses will focus on how spatial distribution of betel nut plantations affect avian communities within the context of the landscape. (ID 16146)

**Tsai, W. L.**, Occidental College, USA, wtsai@oxy.edu  
McCormack, J. E., Occidental College, USA, mccormack@oxy.edu  
Faircloth, B. C., University of California Los Angeles, USA, brant@faircloth-lab.org

#### PERFORMANCE OF SEQUENCE CAPTURE TARGETING THOUSANDS OF LOCI ON BIRD MUSEUM SPECIMENS FROM THE 1880S TO PRESENT

The specimens housed in natural history collections document Earth's biodiversity and provide the raw material for studies over a breadth of disciplines. Many of these specimens were collected prior to the standard preservation of tissue. Next-generation sequencing holds the promise of accessing genomic resources in these specimens. We performed target enrichment of 5,000 ultraconserved elements (UCEs) on DNA extracted from *Aphelocoma* jays from divergent lineages spanning the time period of the 1880s to present. Results show that sample age matters to both number of loci recovered and average locus length, and that more sequence reads ameliorate age issues for the number of loci, but not for average locus length. Despite the clear importance of sample age to generating more sequence data, even the worst performing samples still recovered over half of the targeted loci and could be used in phylogenetic and Structure analysis. Results from these analyses support the existence of three species within the former Western Scrub-Jay complex, and even find evidence for intraspecific divergence not strongly supported elsewhere. This study also demonstrates the utility of ultraconserved elements (UCEs) as effective markers for target enrichment at shallow timescales. These results, and those of other recent studies, have profound implications for natural history collections, where millions of specimens can now be considered 'genomically enabled'. (ID 15964)

**Tucker, A. M.**, Virginia Commonwealth University, USA, tuckera3@vcu.edu  
Dyer, R. J., Virginia Commonwealth University, USA, rjdye@vcu.edu  
Huber, S. K., Virginia Institute of Marine Science, USA, skhuber@vims.edu  
Bulluck, L. P., Virginia Commonwealth University, USA, lpbulluck@vcu.edu  
CONSPECIFIC BROOD PARASITISM AS AN ALTERNATIVE BREEDING STRATEGY IN BOX-NESTING PROTHONOTARY WARBLERS (*PROTHONOTARIA CITREA*)\*

Parental care is energetically expensive and brood parasites avoid this cost by laying eggs in the nests of other individuals. Conspecific brood parasitism (CBP) has been widely described in birds, but mainly in species with precocial young that require little parental care post hatching. Here we describe the occurrence of CBP in the prothonotary warbler (*Protonotaria citrea*), a species in which the parents provide intensive provisioning of young. Using maternal exclusion analyses at eight microsatellite loci of 333 family groups breeding



across five years (2009 to 2013), we found that 23.4% of clutches contained at least one offspring that was not matched to the social mother. We determined that parasite strategy seems opportunistic, and found no evidence that females target hosts based on host characteristics, relatedness, or nest location. We expected that raising unrelated young would impose energetic or fitness costs on the host female, and found that females who raised a mismatched offspring produced fewer biological offspring than those that did not, even when double-brooding ( $1.02 \pm 0.26$  fewer offspring per year). The presence of a mismatched offspring did not affect adult return rate or nest-mate condition and recruitment. Long-term maintenance of nest boxes at our study site might facilitate CBP through visible, high-quality, relatively dense nesting sites. This behavior may be more widespread in altricial species than previously thought, and further research is needed to understand its development and persistence in these systems. (ID 15750)

**Turbek, S. P.**, Archbold Biological Station, USA, sheela.turbek@gmail.com  
**Pruett, M. S.**, Archbold Biological Station, USA, spruett@archbold-station.org  
**Bowman, R.**, Archbold Biological Station, USA, rbowman@archbold-station.org

#### THE EFFECT OF HABITAT-ASSOCIATED PREDATION RISK ON THE NESTLING PROVISIONING RATES AND BEGGING BEHAVIOR OF FLORIDA SCRUB-JAYS

Predation is the leading cause of adult mortality in birds and acts as a strong selective force in the evolution of avian biology. Many bird species adjust their reproductive behaviors in response to environmental cues to minimize the risk of predation. When provisioning offspring in high-risk environments, parents trade off the costs of reduced food delivery to nestlings against the benefits of decreased predation risk through lower rates of nest visitation. Florida Scrub-Jays (*Aphelocoma coerulescens*) experience a direct trade-off between foraging and vigilance and alter their foraging behavior in accordance with habitat structure and associated risk of predation. Jays inhabiting higher-risk, overgrown habitat increase investment in vigilance at the cost of reduced foraging rates, even when raising nestlings. These findings suggest that jays in overgrown habitat sacrifice investment in current reproduction in order to maximize their own survival; however, it is unclear whether the failure to increase foraging in riskier habitat results in lower nestling provisioning rates. This study compared the provisioning rates, response to an experimental increase in perceived predation risk, and nestling begging behavior of jays in habitats with varying vegetative structure. While preliminary analyses suggest that habitat structure does not influence baseline provisioning rates, groups nesting in overgrown habitat may exhibit a greater latency to resume provisioning following predator simulation. Thus, individuals in riskier habitat may balance investment in current offspring and self-maintenance by primarily reducing provisioning rates in the face of an immediate predation risk. (ID 16269 | Poster 9)

**Twedt, D. J.**, USGS Patuxent Wildlife Research Center, USA, dtwedt@usgs.gov  
**BIRD RESPONSE TO RESTORATION AND MANAGEMENT OF BOTTOMLAND HARDWOOD FOREST**

Planting trees on >100,000 ha of agriculture has initiated restoration of bottomland hardwood forest within the Mississippi Alluvial Valley. Bird abundance on ~150 restoration sites, between 1 and 34 years postplanting, indicated age of planting and tree height influenced bird species abundance. Birds characteristic of grasslands were common until tree heights exceeded 5–10 m, at 3 to 15 years postplanting - dependent upon species planted. Further assessment of colonization and reproductive success on 36 reforested sites indicated that densities of thamnian birds (e.g., Yellow-breasted Chat and Indigo Bunting) were positively associated with: 1) taller trees, 2) greater stem densities, 3) increased richness of woody species, and 4) a greater proportion of forest within the landscape whereas grassland associated birds (e.g., Dickcissel) were negatively associated with these factors. Within-site

habitat characteristics had a greater influence on thamnian birds than edge effects or landscape characteristics. Taller trees and increased densities of woody stems and vegetation were positively associated with greater nest success. Nest success exceeded 0.31 for thamnian species, thereby suggesting reforested sites were population sources. Conversely, nest success was <0.23 for grassland-savannah species, suggesting restored bottomlands were population sinks for these species. A restoration strategy that promotes rapid, dense, and diverse forest stands within forested landscapes is successful at promoting colonization by thamnian and silvicolous birds and provides habitat wherein reproductive success appears capable of sustaining their populations. Because increased heterogeneity of mature forest structure appears beneficial to thamnian and silvicolous birds of conservation concern, experimental silvicultural treatments are being undertaken to increase heterogeneity of forest structure to enhance diversity of bird species. (ID 16054)

**Unruh, J. H.**, University of Regina, Canada, jason.unruh@gmail.com  
**Davis, S. K.**, Canadian Wildlife Service - Prairie and Northern Region, Canada, stephen.davis@ec.gc.ca

#### EFFECTS OF OIL DEVELOPMENT ON GRASSLAND SONGBIRDS\*

Native grasslands provide breeding habitat for many avian species of conservation concern, yet the quality and quantity of remaining native grassland in western Canada may currently be threatened by oil development. My research aims to determine the extent to which oil well proximity, density and overall disturbance influence the abundance of grassland songbirds on native and exotic grass pastures. More than 1800 avian point counts and vegetation surveys were conducted over two breeding seasons across a gradient of oil disturbance on native and exotic grass pastures. Preliminary results showed a strong species specific response in grass type preference. There was also a species-specific response to well proximity and well density. Three species showed a preference for increased distance from wells and decreased well density, while one species preferred closer proximity to wells and higher well density. Furthermore, there was evidence that poorer quality habitat compounded negative effects of disturbance on bird presence and abundance. These results suggest that grassland songbirds have species-specific responses to oil development and may be responding to local vegetation and disturbance factors over landscape scale factors. (ID 15729)

**Uy, J. A.**, University of Miami, USA, uy@bio.miami.edu  
**Cooper, E. A.**, Clemson University, USA, ecoope4@clemson.edu

#### THE GENOMICS OF SPECIATION-WITH-GENE-FLOW IN FLYCATCHERS OF THE SOLOMON ISLANDS

Divergence in mating signals, such as plumage color and song in birds, can lead to premating reproductive isolation between populations. However, during the early stages of speciation, reproductive isolation is incomplete and so gene flow is likely to occur between diverging populations. How can populations continue to diverge given incomplete isolation and the homogenizing effects of gene flow? Using a combination of candidate gene and RADSeq approaches, we explore the possibility of speciation-with-gene-flow by characterizing genome-wide patterns of differentiation among three recently-diverged populations of the *Monarcha castaneiventris* flycatcher of the Solomon Islands. Populations of this species have changed in plumage color, which, in turn, is used in conspecific recognition and thus likely important in reproductive isolation. Based on over 70,000 single nucleotide polymorphisms (SNPs), we find that background levels of genomic differentiation are extremely low and that this low differentiation is the result of recent divergence and gene flow between populations. In contrast, point mutations in candidate genes for plumage color are fixed or nearly-fixed among populations. Given the distinct difference in levels of differentiation between background and candidate genes, our results indicate that strong selection keeps the plumage color fixed despite substantial gene flow

between populations. Our results suggest that speciation-with-gene-flow can occur, as long as strong selection can counteract the homogenizing effects of gene flow. (ID 15800)

**Vaidya, G.**, University of Colorado Boulder, USA, gaurav@ggvaidya.com  
Lepage, D., Bird Studies Canada, Canada, dlepage@bsc-eoc.org  
Lapp, H., National Evolutionary Synthesis Center, USA, hlapp@nescent.org  
Guralnick, R. P., University of Colorado Boulder, USA, Robert.Guralnick@colorado.edu

#### MEASURING THE OUTPUTS OF TAXONOMY: HOW MANY SPECIES OF NORTH AMERICAN BIRDS HAVE BEEN RECIRCUMSCRIBED IN THE LAST 128 YEARS?

Measuring taxonomic effort is critical in understanding how the rate of species discovery has been affected by changing technology, funding and institutional support. It can be quantified as the number of new species definitions being produced by taxonomists, which arise in one of two ways: through the description of entirely new species, or the recircumscription of existing species through revisionary taxonomy. Revisionary rates are difficult to measure, but a minimum rate can be determined by counting the number of species definitions added and deleted to taxonomic checklists because of splits and lumps. We use this technique to calculate a minimum rate of revisionary taxonomic effort over the 128 years of the AOU's Checklist of North and Middle American Birds, and compare it to the pattern of species description over the same period. We find that species description appears to be largely complete in North and Central America, with only 13 species (0.6%) described since 1950. However, revisionary taxonomy has resulted in the recircumscription of existing species at a steady rate throughout this time period; since 1889, at least 174 species recognized by the Checklist have been recircumscribed and at least 112 species definitions have been deleted for purely taxonomic reasons. These results point to an overall steady or even increasing rate of taxonomic effort, in contrast to the usual view of North American birds being taxonomically well-understood. We also note an unexpected increase in this rate in the last three decades, whose causes we are currently investigating. (ID 16281)

**van Riper III, C.**, USGS / Univ. of Arizona, USA, charles@charlesvanriper.com  
Puckett, S. L., Univ of Arizona, USA, spuckett@email.arizona.edu  
Darrah, A. J., Univ of Arizona, USA, adarrah@email.arizona.edu

#### CAPTURE AND BANDING PROVIDE INSIGHTS REGARDING THE IMPACT OF THE TAMARISK LEAF BEETLE (DIORHABDA CARINULATA) ON INSECTIVOROUS BIRDS

From 2008-2014 we examined the effects of a biologic control agent, the tamarisk leaf beetle (*Diorhabda carinulata*), on native avifauna in southwestern Colorado. We captured and banded birds to document avian foraging behavior, sampled bird diets, characterized the arthropod community, and undertook an experiment to determine whether tamarisk leaf beetles are palatable to birds. Our goal was to determine to what degree birds eat tamarisk leaf beetles. We observed that tamarisk leaf beetles compose up to 24.4% (95% CI: 19.9-27.4 percent) of arthropod abundance and 35.4% (95% CI: 32.4-45.1 percent) of arthropod biomass in our Dolores River study area. Birds ate few tamarisk leaf beetles, despite a superabundance of *D. carinulata* in the environment. The frequency of occurrence of tamarisk leaf beetles in bird diets was 2.1% (95% CI: 1.3-2.9%) by abundance and 3.4% (95% CI: 2.6-4.2 percent) by biomass. Although most avian foraging occurred within tamarisk habitat, the largest portion of the diet was native insects. We conclude that tamarisk leaf beetles probably do not contribute significantly to the diets of birds in areas where biologic control of tamarisk is being applied. (ID 15860)

**Van Wilgenburg, S. L.**, Environment Canada, Canada, steve.

vanwilgenburg@ec.gc.ca

Obermayer, B., Sir Sanford Fleming College, brennanobermayer@gmail.com

Joyce, T., Sir Sanford Fleming College, Canada, Timothy.Joyce@

flemingcollege.ca

Weddle, B., Sir Sanford Fleming College, Canada, brett.weddle@gmail.com

#### EXPANDING BBS COVERAGE FOR BOREAL CANADA: ARE THERE DISTURBANCE RELATED BIASES IN ROAD NETWORKS NEEDING FURTHER CONSIDERATION?

The North American Breeding Bird Survey (BBS) has been extraordinarily successful, providing crucial data on the status and trends of hundreds of species. Despite the enormous success of the BBS, there remain several regions where little to no BBS coverage exists, including much of the boreal forest. While there has been increased interest in expanding BBS coverage in the boreal forest, remoteness and a paucity of birders has led to slow progress. In addition, there is some concern that the boreal road network disproportionately samples a subset of the habitats, and it is plausible that this could lead to biased inference. Since the boreal forest is typified by high rates of natural disturbance and is also experiencing increased resource development, it is also important to determine whether habitat disturbance along roadside routes are reflective of habitat change across the region as a whole. Much of the road network in the boreal forest has been created to access resources and it is therefore plausible that roadside sampling may result in biased representation of disturbance rates which could result in inaccurate estimation of strata level trends. We used geospatial data to investigate whether a) rates of habitat change along roadsides are comparable to disturbance rate across strata, b) whether bias in disturbance rates is related to the class of road, and c) whether bias differs between natural versus anthropogenic disturbances. It is hoped that results from this work can be used to stimulate discussion on the implementation, analysis and interpretation of BBS within the boreal forest, and aid in the design of regional monitoring to augment the BBS. (ID 15841)

**Vander Zanden, H. B.**, University of Utah, USA, h.vanderzanden@utah.edu

Wunder, M. B., University of Colorado Denver, USA, michael.wunder@ucdenver.edu

Hobson, K. A., Environment Canada, Canada, keith.hobson@ec.gc.ca

Van Wilgenburg, S. L., Environment Canada, Canada, steve.vanwilgenburg@ec.gc.ca

Wassenaar, L. I., Environment Canada, Canada, l.wassenaar@iaea.org

Welker, J. M., University of Alaska Anchorage, USA, jmwelker@uaa.alaska.edu

Bowen, G. J., University of Utah, USA, gabe.bowen@utah.edu

#### DO YEAR-SPECIFIC PRECIPITATION ISOSCAPES IMPROVE PREDICTIONS OF MIGRATORY ORIGIN?

The hydrogen stable isotope composition of feathers has been a useful tracer in determining the origin of migratory birds, owing to assimilation of locally distinctive water isotopes integrated via the diet at the time of feather growth. Because feathers are inert, when the animal migrates, its isotopic composition records the location of formation. Thus, large-scale gradients in  $\delta^2\text{H}$  values of precipitation across continents (or isoscapes) can be used to retrospectively assign the likely geographic origin of each individual based on its tissue  $\delta^2\text{H}$  composition. Water isoscape maps are amount-weighted long-term averages of  $\delta^2\text{H}$  values of precipitation spanning decades. However, animal tissues primarily assimilate H from water and the food web during shorter seasonal periods of the growing cycle, creating a discrepancy in the time periods represented in the isoscape and tissue. We used H isotope datasets from known-origin Eurasian reed warblers and monarch butterflies to address i) whether biologically relevant year-specific  $\delta^2\text{H}$  precipitation isoscapes would improve assignment to origin predictions and affect the accuracy, precision, and similarity of natal assignments using year-specific and multi-decadal

precipitation isoscapes created using IsoMAP, and ii) we examined the effect of spatial density of the sampling stations used to create the  $\delta^2\text{H}$  isoscapes. We did not find that short-term models were more suitable in determining geographic origin. We introduce recommended metrics to evaluate the efficacy of geographic assignment, which can be used in future studies to optimize time periods in the precipitation isoscapes for improved spatial reconstruction of migratory origin. (ID 15973)

**Vargas-Masis, R.**, Universidad Estatal a Distancia (UNED), Costa Rica, ornatehawkeagle@gmail.com  
**Gastezzi-Arias, P.**, Universidad Estatal a Distancia (UNED), Costa Rica, pgastezzi@gmail.com  
**Di Mare-Hering, M.**, Universidad Estatal a Distancia (UNED), Costa Rica, tati@di-mare.com  
**Martínez, D.**, Unión de Ornítólogos de Costa Rica, Costa Rica, jacamerops@yahoo.com

#### AVIFAUNAL RECORDS IN A LANDSCAPE DOMINATED BY PINEAPPLE CROPS IN SAN CARLOS, COSTA RICA

Forest fragmentation coupled with food production for a growing global population has led to altered landscapes. These factors are of concern in Costa Rica where there has been a fast growing production of pineapple crops, and where sustainable development is desirable to achieve both biological conservation and human development. We registered the avifauna present in a pineapple growing region in Northern Costa Rica, where forest patches associated with conventional and organic crop practices occur. We visited 7 sites from January 2011 to May 2013 and recorded the bird species present during belt transects, point counts, sound-recordings, and casual observations. We identified 226 species of 49 families (81.9% residents). In regard to trophic guilds most species (78.3%) were either frugivores or insectivores. Bird presence varied with patch type: 34.1% occurred in patches associated with organic crops, 19.5% in patches associated with conventional crops and 46.5% in patches of both types. Regarding forest dependence, 8% of bird species corresponded to the group that needs at least 50% forest cover; and 11.9% of the species corresponded to the group that is highly sensitivity to changes in the ecosystem. Species records information is an important tool in determining species distribution, habitat use, and contributes in an understanding of their status for their conservation. (ID 16345 | Poster 88)

**Varian Ramos, C. W.**, Colorado State University - Pueblo, USA, claire.ramos@colostate-pueblo.edu  
**Swaddle, J. P.**, College of William and Mary, USA, jpswad@wm.edu  
**Cristol, D. A.**, College of William and Mary, USA, dacris@wm.edu  
**DOES THE TIMING OF EXPOSURE TO METHYLMERCURY INFLUENCE THE DEGREE OF REPRODUCTIVE SUPPRESSION IN ZEBRA FINCH?**

Mercury is a worsening global pollutant that biomagnifies in food webs, placing wildlife at risk of reduced reproductive fitness and survival. Songbirds are the most diverse and numerous branch of the avian evolutionary tree; many are suffering persistent and serious population declines and we know that songbirds are frequently exposed to mercury pollution. Our objective was to determine the effects of environmentally relevant doses of mercury on reproductive success of songbirds exposed throughout their lives or only as adults. The two modes of exposure simulated exposure of philopatric species versus dispersive species, and are particularly relevant because of the heightened mercury-sensitivity of developing nervous systems in young animals. We performed a dosing study with dietary methylmercury fed to a model songbird species, the zebra finch (*Taeniopygia guttata*). Birds were exposed to mercury either as adults only or throughout their lives. All doses of mercury reduced reproductive success. Mercury had the most consistent effect on the proportion of hatched chicks that fledged from the nest,

regardless of mode of exposure. Among birds exposed as adults, mercury caused a steep increase in the latency to re-nest after loss of a clutch. Birds exposed for their entire lifetimes, had up to 50% lower reproductive success than adult-exposed birds at low doses of methylmercury. Our results indicate that mercury levels present in prey items at contaminated sites pose a significant threat to local populations of songbirds through reduced reproductive success. (ID 16047 | Poster 123)

**Veech, J. A.**, Texas State University, USA, joseph.veech@txstate.edu  
**Jensen, J.**, Texas State University, USA, jjensen@txstate.edu  
**ASSESSING LAND COVER COMPOSITION AND CONFIGURATION ALONG ROUTES OF THE NORTH AMERICAN BREEDING BIRD SURVEY**

The distribution and abundance of bird species along Breeding Bird Survey routes is undoubtedly influenced by the composition and configuration of land cover along the routes. Assessments of land cover along routes can inform us as to whether the routes are representative of larger landscapes and regions. Such information can be useful in making inferences from the bird data, regardless of whether one is studying bird-habitat relationships or using the BBS data for some other purposes. The National Land Cover Database (NLCD) is one of the most extensive GIS-based sources of land cover data for the continental USA. It is both an inventory and a monitoring instrument in that an updated version is released about every five years. The NLCD is based on remote-sensing imagery primarily from the Landsat satellites. The NLCD classifies each of about 27 billion 30 x 30 m pixels to one of 16 land cover types representing natural as well as anthropogenic land. NLCD data have been used previously to assess local and regional representativeness of BBS routes and to examine bird-habitat relationships at landscape and biogeographic scales. These studies will be discussed along with on-going research that investigates temporal changes in land cover along BBS routes. (ID 16001)

**Velas, K. L.**, Audubon California, USA, kvelas@audubon.org  
**Soykan, C.**, National Audubon Society, USA, csoykan@audubon.org  
**Schuetz, J. G.**, National Audubon Society, USA, jschuetz@audubon.org  
**Distler, T. K.**, National Audubon Society, USA, tdistler@audubon.org  
**WE ARE NOT IN EUROPE ANYMORE: AVIAN RESPONSE TO NATIVE HEDGEROWS IN CALIFORNIA'S CENTRAL VALLEY**

Clean-edge farming in California's Central Valley has reduced habitat for native bird populations; however, anecdotal evidence suggests that planting linear strips of native vegetation, called hedgerows, between fields could benefit birds. We surveyed birds at hedgerow and nearby control sites (unmanaged field margins) to estimate the effects of hedgerows on bird species. Twenty hedgerow and 20 control sites were surveyed during each of two seasons, winter 2012-2013 and spring 2013, noting species composition and abundance. In order to assess the effects of landscape context, we considered additional landscape-scale covariates in our analyses, incorporating data on adjacent field type, distance to urban, forest, and riparian habitats, and the heterogeneity of the surrounding landscape. Data were analyzed using mixed and standard generalized linear models. Results were compared between models built with just a hedgerow covariate, and those that included other landscape features and their interaction with hedgerows. Hedgerows had a positive effect on species richness and abundance during winter and spring surveys. During the spring, significantly more taxa were restricted to hedgerows than control sites or were more abundant at hedgerow sites. Landscape context, however, mattered when describing patterns in richness and abundance. The effect of hedgerows on species richness decreased and became less significant when other landscape-level covariates were introduced into the model. The opposite held for average abundance models. The two response variables therefore responded differentially to the influence of landscape-scale covariates,



with species richness being more influenced by local factors and average abundance by the surrounding landscape. Conservation planning, even when focused at smaller scales, must recognize the influence of landscape context and incorporate a regional perspective into the decision-making process to maximize the chances of success. (ID 16308)

**Verheijen, B. H.**, Kansas State University, USA, bramverheijen@ksu.edu  
Sandercock, B. K., Kansas State University, USA, bsanderc@ksu.edu

#### EFFECTS OF PATCH-BURN GRAZING MANAGEMENT ON NEST SURVIVAL AND BROOD PARASITISM RATES OF DECLINING SPECIES OF GRASSLAND SONGBIRDS\*

Many species of grassland songbirds are declining in population numbers in North America. Population losses are related to change in land-use and agricultural intensification in breeding habitats. Patch-burn grazing management increases heterogeneity in vegetative structure and species diversity of grassland songbirds. We assessed how patch-burn grazing affected the nest demography of four declining species of grassland songbirds that breed in tallgrass prairie habitat. Our study was conducted at Konza Prairie Biological Station, a tallgrass prairie reserve in northeast Kansas. Between 2011 and 2014, we monitored nests of Dickcissel, Eastern Meadowlark, Grasshopper Sparrow and Henslow's Sparrow. We compared nest survival and brood parasitism rates by Brown-headed Cowbirds among pastures managed with a patch-burn grazing management regime. Pastures managed by annual burning and different grazing treatments functioned as controls. We found that the relative abundance of grassland songbird species differed among treatments. Nest survival was low, and similar among treatments, but brood parasitism rates were lower in the patch-burn grazing treatment. Results of our study will help to understand how alternative management regimes affect population dynamics of declining species of grassland songbirds. (ID 15738)

**Visco, D. M.**, Tulane University, USA, dvisco@tulane.edu

#### PERSISTENCE AND PERIL IN FRAGMENTED TROPICAL FOREST: EVIDENCE FROM THE DEMOGRAPHY OF AN UNDERSTORY INSECTIVORE

Despite a long breeding season, the combination of small clutches, low nesting success, and a long nesting cycle leave many tropical passerines with low productivity, making population maintenance or growth difficult. Tropical birds' relatively long adult life spans can mitigate effects of low seasonal fecundity; failure in one season does not preclude a chance at self-replacement next year. Within a season, birds that can shorten intervals between renestings should gain more chances to raise a successful brood as well. How do these demographic parameters interact to determine whether a population persists or declines? I studied populations of chestnut-backed antbirds (*Myrmeciza exsul*) in contiguous, peninsular (a protected forest reserve surrounded by pasture on three sides), and fragmented habitats to evaluate the relative importance of apparent survival and productivity to the population growth rate. For each of the three habitat types, I built an age-classified population model with a matrix model of productivity that includes nest success and renesting probabilities. Adult survival did not significantly differ across habitats and is high relative to other tropical species and thamnophilids. Nest success was lowest in the peninsula and highest in fragments. Renesting attempts occurred most frequently in the peninsula. Based on a six-month breeding season, I estimated that populations in contiguous and fragmented forest have stable to positive growth rates. However, our models indicate that the peninsular population is declining—population growth was sensitive to the extremely low probability of nest success. Residing within a well-protected reserve is no guarantee for an avian population's persistence. Conversely, growing populations in dispersal-restricted habitats like forest fragments may endanger themselves to resource limitation or inbreeding. (ID 16247)

**Wagner, M. A.**, Simon Fraser University, Canada, mawagner@sfu.ca  
Reynolds, J. D., Simon Fraser University, Canada

#### IMPACTS OF SALMON ON SONGBIRD COMMUNITIES

Pacific salmon provide a complex cross-ecosystem link between the ocean, freshwater, and terrestrial systems. When marine-derived nutrients from spawning salmon are transferred to riparian forests through various food web pathways, they increase invertebrate abundance and enhance plant structure; thereby subsidizing resources that are important to birds. We quantified the influence of the annual salmon spawning event on the spatial aggregation of songbird communities across a wide range of salmon-spawning biomass (0-3.2 kg salmon/m<sup>2</sup>) on 14 discrete streams on the remote Central Coast of British Columbia. Point count data spanning two years were combined with environmental variables in riparian forests to create a priori models based on individual bird species and ecological guilds (insectivores, frugivores, generalists) that were ranked using an information-theoretic approach. Results show that bird density increases with salmon biomass and that watershed size and vegetation composition are also important predictors. This work further elucidates the holistic ecological importance of salmon to terrestrial ecosystems in the Pacific Northwest and provides new information to inform ecosystem-based management. (ID 16377)

**Walker, B. L.**, Colorado Parks and Wildlife, USA, brett.walker@state.co.us

#### GREATER SAGE-GROUSE CONSERVATION AND MANAGEMENT IN OIL AND GAS FIELDS OF NORTHWESTERN COLORADO: HOW WELL DO LEK BUFFERS WORK?

Effective management is crucial for persistence of Greater Sage-Grouse (*Centrocercus urophasianus*) populations in developing oil and gas fields. State wildlife agencies often use circular buffers around lek locations to prioritize and manage important sage-grouse habitat. However, lek buffers may be inadequate to conserve populations if not all lek locations are known, lek buffers are too small, or breeding habitat is distinct from other seasonal habitats. Conversely, lek buffers may lead to unnecessary land-use conflict if they are too large or include unsuitable habitat. To test the effectiveness of lek buffers, I tracked 199 male Greater Sage-Grouse with solar GPS PTT transmitters in two study areas with oil and gas development in northwestern Colorado between 2011-2014 and used an adaptive local convex hull estimator to estimate seasonal home ranges. The radius of buffers around known leks required to encompass ≥95% of male breeding, summer-fall, and winter core and home ranges varied substantially among leks, among seasons, and between populations. In one study area, area-based buffers derived from resource selection models achieved greater protection with less acreage than circular lek buffers. Knowing the locations of a greater proportion of leks and having greater overlap in seasonal use both increase the effectiveness of lek buffers at protecting year-round habitat. Data from GPS PTT transmitters allowed us to produce defensible lek buffer size recommendations that were population specific, based on local data, and consistent with state policy goals for conserving Greater Sage-Grouse and their habitat. Managers can simultaneously improve sage-grouse conservation and reduce land-use conflict in areas with energy development by conducting additional intensive lek searches, using area-based lek buffers derived from resource selection models, or using data from GPS PTT transmitters to generate population-specific buffer recommendations. (ID 16258)

**Walker, L. E.**, University of Washington, USA, lseckel@uw.edu  
Marzluff, J. M., University of Washington, USA, corvid@uw.edu

#### SMALL PATCHES OF LOWER QUALITY HABITAT CONTRIBUTE TO THE POPULATION OF AN ENDANGERED SONGBIRD, THE BLACK-CAPPED VIREO (*VIREO ATRICAPILLA*)\*

Although efforts to conserve threatened species often focus on the creation and preservation of high quality habitat patches, low quality habitat may

also contribute to the stability and long term survival of populations. Low quality habitat is often found in greater abundance and reproduction in these patches may contribute to overall population size. The black-capped vireo (*Vireo atricapilla*) is an endangered songbird which breeds throughout central Texas and southern Oklahoma. In central Texas, the largest subpopulation of vireos is comprised of approximately 5000 pairs, found on the Fort Hood Military Reservation. Smaller populations of between 10 and 100 pairs exist in surrounding habitat remnants on private properties, wildlife refuges, and city and state parks. We measured variables of vireo demography in central Texas subpopulations that varied in area, density, habitat composition, and cowbird parasitism rates from 2011 through 2013. Fort Hood sites (n=3) boasted relatively high productivity rates with an average of 2.13 fledglings produced per territory (sd=0.67). Although productivity at off-post sites (n=4) was on average only 1.12 fledglings per territory (sd=0.56), some of these subpopulations may still be self-sustaining. While dispersal events between subpopulations were rare, we observed movements greater than 72 km indicating both immigration to and emigration from Fort Hood. Although subpopulations located off of Fort Hood may be more vulnerable due to isolation and relatively small size, evidence of dispersal suggests they contribute to the size of the overall central Texas metapopulation and are thus likely important to its long term stability. (ID 15984)

**Walsh, J.**, University of New Hampshire, USA, jlw27@wildcats.unh.edu  
Kovach, A. I., University of New Hampshire, USA, adrienne.kovach@unh.edu  
Rowe, R. J., University of New Hampshire, USA, rebecca.rowe@unh.edu  
Olsen, B. J., University of Maine, USA, brian.olsen@maine.edu  
Shriver, W. G., University of Delaware, USA, gshriver@udel.edu

#### EXOGENOUS SELECTION IN AN AVIAN HYBRID ZONE: INFERENCES FROM GENOTYPE-HABITAT ASSOCIATIONS AND ECOLOGICAL NICHE MODELS

Hybrid zones commonly occur along environmental gradients, as transitional habitats (ecotones) facilitate contact between species occupying adjacent niches. Environment-dependent (exogenous) selection plays a role in hybrid zone maintenance when hybrids are bounded by ecotones or when patchily distributed habitat types lead to a corresponding mosaic of genotypes. We investigated the role of exogenous selection in shaping a hybrid zone between the Saltmarsh (*Ammodramus caudatus*) and Nelson's (*A. nelsoni*) sparrow. The two species display some variation in habitat preference and occur sympatrically from southern Maine to northern Massachusetts, where they interbreed. We tested for the influence of habitat on hybrid distribution by sampling 290 sparrows from 35 marshes along a transect from Maine to Connecticut. Sparrows were genotyped at 24 microsatellite loci, and scores from the first axis of a PCA were used to describe the proportion of Nelson's/Saltmarsh alleles at each site. To characterize habitat we measured marsh size, salinity, shoreline distance, and dominant vegetation types. We used linear regression to test for associations between habitat features and the distribution of pure and admixed sparrows and Maxent to develop ecological niche models for each taxon. We found a strong correlation between genotype and habitat ( $r=0.48$ ;  $p < 0.001$ ). The distribution of pure and admixed individuals varied across the hybrid zone, corresponding to the distribution of riverine and coastal marshes, reflective of a mosaic model of exogenous selection. The niche of hybrids was more similar to that of nelsoni and suitability was influenced strongly by distance from coastline. (ID 16008)

**Walsh, S. E.**, San Diego State University, USA, shannonwalsh023@gmail.com  
Burns, K. J., San Diego State University, USA, kburns@mail.sdsu.edu  
Cicero, C., University of California, Berkeley, USA, ccicero@berkeley.edu

#### GENETIC AND PHENOTYPIC DIVERGENCE OF THE SPOTTED TOWHEE (*PIPILO MACULATUS*) ON THE CALIFORNIA CHANNEL ISLANDS\*

The Channel Islands are a system of eight islands located off the coast of California. Although many endemic avian taxa occur on these islands, few

have been studied genetically. The Spotted Towhee (*Pipilo maculatus*) occurs as an endemic subspecies (*P. m. clementae*) on Santa Rosa and Santa Catalina Islands, and historically it occurred on San Clemente Island. In addition, the southern California mainland subspecies (*P. m. megalonyx*) occurs on Santa Cruz Island. We used genetic samples from each of the three islands in which the Spotted Towhee is currently found and two nearby mainland populations to investigate the evolutionary relationships between populations on the islands and the nearby mainland. We sequenced one mitochondrial DNA gene (ND2) and used a next-generation sequencing technique, genotyping by sequencing (GBS), to collect thousands of SNPs from across the genome. ND2 sequences showed little variation, and this variation did not correspond to geography, subspecies designation, or a mainland to island division. However, using 5,302 SNPs for 46 individuals sequenced using GBS, we found four highly supported clades, corresponding to Santa Catalina, Santa Rosa, Santa Cruz and the mainland. Although each island population forms a separate clade, widespread gene flow is apparent between the San Diego and Los Angeles populations. Morphological analyses indicate that bills of the Spotted Towhee on the Channel Islands have diverged more than expected based on neutral genetic variation, suggesting adaptation of bill size to island conditions. Our results contrast with current subspecies designations and suggest taxonomic revision is necessary. (ID 15814)

**Wang, A. X.**, University of Hawaii, Hilo, USA, Axwang@hawaii.edu  
Hart, P. J., University of Hawaii, Hilo, USA, Pjhart@hawaii.edu

#### THE PRESENCE OF AN ECOLOGICAL TRAP IN THE JUVENILE DISPERSAL OF A CRITICALLY ENDANGERED HAWAIIAN HONEYCREEPER, THE AKOHEKOHE (*PALMERIA DOLEI*), A POPULATION-LIMITING LIFE STAGE?\*

The Akohekohe, endemic to the island of Maui, remains critically endangered despite relatively high nest success (Simon et al. 2001) and decades of habitat restoration. In this study, I examine the hypothesis that an ecological trap may exist in this system, whereby there is a mismatch between perceived and actual habitat quality for Akohekohe foraging across the landscape. These birds are extremely vulnerable to avian malaria spread by mosquitoes, which limits Akohekohe's range to high elevation, mosquito-free refugia (Atkinson & Lapointe 2009). It has been suggested that in summer, the nectarivorous Akohekohe follows seasonal flower blooms of the dominant canopy tree, ohia (*Metrosideros polymorpha*) to lower elevations where they experience increased mortality from malaria and that this mainly occurs with juvenile birds. This misalignment of an environmental indicator (flower bloom) with true habitat quality (risk of malaria infection) can be considered an ecological trap operating on a landscape scale. To test this hypothesis, I used radio telemetry to track individual Akohekohe movements and measured ohia bloom across a 450m elevational gradient. Information from 25 birds over two seasons indicates there are major behavioral differences between adult and juvenile birds. Adults remain constrained to relatively small territories well above the malaria zone whereas juveniles disperse widely and often downslope, increasing the potential for exposure to malaria infected mosquitoes. This study provides evidence that an ecological trap may indeed be operating in this system, and that it occurs primarily during the juvenile dispersal period. Atkinson, C.T., and D.A. LaPointe. 2009. Introduced avian diseases, climate change, and the future of Hawaiian honeycreepers. *Journal of Avian Medicine and Surgery* 23:53-63. Simon, J.C., Pratt T.K., Berlin, K.E., and Kowalsky, J.R. 2001. Reproductive ecology and demography of the akohekohe. *The Condor* 103: 736-745. (ID 16115)

**Wang, S. Y.**, University of Washington, USA, sarayw@uw.edu  
Battey, C. J., University of Washington, USA, cjbattey@uw.edu  
Klicka, J., University of Washington, USA, klicka@uw.edu

#### BIOGEOGRAPHY OF THE GREAT-TAILED/BOAT-TAILED GRACKLE AVIAN SPECIES COMPLEX\*

Grackles are gregarious blackbirds (*Icteridae*) native to the New World. We focus on the genetic structuring and biogeography of two sister species: the boat-tailed grackle (*Quiscalus major*), and the great-tailed grackle (*Quiscalus mexicanus*), the latter consisting of eastern and western clades. The recent anthropogenic range expansion of the great-tailed grackle creates a unique opportunity to observe secondary contact between these previously isolated populations. Niche models of the boat-tailed grackle, western great-tailed grackles, and eastern great-tailed grackles indicate that they occupy distinct climatic niche spaces. A molecular phylogeny constructed using ND2 mitochondrial sequences shows that the great-tailed grackle forms a paraphyletic complex, with the eastern great-tailed grackle sharing a common ancestor with the boat-tailed grackle more recently than with western great-tailed grackles. In order to further characterize the amount and location of gene flow between these lineages, we are currently sequencing a genome-wide sampling of SNP's using a ddRADseq protocol. Here we present preliminary results from a Bayesian clustering analysis in the program STRUCTURE and coalescent modeling in the program SNAPP. The great-tailed/boat-tailed grackle species complex presents a rare opportunity to observe ongoing secondary contact and, possibly, reticulate speciation, thus furthering our understanding of the process of speciation in avian communities. (ID 16205 | Poster 59)

**Wann, G. T.**, Colorado State University, USA, greg.wann@colostate.edu  
Aldridge, C. L., Colorado State University, USA, cameron.aldrige@colostate.edu  
Braun, C. E., Grouse Inc, USA, sg-wtp@juno.com

#### INVESTIGATING CHANGES IN ABUNDANCE, SURVIVAL, AND REPRODUCTION OF WHITE-TAILED PTARMIGAN AT ROCKY MOUNTAIN NATIONAL PARK USING HISTORIC AND CONTEMPORARY BANDING AND SURVEY DATA

Alpine ecosystems in Colorado support the largest extent of white-tailed ptarmigan habitat in the contiguous United States and research on these populations has provided foundational information on the species biology. White-tailed ptarmigan are thought to be vulnerable to climate change largely due to their reliance on habitat which may be lost due to encroachment of woody vegetation from lower elevations under warming regimes. Monitoring of a ptarmigan population at Rocky Mountain National Park took place from 1966 to 2000, and abundance declined sharply beginning in the mid-1970s. Overabundance of elk in the park was thought to be a major contributing factor to declines of ptarmigan in the park, but warming winters have also been implicated as a factor. We began monitoring the Trail Ridge population again from 2010 to 2013 to assess if the population had returned to historic levels. Capture-recapture analysis of historic data (1966-2000) indicated annual survival of adults did not decline across time and varied from a low of 0.50 to a high of 0.87. Over the same period densities declined from a high of 8.7 birds/km<sup>2</sup> in 1977 to a low of 1.1 birds/km<sup>2</sup> in 1999, and annual fecundity also declined ( $P < 0.001$ ). From 2010 to 2013, average annual survival for adults was 0.63, and densities ranged from 1.7 to 2.4 birds/km<sup>2</sup>. Climate covariates fit to historic data indicate years with above-average winter precipitation are beneficial for adult survival, but the primary factors affecting annual variation in reproduction were not strongly related to summer weather. Thus ptarmigan populations persist at Trail Ridge, although at densities that are generally much lower than historic times. The Trail Ridge population has likely been negatively impacted by both local biotic factors (reduction of willow communities) and abiotic factors (changes in winter precipitation). (ID 16245)

**Ware, H. E.**, Boise State University, USA, heidiware@u.boisestate.edu  
McClure, C. J., The Peregrine Fund, USA, chrimcc@gmail.com  
Carlisle, J. D., Intermountain Bird Observatory, USA, jaycarlisle@boisestate.edu  
Barber, J. R., Boise State University, USA, jessebarber@boisestate.edu

#### ROAD NOISE REDUCES FORAGING AND STOPOVER EFFICIENCY OF MIGRATING SONGBIRDS

Over the last 40 years, anthropogenic noise has expanded across the landscape dramatically, and road noise in particular continues to increase in both urban and natural areas. Since the 1970's, vehicle traffic has tripled in the US and more than 83% of land in the United States is now within ~1km of a road. Previous studies indicate that traffic noise may be the cause of observed declines in animal populations near roads; however the mechanism of these road impacts has not been tested experimentally. By adding road noise to the landscape using an array of speakers, we were able to experimentally test the effects of noise alone on more than 20 species of songbirds. Since increased sound levels are known to reduce a bird's ability to forage, we predicted that birds exposed to traffic noise would have lower body condition. We found that migrants caught when the noise was on had lower body condition, and also gained weight more slowly throughout the day. We conducted additional experiments in the lab exposing one of our study species, white-crowned sparrows (*Zonotrichia leucophrys*), to traffic noise while foraging. The sparrows significantly reduced foraging and increased vigilance in noise, further supporting our hypothesis that road noise interferes with foraging and vigilance of migrants during stopover. Our findings have broad application to management concerns since mitigation of noise could potentially prevent habitat degradation for a variety of species. (ID 15839)

**Warning, N.**, University of Northern Colorado, USA, natwarning@gmail.com  
Benedict, L., University of Northern Colorado, USA, lauryn.benedict@unco.edu  
PAVING THE WAY; FUNCTIONAL NEST ARCHITECTURE OF THE ROCK WREN

Effective nest construction is integral to reproductive success in most species of birds. Many unique nest building behaviors have evolved to mitigate predation, parasitism, and hatching failure. One unique nest building behavior is the extensive use of small rocks during nest construction, which occurs in only approximately 0.3% of avian species. Rock Wrens (*Salpinctes obsoletus*) stereotypically augment their nests with a pavement of small, flat stones, apparently incurring considerable energy costs, with benefits that are not understood. We tested the function of stone pavements in 36 Rock Wren nests. We quantified stone use and measured how stones occlude the nest by decreasing the effective size of the nest cavity entrance. We examined three hypotheses about the benefits of nest cavity occlusion: (1) stones ameliorate temperature fluctuations and improve nest thermoregulation, (2) stones improve nest microclimates by keeping them dry, and (3) stones have the potential to reduce nest predation by alerting incubating females when predators approach. We found that stones decreased nest cavity openings by a mean of 36.5%. Presence of stones did not influence temperature in unoccupied nest cavities, but did significantly decrease water infiltration into the nests during simulated rainfall. Human subjects were able to discriminate the approach of a simulated predator across stones in blind audio trials, supporting the idea that stone patios may serve an alarm function for vulnerable incubating females. Our data indicate that stone foundations built by Rock Wrens are multifunctional, providing benefits to nesting wrens for predator avoidance and physical protection. (ID 15862)

**Weaver, R. J.**, Auburn University, USA, rjw0019@auburn.edu  
Wilson, A. E., Auburn University, USA, aew0009@auburn.edu  
Hill, G. E., Auburn University, USA, hillgee@auburn.edu

#### SIGNALS OF INDIVIDUAL QUALITY FROM CAROTENOID-PIGMENTED PLUMAGE: A META-ANALYSIS OF YELLOW AND RED CAROTENOIDS

The condition-dependent nature of carotenoid pigmentation has been demonstrated repeatedly in the study of sexually selected ornaments in birds and as such, is thought to serve as the basis for honest signaling of individual



quality. However the mechanisms that act to maintain the strength of signal honesty are not fully understood. Carotenoids can be deposited to feathers unmodified from their dietary form to produce yellow coloration or can be deposited after being bioconverted to produce red coloration. We hypothesize that the cost of the bioconversion process of dietary yellow carotenoids to red ketolated carotenoids acts to maintain signal honesty of carotenoid-based plumage coloration. Here we use meta-analytic techniques to examine the differences in signal strength between bird species that display either dietary or ketolated carotenoid-pigmented plumage and several aspects of individual quality. From 44 published studies we extracted 132 effect sizes that measure the relationship between carotenoid-based feather coloration and the following aspects of individual quality: 1) body condition 2) immune function 3) parasite resistance or 4) parental and reproductive quality. We find that both dietary yellow and ketolated red plumage is positively associated with each aspect of quality, but the relationship of quality measures with yellow plumage color is only marginally significant. Additionally we show that dietary yellow plumage color, on average, is a significantly weaker signal of individual quality than red plumage color. We suggest that the conversion process of dietary carotenoids be investigated further as an important factor that acts to maintain signal honesty of this condition-dependent trait. (ID 16092 | Poster 109)

**Webster, M. S.**, Cornell University, USA, msw244@cornell.edu  
Reeve, H. K., Cornell University, USA, hkr1@cornell.edu

#### HONEST SIGNALING OF COMPETITIVE ABILITY WITHOUT DIRECT SIGNAL COSTS: HOW COMMUNICATION CAN LESSEN THE COSTLINESS OF COMPETITION

Male birds typically communicate with potential mates and rivals via sexual signals, such as bright plumage or song, that appear to be honest indicators of relative quality and competitive ability. The mechanisms that maintain honesty in these signals remain unclear, and it is generally thought that the costs of signal production maintain honesty. For example, testosterone (T) is often needed for full development of sexual signals in birds, and the costs of high T levels (e.g., immunosuppression) may constrain low quality individuals to lower levels of signaling. Yet selection should strongly favor lower cost signals, for example production of signals with lower levels of T, leading to the spread of dishonest signaling. We develop a game theoretical "tug of war" model that examines the relationships among signaling, costs, and individual competitive ability. We show that social costs can maintain honest signaling even when signal production costs are absent, without the need for a costly testing process. Intriguingly, the model yields the result that stable signals will be "relationally honest" but not "strictly honest": high quality individuals should over-represent their quality, whereas low quality individuals should under-represent their quality. The competition that results between the sender and the receiver is on average less costly than competition that results between the two parties in the absence of signals, because communicating parties end up investing less effort in competition. Thus, communication signals can reduce the overall costs of competition, with honesty maintained by social interactions rather than costly physiological mechanisms. (ID 15968)

**Wegner, S.**, Bowdoin College, USA, swegner@bowdoin.edu

#### STARS, PIES AND CASH: THE PASSENGER PIGEON IN NORTH AMERICAN ART AND CULTURE, 1500-2014<sup>1</sup>

Most know well the fate suffered by the wild passenger pigeon, whose vast flocks were recorded in awe by Champlain in 1609 and Wilson and Audubon in the early 1800s. Fewer know how deeply the wild pigeons informed the cultural life of North Americans from the First Nations peoples to the early European immigrants to those today who seek to learn from the species' demise. Some found cosmic and spiritual meaning in the birds, like the Micmac of the northeast who still trace the path of the pigeon in the

movement of the circumpolar stars. Others, like 19th-century Canadian and New England youth, embraced pigeon hunting as a rite of passage, earning them pocket money or birds to fatten for pigeon pie. Visual artists, musicians and writers, professional and amateur, evoked the pigeons in paintings, a symphony, poems and memoirs. Poet Longfellow, and novelists Cooper, Hawthorne and Harriet Beecher Stowe; painters, Audubon, Thayer, Lewis Cross of Michigan; theologians Cotton Mather and Reverend Jonathan Fisher of Blue Hill, Maine, all drew inspiration from the wild pigeons that they hunted or witnessed in stunning migrations. This paper presents just a sample of the many cultural expressions arising from humans' interaction with the passenger pigeon, demonstrating its iconic status in the arts and in the domestic and community traditions of North America. (ID 15998)

**Weiser, E. L.**, Kansas State University, USA, emily.l.weiser@gmail.com  
Grueber, C. E., San Diego Zoo Global, Australia, catherine.grueber@otago.ac.nz  
Kennedy, E. S., Department of Conservation, New Zealand, ekennedy@doc.govt.nz  
Jamieson, I. G., University of Otago, New Zealand, ian.jamieson@otago.ac.nz

#### UNEXPECTED POSITIVE EFFECTS OF INBREEDING IN THE HIGHLY INBRED CHATHAM ISLAND BLACK ROBIN

Inbreeding depression can jeopardize the survival of endangered species. However, the effects of inbreeding depend on the genetic history of the species in question, and can be strongly influenced by chance events. The black robin (*Petroica traversi*), one of New Zealand's iconic bird species, has recovered from a single-pair bottleneck in 1979 to 280 highly inbred adults today. Despite apparent demographic viability thus far, there is concern that inbreeding depression may eventually threaten this species. We used detailed demographic data and a complete pedigree to assess inbreeding effects in this species. We found no effects of inbreeding on adult survival, but moderate inbreeding depression on juvenile survival and on annual reproductive success of males. In contrast, we found an unexpected positive effect of inbreeding on reproductive success of females, strongest when females were closely related to their mates. To our knowledge, this is the first positive effect of inbreeding that has been clearly documented in a wild vertebrate population. The mixed effects of inbreeding had a counterintuitive positive effect on expected population viability. Our analyses suggest an optimistic future for this species, but a small amount of management effort is still warranted and would maximize the long-term probability of persistence for this endangered bird. (ID 15730)

**West, E. H.**, University of Wisconsin-Madison, USA, doucetbeer@wisc.edu  
Peery, M. Z., University of Wisconsin-Madison, USA, mpeery@wisc.edu

#### FOOD FOR THOUGHT: THE INFLUENCE OF RESOURCE SUBSIDIES ON THE ECOLOGY AND BEHAVIOR OF STELLER'S JAYS IN PROTECTED AREAS

Populations of many native synanthropic species have expanded as a result of increased availability of anthropogenic food and threaten less common native species through spillover predation, which occurs when synanthropic predators move into unaltered landscapes where they prey on native species. As the expansion of many synanthropic species is linked to the prevalence of human-derived foods, understanding how spatial and temporal variation in food subsidies influence behavior and population processes is essential for controlling impacts to threatened species. In California, populations of Steller's jays have increased dramatically in protected areas containing remnant populations of the threatened marbled murrelet, presumably in response to the availability of human foods in recreational areas within these parks. Therefore, we studied how human-derived foods in protected areas containing murrelet breeding populations influence the foraging ecology of Steller's jays. We used stable isotope analysis of Steller's jay tissue samples to estimate the importance of human foods in Steller's jay diets, as well

to determine how the consumption of human foods varied among four state parks with different levels of human use and whether diet reflected seasonal changes in patterns of visitation. We also combined stable isotope analysis and radio-telemetry at one study park to determine how human food resources influenced the movement patterns and territory spacing of individual Steller's jays. Results indicate that human foods are an important component of the diet of Steller's jays in campgrounds, but vary in terms of park size and seasonally with human use. Results also indicate that individual jays that are enriched in human foods have small home ranges and exhibit greater home range overlap with conspecifics. Collectively, our work provides insight into the mechanisms by which food subsidies within protected areas can increase the abundance of a synanthropic species. (ID 15987)

**Westwood, A. R.**, Dalhousie University, Canada, a.westwood@dal.ca  
Staicer, C., Dalhousie University, Canada, cindy.staicer@dal.ca

#### HABITAT ASSOCIATIONS OF THE RUSTY BLACKBIRD IN NOVA SCOTIA, AND OPPORTUNITIES FOR CONSERVATION WITHIN A MULTI-SPECIES SUITE\*

A critical step in species at risk (SAR) conservation is identification of breeding habitat. The Rusty Blackbird (RUBL) has suffered global population loss of up to 95%, with steepest declines in the eastern breeding range, including Nova Scotia, Canada. In this region, threats are numerous, including habitat conversion (primarily through logging), mercury contamination, blood parasites, etc. Data about availability/quality of habitat is urgently needed, as well as accurate characterization of occupied wet forest ecosystems. In the Southwest Nova Biosphere Reserve (SNBR) two other listed SAR (Olive-Sided Flycatcher [OSFL], Canada Warbler [CAWA]) occupy wet forest ecosystems in both protected areas and lands undergoing forest management. From 2012-2013, point count and playback surveys were conducted in 331 plots to locate SAR and quantify their habitat. Vegetation and physical characteristics were measured at RUBL-occupied sites ( $n = 38$ ), and OSFL/ CAWA sites ( $n = 63$ ). RUBL-occupied sites in harvested forest matrices ( $n = 22$ ) had higher coniferous and broadleaf shrub cover, more ground debris, and less herbaceous cover than those in non-harvest areas ( $n = 16$ ). However, these differences may not be biologically significant, suggesting opportunities to not only conserve habitat via formal protection, but also using management protocols to minimize habitat disturbance in and active forest harvesting operations. Further comparison of occupied and unoccupied sites indicates useful features for targeting conservation lands. Despite extremely high habitat heterogeneity of habitats in southwestern Nova Scotia, RUBL occupied similar ecosites to OSFL and CAWA. Further research will use land cover classifications derived remote sensing to identify wet forest habitat at landscape scales, and model the distribution of these SAR across the Maritimes, exploring the possibility of developing conservation plans for all three species as a suite. (ID 16094)

**Wheelwright, N. T.**, Bowdoin College, Department of Biology, Brunswick, USA, nwheelwr@bowdoin.edu  
Teplitsky, C., Muséum National d'Histoire Naturelle, Département Ecologie et Gestion de la Biodiversité UMR 7204, Paris, France

#### INHERITANCE OF DIVORCE IN SAVANNAH SPARROWS: NEITHER GENETIC NOR CULTURAL

Divorce (mate-switching) in birds is often considered an adaptive mating strategy favored by natural selection. However, its genetic basis and mechanism of inheritance are unknown. We studied divorce in Savannah sparrows (*Passerculus sandwichensis*) breeding on Kent Island, New Brunswick, Canada. In this population, natal and breeding philopatry are high so we could document the frequency of divorce within and between seasons and generations. We estimated the additive genetic variance for divorce by comparing the mating behavior of relatives and applying animal models. We also measured repeatability and the

strength of natural selection on divorce, using lifetime production of recruits as a measure of fitness. Although divorce sometimes improved a female's fitness (but not of males that had been divorced), we found very low additive genetic variance for the behavior. Likewise, there was no evidence for cultural transmission of divorce, even though strong philopatry conceivably could allow offspring to monitor and adopt the mating behavior of their parents. Our results raise the question of whether complex mating behaviors such as divorce can evolve rapidly in changing environments in the absence of genetic variation for the trait. (ID 16391)

**Wilkins, M. R.**, University of Colorado at Boulder, USA, wilkinm@colorado.edu  
Joseph, M. B., University of Colorado at Boulder, USA, maxwell.joseph@colorado.edu  
Hubbard, J. K., University of Colorado at Boulder, USA, joanna.hubbard@colorado.edu  
Safran, R. J., University of Colorado at Boulder, USA, rebecca.safran@colorado.edu

#### MULTIMODAL SIGNALING IN THE NORTH AMERICAN BARN SWALLOW: INFLUENCES OF INTRA- AND INTERSEXUAL SELECTION ON SIGNAL EVOLUTION

Complex signals, involving multiple components within and across modalities (e.g. visual or acoustic), are ubiquitous in animal communication. Numerous studies show benefits of complex signals in reducing search costs and maximizing signal efficacy. However, the interactions between multiple components of complex signals across modalities have not often been considered. Additionally, studies of complex signaling have typically focused on the role of female preferences in driving complexity, ignoring the contribution of intrasexual competition. Here, we utilize the North American barn swallow (*Hirundo rustica erythrogaster*) to demonstrate a novel approach for understanding the evolution of complex communication systems, in the context of male and female receivers. We integrate model testing with correlation-based phenotype networks to infer the contributions of intra- and intersexual selection on the evolution of the barn swallow communication system. We find that different signaling traits likely evolved via female choice versus male-male competition, with little signal overlap across contexts. We suggest that applying our approach broadly across taxa and sender-receiver contexts will afford researchers new insight into the selective pressures and constraints affecting the evolution of communication. (ID 15761)

**Williams, E. J.**, Kansas State University, USA, ejwillia@ksu.edu  
Boyle, W. A., Kansas State University, USA, aboyle@ksu.edu

#### GRASSHOPPER SPARROWS ON THE MOVE: WHAT EXPLAINS VARIATION IN WITHIN-SEASON BREEDING DISPERSAL IN A DECLINING SONGBIRD?

Grassland birds are declining throughout North America, likely primarily due to habitat loss. The grassland-obligate Grasshopper Sparrow (hereafter, sparrows) is declining at 3% per year, including in their core breeding range in the Flint Hills of Kansas. During the 2013 breeding season, we observed that many sparrows dispersed 1-3km within our 3,487-ha study area at the Konza Prairie Biological Station, presumably between nesting attempts. Consequently, patterns of sparrow relative abundance changed dramatically over the breeding season. We hypothesized that these dispersal events are due to spatial differences and temporal changes in relative food abundance associated with different land use. We predicted that densities of sparrows would be associated with higher food intake rates. We captured and blood-sampled 170 male Grasshopper Sparrows between May-July 2013 on 18 plots managed with cattle, bison, or no grazers, and burn frequencies of 1-3 years. We measured triglyceride (TRIG) concentrations in a plasma sample from each individual to determine food intake rate. Preliminary results indicate that sparrows foraging on plots burned in early Spring had higher food intake

rates than did sparrows in areas not burned in 2013, independent of burning interval or grazing regime. Contrary to prediction, food intake rates were unrelated to sparrow densities, suggesting that dispersal movements may not be driven by simple spatial differences in food availability. Ongoing studies quantifying the temporal and spatial patterns of food abundance directly will help determine the consequences of different land management regimes on grassland bird movements and habitat quality. (ID 15743)

**Williams, K. A.**, Biodiversity Research Institute, USA, kate.williams@briloon.org  
**Keenan, P. C.**, Biodiversity Research Institute, USA, patrick.keenan@briloon.org  
**Tash, J.**, Biodiversity Research Institute, USA, jeffrey.tash@briloon.org  
**Adams, E. M.**, Biodiversity Research Institute, USA, evan.adams@briloon.org  
**Goodale, M. W.**, Biodiversity Research Institute, USA, wing\_goodale@briloon.org

#### THE INFLUENCE OF WEATHER, LANDCOVER, AND GEOGRAPHY ON NORTHERN SAW-WHET OWL (*AEGOLIUS ACADICUS*) MIGRATION IN COASTAL MAINE

Northern Saw-whet Owls (*Aegolius acadicus*) are present in Maine year-round and large numbers migrate through the state each fall. Coastal and offshore migration by Saw-whet Owls has been widely regarded in the literature as an irregular phenomenon. In order to examine this hypothesis, we conducted Saw-whet Owl migration banding surveys over five years (2009-2013; 829 captures) at 17 island and mainland sites in coastal Maine. Data were analyzed using generalized linear mixed models to determine the degree to which topography, land cover, and weather influence Saw-whet Owl migratory activity. Migrating owls were most likely to be captured at the edges of boreal forests and other upland forest habitats on nights with cooler average temperatures, tail winds, and clear skies with relatively little moonlight. Saw-whet Owl migration stopover activity also varied with the topography of the Maine coastline; owl captures were more frequent on island sites and along the coast, but capture rates decreased in areas with high proportions of coastal scrub habitat. This suggests that while owls may track the Maine coastline and use it as a directional guide during migration, they prefer more heavily forested areas to coastal scrub habitats. Our results suggest that despite the common perception of Saw-whets as land migrants, at least a subset of the state's migrant population appears to be using an over-water migration route in the Gulf of Maine. (ID 16087)

**Williams, K. A.**, Biodiversity Research Institute, USA, kate.williams@briloon.org  
**Stenhouse, I. J.**, Biodiversity Research Institute, USA, iain.stenhouse@briloon.org  
**Adams, E. M.**, Biodiversity Research Institute, USA, evan.adams@briloon.org  
**Connelly, E.**, Biodiversity Research Institute, USA, emily.connelly@briloon.org  
**Duron, M.**, Biodiversity Research Institute, USA, melissa.duron@briloon.org  
**Gilbert, A. T.**, Biodiversity Research Institute, USA, andrew.gilbert@briloon.org

#### COMPARISON OF SHIPBOARD AND HIGH DEFINITION VIDEO AERIAL SURVEY TECHNIQUES FOR CONDUCTING SURVEYS OF AVIAN DISTRIBUTIONS AND ABUNDANCE ON THE MID-ATLANTIC OUTER CONTINENTAL SHELF

Aerial surveys using a high definition video platform are a recent methodological approach for the United States, though they have become common practice for offshore wind energy development in Europe. As part of a three-year study of wildlife distributions and abundance on the mid-Atlantic Outer Continental Shelf, we conducted a comparison study of ship-based and high definition video aerial surveys off the coast of Virginia in March of 2013 (between 5.5 and 85 km from shore). There were substantial differences between the survey methods in terms of identification to species level, though identification rates by family were correlated between survey methods. Detection rates were statistically similar between the six aerial replicates of the transects, both by family group (Anatidae, Sulidae, Gaviidae) and overall. The six aerial replicates were thus bootstrapped to provide mean

estimates of number of individuals in the study area. Controlling for transect strip width, aerial surveys had significantly higher numbers of detections by family group than did boat surveys prior to distance correction; a preliminary distance model for boat data, however, provided estimated population sizes 3-4 times higher than bootstrapped aerial estimates. We are currently developing alternative modeling approaches for the aerial survey data that allow for explicit estimation of detection and development of confidence intervals around estimates of local population size. It is critical to understand the biases, efficiency, and utility of high-definition aerial video surveys versus a traditional boat-based survey platform if we are to continue using digital survey methodologies for monitoring avian populations in the United States or integrate new digital survey data with historical datasets. Variations in detection and identification of seabirds between survey methods should be carefully considered when choosing which methodology to use for offshore surveys. (ID 16082)

**Wilsey, C. B.**, National Audubon Society, USA, cwilsey@audubon.org  
**Pollock, J.**, Audubon Chicago Region, USA, jpollock@audubon.org  
**Schuetz, J. G.**, National Audubon Society, USA, jschuetz@audubon.org

#### CONSERVING GRASSLAND BIRDS IN THE CHICAGO WILDERNESS USING CITIZEN SCIENCE AND REMOTE-SENSING

Grassland birds are the fastest declining group of birds in the United States, suffering from a suite of threats including afforestation, conversion to agriculture, and rangeland deterioration. In the greater Chicago region, citizen volunteers coordinated through the National Audubon Society have sampled grassland birds each June since 1998. Concurrently, Chicago Wilderness, an alliance of more than 300 non-profit, industry, and governmental groups in the greater Chicago area, has identified grassland protection and restoration of the region's 12,000 ha of grasslands as a top conservation priority. Here, we describe a novel approach to leveraging the effort of citizen volunteers, remote-sensing-derived data sources, and Chicago Wilderness to model populations of five grassland bird species (i.e., Bobolink, Eastern Meadowlark, Grasshopper Sparrow, Henslow's Sparrow, Sedge Wren) and set conservation and restoration priorities across the region. First, we use existing data along with remote-sensing-derived data products to model abundances and identify gaps in existing data coverage. Second, we ask citizen volunteers to conduct targeted bird surveys in areas of greatest model uncertainty. And third, we rebuild models using the new data and identify grassland conservation priorities in the Chicago region. Models constructed using classified land-use/landcover maps explained 41-60% of deviance in an independent test dataset while models built with raw reflectance values from Landsat imagery explained 33-49% of deviance. We prioritize the landscape for additional surveys in June 2014 based on historical survey coverage and the uncertainty across modeling approaches. Models can be used with land-use/landcover or satellite data to update population estimates as well as to explore the trade-offs in birds/ha among proposed management actions. (ID 15971)

**Wilson, S.**, Environment Canada, Canada, scottd.wilson@ec.gc.ca  
**MacDonald, E. C.**, University of British Columbia, Canada, ecmacdonald@mta.ca  
**Martin, M.**, University of British Columbia, Canada, mma110@sfu.ca  
**Camfield, A. F.**, Environment Canada, Canada, alaine.camfield@ec.gc.ca  
**Martin, K.**, University of British Columbia/Environment Canada, Canada, kathy.martin@ubc.ca

#### NEST SUCCESS OF ALPINE SONGBIRDS IN CENTRAL BRITISH COLUMBIA: VARIABLE RESPONSES TO HABITAT AND SEVERE WEATHER

Alpine species must cope with short breeding seasons and inclement weather but few studies have compared the susceptibility of sympatric species to these conditions. We examined nest survival of two songbirds, horned lark



( $n=189$  nests) and savannah sparrow ( $n=89$  nests) at Hudson Bay Mountain, British Columbia in relation to year, time of season, nest age, habitat structure and severe weather. Annual nest success was strongly correlated between the species ( $r=0.86$ ,  $n=4$  years) suggesting they are influenced by similar environmental conditions that vary among years, and average daily nest survival was similar at  $0.29 + 0.03$  (SE) for horned lark and  $0.35 + 0.06$  for savannah sparrow. Within seasons, horned lark nest survival increased over time but decreased with nest age while savannah sparrow nest survival increased during each of the incubation and nestling stages. The two species varied in their response to habitat and severe weather with abandonment a greater cause of failure for savannah sparrows (41% of nests) compared to horned larks (15%). Nest site cover had no influence on daily nest survival for horned larks but a strong and positive influence for savannah sparrows. While both species were resilient to low amounts of precipitation on single days they became increasingly susceptible to multiple days of precipitation and storm events with  $>10\text{mm}$  over a 24-hour period. Savannah sparrows were more severely affected by these events; predicted daily nest mortality (DNM) for a 10 day old nest was 11.4 times greater during storm events (0.013 vs 0.148), while for Horned Larks, DNM increased 3.2 fold (0.015 vs 0.050) over background levels. Although these two sympatric songbirds varied in their response to severe weather, our results indicate that populations of both species will be susceptible to an increased frequency of heavy precipitation as predicted from climate change models for alpine regions. (ID 15903)

**Wilson, S.**, Environment Canada, Canada, scottd.wilson@ec.gc.ca  
 Pillar, A. G., Thompson Rivers University, Canada, andrew.pillar@gmail.com  
 Reudink, M. W., Thompson Rivers University, Canada, mreudink@tru.ca  
 Ladeau, S. L., Cary Institute of Ecosystem Studies, USA, ladeaus@caryinstitute.org

Tøttrup, A. P., University of Copenhagen, Denmark, aptottrup@snm.ku.dk  
 Marra, P. P., Smithsonian Migratory Bird Center, USA, marrap@si.edu

#### COMBINING BREEDING BIRD SURVEY DATA WITH REMOTE SENSING TO ASSESS THE EFFECTS OF BREEDING AND WINTER CLIMATE ON THE RANGE-WIDE ABUNDANCE OF NEOTROPICAL MIGRANTS

Environmental factors affect migratory bird populations in every phase of their annual cycle and have significant impacts on breeding success and survival. The majority of studies have focused on environmental effects at small spatial scales, but range-wide analyses aid our understanding of how these effects influence population dynamics at the large scales over which conservation decisions are made. Recent advances in the analysis of the Breeding Bird Survey (BBS), remote sensing techniques and our knowledge of migratory connectivity allow us to examine how the range-wide abundance of a species is affected by environmental conditions at different stages of the annual cycle. Studies on two Neotropical migrants, the American redstart and Bullock's oriole, used the Normalized Difference Vegetation Index (NDVI), a measure of vegetation greenness, as a productivity covariate in hierarchical models of BBS data. Abundance of American redstarts in eastern North America was positively influenced by winter productivity in the Caribbean where they over-winter but western breeding populations showed little response to productivity in their overwintering areas in Mexico. The abundance of Bullock's orioles showed no response to environmental productivity during the non-breeding season (including moult and winter), but populations in the core area of the breeding range responded positively to conditions in the prior breeding season. The variable response to vegetation productivity across regions may be due to differing ecological mechanisms across a species' range but also statistical limitations in our ability to link BBS abundance with environmental productivity. Improved knowledge on migratory connectivity and how ecological mechanisms affect individuals, especially during the non-breeding period, would improve our ability to assess how environmental conditions throughout the annual cycle affect species at large spatial scales. (ID 16132)

**Winder, V. L.**, Benedictine College, USA, vwinder@benedictine.edu  
 McNew, L. B., U.S. Geological Survey, USA, lmcnew@usgs.gov  
 Sandercock, B. K., Kansas State University, USA, bsanderc@ksu.edu

#### DEMOGRAPHIC AND MOVEMENT RESPONSES OF GREATER PRAIRIE-CHICKENS TO PATCH-BURN GRAZING ON PRIVATE LANDS

Populations of Greater Prairie-Chickens (*Tympanuchus cupido*) have declined across their extant range over the past 30 years. Prairie-chickens are an umbrella species for prairie ecosystems and require a mosaic of habitats for successful reproduction and survival. The timing of population declines of prairie-chickens corresponds to the implementation of intensive rangeland management practices that homogenize grassland habitats. Patch-burn grazing has been introduced as an alternative management technique, mimicking historically heterogeneous fire and grazing regimes. We conducted a 3-year study (2011–2013) to investigate demographic and spatial ecology responses of prairie-chickens to patch-burn grazing v. intensive management in the central Flint Hills of Kansas. Vertical cover was the strongest predictor of both nest site selection and nest survival and was heavily dependent on fire return interval. The quantity and quality of nesting habitat was improved under patch-burn grazing management. We used resource utilization functions (RUFs) to investigate landscape-level drivers of space use by female prairie-chickens. We explored the effects of prescribed fire, stocking density, elevation, and proximity to lek, edge, and road on habitat selection. Female prairie-chickens disproportionately used space close to leks, at high elevations, and away from land cover patch edges, and many individuals selected areas with lower stocking densities and longer fire return intervals. Our results support a growing body of evidence that rangeland management strategies that mimic historical heterogeneous fire and grazing regimes benefit native prairie wildlife and ecosystem health. (ID 15881)

**Winder, V. L.**, Benedictine College, USA, vwinder@benedictine.edu  
 Sandercock, B. K., Kansas State University, USA, bsanderc@k-state.edu  
 Hagen, C. A., Oregon State University, USA, Christian.Hagen@oregonstate.edu  
 Haukos, D. A., U.S. Geological Survey, Kansas State University, USA, dhaukos@ksu.edu

Kesler, D. C., University of Missouri-Columbia, USA, keslerd@missouri.edu  
 Patten, M. A., Oklahoma Biological Survey, Sutton Avian Research Center, Oklahoma University, USA, mpatten@ou.edu  
 Powell, L. A., University of Nebraska-Lincoln, USA, lpowell3@unl.edu

#### LEK SITES DRIVE FEMALE RESOURCE USE IN TEN POPULATIONS OF PRAIRIE-CHICKENS

Conservation of wildlife populations depends on an understanding of the interaction between animals and key landscape metrics. Population ecology can vary spatially, but replicated studies at multiple sites are rare. We investigated the spatial ecology of two closely related species of conservation concern at ten sites in five states: Greater Prairie-Chickens (*Tympanuchus cupido*) and Lesser Prairie-Chickens (*T. pallidicinctus*). We used resource utilization functions to investigate female prairie-chicken space use in relation to lek sites and anthropogenic alteration to the landscape. Distance to lek was the strongest predictor of space use for female prairie-chickens at all ten sites, and prairie-chickens selected grassland even where  $\geq 90\%$  of the study site was native prairie. Breeding range size varied by  $\sim 8$ -fold (8–65 km<sup>2</sup>) across sites, indicating that site-specific variation in ecology can have substantial consequences for space use requirements. We observed a tradeoff between breeding range size and lek spacing: ranges were large when leks were clustered and small when leks were dispersed. Over 95% of the females monitored in our study had centers of activity within 5 km of leks. Our data are most consistent with the hotspot hypothesis that predicts that males choose lek sites in areas where female seasonal ranges are relatively dense or at the intersection of more dispersed ranges. Our data provide evidence that lek surveys may signify an aspect of habitat quality that goes beyond a basic

count of individuals. We recommend management actions to improve nesting habitat outside the immediate proximity of leks. (ID 15885)

**Winger, B.**, University of Chicago/Field Museum, USA, bwinger@uchicago.edu  
Bates, J., Field Museum of Natural History, USA, jbates@fieldmuseum.org  
A TIME THRESHOLD FOR PLUMAGE DIVERGENCE IN ALLOPATRIC ANDEAN BIRDS\*

The differentiation of populations in geographic isolation (allopatry) is widely recognized as the most common pathway to speciation in birds and a driving force in the generation of biodiversity. Yet, a single geographic barrier may affect the differentiation of co-distributed taxa in variable and unpredictable ways, and our understanding of what processes control the pace and degree of population divergence in allopatry is poor. Consequently, though speciation via geographic isolation is considered an elementary aspect of evolution, it remains difficult to explain observed variation in the evolutionary outcomes of allopatry. For example, why do some taxa exhibit profound geographic variation in phenotype, whereas others are similar or uniform throughout their ranges? We addressed this question by integrating genomic methods with a natural experiment comprised of Andean cloud forest bird species that show variable levels of phenotypic differentiation across the Marañon River valley in northern Peru. We examined genetic and phenotypic divergence across the Marañon, and tested whether the degree of phenotypic differentiation between sister populations is predicted by time spent in allopatric isolation, rates of introgression (secondary admixture) between populations, or idiosyncrasy in the rate of phenotypic evolution. We found that time spent in geographic isolation is the most important predictor of phenotypic differentiation. Populations in this system required approximately two million years of allopatric isolation to evolve differences in plumage and song; conversely, morphological change occurred more slowly. Our results suggest that despite a high degree of idiosyncrasy in the relationship between genetic and phenotypic differentiation across regions and environments, phenotypic differences among allopatric populations may nevertheless evolve at a steady pace within a particular geographic and ecological context. (ID 15901)

**Wingert, A. K.**, University of Illinois/Illinois Natural History Survey, USA, amber.wingert@gmail.com  
Benson, T. J., University of Illinois/Illinois Natural History Survey, USA, tjbenison@illinois.edu

FACTORS ASSOCIATED WITH OCCUPANCY OF BARN OWL NEST BOXES IN ILLINOIS

Barn Owl populations have decreased in the Midwestern U.S. in recent years, and they are listed as endangered in several states, including Illinois. This is largely due to the loss of grassland habitat to increased row cropping and development, as well as a potential decrease in suitable nesting substrates. To deal with the problem of nest site scarcity, many states, including Illinois, have initiated nest-box programs. In Illinois, >300 nest boxes have been installed since 1990. However, monitoring of these nest boxes has been intermittent. We set out to examine factors associated with nest box use, estimate the number of occupied nest boxes in Illinois, and examine survival of nests in these boxes. We monitored 235 previously installed nest boxes located throughout Illinois, and examined landscape composition and structure at Barn Owl nest sites and unoccupied boxes. Although most boxes were unoccupied, we found that a number of factors, including crop cover and grassland cover in the surrounding landscape, were associated with nest box use. At active nests sites, nest box type and grassland cover affected daily survival rates. In addition to improving our understanding of Barn Owl ecology, this information will aid in the placement of future nest boxes and will contribute to efforts to conserve this species in Illinois and elsewhere in the Midwestern U.S. (ID 15766)

**Winkler, D. W.**, Cornell University, USA, dw4@cornell.edu

CLIMATE CHANGE, NESTING AND FORAGING ECOLOGY, AND GLOBAL LIFE-HISTORY VARIATION IN TACHYCINETA SWALLOWS.†

One of the earliest indicators of avian life-history response to changing temperate climates was the earlier laying of swallows across North America. Curiously, these temporal trends detected at large regional scales are sometimes very difficult to detect in long-term single-site studies. But an increasingly detailed picture is emerging of other effects of weather on aerial insectivore reproduction. Despite the generally warming climates of the north temperate, aerial insectivores are still most strongly affected by cold snaps, temporary periods of weather that never gets warm enough to allow most insects to fly. For most aerial insectivores, insects on the ground are not available as prey, and there are interesting complexities in the relation of environmental temperatures to both insect flight behavior and the development and physiology of birds. Environmental temperatures have a large effect on the lay dates of swallows in the temperate zone, and clutch size declines with later lay date in virtually all populations of Tachycineta. The regression of clutch size on lay date shows remarkable regularities across latitude in the Western Hemisphere. A decomposition of the causes of this latitudinal variation is one of the most subtle and interesting challenges in the comparative biology of these birds, as it causes us to consider influences as diverse as individual quality, mating systems and demography. (ID 16118)

**Winkler, D. W.**, Cornell University, USA, dw4@cornell.edu

LIVING ALOFT: PERSPECTIVES ON THE AEROSPHERE AND HOW BIRDS USE IT. †

Aerial habitats have a remarkable amount of structure, a structure that varies over very short time-scales compared to habitats on Earth's surface. These habitat regularities in relatively still air are associated with a steep decline in the densities of insects with altitude. Yet, another key attribute of aerial habitats is that they involve large-scale displacements of air-masses and entrained insects over enormous distances, both vertically and horizontally. The vast majority of aerially coursing insectivores forage on insects that are transported, and sometimes concentrated, by convective or lateral air flows. Thus, aerial insectivores have habitats that are more dynamic than any others. Though many large aerial insectivores concentrate their foraging in low-altitudes, a surprising number are very high altitude foragers, and they may have special sensory abilities that allow them to track convective cells and other concentrations and preferentially target larger prey from great distances. The variability and unpredictability of aerial insect distributions, together with the specialized morphology of many species of aerial insectivore, have far-ranging implications for space use, habitat choice and social system during the breeding season. It is becoming increasingly clear that these patterns carry over onto patterns of distribution and space use in the non-breeding season and during migration. Recent observations confirming the long-held suspicion that swifts, and perhaps other aerial insectivores, remain aloft for most of the year outside the breeding season raise the interesting question of the limits to the aerial life style. (ID 16114)

**Withey, J. C.**, Florida International University, USA, jwithey@fiu.edu  
Lopez, L., Florida International University, USA, pipra@yahoo.com

BREEDING AND MIGRATORY LANDBIRD COMMUNITY RESPONSES TO HARDWOOD HAMMOCK PATCH SIZE AND LANDSCAPE CONTEXT IN SOUTH FLORIDA

Hardwood hammock, the dominant closed canopy forest community in South Florida, provides habitat for both year-round resident birds as well as species migrating through and overwintering in the area. The majority of historical hardwood hammocks have been converted to human uses, especially urban development and agriculture, but a number of remnant patches of

various sizes still remain. We used a standardized search method to survey bird communities in 14 patches of hardwood hammock from 4/2013 to 2/2014. The hammocks varied in size (3.4 to 56 ha) and landscape context (surrounded by mostly agricultural, mostly developed, or mostly natural land cover). The richness of year-round residents, but not migrants, increased with patch size. Despite this, richness of residents and migrants was correlated ( $R^2 \sim 0.5$ , depending on the season). Migratory species assemblages were more similar when they were from patches with more-similar surroundings, especially more-developed and more-agricultural land cover. Therefore migratory species may be responding more to the landscape context than patch size during migration or overwintering. (ID 16350)

**Witt, C. C.**, University of New Mexico, USA, cwitt@unm.edu

#### REPEATED GENETIC ADAPTATION TO ALTITUDE IN HUMMINGBIRD HEMOGLOBIN

Hummingbirds are diverse and conspicuous across a broad range of elevations (0~4800 m) in the tropical Andes, although individual hummingbird species typically have narrow elevational ranges. Inter-specific comparisons and functional experiments demonstrate that amino acid replacements in the alpha and beta hemoglobin genes have fine-tuned the oxygen binding affinity of the hemoglobin protein to match the atmospheric pressure at the local elevation. Two amino acid replacements in the beta hemoglobin gene (beta13 and beta83) have occurred repeatedly across the hummingbird phylogeny in conjunction with evolutionary increases in elevation, and these same replacements have been reversed upon evolutionary reductions in elevation. In this study, we survey the beta hemoglobin genotypes across a wide array of hummingbird species and within hummingbird populations that vary in elevation. We found evidence for at least 26 instances of parallel evolution at beta13 and beta83. In some cases, retention of ancestral polymorphism can explain apparent parallelism. In other cases, mutational parallelism is the most likely explanation. Five species were polymorphic for the replacement at beta83, and in all five cases the alternative alleles were structured predictably with respect to elevation. This study demonstrates a genetic basis to local adaptation to altitude that is at least somewhat predictable. (ID 16009)

Wohner, P. N., University of Georgia, USA, pattijean.newell@gmail.com

**Foss, C. R.**, Audubon Society of New Hampshire, USA, cfoss@nhaudubon.org  
Greenberg, R., Smithsonian Migratory Bird Center, USA  
Cooper, R., University of Georgia, USA, rcooper@warnell.uga.edu

#### RUSTY BLACKBIRD SURVIVORSHIP AND HABITAT SELECTION DURING THE POSTFLEDGING PERIOD

Rusty Blackbird populations have declined dramatically since early in the 20th century for reasons that remain unclear. Most research on this species has been conducted during the nesting and wintering periods; the post-fledging period, when young birds are particularly vulnerable, has been understudied. We used radio-telemetry to study survivorship and habitat use of adult and fledgling Rusty Blackbirds in the Acadian spruce-fir forest of northern New Hampshire during late May to early August of 2010 to 2012. Within-season survivorship estimates of adult (0.84 over 12 weeks) and fledgling (0.53 over 12 weeks) blackbirds were comparable to other passerine species breeding in the temperate-zone. Habitat use of adults and fledglings did not differ significantly. Increasing probability of Rusty Blackbird presence included increasing proportions of wetlands and spruce-fir (*Picea rubens* - *Abies balsamea*) seedling or sapling stands within 30 meters, decreasing proportion of mixed-age stands within 30 meters, and decreasing distance to a stream of any order. (ID 16343)

**Wolf, B. O.**, Univ. of New Mexico, USA, wolf@unm.edu

McKechnie, A. E., Univ. of Pretoria, South Africa, aemckechnie@gmail.com  
Gerson, A. R., Univ. of New Mexico, USA, agerson@unm.edu  
Smith, E. K., Univ. of New Mexico, USA, ericksmith@yahoo.com  
Talbot, W. A., Univ. of New Mexico, USA, wtalbot@unm.edu  
Whitfield, M. C., Univ. of Pretoria, South Africa, maxinecw@gmail.com  
Smit, B., Univ. of Port Elizabeth, South Africa, smitbe@gmail.com  
O'Neil, J. J., Univ. of New Mexico, USA, jaoneill@unm.edu  
McWhorter, T. J., Univ. of Adelaide, Australia, todd.mcwhorter@adelaide.edu.au

#### SENSITIVITY TO EXTREME HEAT VARIES GREATLY AMONG AVIAN ORDERS

Predicting how human-induced climate change will affect animal distribution, abundance and diversity requires an understanding of the mechanisms underlying both the direct and indirect effects of global warming on individuals. Although little studied, among the most important direct effects may be catastrophic mortality associated with extreme heat and drought. Climate models predict an increase in both the frequency and severity of these extreme climate events, and historical records demonstrate the potential for catastrophic mortality. Here we show how functional differences in avian sensitivity to heat stress vary across orders of birds. We measured rates of evaporative water loss, resting metabolism and body temperature in birds exposed to varying levels of heat stress. Birds in the order Passeriformes and Strigiformes were the poorest performers and those from the Columbiformes and Caprimulgiformes performed best when exposed to extreme heat stress. These results have implications for understanding challenges to thermoregulation and water balance and well as reproduction in hot environments in a rapidly warming environment (ID 16368)

**Wolfe, J. D.**, Louisiana State University, USA, jwolfe5@lsu.edu

Mokross, K., Louisiana State University, USA, kmokro1@lsu.edu  
Stouffer, P. C., Louisiana State University, USA, pstouffer@lsu.edu

#### INFLUENCE OF SECOND GROWTH AND FOREST FRAGMENTATION ON THE COMPOSITION, DEMOGRAPHY AND FLOCK DYNAMICS OF AMAZONIAN BIRDS.

Forest clearing and regeneration in the Amazon basin has created a dynamic matrix of habitat where avian diversity depends on a balance between extinction and recovery in cleared and disturbed areas. Within this matrix, regenerating second growth is believed to encourage the recolonization of previously depauperate forest fragments and may help sustain rainforest bird populations. Determining the actual ecological value of regenerating forest for tropical birds is critical given that the amount of second growth is projected to increase throughout the Amazon basin. We used point counts, capture data, and behavioral observations in association with mark-recapture and network models to determine how regenerating forest, islands bounded by water, and forest fragmentation influenced community composition, bird survival, and flock dynamics in central Amazonian Brazil. In general, understory insectivores and obligate-flocking species were nearly absent on islands and in young second growth. Conversely, fragments surrounded by regenerating forest were surprisingly species rich, suggesting that a developing matrix may mitigate extinction events associated with forest fragmentation. We found that most species avoided young (15 yr) second growth, with the exception of frugivorous birds, until it matured (25 yr). Similarly, mixed-species flocks were less cohesive in young second growth relative to older second growth, forest fragments, and primary forest. Survival also differed between habitats: most species exhibited lower survival in second growth than in primary forest. Our results suggest that the ecological value of regenerating forest is relative, where young second growth is used by many forest birds and facilitates recolonization of forest fragments, but



may not be suitable for diverse communities, the integrity of socially complex mixed-species flocks, and survival of sensitive bird species. (ID 15939)

**Wolfe, J. D.**, Louisiana State University, USA, jwolfe5@lsu.edu  
 Stouffer, P. C., Louisiana State University, USA, pstouffer@lsu.edu  
 INSIGHTS FROM THE LONGEST OPERATING BIRD BANDING EFFORT  
 IN THE AMAZON BASIN: THE BIOLOGICAL DYNAMICS OF FOREST  
 FRAGMENTS PROJECT.

Since 1979, researchers at the Biological Dynamics of Forest Fragments Project (BDFFP), located 80 km north of Manaus, Brazil, have banded over 66,000 birds, representing 201 species. The banding project has operated nearly continuously in conjunction with the world's largest landscape study of habitat fragmentation, thereby providing unprecedented insights into community deterioration following fragment isolation, the influence of regenerating forest on recolonization dynamics, the asymmetrical response of foraging guilds to habitat degradation, and the efficacy of the island model to predict extinction within a fragmented landscape. More recently, the ongoing banding project has focused on documenting the lifecycle phenology of Amazonian birds, including nesting seasonality and the prevalence of molt-breeding overlap. Additionally, survival estimates have been generated for widely dispersed species that were compared with similar estimates from Ecuador, Peru (western Amazonia) and French Guiana (eastern Amazonia). While the averaged annual survival estimate for central Amazonian species ( $\phi=0.59$ ,  $SE=0.10$ ) was concordant with previously published estimates from the western Amazon ( $\phi=0.58$ ,  $SE=0.02$ ), and eastern Amazon ( $\phi=0.63$ ,  $SE=0.06$ ), individual species values varied greatly across the Amazon. Overall, results from the BDFFP suggest that geographic variation in population processes may be significant for widespread Amazonian species. (ID 16175)

**Woltmann, S.**, Austin Peay State University, USA, woltmanns@apsu.edu  
 Stouffer, P. C., Louisiana State University AgCenter, USA, pstouffer@lsu.edu  
 Woodrey, M. S., Mississippi State University Coastal Research and Extension Center, USA, msw103@ra.msstate.edu  
 Bergeon Burns, C. M., Louisiana State University AgCenter, USA, cbburns@agcenter.lsu.edu  
 Taylor, S. S., Louisiana State University AgCenter, USA, staylor@agcenter.lsu.edu  
 POPULATION GENETICS OF THE GULF COAST SUBSPECIES OF  
 THE SEASIDE SPARROW (*AMMODRAMUS MARITIMUS*): SUBSPECIES  
 VALIDITY AND CONSERVATION IMPLICATIONS

Seaside Sparrows (*Ammodramus maritimus*) along the Gulf of Mexico are currently recognized as four subspecies, including peripheral taxa in Florida (*A. m. juncicola* and *A. m. peninsulæ*) and southern Texas (*Ammodramus m. sennetti*), plus a widespread taxon between them (*A. m. fisheri*). We examined population genetic structure of this "Gulf Coast clade" (sensu Avise and Nelson 1989). Results of Bayesian analyses (Structure, GeneLand) of microsatellite data from nine populations generally align with current subspecific taxonomy. *Ammodramus m. sennetti* from southern Texas is significantly differentiated from all other populations, but we found evidence of an admixture zone with *A. m. fisheri* near Corpus Christi. The two subspecies along the northern Gulf Coast of Florida are significantly differentiated from both *A. m. sennetti* and *A. m. fisheri*, but are not distinct from each other. We found a weak signal of isolation by distance within *A. m. fisheri*, indicating this population is not entirely panmictic throughout its range. Although continued conservation concern is warranted for all populations along the Gulf Coast, *A. m. fisheri* appears more secure than the far smaller populations in south Texas and the northern Florida Gulf Coast. In particular, the most genetically distinct populations, those in Texas south of about Corpus Christi, occupy unique habitats within a very small geographic range. (ID 16155)

**Wood, E. M.**, Cornell Lab of Ornithology, USA, ericmwood@cornell.edu  
 Barker, S. E., Cornell Lab of Ornithology, USA, sb65@cornell.edu  
 Hochachka, W. M., Cornell Lab of Ornithology, USA, wmh6@cornell.edu  
 Rohrbach, R. W., Cornell Lab of Ornithology, USA, rwr8@cornell.edu  
 Rosenberg, K. V., Cornell Lab of Ornithology, USA, kvr2@cornell.edu  
 Rodewald, A. D., Cornell Lab of Ornithology, USA, arodewald@cornell.edu  
 MEET YOU IN THE MIDDLE: HYBRID HABITAT PREFERENCES AND  
 GENETIC INTROGRESSION IN GOLDEN-WINGED WARBLER

A main factor implicated in the precipitous decline of Golden-winged Warbler (*Vermivora chrysoptera*) is hybridization with its sister species, Blue-winged Warbler (*V. cyanoptera*). Although territory-level habitat associations of both species are well described, the extent to which habitat preferences by hybrids may exacerbate the transfer of Blue-winged Warbler genes into Golden-winged Warbler populations is unknown. We evaluated if habitat attributes predicted the genetic identity not just of territorial Golden-winged Warbler and Blue-winged Warbler, but also their phenotypic and cryptic hybrids (i.e. birds that phenotypically resemble either species, but have genetic markers from both) in the St. Lawrence River Valley, New York. In 2009 and 2010, we captured and obtained blood samples from 120 individuals, identified genotype (which was used as the response treatment classification), measured habitat at the capture territory (50-m<sup>2</sup>), and quantified broader-scale habitat attributes within 250-m and 500-m buffers. Occurrence probability by Golden-winged Warbler was higher in habitat that was structurally heterogeneous within territories yet homogeneous at broader-scales (indicative of contiguous deciduous forest cover), and lower with increased agricultural land within 500-m and closer distance to major roads and urban areas. Blue-winged Warbler showed the exact opposite associations. Interestingly, hybrids were intermediate, using territories similar to pure Golden-winged Warbler but broad-scale features similar to Blue-winged Warbler. This intermediacy suggests that the habitat affinities of hybrids effectively expands the footprint of Blue-winged Warbler genes and thus may bring them into closer contact with pure Golden-winged populations. Thus, habitat preferences of hybrids may potentially exacerbate genetic introgression. (ID 16172)

**Wood, P. B.**, US Geological Survey, USA, pbwood@wvu.edu  
 LONG-TERM AVIAN RESPONSE TO FOREST FRAGMENTATION FROM  
 SHALE GAS DEVELOPMENT

The extensive tracts of mature hardwood forest in West Virginia support a high diversity and abundance of breeding songbirds, including species of high conservation priority in the Appalachian Mountains region. The region also is experiencing extensive forest fragmentation from shale gas development. To understand effects of shale gas development on breeding songbirds, we conducted point count surveys annually during 2008-13 at 142 survey stations in a 6,521 ha study area of primarily mature forest in northwestern West Virginia. Also annually, we developed a cover type map of the study area highlighting any habitat disturbances related to shale gas development. In 2008, little shale gas development had occurred on the site but it has increased annually since that time. In this presentation, we will compare and contrast the spatially explicit response of selected avian species over time and relate the response to habitat change that resulted from development of shale gas infrastructure (well pads, roads, pipelines). For example, abundance and distribution of Cerulean Warblers (*Setophaga cerulea*) has declined ~40% but that of Worm-eating Warblers (*Helmitheros vermivorum*) only slightly. Brown-headed Cowbirds (*Molothrus ater*) increased substantially from initially occurring at almost no points to occurring at ~25% of points in 2013. Avian surveys and mapping of cover types is being repeated in the 2014 breeding season and will be incorporated into the presentation. (ID 15913)

**Woolley, C. A.**, University of Colorado Denver, USA, colin.woolley@ucdenver.edu

Conrey, R. Y., Colorado Parks and Wildlife, USA, reesa.conrey@state.co.us  
Dwyer, A., Rocky Mountain Bird Observatory, USA, angela.dwyer@rmbo.org  
Jorgensen, J., Nebraska Game and Parks Commission, USA, joel.jorgensen@nebraska.gov

Stoner, K., Nebraska Game and Parks Commission, USA, kristal.stoner@nebraska.gov

Wunder, M. B., University of Colorado Denver, USA, michael.wunder@ucdenver.edu

#### HABITAT USE BY MOUNTAIN PLOVERS DURING NEST INCUBATION

The Mountain Plover (*Charadrius montanus*) is a species of conservation concern throughout its range, native to short-grass prairie habitat of the western Great Plains. Mountain Plovers prefer to nest in recently disturbed areas with bare ground, short vegetation, and little to no slope. Historically, formation of these conditions was facilitated by native grazers such as Bison (*Bison bison*) and prairie dogs (*Cynomys spp.*). Over the past 150 years, local extirpation of these native grazers and the expansion of agriculture across the prairie have greatly reduced the availability of suitable native habitat. Mountain Plovers, however, will readily nest on agricultural fields, whether fallow or with low-growing crop. During the 2014 and 2015 breeding season, we will deploy GPS-tags on nesting Mountain Plovers to estimate home-range size and habitat use during the nest incubation period. Our study site consists of private, mostly agricultural land in Kimball Co., Nebraska and Weld Co. Colorado. Do these crop fields support plover foraging needs in addition to providing nesting habitat, or do plovers nesting on cropland travel to nearby native rangeland to meet their foraging needs? We aim to better understand how plovers are using the agricultural landscape matrix that has supplanted much of their native breeding range. (ID 15941 | Poster 80)

**Wright, N. A.**, University of New Mexico, USA, nawright@unm.edu  
Witt, C. C., University of New Mexico, USA, cwitt@unm.edu

#### A NEW ISLAND RULE FOR BIRDS: EVOLUTION TOWARDS FLIGHTLESSNESS\*

Flightlessness has evolved in over 1,000 bird lineages on islands with no land-based predators. The majority of island birds, however, retain flight despite sharing these low-predation island habitats. Are these flighted island birds evolving towards flightlessness as well? We examined flight musculature from over 700 species of birds, including populations from over 75 islands. Across the avian tree, island species have evolved smaller flight muscles than their continental relatives. Within taxa, flight muscles and legs evolve in concert along a continuum from large flight muscles/short legs on species-rich islands to small muscles/long legs on species-poor islands. This pattern is widespread among avian taxa and island systems. How do these morphological differences affect function? Birds on species-poor islands might experience reduced predation pressures, and thus not need to takeoff as rapidly. We tested this hypothesis with populations of birds from the islands of Trinidad and Tobago. Birds on the small, species-poor island of Tobago have smaller flight muscles and longer legs than conspecifics on larger, species-rich Trinidad. We used high-speed videos and a perch fitted with a force gauge to measure force generated by the leg thrust and flight velocity, acceleration, and wing kinematics during take-off. Different flight morphologies were associated with different take-off styles and speeds. Our findings suggest that flighted island birds have reduced escape abilities. The susceptibility of island birds to introduced predators and human hunting may be due in part to their reduced flight muscles and thus reduced burst flight and escape ability. (ID 16234)

**Wunderle, J. M.**, Intl. Inst. Tropical Forestry, USDA Forest Service, Puerto Rico, jmwunderle@gmail.com

Lebow, P. K., Forest Products Lab, USDA Forest Service, USA

Powell, A., Oxford University, United Kingdom

Bearhop, S., Exeter University, United Kingdom

Rockwell, S. M., Smithsonian Conservation Biology Inst., Migratory Bird Center, USA

Marra, P. P., Smithsonian Conservation Biology Inst., Migratory Bird Center, USA

White, J. D., Intl. Inst. Tropical Forestry, USDA Forest Service, Puerto Rico

Currie, D., Intl. Inst. Tropical Forestry, USDA Forest Service, Puerto Rico

Ewert, D. N., The Nature Conservancy, USA

#### STABLE ISOTOPES REVEAL INCREASES OVER THE WINTER IN THE PROPORTION OF PREDACEOUS ARTHROPODS IN THE DIET OF KIRTLAND'S WARBLERS

We observed wintering Kirtland's Warblers (*Setophaga kirtlandii*) feeding on arthropods and fruits in The Bahamas. To determine the extent of the warbler's diet variation among and within four winters and between adults (AHY/ASY) and juveniles (HY/SY) we used a mixing model within a Bayesian framework (SIAR, stable isotope analysis in R; Parnell et al. 2008; Jackson et al. 2009) to estimate the proportional contribution of each diet item to blood carbon and nitrogen. Mean  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values for each of five diet items (based on prior observations) including predaceous arthropods, herbivorous (including omnivores, detritivores) arthropods, and fruits of *Chiococca alba*, *Erithalis fruticosa*, and *Lantana involucrata* were used in the SIAR model to account for variation in C and N in different sources. Trophic enrichment factors used in the model were based on studies of similar-sized passerines. Results indicated little variation in proportional representation of the five diet items between adults and juveniles, although there was considerable variation in proportional representation of the different diet items among winters, especially for fruits of *C. alba* and *L. involucrata*. During each winter, the proportional contribution of predaceous arthropods (mostly spiders) to the warbler's diet increased from early to late winter. By late winter (Mar-April), predaceous arthropods were proportionately the highest or among the highest of the five items contributing to the diet. Predaceous arthropods, such as spiders, may be especially important for the warbler in drought years when fruits are scarce. (ID 15893 | Poster 73)

**Yackel Adams, A. A.**, USGS, USA, yackela@usgs.gov

Mazurek, M. J., Cherokee Services Group, USA, mmazurek@usgs.gov

Reed, R. N., USGS, USA, reedr@usgs.gov

Klug, P. E., USGS, USA, pklug@usgs.gov

Cruce, J., USFWS, Guam

#### ASSESSING LOCALIZED BROWN TREESNAKE SUPPRESSION ON THE GUAM NATIONAL WILDLIFE REFUGE TO SUPPORT THE RECOVERY OF LISTED AVIAN SPECIES

On Guam, the accidental introduction of the Brown Treesnake (*Boiga irregularis*) has resulted in high snake densities across the island and caused the extirpation of most of the native terrestrial vertebrates, including 13 of 22 native breeding birds. We report on a study that assesses the feasibility of snake suppression via trapping within a wildlife barrier enclosure. Predator barriers have created opportunities for reintroduction of threatened and endangered avian species. While eradication of Brown Treesnakes has been achieved at the scale of 1-ha enclosures, suppression is only recently being attempted at larger scales (e.g., 55 ha enclosure) with existing control tools. In 2012 a multi-species barrier fence was constructed around a portion of the Guam National Wildlife Refuge (51 ha); this fence includes a one-way barrier designed to exclude snakes while allowing snakes on the refuge to leave the enclosed area. Operational Brown Treesnake control (i.e., regular trapping with rodent bait) has occurred within the barrier to reduce snake populations (n = 392 snakes captured in 2013) and other potential avian predators (viz.,

rats and feral cats). The frequency of snakes contacting birds on the refuge is currently being assessed with bird-baited traps and wildlife cameras. With sufficient predator suppression, the forest habitat on the Guam NWR can be expected to provide high-quality essential habitat for a number of extirpated listed birds. (ID 15979 | Poster 35)

**Yoon, H.**, Korea National University of Education, Republic Of Korea, ynhj31@hanmail.net  
**Yoon, J.**, Korea National University of Education, Republic Of Korea, migrate2u@gmail.com  
**Joo, E.**, Korea National University of Education, Republic Of Korea, hanjiow@empas.com  
**Park, S.**, Korea National University of Education, Republic Of Korea, srpark@knue.ac.kr

#### PARENT RECOGNITION IN CHICKS OF THE GROUND-NESTING, NIDIFUGOUS SAUNDERS'S GULL SAUNDERSILARUS SAUNDERSI

In birds, offspring-parent interactions play an essential role in facilitating offspring survival at nest-leaving. In contrast to nidicolous nestlings, nidifugous chicks are expected to hatch in ground nests, leave the nest soon after hatching, and presumably exhibit precise parent-offspring recognition during this time. Yet, some studies document variation in nidifugous behavior and offspring-parent recognition of semi-precocial chicks during the nest-leaving stage in the family Laridae. We examine patterns in nest-leaving age, mobile capacity, and parent recognition in wild and captive chicks of the Saunders's Gull *Saundersilarus saundersi* that is one of ground nesting and colonially breeding species. Our results indicated that the development of locomotor activity in nidifugous chicks coincided with the nest-leaving age. Soliciting behavior of experimental chicks increased with age, but they strongly discriminated vocalizations of pseudo-parents against unfamiliar adults only at the early stage of nest-leaving. We suggest that parent recognition by chicks during this short period may play a key role in facilitating their own survival while moving to a new environment with their parents after leaving the nest. Furthermore, we discuss on how nesting ecology and nest-leaving behavior are interconnected in the members of the family Laridae using a comparative approach. (ID 15763 | Poster 1)

**Yoon, J.**, Korea National University of Education, Republic Of Korea, migrate2u@gmail.com  
**Jung, J.**, Korea National University of Education, Republic Of Korea, jduri@daum.net  
**Kim, B.**, Korea National University of Education, Republic Of Korea, kbs8099@empal.com  
**Joo, E.**, Korea National University of Education, Republic Of Korea, hanjiow@empas.com  
**Yoon, H.**, Korea National University of Education, Republic Of Korea, ynhj31@daum.net  
**Park, S.**, Korea National University of Education, Republic Of Korea, srpark@knue.ac.kr

#### PLASTICITY IN INCUBATION BEHAVIOR UNDER PROLONGED AND PULSE RISKS OF NEST PREDATION IN TWO CAVITY-NESTING PASSERINES

Nest predators assess nest activities of prey parents to locate the nests while the parents modify their behaviors to reduce the probability of nest predation. We examined how a mixture of prolonged and pulse risks of nest predation shape incubation behavior and nest failure of great tits and marsh tits breeding in nest-boxes. Here, great tits with larger body size that prefer cavities with larger hole are anticipated to cope with high nest predation, compared to marsh tits with smaller body size. We installed 50 nest-boxes with the entrance hole of 3 cm diameter that can be shared by both species on the Korea National University of Education campus, South Korea, in

2012-2014. Once the clutch was completed, we enlarged the entrance size up to a diameter of 5 cm to increase prolonged risk of nest predation only for the treatment. Then, the incubation behavior was filmed under a pulse risk playback design using oriental turtle dove (non-predator) and black-billed magpie (nest predator) sounds. Also, the rate of nest predation was monitored. We found the negative effect of prolonged risk of nest predation on nest success in marsh tits, but not in great tits. Male incubation feeding was lower in great tits than in marsh tits; female nest attentiveness was similar between the two species. During the magpie playbacks, male incubation feeding was reduced in marsh tits, but not in great tits. These results highlight that male incubation feeding increases nest predation in cavity-nesting tits under prolonged risk of nest predation where male incubation feeding may be plastic in smaller tits nesting in relatively safe conditions, compared to larger tits. (ID 15762)

**Youngberg, E. N.**, Rocky Mountain Bird Observatory, USA, erin.youngberg@rmbo.org  
**Panjabi, A. O.**, Rocky Mountain Bird Observatory, USA, arvind.panjabi@rmbo.org

#### DENSITY AND TRENDS OF GRASSLAND BIRDS ON CITY OF FORT COLLINS PROPERTIES IN THE MOUNTAINS TO PLAINS AREA OF NORTHERN COLORADO

In an ongoing effort to aid conservation and management of a biological corridor containing some of the last high quality shortgrass prairie along northern Colorado's Front Range, the Rocky Mountain Bird Observatory has partnered with the City of Fort Collins to monitor grassland birds on 45,000 acres of city-owned properties annually since 2006. In 2008 the area experienced an outbreak of sylvatic plague that significantly decreased the Black-tailed prairie dog (*Cynomys ludovicianus*) population. Many declining shortgrass prairie bird species rely on habitat created and maintained by prairie dogs. To examine the indirect impacts of plague on shortgrass bird populations we conducted point counts within prairie dog colony habitat (PDCH) from 2006-2013. A comparison of annual densities of McCown's Longspur within PDCH suggests that the population has declined steadily and rapidly by upwards of 50%, most noticeably following the plague event. Mountain Plover and Burrowing Owl densities also declined by >50% within PDCH. Plovers and owls declined more rapidly after the 2008 plague event even though prairie dogs have now recolonized 72% of former colonies, suggesting a delayed response to habitat loss. We observed that plover populations recovered slightly, most likely in response to controlled burns and flea dusting in 2012. It is clear these species have not recovered from the plague-driven loss of suitable PDCH. Management should strive to conserve and augment prairie dog populations, maintain and restore native shortgrass prairie, minimize disturbance from natural resource development and recreation, and closely monitor grassland bird populations. (ID 16064)

**Yuri, T.**, Sam Noble Museum, University of Oklahoma, USA, tyuri@ou.edu  
**Grzybowski, J. A.**, University of Central Oklahoma, USA, jgrzybowski@ucok.edu  
**Siler, C. D.**, University of Oklahoma, USA, camsiler@ou.edu  
**Schnell, G. D.**, University of Oklahoma, USA, gschnell@ou.edu

#### GENETIC ANALYSIS OF RECENT HYBRIDIZATION BETWEEN WHITE-FACED AND GLOSSY IBISES

In response to climate change, animals and plants are significantly shifting their distributions. As a consequence of these shifts and a reduction in suitable habitats, the breeding ranges of historically isolated species have begun to overlap, increasing the occurrences of hybridization. This study aims to describe hybridization of two wetland bird species, White-faced and Glossy ibises (*Plegadis chihi* and *P. falcinellus*), which have experienced rapid range expansions in the last 20 years, resulting in range overlaps in the Great Plains and coastal Gulf regions. This research will document the occurrences



of hybrids, presence/absence of strong reproductive isolation mechanisms, and concordance between maternal and autosomal inheritance patterns of genetic markers. A decrease in the population size of pure Glossy Ibises might have resulted from the hybridization, which could have a profound impact on conservation assessments of species experiencing climate-driven hybridization. (ID 16316)

Zeng, L., University of California, Riverside, USA, lijn.zeng@gmail.com

**Rotenberry, J. T.**, University of Minnesota, Twin Cities, USA, jrotenbe@umn.edu

Zuk, M., University of Minnesota, Twin Cities, USA, mzuk@umn.edu

Pratt, T., USGS PIERC (ret.), USA, thane-linda@earthlink.net

#### SOCIAL BEHAVIOR AND COOPERATIVE BREEDING IN A PRECOCIAL SPECIES: KALIJ PHEASANTS (*LOPHURA LEUCOMELANOS*) IN HAWAII

Cooperative breeding in birds occurs mostly in altricial species, in which the helpless hatchlings require extensive parental care. By contrast, cooperative breeding in precocial species is rare. We examined social behavior and documented cooperative breeding in Kalij Pheasants (*Lophura leucomelanos*) in an introduced population in Hawaii, one of the few reported instances of cooperative breeding in Galliformes. From 2009 to 2011, the population averaged 28 groups; each social group contained one female and one to six males. All adults exhibited cooperative behavior including caring for chicks, agonistic behaviors against conspecific intruders, and vigilance against predators. Within each group, one male was dominant over the others and appeared to be the breeder. Age was the only factor found to determine within-group dominance, suggesting that subordinate males can eventually gain dominance and breeding status by staying in the group. Average population density was high, averaging 3.21 residents/ha (vs. about 0.3/ha under natural conditions. Adult sex ratio was biased toward male with an average of M:F = 2.10. Genetic sex identification of egg samples revealed unbiased primary and secondary sex ratios, suggesting that bias in adult sex ratio may be caused by differential survival between males and females. In 2011, we removed 12 out of 29 groups to create vacant breeding habitats. After removal, the subordinate male(s) in 6 out of 10 remaining groups with multiple males left their original group to establish a new group. The average males/group decreased from 2.17 (n=29) before removal to 1.36 (n=28) after removal. Subsequent to removal, 9 groups contained previously unidentified females, most of which were likely previous floaters. We conclude that habitat saturation contributed to promote cooperative breeding in this population. (ID 16203)

Zenzal, T. J., University of Southern Mississippi, USA, tjzenzal@gmail.com

Diehl, R. H., Northern Rocky Mountain Science Center, USA, rhdiehl@usgs.gov

Ward, M. P., University of Illinois, USA, mpward@illinois.edu

**Moore, F. R.**, University of Southern Mississippi, USA, frank.moore@usm.edu

Schofield, L. N., Eastern Illinois University, USA, schofield.lynn@gmail.com

Deppe, J. L., Eastern Illinois University, USA, jldeppe@eiu.edu

#### DEPARTURE DECISIONS OF RUBY-THROATED HUMMINGBIRDS DURING AUTUMN MIGRATION

There is much to learn about movement biology during migration, particularly factors related to an individual's decision to resume migratory flight after stopover. The Ruby-throated Hummingbird (*Archilochus colubris*) is a Neotropical migrant whose migration biology is poorly understood. Their small size and high energy expenditure could make crossing ecological barriers, like the Gulf of Mexico, quite formidable in which a miscalculation could be fatal. We hypothesized that departure direction will depend on energetic condition, while time of departure will be weather dependent. Additionally, we expected to see a relationship between departure time and departure direction. To investigate these expectations, we attached miniature radio transmitters to Ruby-throated Hummingbirds that stopped along the

northern coast of the Gulf of Mexico in 2011-2013 and recorded departure decisions using an automated radio-telemetry system. Departure direction and time of departure were selected as response variables in circular-circular and circular-linear regression models, while sex, energetic condition, wing length, wind direction, wind speed, and barometric pressure were selected as predictor variables. A test of homogeneity was used to examine the relationship between departure time and departure direction. These data suggest that an individual's condition and morphology as well as prevailing winds influence migratory route and indirectly time of departure because departure time is correlated with departure direction. (ID 15776 | Poster 47)

**Zink, R. M.**, University of Minnesota, USA, zinkx003@umn.edu

#### THE IMPORTANCE OF VALID TAXONOMY AT THE INTRA-SPECIFIC LEVEL<sup>†</sup>

The subspecies category in birds has been used as a drop box for observations ranging from slight but conflicting clines in morphological characters to major well-delineated taxa (although the former are overrepresented). Many subspecies are based on early 20th century theory and technology, which is true for few other areas of biology. Modern molecular methods have revealed that on average, biological species include two evolutionarily significant taxa, despite twice that many named subspecies. Thus current species and subspecies taxonomy provide a mostly unreliable guide to evolutionary diversity, which should form the basis for comparative biology and conservation. There is a classification crisis because of subspecies. Large amounts of money are spent on some invalid subspecies that are nonetheless listed under the Endangered Species Act (ESA). For example, the endangered southwest Willow Flycatcher (*Empidonax traillii extimus*; SWWF) was described in 1948 based on sparse sampling and conflicting patterns of size and coloration. I evaluated the modern genetic and plumage coloration basis for the SWWF and found that neither data set supports the SWWF. I also used ecological niche modeling to show that the SWWF is not ecologically distinct. Hence, the SWWF is incorrectly listed under the ESA, and large amounts of funding and attention are diverted from other taxa worthy of listing. (ID 15803)

Zlonis, E., Natural Resources Research Institute, USA, zloni011@d.umn.edu

Bednar, J., University of Minnesota-Duluth, USA, bedn0050@d.umn.edu

**Panci, H.**, Natural Resources Research Institute, USA, hpanci@gmail.com

Niemi, G. J., Natural Resources Research Institute, USA, gniemi@d.umn.edu

#### IDENTIFICATION OF HABITATS AND LANDSCAPES ASSOCIATED WITH BIRD SPECIES IN LOWLAND-CONIFER FORESTS OF THE AGASSIZ LOWLAND SUBSECTION

Concern over the persistence of lowland conifer forests in hemiboreal regions is increasing due to potential effects of climatological changes as well as increased harvest levels. These forests support many breeding bird species and effectively extend the range limits of several boreal species into hemiboreal and even temperate regions. These species are of concern, as shifting patterns in forest composition will likely affect their populations, especially at the southern boundaries of their ranges. It is important to understand the details of these species' breeding habitats to effectively manage appropriate habitat. We have modeled and mapped habitat suitability for seven species of birds that breed in the lowland conifer forests of the Agassiz Lowland Ecological Subsection in northern Minnesota: Connecticut Warbler (*Oporornis agilis*), Yellow-bellied Flycatcher (*Empidonax flaviventris*), Boreal Chickadee (*Poecile hudsonicus*), Ruby-crowned Kinglet (*Regulus calendula*), Yellow-rumped Warbler (*Setophaga coronata*), Palm Warbler (*Setophaga palmarum*), and Golden-crowned Kinglet (*Regulus satrapa*). A priori sets of 16 to 23 potential environmental variables, including both stand-level attributes and landscape metrics, were developed and used to calibrate individual species models. We found significant selection for specific forest

and landscape characteristics by each of these species, with the best models including between one and nine variables. Habitat suitability maps were developed from these models. In addition, we present a map that combines suitability scores of five of these species, which can be used by managers to help identify particularly important forests for conservation. (ID 15975 | Poster 69)

**Zonana, D. M.**, University of Colorado, Boulder, USA, david.zonana@colorado.edu

THE ROLE OF SOCIAL AND SEXUAL SIGNALS IN AVIAN TERRITORY SETTLEMENT: USING AGENT-BASED MODEL PREDICTIONS TO TEST PATTERNS FROM LONG-TERM FIELD DATA

Across the animal kingdom, organisms go to great lengths to locate, establish, and defend territories. Conspecific attraction and avoidance are increasingly recognized as important factors in explaining individual settlement decisions

and the emergent spatial distributions of individuals. Yet, no study to date has investigated how individual variation in sexual and social signals - long known to advertise competitive ability and attractiveness - may influence fine-scale settlement processes. Here, I construct a spatially explicit, individual-based model to generate predictions about the spatial patterns generated through settlement processes that incorporate signal-driven conspecific attraction, and repulsion. The results of my model demonstrate that different forms of assessment of conspecific proximity and perceived quality are capable of producing starkly different spatial patterns of settlement within colonies. Results from this study have implications for our understanding of the spatial distributions of animals in the wild as well as the evolutionary causes and consequences of the decisions that dictate where individual organisms settle and breed. Predictions generated from the model will be used in comparison against spatial settlement patterns observed in a long-term field data set from the barn swallow (*Hirundo rustica*). (ID 15930 | Poster 107)

# Index

## A

Ackerman, J. T. 112  
 Adams, E. M. 2, 151  
 Adelman, J. S. 2  
 Aguilar, C. E. 95  
 Aguilon, S. M. 2  
 Ahlers, D. D. 21, 124  
 Aiello, C. M. 65  
 Ainley, D. G. 38, 68  
 Akresh, M. E. 2  
 Albrecht, T. 118  
 Albrect, T. 64  
 Alcaide, M. 3  
 Aldridge, C. 17, 60, 100, 148  
 Aldridge, C. L. 17, 100, 148  
 Aleixo, A. 19, 30  
 Alexander, J. D. 3  
 Alexander, J. L. 114  
 Alfaro, M. 120  
 Allred, B. W. 48  
 Almberg, E. S. 65  
 Altwegg, R. 17  
 Ambrosini, R. 43  
 Amundson, C. L. 57  
 Andersen, M. J. 3, 99  
 Anderson, A. M. 4, 60  
 Anderson, D. J. 86  
 Anderson, E. 4, 116  
 Anderson, E. C. 116  
 Anderson, J. 126  
 Anderson, M. L. 31  
 Angers, B. 22  
 Apa, A. D. 4, 112  
 Apkenas, V. 116  
 Arcese, P. 4, 30, 70  
 Ardia, D. R. 4  
 Arendt, W. J. 140  
 Arnold, T. W. 5, 132  
 Arns, R. M. 103  
 Asigau, S. S. 102  
 Atkinson, C. T. 119  
 Atuo, F. A. 5  
 Atwood, J. A. 27  
 Aubry, Y. 135  
 Auer, M. T. 119  
 Augustine, D. J. 5

## B

Baillie, S. M. 17  
 Baker, A. J. 5  
 Bakker, V. J. 115  
 Balakrishnan, C. N. 6  
 Balasubramaniam, P. 6  
 Baldassarre, D. 6, 41  
 Baldassarre, D. T. 6  
 Ballard, G. 38, 68  
 Barber, J. R. 21, 25, 88, 148  
 Barker, F. K. 6  
 Barker, S. E. 155  
 Barrowclough, G. F. 6  
 Bart, J. 130  
 Barton, E. P. 17  
 Barton, K. 38  
 Bartuszevige, A. M. 7  
 Bates, J. 153

Batthey, C. J. 7, 128, 147  
 Bayne, E. M. 131  
 Bearhop, S. 156  
 Beasley, J. C. 63  
 Beason, J. P. 7  
 Beck, J. L. 79  
 Beck, M. 7, 26  
 Beckman, E. J. 8  
 Beckmann, C. 8  
 Beck, M. L. 26  
 Bednar, J. 98, 158  
 Beever, E. A. 31  
 Behney, A. C. 8  
 Beissinger, S. R. 9, 85  
 Belant, J. L. 35, 141  
 Belisle, M. 9  
 Benedict, L. 9, 11, 25, 97, 148  
 Benham, P. M. 9, 133  
 Benites, P. 10  
 Benkman, C. W. 10  
 Bennett, V. J. 56  
 Benson, D. P. 100  
 Benson, T. J. 22, 24, 153  
 Bentler, K. T. 126  
 Benz, B. W. 3  
 Benz, S. 45  
 Bergeon Burns, C. M. 10, 155  
 Bergland, A. O. 6  
 Berlanga, H. 114  
 Bernath-Plaisted, J. 76  
 Bertram, D. 4  
 Berzins, L. L. 10, 43  
 Best, H. E. 11  
 Betts, M. G. 11, 71, 113  
 Bida, M. 101  
 Billerman, S. M. 11  
 Billy, S. 41  
 Biro, P. 8  
 Bishop, C. A. 46, 76  
 Bize, P. 22  
 Blackwell, B. F. 35  
 Blanchard, W. 17  
 Bled, F. 11  
 Blight, L. 4  
 Block, M. G. 89  
 Blockstein, D. E. 12  
 Bogdanowicz, S. 33  
 Bohrer, G. 12  
 Bolus, R. 12, 122  
 Bolus, R. T. 12  
 Bombaci, S. P. 12  
 Bonier, F. 12  
 Bonisoli-Alquati, A. 12  
 Bonter, D. N. 13, 125  
 Borchert, S. M. 13  
 Borgman, C. C. 13  
 Borgo, J. S. 99  
 Boroski, B. B. 130  
 Borowske, A. C. 13  
 Bowen, G. J. 144  
 Bower, G. C. 26  
 Bowie, R. 14, 90, 123  
 Bowie, R. C. 14, 90  
 Bowlin, M. S. 14  
 Bowman, J. R. 14  
 Bowman, R. 18, 27, 109, 143  
 Boyce, A. J. 14  
 Boyle, W. A. 14, 116, 150  
 Bradley, D. W. 15, 43  
 Brady, M. L. 15

Brandt, J. 115  
 Brauch, J. 15, 137  
 Braun, C. E. 17, 100, 148  
 Braun, E. L. 15, 64, 74  
 Brautigam, K. J. 16  
 Bravo, G. A. 16, 30  
 Brawn, J. 22, 106, 133  
 Brawn, J. D. 106  
 Brawn, J. J. 133  
 Brelsford, A. 140  
 Bridge, E. S. 16, 27, 105, 116  
 Brigham, R. M. 108  
 Brightsmith, D. 62  
 Brindock, K. M. 75  
 Brittingham, M. C. 17, 139  
 Broberg, A. R. 17  
 Broms, K. M. 17  
 Brown, C. E. 17  
 Browne, L. 72  
 Brown, L. M. 22  
 Brown, M. B. 130  
 Brown, S. 24  
 Brown, T. 98  
 Brumfield, R. T. 16, 22, 30, 58, 71  
 Brunton, D. H. 17  
 Brush, J. 98  
 Bryan, A. L. 63  
 Bryant, L. C. 18  
 Bryson, Jr., R. W. 128  
 Bryson, R. W. 7  
 Buechley, E. R. 18  
 Buehler, D. A. 18, 63, 108  
 Buerkle, A. 123  
 Buerkle, C. A. 118  
 Buitrago R., D. E. 95  
 Buler, J. J. 18  
 Bulluck, L. P. 19, 142  
 Burger, J. 48, 92  
 Burger, J. R. 48  
 Burnett, J. 115  
 Burnham, D. A. 43  
 Burns, K. J. 74, 139, 147  
 Butler, M. W. 19  
 Byrne, M. B. 63

## C

Cabanne, G. S. 19  
 Cable, T. T. 110  
 Cadieux, P. M. 19  
 Cadman, M. 94  
 Call, E. M. 20  
 Callicrate, T. E. 20  
 Camfield, A. F. 151  
 Camina, A. 20  
 Campagna, L. 20, 21  
 Campbell, Jr., K. E. 61  
 Campomizzi, A. J. 98  
 Cardille, J. A. 48  
 Carling, M. D. 11, 23, 92  
 Carlisle, J. D. 21, 148  
 Carstensen, D. L. 21  
 Carter, M. 7  
 Carvalho Provinciano, I. 22  
 Casey, A. E. 120  
 Castillo-Guerrero, J. A. 52  
 Cauchard, L. 22  
 Cavallaro, M. 96  
 Celis Murillo, A. 22  
 Cerame, B. 22  
 Chace, J. F. 23  
 Chades, I. 88  
 Chainé, A. S. 126  
 Chalfoun, A. D. 21, 23  
 Chandler, C. R. 33, 79, 126  
 Chang, K. 142  
 Chan, S. 118  
 Chatfield, M. 41  
 Chesser, R. T. 23  
 Chesser, T. 30  
 Cheviron, Z. A. 9, 23, 106, 129, 133  
 Chiavacci, S. J. 24  
 Chilson, P. B. 24, 73, 105  
 Chin, S. 26  
 Chipault, J. 108  
 Choi, C. Y. 24  
 Churchwell, R. T. 24  
 Cicero, C. 25, 123, 147  
 Cimprich, D. A. 59  
 Cinto Mejia, E. 25  
 Claramunt, S. 19, 30  
 Clark, A. B. 91  
 Clark, D. A. 38  
 Clark, N. A. 84  
 Clark, R. G. 15, 25, 35, 93, 94, 96, 134  
 Class Freeman, A. M. 47  
 Clatterbuck, C. A. 26  
 Clement, M. J. 26  
 Cochran, J. 14  
 Cochran, W. W. 14  
 Coe, B. H. 26  
 Cohen, E. B. 26, 96  
 Cohen, J. 83  
 Colangelo, J. 45  
 Collins, C. T. 27  
 Commons, K. A. 27  
 Compton, B. 33  
 Conant, S. 20  
 Connelly, E. 151  
 Conquest, L. L. 17  
 Conrey, R. Y. 27, 156  
 Contina, A. 16, 27  
 Contina, A. J. 27  
 Conway, C. J. 36, 83  
 Conway, W. 73  
 Coombs, J. 70  
 Cooper, E. 89, 143  
 Cooper, E. A. 143  
 Cooper, J. 27, 61  
 Cooper, J. C. 27  
 Cooper, N. W. 28, 107  
 Cooper, R. 70, 80, 154  
 Cooper, R. J. 70, 80  
 Cooper, Z. R. 28  
 Corey, K. A. 27  
 Cormier, R. L. 28, 65, 124  
 Cornelius, E. A. 28  
 Cornell, A. 29  
 Correll, M. D. 29  
 Covino, K. M. 29  
 Cox, J. A. 22, 29, 31  
 Cox, S. W. 28  
 Cox, W. A. 140  
 Cracraft, J. 30  
 Crampton, L. 104  
 Crawley, M. J. 108  
 Cristol, D. A. 145  
 Crombie, M. D. 30  
 Cruce, J. 156



Cruz, A. 23, 74  
Cruz-McDonnell, K. K. 30  
Cuervo, A. M. 30, 141  
Culliney, S. 104  
Culver, M. 92  
Cumming, S. G. 131  
Currie, D. 156  
Curry, C. M. 31  
Curry, R. L. 137  
Curtis, J. R. 31  
Cusick, J. A. 31  
Cuthbert, F. J. 121  
Cutler, P. 98  
Cutting, K. A. 31

## D

Dahlgren, D. 105, 106  
Dale, C. A. 32  
Danner, R. M. 32, 55, 99  
Dantas, G. 19  
Darrah, A. J. 144  
Datta, S. 66  
Davis, A. K. 28  
Davis, C. A. 32, 48  
Davis, K. P. 109  
Davis, R. J. 38  
Davis, S. K. 143  
Dawson, R. D. 10, 15, 25, 43, 110  
Deane-Coe, P. E. 33  
Deaner, L. 33, 79  
Deaner, L. M. 33  
Debinski, D. M. 94  
DeLap, J. H. 33, 88  
Deluca, W. V. 91  
DeLuca, W. V. 33  
Demarest, D. 122  
Demko, A. D. 34  
Dent, M. 109  
Deppe, J. L. 12, 122, 158  
Derbyshire, R. E. 34  
Derksen, C. 93  
Derner, J. D. 5  
Derryberry, E. 30, 34, 84, 104  
Derryberry, E. P. 30, 34, 104  
Derryberry, G. 30, 124  
Dertien, J. S. 34  
DeSante, D. F. 117  
Dettling, M. D. 35  
DeVault, T. L. 35, 63  
Devries, J. H. 35  
Dey, A. D. 84  
de Zwaan, D. R. 32  
Dhondt, A. A. 35  
Dhondt, K. V. 35  
Diamond, A. W. 123  
DiCicco, L. H. 138  
Diehl, R. 12, 36, 96, 122, 158  
Diehl, R. H. 12, 36, 158  
Dietsch, T. V. 36  
Dietterich, T. G. 44  
DiFiori, A. 72  
Dillon, K. G. 36  
Di Mare-Hering, M. 49, 145  
Dinsmore, S. J. 36, 105  
Distler, T. K. 145  
Doak, D. F. 115  
Dobson, A. P. 35  
Doherty, Jr., P. F. 27, 34, 114  
Doherty, P. F. 11, 85

Doligez, B. 22  
Doll, A. C. 37  
Dos Santos, E. B. 37  
Dossman, B. D. 37  
Doster, R. H. 124  
Doucet, S. M. 22, 61, 83  
Downes, C. 37  
Drake, A. 53  
Drapeau, P. 19  
Dreitz, V. J. 38  
Drever, M. C. 93  
Drovetski, S. V. 124  
DuBay, S. G. 38  
Duchardt, C. J. 94  
Duckworth, R. A. 2  
Dugger, K. M. 38, 68  
Dunham, S. W. 39  
Dunn, P. O. 25  
Duron, M. 151  
DuVal, E. H. 31, 39  
Dwyer, A. 110, 114, 156  
Dwyer, A. M. 110, 114  
Dwyer, J. F. 114  
Dybala, K. E. 39  
Dyer, R. J. 142  
Dzielski, S. 55

## E

Eadie, J. M. 106, 112  
Eagles-Smith, C. A. 41, 67, 69  
Eaton, R. A. 40  
Echeverri, S. 80  
Edwards, S. V. 139  
Eichholz, M. W. 8, 40, 127  
Elizondo, L. 40  
Elizondo, P. 40  
Elliott, L. H. 41  
Ellis, J. W. 126  
Elmore, R. D. 48, 64  
Elphick, C. S. 13, 118  
Emery, C. S. 41  
Enbody, E. D. 41  
Eng, C. 77  
Engelman, F. 50  
Engelman, T. 50  
Engilis, A. 39  
Engilis, I. E. 39  
Engilis Jr, A. 39  
Engle, D. M. 48, 64, 94  
English, P. A. 41  
Enstrom, D. A. 14  
Erickson, W. 42, 50  
Etterson, M. A. 42, 118  
Evans, B. S. 42  
Evans, M. R. 118  
Ewert, D. N. 156  
Eyes, S. A. 43

## F

Faaborg, J. 67, 71, 140  
Faaborg, J. M. 71  
Faaborg, J. R. 67  
Fagin, T. 105  
Fago, A. 90  
Faircloth, B. C. 15, 74, 89, 142  
Fairhurst, G. D. 43  
Falk, A. R. 43  
Farley-Dawson, E. A. 43  
Farnsworth, A. 44

Farquhar, M. L. 44  
Farr, C. M. 44  
Faulhaber, C. A. 95  
Feduccia, A. 44  
Feldman, R. E. 45  
Fernández, G. 52  
Ferretti, V. 137  
Fike, J. A. 45, 66, 100, 137  
Fink, D. 44  
Finkelstein, M. E. 77, 115  
Fischer, P. C. 82  
Fischer, R. A. 18, 108  
Fischelli, N. A. 45  
Fitzpatrick, J. W. 109  
Flather, C. H. 56  
Flaxman, S. M. 118  
Fleischer, R. 20, 84  
Fletcher, D. M. 80  
Fletcher, R. J. 46  
Folkerts, M. M. 46  
Fomina, C. 46  
Fontaine, J. J. 51  
Fontaine, P. 131  
Forrester, T. R. 46  
Forsman, E. D. 38  
Foss, A. R. 138  
Foss, C. 83, 122, 154  
Foss, C. R. 83, 154  
Foster, M. J. 19  
Fowler, J. A. 114  
Francis, C. D. 47, 74  
Francis, C. M. 37, 129  
Frank, D. 55  
Franklin, A. B. 47, 66, 126  
Franks, S. E. 32  
Frantz, M. 47, 78  
Frantz, M. W. 47  
Freeman, B. G. 47  
Freeman, F. 48  
Frei, B. 48  
Freifeld, H. 68  
French, J. P. 101  
Frey, R. I. 3  
Frey, S. 91  
Friedman, N. R. 48  
Friesen, V. L. 139  
Fristoe, T. S. 48  
Fronk, N. R. 17  
Frye, K. W. 128  
Fuhlendorf, S. D. 32, 48, 64  
Fyles, J. W. 48

## G

Gabelli, F. 10  
Gallagher, S. 81, 102  
Gallo, T. 12  
Garcia, V. 49  
Gardali, T. 28, 35, 49, 65, 106, 124  
Garfinkel, M. 49, 95  
Garman, S. 60  
Garzón V., J. L. 95  
Gastezzi-Arias, P. 49, 145  
Gay, L. 124  
Geary, B. 50  
Geary, S. 35  
Geevarghese, J. 44  
Gehring, J. L. 42, 50  
Geist, N. R. 50  
George, G. 47

George, T. L. 50  
Gergel, S. 67  
Germain, R. R. 30  
Gerson, A. R. 154  
Geupel, G. R. 65, 106  
Gibbons, R. E. 51  
Gibson, M. R. 114  
Gichuiki, P. 129  
Gifford, G. L. 51  
Gilbert, A. T. 151  
Gilbert, M. M. 49  
Gillespie, C. R. 51  
Gillespie, L. M. 51  
Gill, F. B. 51  
Glenn, T. C. 15, 74  
Golet, G. 124  
Gonser, R. A. 6  
González-Medina, E. 52  
Gonzalez-Rojas, J. I. 101  
Goodale, M. W. 151  
Goodman, S. 135  
Goodnight, A. 77  
Gorbet, A. C. 28  
Gow, E. A. 52  
Graham, B. A. 52  
Grand, J. 33  
Gratto-Trevor, C. L. 52  
Graves, G. R. 71  
Greenberg, J. 135  
Greenberg, R. 32, 42, 84, 99, 138, 154  
Greenberg, R. S. 138  
Green, D. J. 41, 46, 61, 75, 85  
Green, M. C. 58, 96, 118  
Green, R. E. 125  
Gregory, N. C. 53  
Greig, E. I. 13, 53, 125  
Grether, G. F. 103  
Griffin, C. R. 45  
Grinde, A. R. 53  
Grond, K. 54  
Grossen, C. 140  
Grovenburg, T. W. 66  
Grueber, C. E. 149  
Grunst, A. S. 54  
Grunst, M. L. 54  
Grunzel, D. P. 54  
Grzybowski, J. A. 157  
Gulson, E. 55  
Gummer, D. 60  
Guralnick, R. 74, 144  
Guralnick, R. P. 144  
Gutierrez Ramirez, M. 55, 59, 75  
Gutowsky, S. E. 55  
Gutzwiller, K. J. 56, 105

## H

Hache, S. 131  
Hackett, S. J. 127  
Hadley, A. S. 11  
Hagen, C. A. 79, 120, 152  
Hahn, B. A. 38  
Hajdukovich, N. 89  
Hale, A. M. 56  
Hall, K. 87  
Hall, R. J. 136  
Hallworth, M. T. 56  
Hamilton, R. 48, 56, 64  
Hamilton, R. G. 56, 64

Handel, C. M. 57  
 Hanni, D. J. 102  
 Hanser, S. E. 57  
 Harding-Scurr, A. 89  
 Hardy, M. A. 57  
 Hargrove, L. 57  
 Harness, R. E. 98  
 Harper, C. A. 82  
 Harriman, V. B. 25  
 Harris, J. P. 57  
 Harrison, A. L. 68  
 Harrison, D. J. 39  
 Harrison, M. L. 85  
 Harrison, R. G. 33  
 Harris, R. B. 58  
 Harrod, S. E. 58  
 Hartman, D. A. 102  
 Hart, P. J. 119, 147  
 Harvey, M. G. 30, 58  
 Hatcher, P. 76  
 Hatchett, E. S. 56  
 Hauber, M. E. 58  
 Haukos, D. A. 73, 79, 105, 106, 113, 120, 152  
 Hawley, D. H. 35  
 Hawley, D. M. 2, 7  
 Hayward, J. L. 59, 60, 111, 120  
 Hazelhurst, J. 41  
 Headley, J. 96  
 Hearn, J. 119  
 Heath, D. D. 52  
 Heath, J. A. 4, 21, 60, 131, 132  
 Heath, S. K. 59  
 Heckscher, C. M. 55, 59, 75  
 Heimbuch, M. R. 59  
 Heinrich, D. 80  
 Heinrichs, J. 60  
 Heiss, R. 99  
 Hekel, J. R. 60  
 Henderson, M. 60  
 Henry, H. P. 84  
 Henson, S. M. 59, 60, 111, 120  
 Hepp, M. G. 61  
 Hernandez-Palma, A. 61  
 Hertel, F. 61, 121  
 Heyden, K. 122  
 Hick, K. G. 61  
 Hille, D. C. 62  
 Hillenius, W. J. 62  
 Hill, G. E. 61, 148  
 Hindmarch, S. 76  
 Hines, J. K. 19  
 Hobson, K. 4, 43, 62, 93, 135, 138, 144  
 Hobson, K. A. 43, 62, 93, 135, 138, 144  
 Hochachka, W. 35, 155  
 Hochachka, W. M. 35, 155  
 Hockman, E. V. 18, 63, 108  
 Hodgman, T. p. 118  
 Hodgman, T. P. 29, 83  
 Hoeting, J. A. 131  
 Holcomb, E. D. 32, 82  
 Holland, A. E. 63  
 Hollenhorst, T. 42  
 Holloran, M. J. 79  
 Holt, S. M. 103  
 Homan, H. J. 40  
 Homer, C. 60  
 Homsher, M. 19

Honey, J. P. 16  
 Hooper, D. M. 63  
 Hopkins, W. A. 7, 26  
 Horton, K. 63, 73  
 Horton, K. G. 63  
 Hosner, P. A. 15, 64, 74  
 Hostetler, J. A. 26, 64, 118  
 Hovick, T. J. 48, 64, 94  
 Hsu, F. 142  
 Hubbard, J. K. 64, 65, 150  
 Huber, S. 19, 142  
 Huber, S. K. 142  
 Hudson, E. J. 64  
 Hudson, M. A. 129  
 Hudson, M. R. 37  
 Hudson, P. J. 65  
 Hull, S. D. 57  
 Humple, D. L. 28, 65, 106  
 Hund, A. K. 64, 65  
 Hunter, M. L. 20  
 Hunt, P. 65, 102  
 Hurlbert, A. H. 42  
 Husak, M. S. 65, 77  
 Hussell, D. J. 25  
 Huyvaert, K. P. 47, 66, 114

## I

Iartelli, R. 136  
 Ibarzabal, J. 141  
 Igl, L. D. 66  
 Iko, W. M. 66  
 Ingold, J. L. 46  
 Inselman, W. M. 66  
 Irvine, J. 44  
 Irwin, D. E. 3, 140  
 Isler, M. L. 23

## J

Jachowski, C. M. 26  
 Jackson, A. 41, 67, 69  
 Jackson, A. K. 41, 67  
 Jackson, B. P. 7  
 Jackson, M. M. 67  
 Jahn, A. E. 22  
 James, F. C. 107  
 James, H. 55  
 Jamieson, I. G. 149  
 Jankowski, J. E. 67  
 Jaramillo, M. C. 102  
 Jawor, J. M. 51  
 Jenkins, J. M. 67  
 Jenkinson, S. 12  
 Jenks, J. A. 66  
 Jennings, S. 68  
 Jensen, J. 145  
 Jensen, K. C. 66  
 Jiguet, F. J. 84  
 Jirinec, V. 68  
 Jodice, P. 68  
 Johnsen, A. 73  
 Johnson, A. S. 69  
 Johnson, D. 17, 69, 104, 112, 139  
 Johnson, D. H. 69, 112, 139  
 Johnson, D. S. 17  
 Johnson, E. I. 46, 69  
 Johnson, G. D. 79  
 Johnson, J. A. 138  
 Johnson, J. M. 69  
 Johnson, K. 70, 136

Johnson, K. M. 70  
 Johnson, K. P. 136  
 Johnson, M. 43, 49, 95, 129  
 Johnson, M. D. 43  
 Johnson, M. J. 129  
 Johnson, O. 126  
 Johnson, T. N. 120  
 Johnson, T. R. 82  
 Johnston, R. A. 70  
 Jones, C. D. 70  
 Jones, J. K. 115  
 Jones, K. N. 71  
 Jones, M. R. 23  
 Jonsen, I. 55  
 Joo, E. 71, 157  
 Joos, C. J. 71  
 Jorgensen, D. 105  
 Jorgensen, J. 156  
 Joseph, L. 71  
 Joseph, M. B. 150  
 Joyce, T. 144  
 Judy, C. D. 58, 71  
 Jung, J. 71, 157  
 Jurich, P. 14

## K

Kaiser, S. A. 72  
 Kalasz, K. S. 84  
 Kaltenecker, G. S. 21  
 Kaluthota, C. D. 72  
 Kane, N. 123  
 Karaardic, H. 118  
 Karin, B. 25  
 Karsten, K. B. 56  
 Karubian, J. 6, 41, 50, 72, 78  
 Karubian, J. O. 72, 78  
 Kasahara, S. 72  
 Katzner, T. 87  
 Kaushik, M. 104  
 Kearns, A. M. 73  
 Kearns, B. V. 73  
 Keenan, P. C. 151  
 Kellermann, J. L. 73  
 Kelley, J. P. 104  
 Kelling, S. T. 44  
 Kelly, J. F. 16, 27, 63, 73, 105, 116  
 Kelsey, R. 124  
 Kendall, S. 24  
 Kendall, W. L. 117  
 Kendrick, S. W. 71  
 Kennedy, E. S. 149  
 Kern, R. 13  
 Kesler, D. C. 120, 133, 152  
 Ketterson, E. D. 128  
 Keyser, P. D. 82  
 Khaydarov, D. R. 124  
 Kim, B. 157  
 Kimball, R. T. 15, 64, 74  
 King, C. 25  
 King, D. I. 2, 45  
 King, E. 118  
 King-Johnston, A. 45  
 Kirkman, K. P. 91  
 Kirsch, E. M. 74  
 Kitchens, W. M. 46  
 Kleist, N. J. 74  
 Klicka, J. 7, 74, 93, 128, 147  
 Klicka, L. B. 74  
 Klug, P. E. 75, 156

Kneidel, A. H. 55, 59, 75  
 Knick, S. T. 57  
 Knight, E. C. 75  
 Knight, R. N. 128  
 Knopf, F. L. 36  
 Knutsen, C. J. 75  
 Kolberg, H. 80  
 Koper, N. 76  
 Korb, N. 31  
 Kordonowy, L. 76  
 Kovach, A. I. 76, 118, 147  
 Kraft, J. 105, 106, 113  
 Kraft, J. D. 113  
 Krebs, E. 4, 76  
 Krebs, E. A. 76  
 Kumar, A. 15  
 Kus, B. E. 74, 76  
 Kuspa, Z. E. 77  
 Kwon, E. 77  
 Kyser, T. K. 32

## L

Ladeau, S. L. 152  
 Lain, E. J. 96  
 Lajoie, J. L. 73  
 Lanctot, R. B. 37, 54  
 Landoll, D. V. 65, 77  
 Lang, A. S. 113  
 Langlois, L. A. 17  
 Lansdorp, O. C. 77  
 Lantz, S. 41, 78  
 Lantz, S. M. 78  
 Lao, S. 116  
 LaPointe, D. A. 119  
 Lapp, H. 144  
 Larned, A. F. 78  
 La Sorte, F. 44  
 Latif, Q. S. 59  
 Latimer, C. E. 78  
 Latta, S. C. 78, 142  
 Laughlin, A. J. 78, 136  
 Laursen, I. M. 126  
 Lautenbach, J. 79, 105, 106, 113  
 Lautenbach, J. M. 79, 113  
 Lavender, J. 79  
 Leather, S. R. 108  
 LeBeau, C. W. 79  
 Leberg, P. L. 50  
 Lebow, P. K. 156  
 Lehmicke, A. J. 80  
 Lehnen, S. E. 125  
 Leighton, G. M. 80  
 Leist, A. J. 80  
 Leitner, W. A. 80  
 Leonard, M. 55  
 Lepage, D. 144  
 Lester, L. A. 55, 75  
 Leu, M. 68  
 Levandoski, G. 7, 81, 85, 101  
 Levandoski, G. J. 7, 81, 101  
 Levin, I. I. 102  
 Lewis, W. B. 81  
 Ley, D. H. 35  
 Lezama-Lopez, M. 62  
 Liao, C. 81  
 Liao, W. 119  
 Liber, K. 96  
 Liechti, F. 43  
 Lindell, C. A. 40, 125

Link, A. 72  
 Link, W. A. 81  
 Lin, R. 81  
 Linz, G. M. 40  
 Lipshutz, S. 34, 84  
 Lipshutz, S. E. 34  
 Lituma, C. M. 82  
 Lloyd, J. D. 82, 97  
 Lohr, B. 78, 84  
 Lombardo, M. P. 25  
 Londoño, G. A. 67  
 Loomis, D. 89  
 López-Hernandez, C. 20  
 Lopez, L. 153  
 Lorenz, T. J. 82  
 Loss, S. R. 40, 82  
 Lotem, A. 118  
 Loughman, D. 112  
 Lovette, I. J. 20, 33, 69, 137  
 Lubas, E. 19  
 Luepold, S. B. 83  
 Lukacs, P. M. 38  
 Lukianchuk, K. C. 83  
 Lundblad, C. G. 83  
 Luther, D. 84, 104  
 Luther, D. A. 84  
 Luttrell, S. A. 84  
 Luzuriaga, N. L. 84  
 Lyon, B. E. 126  
 Lyons, J. E. 84  
 Lyons, T. P. 94  
 Lyver, P. 38

## M

MacDonald, E. C. 151  
 MacDonald, N. M. 85  
 MacDonald, S. 129  
 Macfarland, L. E. 85  
 MacGregor-Fors, I. 116  
 Macias-Duarte, A. 101  
 Macias-Duarte, A. 85, 134  
 Mack, A. L. 85  
 Mackin, W. 68  
 MacLean, S. A. 85, 125  
 Maglianesi-Sandoz, M. 49  
 Mahon, C. L. 131  
 Mahoney, A. C. 23  
 Mahony, N. A. 75, 85, 86  
 Main, A. 96  
 Maley, J. M. 58, 119  
 Malpass, J. S. 86  
 Malykh, I. M. 124  
 Mandelbaum, G. E. 91  
 Maness, T. J. 69, 86  
 Mangan, A. M. 87  
 Manlove, K. R. 65  
 Manne, L. L. 100  
 Manthey, J. D. 87  
 Maple, A. 40  
 Marini, K. L. 111  
 Marra, P. P. 26, 28, 42, 56, 64, 82,  
 107, 111, 115, 118, 135, 141,  
 152, 156  
 Marshall, J. S. 46  
 Marshall, L. 78  
 Martell, M. S. 87  
 Martínez, D. 49, 145  
 Martin, J. A. 35  
 Martin, K. 8, 67, 87, 100, 151

Martin, K. M. 100  
 Martin, M. 151  
 Martin, T. E. 14  
 Martin, T. G. 88  
 Marzluff, J. M. 33, 88, 136,  
 140, 146  
 Marzuff, J. M. 73  
 Masero, J. A. 52  
 Mason, J. T. 88  
 Mason, N. A. 88  
 Mathewson, H. A. 109  
 Matsuoka, S. A. 138  
 Matsuoka, S. M. 57, 89  
 Matthews, S. N. 37, 45, 90  
 Maya-Gracia, O. 122  
 Mazurek, M. J. 75, 156  
 McArthur, S. 111  
 McCabe, J. D. 89  
 McCain, C. M. 89  
 McClung, M. R. 89  
 McClure, C. J. 21, 25, 88, 148  
 McCormack, J. E. 89, 119, 142  
 McCormick, J. K. 29  
 McCracken, K. G. 90  
 McCreedy, C. 59  
 McDermott, M. E. 90  
 McDonald, D. B. 90  
 McDowell, S. 73  
 McEntee, J. P. 90  
 McFadden, M. A. 89  
 McFarland, K. 91, 102, 135  
 McFarland, K. P. 91, 135  
 McGarigal, K. 33  
 McGowan, C. P. 84, 91  
 McGowan, K. J. 25, 91  
 McGranahan, D. A. 91  
 McGraw, K. J. 97  
 Mckechne, A. E. 154  
 McKellar, A. E. 92, 111  
 McKinney, S. T. 140  
 McLandress, M. R. 112  
 McLeod, M. A. 92  
 McNeil, S. E. 92, 133  
 McNew, L. B. 152  
 McNulty, S. A. 83  
 McWhorter, T. J. 154  
 Megna, L. C. 92, 120  
 Mehus, S. 87  
 Meiklejohn, K. A. 15  
 Meine, C. 93  
 Méndez, C. 120  
 Mennill, D. J. 34, 52, 61, 83  
 Merchant, C. R. 130  
 Messmer, D. J. 93  
 Mettler, R. 93, 128  
 Mettler, R. D. 93  
 Meyer, J. A. 56  
 Michel, N. 93, 96  
 Michel, N. L. 93  
 Michelson, C. 94, 96  
 Michelson, C. I. 94  
 Mila, B. 140  
 Milinevsky, G. 12  
 Miller, D. A. 94  
 Miller, J. R. 94  
 Miller, K. E. 95  
 Miller, M. J. 95  
 Miller, R. A. 21  
 Miller-Rushing, A. J. 45  
 Miller, T. 87

Miller, W. B. 34  
 Milligan, M. 95, 129  
 Milligan, M. C. 129  
 Mills, L. S. 137  
 Millsbaugh, J. J. 141  
 Minnich, A. N. 95  
 Mitchell, G. W. 37  
 Miyaki, C. Y. 19  
 Mohren, S. 73  
 Mokross, K. 154  
 Moldoff, D. 14  
 Møller, A. P. 12  
 Monahan, W. B. 45  
 Mong, T. W. 120  
 Mooers, N. L. 126  
 Moon, J. 73  
 Moore, A. A. 96  
 Moore, F. 12, 29, 70, 81, 96, 102,  
 116, 122, 158  
 Moore, F. M. 116  
 Moore, F. R. 12, 29, 70, 81, 96,  
 102, 158  
 Moore, S. D. 21  
 Morgan, J. 82  
 Morin, A. M. 44  
 Moriyama, H. 90  
 Morrison, M. L. 109  
 Morrissey, C. 93, 94, 96, 134  
 Morrissey, C. A. 93, 94, 134  
 Morris, S. R. 29  
 Mount, A. R. 97  
 Mousseau, T. A. 12  
 Moyers, S. C. 2  
 Moyle, R. 3, 30, 87, 99  
 Moyle, R. G. 3, 87, 99  
 Mueller, J. M. 125  
 Mullin, R. D. 82, 97  
 Murphy, B. J. 14  
 Murthy, A. 48

## N

Naiman, A. 26  
 Nairn, C. J. 80  
 Najjar, N. A. 97  
 Nakashima, F. 136  
 Naoki, K. 19  
 Natarajan, C. 90  
 Naugle, D. E. 137  
 Neiles, B. Y. 97  
 Nemeth, Z. 96  
 Nenninger, H. 76  
 Neudorf, D. 110  
 Neville, T. 70  
 Newbrey, J. L. 97  
 Newell, P. J. 138  
 Newman, A. E. 83  
 Newman, S. H. 24  
 Newnam, C. 109  
 Nichols, J. D. 26, 84  
 Nicol, S. 88  
 Nielsen, C. K. 97, 126  
 Nielsen, L. A. 98  
 Niemi, G. 53, 98, 104, 158  
 Niemi, G. J. 53, 98, 158  
 Niemuth, N. D. 139  
 Niles, L. J. 84, 92  
 Njoroge, P. 95  
 Nocera, J. J. 32, 41, 44, 48, 98  
 Noel, B. L. 98

Nol, E. 69, 85  
 Noon, B. R. 131, 134  
 Norris, D. R. 15, 34, 83  
 Norris, R. 4  
 Nosil, P. 118  
 Nott, M. P. 100  
 Novak, B. 125  
 Novak, S. J. 4  
 Novotny, M. V. 128

## O

Obermayer, B. 144  
 O'Connell, T. J. 5, 28, 57, 127  
 Odom, K. J. 120  
 O'Donnell, L. 111  
 O'Donnell, M. 60  
 Ogle, S. 97  
 Okamoto, K. 76  
 Oldenburger, S. L. 112  
 Oleyar, M. D. 88  
 Oliver, K. D. 99  
 Oliveros, C. H. 3, 99  
 Olney, J. A. 130  
 Olsen, A. M. 99  
 Olsen, B. J. 2, 29, 54, 89, 99,  
 118, 147  
 Omeland, K. E. 73  
 O'Neil, J. J. 154  
 Ortega, C. P. 100  
 Ortega, J. C. 100  
 Ortiz, N. 20  
 Osborne, D. C. 16  
 O'Shaughnessy, R. 8  
 Oswald, J. A. 100  
 Ottewell, K. 72  
 Otto, M. 51  
 Oyler-McCance, S. J. 45, 66,  
 100, 137  
 Ozelski-McKelvy, A. 100

## P

Pabian, S. E. 17  
 Pagano, T. 101, 130  
 Palm, E. C. 24  
 Panci, H. 158  
 Panjabi, A. O. 27, 81, 85, 101, 132,  
 134, 157  
 Pansing, E. R. 101  
 Paprocki, N. 21  
 Parchman, T. 123  
 Pardieck, K. 11, 26, 114  
 Pardieck, K. L. 11, 26  
 Parent, K. 65  
 Parker, C. 54  
 Parker, P. G. 102  
 Park, S. 71, 157  
 Parrish, C. 102  
 Paszkowski, C. A. 97  
 Patricelli, G. L. 104  
 Patten, M. A. 31, 62, 120, 152  
 Pavlacky, D. C. 102  
 Paxton, E. B. 96  
 Paxton, E. H. 124  
 Paxton, K. 70, 96, 102, 116  
 Paxton, K. L. 70, 96, 102  
 Peak, R. G. 103  
 Peele, A. M. 103  
 Peer, B. D. 103  
 Peery, M. Z. 149



Peiman, K. S. 103  
 Pejchar, L. 12, 44, 87, 104  
 Pellegrini, A. R. 92  
 Peru, K. 96  
 Perz, J. S. 69  
 Peters, M. P. 45  
 Peterson, A. 36, 98, 104  
 Peterson, A. C. 36  
 Peterson, S. L. 131  
 Phillips, J. L. 104  
 Phillips, J. N. 104  
 Phillips, M. L. 4  
 Phillips, R. 68  
 Pierce, A. K. 105  
 Pillar, A. G. 152  
 Pillsbury, F. C. 94  
 Pinney, T. A. 105  
 Pitman, J. C. 79, 105, 106, 113  
 Pitt, W. C. 75  
 Plaza, E. 14  
 Pletschet, S. M. 105  
 Plumb, R. T. 79, 105, 106, 113  
 Plunkett, E. 33  
 Pockette, T. 114  
 Pollock, H. S. 106, 133  
 Pollock, J. 151  
 Pollock, L. 130  
 Pool, D. B. 101  
 Pope, T. L. 106  
 Porneluzi, P. A. 71  
 Porter, B. A. 142  
 Porter, R. R. 92  
 Porzig, E. L. 106  
 Pourtless, J. A. 107  
 Powell, A. 24, 156  
 Powell, A. N. 24  
 Powell, L. A. 120, 130, 152  
 Powell, L. L. 27, 42, 107  
 Power, H. W. 107  
 Powers, A. 45  
 Pratt, T. 158  
 Preston, P. J. 108  
 Prevost, S. 18, 63, 108  
 Prevost, S. C. 18, 108  
 Price, T. D. 3, 63  
 Príncipe, K. 115  
 Pringle, H. E. 108  
 Projecto-Garcia, J. 90  
 Prosser, D. J. 24  
 Pruett, C. L. 112  
 Pruett, H. L. 109  
 Pruett, M. S. 18, 27, 109, 143  
 Pryor, D. 115  
 Puckett, S. L. 144

## Q

Quattrini, L. 81  
 Quick, D. E. 109  
 Quintana-Ascencio, P. F. 119  
 Quirós Guerrero, E. 113

## R

Raherilalao, M. J. 135  
 Ralph, C. J. 3, 40, 80, 109  
 Ralph, P. L. 80  
 Ramos, C. V. 95  
 Ramsdell, C. P. 110  
 Ramsdell, J. 76  
 Randall, C. A. 110

Randall, J. A. 110  
 Ratcliffe, L. M. 32, 111  
 Raynor, E. J. 110  
 Reddy, S. 111, 127, 135  
 Reed, R. N. 75, 156  
 Reed, S. E. 44  
 Reeve, H. K. 149  
 Reichert, A. 111  
 Reidy, J. L. 111  
 Reitsma, L. 102  
 Reitsma, R. 42  
 Reme, V. 48  
 Remsen, J. V. 16  
 Rendall, D. 37, 72  
 Rendell, W. B. 12  
 Renton, K. 116  
 Restani, M. 73  
 Reudink, M. W. 98, 111, 152  
 Reynolds, J. D. 146  
 Rhodes, O. E. 63  
 Ribic, C. A. 139  
 Rice, M. B. 112  
 Richmond, A. 53  
 Ricono, A. 112  
 Riffell, S. K. 56  
 Rigby, E. 73, 112  
 Rigby, E. A. 112  
 Rimmer, C. C. 91, 135  
 Ringelman, K. M. 112  
 Risk, B. B. 72  
 Ritter, N. 19  
 Rivera-Cáceres, K. D. 113  
 Rivers, J. W. 71, 113  
 Robb, L. A. 123  
 Robertson, E. P. 46  
 Robertson, G. J. 113  
 Robertson, R. J. 12  
 Roberts, S. L. 43  
 Robinson, S. G. 105, 106, 113  
 Robinson, S. K. 67  
 Robinson, W. D. 31  
 Rockwell, S. M. 3, 156  
 Rockwood, L. L. 56  
 Rodewald, A. D. 51, 86, 90, 114, 155  
 Rodewald, P. G. 37  
 Rodrigues Soares, A. E. 125  
 Rodriguez-Contreras, V. 114  
 Rodriguez, M. D. 114  
 Rogers, A. M. 114  
 Rogers, C. M. 132  
 Rohrbaugh, R. W. 155  
 Roitberg, B. 32  
 Rolland, V. 114  
 Romano, A. 43  
 Romano, M. 43  
 Romero, M. 54  
 Ronconi, R. 68  
 Root, J. J. 47, 66, 126  
 Rosa, P. 76  
 Rose, A. P. 115  
 Rose, E. T. 115  
 Rosenberg, K. V. 115, 155  
 Ross, E. J. 115  
 Rossi, L. 112  
 Ross, J. D. 16, 27, 116  
 Rotenberry, J. T. 6, 54, 158  
 Rowe, R. J. 147  
 Rowin, S. M. 125  
 Royle, J. A. 11

Ruben, J. 109, 116  
 Ruben, J. A. 109  
 Rubenstahl, T. G. 56  
 Rubtsov, A. 123  
 Rueda-Hernandez, R. 117  
 Rueda-Hernández, R. 116  
 Ruegg, K. C. 116, 117  
 Ruiz-Gutierrez, V. 117  
 Ruiz-Gutiérrez, V. 117  
 Ruiz-Sanchez, A. 117  
 Rupp, E. 68  
 Rushing, C. S. 118  
 Ruskin, K. J. 118  
 Russell, R. 94  
 Ruvalcaba-Ortega, I. 85, 101  
 Ryan, V. M. 124  
 Ryder, T. B. 42  
 Rylander, R. J. 118  
 Ryu, H. 54

## S

Sadoti, G. 70  
 Safran, R. 64, 65, 118, 123, 150  
 Safran, R. J. 64, 65, 118, 150  
 Sage, R. B. 108  
 Sager-Fradkin, K. 141  
 Saint Martin, W. 60  
 Saless, R. E. 130  
 Salter, J. F. 119  
 Samuel, M. D. 119  
 Sanchez, C. C. 119  
 Sanchez-Clavijo, L. M. 119  
 Sánchez-Guzmán, J. M. 52  
 Sandercock, B. K. 54, 77, 110, 120, 146, 152  
 Sandler, A. G. 120  
 Sandoval, L. 120  
 Santiago-Quesada, F. 52  
 Santo Domingo, J. W. 54  
 Santos, F. 19  
 Saracco, F. S. 117  
 Saracco, J. F. 117  
 Sardell, J. M. 121  
 Satge, Y. 68  
 Sauer, J. R. 11, 57, 81, 121  
 Saunders, S. P. 121  
 Sausner, J. S. 121  
 Savard, J. P. 141  
 Scandolara, C. 43  
 Scarl, J. C. 91, 122  
 Schaming, T. D. 45, 122  
 Schelsky, W. 22  
 Schlosser, J. 25  
 Schmidt, K. A. 43  
 Schmiegelow, F. 131  
 Schnell, G. D. 157  
 Schofield, L. N. 12, 122, 158  
 Schondube, J. E. 122  
 Schrage, A. 123  
 Schroeder, M. A. 100, 123  
 Schroeder, S. 101  
 Schroff, S. 31  
 Schuetz, J. G. 145, 151  
 Schumaker, N. 60  
 Schwarzer, A. 98  
 Scopel, L. C. 123  
 Scordato, E. 3, 123  
 Scordato, E. S. 3  
 Scott, J. D. 140

Searcy, W. A. 80  
 Seavy, N. E. 28, 35, 49, 65, 106, 124  
 Seay, J. L. 130  
 Sechrist, J. D. 124  
 Seeholzer, G. F. 58  
 Semenov, G. 123, 124  
 Senner, N. R. 69  
 Sensenig, R. L. 53  
 Sesnie, S. E. 125  
 Shaffer, S. 26, 55  
 Shaffer, S. A. 26  
 Shah, S. S. 125  
 Shapiro, B. 125  
 Shave, M. E. 125  
 Shaw, D. 89  
 Sheehan, J. 47  
 Sheldon, D. 44, 78  
 Sheldon, D. R. 78  
 Sheldon, F. H. 17  
 Shenk, T. 50  
 Sherry, T. W. 28  
 Shew, J. J. 126  
 Shipley, A. 14  
 Shirk, A. J. 123  
 Shizuka, D. 64, 115, 126  
 Shouse, R. A. 126  
 Shrimpton, J. M. 10  
 Shriner, S. A. 47, 66, 126  
 Shriver, W. G. 13, 29, 99, 118, 147  
 Shultz, A. J. 139  
 Shutler, D. 25  
 Siegel, R. B. 116  
 Siepielski, A. M. 45  
 Sierzega, K. P. 127  
 Siewerdt, F. 20  
 Sigel, B. J. 60  
 Sih, A. 112  
 Siler, C. D. 157  
 Sillett, T. S. 26, 56, 64, 72  
 Silveira, L. F. 20, 30  
 Silverio, C. A. 127  
 Simons, T. R. 115  
 Simpson, T. R. 58  
 Sinclair, P. 122  
 Sinnott, E. A. 127  
 Skagen, S. K. 131, 134  
 Skeen, H. R. 127  
 Slager, D. L. 7, 128  
 Slater, S. J. 128  
 Slattery, S. M. 93  
 Slowinski, S. P. 128  
 Sly, N. D. 129, 133  
 Small, A. 98  
 Smit, B. 154  
 Smith, A. C. 37, 94, 129  
 Smith, C. 41, 95, 129  
 Smith, C. J. 129  
 Smith, D. R. 18, 77, 84, 108  
 Smith, E. K. 154  
 Smith, J. 4, 70, 130  
 Smith, J. A. 130  
 Smith, J. F. 4  
 Smith, J. P. 130  
 Smith, P. A. 92, 130  
 Smith, S. B. 101, 130  
 Smith, S. H. 131  
 Smith, T. B. 70, 116  
 Smolinsky, J. 122  
 Snyder, L. H. 110  
 Soehren, E. 87

Sofaer, H. R. 131  
 Soini, H. A. 128  
 Solorzano, E. 76  
 Solymos, P. 131  
 Somershoe, S. 87  
 Song, S. 131  
 Sood, H. 130  
 Sorenson, M. D. 135  
 Sorice, M. G. 110  
 Sousa, B. F. 131  
 Soykan, C. 145  
 Sparks, R. A. 7, 132  
 Sparling, D. W. 97, 126  
 Spaul, R. J. 132  
 Specht, H. M. 132  
 Spellman, G. M. 93, 128  
 Spellmeyer, A. J. 132  
 Spenn, C. 112  
 Spragens, K. A. 24  
 Stafford, J. D. 8  
 Stager, M. 133  
 Staicer, C. 150  
 Stanek, J. R. 133  
 Stanley, T. R. 133  
 Stanton, J. C. 138  
 Stanton, R. 94, 96, 133, 134  
 Stanton, R. A. 133  
 Stanton, R. L. 94, 134  
 Steenhof, K. 4, 132  
 Steen, V. A. 131, 134  
 Stendell, R. C. 66  
 Stenhouse, I. J. 151  
 Stepanian, P. 63, 73  
 Stepanian, P. M. 63  
 Stephens, J. L. 3  
 Stevens, T. K. 56  
 Stinson, L. T. 38  
 Stodola, K. W. 70  
 Stoleson, S. H. 139  
 Stoner, K. 156  
 Storz, J. F. 90  
 Stouffer, P. C. 10, 13, 61, 154, 155  
 Stralberg, D. 131  
 Strasser, E. H. 85, 134  
 Stricker, C. A. 37  
 Strickland, D. 34  
 Strozier, L. S. 135  
 Strum, K. M. 120  
 Strykowski, K. F. 135  
 Studds, C. E. 135  
 Stutchbury, B. 127, 137  
 Stutchbury, B. J. 127  
 Sullins, D. 105, 106, 113  
 Sullins, D. S. 113  
 Sullivan, H. J. 126  
 Sullivan, S. M. 135  
 Suzanne Beauchesne, S. 61  
 Swaddle, J. P. 145  
 Swanson, C. C. 66  
 Swanson, H. M. 23  
 Sweet, A. D. 136  
 Sweka, J. A. 84  
 Swider, C. 76  
 Swift, K. N. 136  
 Szabo, I. 73

## T

Tack, J. D. 137  
 Takekawa, J. Y. 24

Talbot, W. A. 154  
 Tamura, E. K. 136  
 Tapia, W. T. 84  
 Tash, J. 151  
 Tavares, E. 5  
 Taylor, C. M. 15, 60, 78, 136, 137  
 Taylor, D. R. 137  
 Taylor, R. L. 137  
 Taylor, S. A. 88, 137, 138  
 Taylor, S. S. 10, 22, 155  
 Temple, S. A. 138  
 Teplitsky, C. 150  
 Terpsma, C. 77  
 Terrill, R. s. 138  
 Terrill, S. B. 130  
 Tessler, D. F. 89, 138  
 Thomas, E. H. 139  
 Thomas, W. K. 76  
 Thompson, F. R. 67, 71, 111  
 Thompson III, F. R. 103, 133  
 Thompson, S. J. 139  
 Thorpe, P. A. 25  
 Thorup, K. 139  
 Tibbitts, T. L. 52  
 Tigano, A. 139  
 Tingley, M. W. 9  
 Title, P. O. 74, 139  
 Toews, D. P. 140  
 Tomasevic, J. A. 140  
 Tomback, D. F. 45, 101, 140  
 Toms, J. 78, 140, 141  
 Toms, J. D. 140, 141  
 Tonra, C. M. 59, 141  
 Tøttrup, A. P. 152  
 Tracy, D. D. 133  
 Trahan, K. J. 141  
 Tremblay, J. A. 141  
 Trevelline, B. K. 142  
 Tripp, D. W. 27  
 Trochet, J. A. 39  
 Trosen, C. 132  
 Truan, M. L. 39  
 Trujillo-Arias, N. 19  
 Tsai, J. 81, 142  
 Tsai, W. L. 142  
 Tubaro, P. L. 10, 19  
 Tucker, A. M. 142  
 Tucker, J. W. 22  
 Tulman, E. 35  
 Turbek, S. P. 143  
 Tuttle, E. M. 6  
 Twedt, D. J. 143

## U

Unitt, P. 57  
 Unruh, J. H. 143  
 Urban, E. H. 60, 131  
 Uy, J. A. 121, 143

## V

Vaidya, G. 144  
 VanDalen, K. K. 126  
 VanderWerf, E. A. 26  
 Vander Zanden, H. B. 144  
 Van Doren, B. M. 44, 69  
 van Oort, H. 61  
 van Riper III, C. 144  
 Van Wilgenburg, S. L. 62, 144  
 Vargas-Masis, R. 49, 145

Varian Ramos, C. W. 75, 145  
 Varsani, A. 68  
 Vazquez, M. 7  
 Veech, J. A. 145  
 Velas, K. L. 145  
 Veran, S. V. 84  
 VerCauteren, T. 81  
 Verheijen, B. H. 146  
 Vieira Chaves, A. 19  
 Vierling, K. T. 82  
 Villegas, A. 52  
 Vincent, T. J. 46  
 Vinton, A. C. 23  
 Visco, D. M. 146  
 Voelker, G. 128

## W

Wagner, A. C. 101  
 Wagner, M. A. 146  
 Waite, H. 19  
 Walker, B. L. 146  
 Walker, L. E. 146  
 Wallace, G. 68  
 Walsh, J. 76, 147  
 Walsh, S. E. 147  
 Walters, J. R. 49, 99  
 Walter, S. T. 50  
 Wang, A. X. 147  
 Wang, S. 81, 147  
 Wang, S. Y. 147  
 Wann, G. T. 17, 100, 148  
 Ward, M. 12, 24, 70, 122, 158  
 Ward, M. P. 12, 24, 70, 158  
 Ware, H. E. 21, 148  
 Warning, N. 9, 148  
 Warren, W. C. 6  
 Washburn, B. E. 141  
 Wassenaar, L. I. 135, 144  
 Weaver, R. J. 148  
 Webber, H. 45  
 Weber, R. E. 90  
 Webster, M. S. 6, 53, 72, 149  
 Weckerly, F. W. 58  
 Weckstein, J. D. 127  
 Weddle, B. 144  
 Weeber, R. C. 94  
 Wegner, S. 149  
 Weir, J. 5  
 Weiser, E. L. 149  
 Welch, A. T. 115  
 Welker, J. M. 144  
 Wellik, M. J. 74  
 Wendt, C. 129  
 Werner, S. J. 87  
 West, E. H. 149  
 Westphal, K. A. 46  
 Westwood, A. R. 150  
 Whalen, C. 130  
 Wheelwright, N. T. 150  
 White, D. 16  
 White, J. D. 105, 156  
 White, L. 108  
 White, T. A. 6, 137  
 Whitfield, M. C. 154  
 Whitney, H. G. 113  
 Whittaker, D. J. 128  
 Whittingham, L. A. 25  
 Wickersham, J. 70  
 Wickersham, L. 70

Wiebe, K. L. 52  
 Wiechman, L. A. 4  
 Wiedenfeld, D. A. 62  
 Wiest, W. A. 29  
 Wilcove, D. S. 53  
 Wilkerson, J. B. 18, 108  
 Wilkins, M. 118, 123, 150  
 Wilkins, M. R. 118, 150  
 Williams, E. J. 150  
 Williams, H. 83  
 Williams, K. A. 151  
 Williams, P. D. 35  
 Williams, T. D. 29  
 Will, T. 82  
 Wilsey, C. B. 119, 151  
 Wilson, A. E. 148  
 Wilson, S. 4, 151, 152  
 Winchell, C. S. 34  
 Winder, V. L. 120, 152  
 Winger, B. 153  
 Wingert, A. K. 153  
 Winker, K. 112  
 Winkler, D. W. 15, 17, 25, 55, 78, 153  
 Winner, K. 44  
 Withey, J. C. 153  
 Witt, C. C. 8, 154, 156  
 Wohner, P. N. 154  
 Wolf, B. O. 13, 14, 30, 154  
 Wolfe, J. D. 27, 40, 69, 154, 155  
 Wolstenholme, R. 77  
 Woltmann, S. 10, 155  
 Wood, E. M. 155  
 Wood, P. B. 47, 155  
 Woodrey, M. S. 155  
 Woodworth, B. L. 119  
 Woolley, C. A. 156  
 Wright, N. A. 156  
 Wunderle, J. M. 156  
 Wunder, M. B. 37, 45, 101, 105, 140, 144, 156

## X

Xiao, X. 24

## Y

Yackel Adams, A. A. 75, 156  
 Yarris, G. 112  
 Yoon, H. 71, 157  
 Yoon, J. 71, 157  
 Youngberg, E. N. 27, 157  
 Young, L. C. 26  
 Yuri, T. 157

## Z

Zajac, M. 25  
 Zeng, L. 158  
 Zenzal, T. 12, 96, 122, 158  
 Zenzal, T. J. 12, 96, 158  
 Zimmerman, G. S. 121  
 Zink, R. M. 158  
 Zirpoli, J. A. 130  
 Zlonis, E. 98, 158  
 Zlonis, E. J. 98  
 Zonana, D. M. 159  
 Zuckerberg, B. 57, 78, 108, 115, 138  
 Zuk, M. 158



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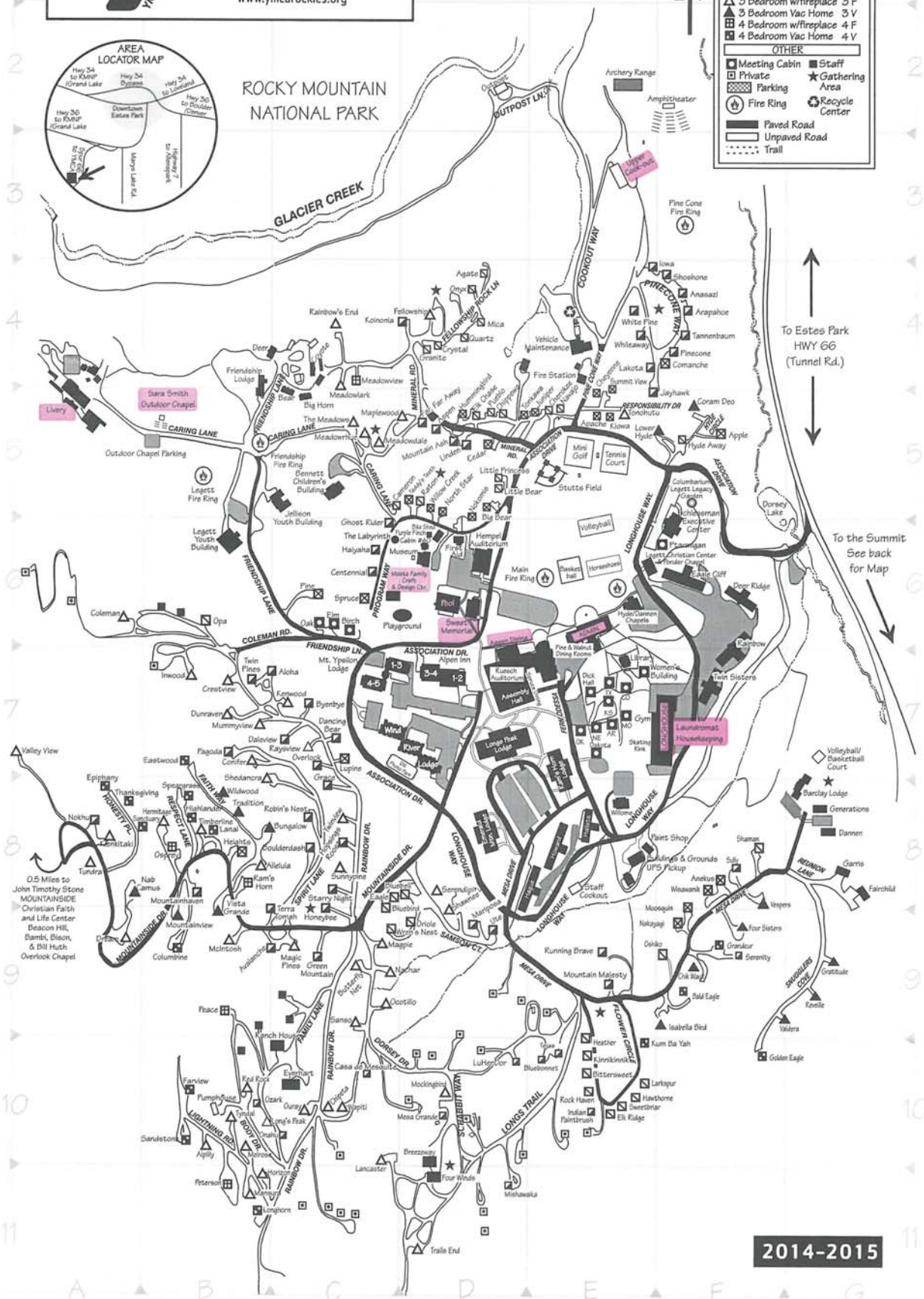


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The Schneider Group, Inc.  
5400 Bosque Blvd., Suite 680  
Waco, TX 76710 USA  
Telephone: +1 254-776-3550  
Fax: +1 254-776-3767  
E-mail: [aoucossco2014@sgmeet.com](mailto:aoucossco2014@sgmeet.com)  
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