

One Hundred and Twenty-Fifth  
Stated Meeting of the  
**American Ornithologists' Union**

9 - 11 August 2007  
at  
The University of Wyoming, Laramie, WY

**Abstracts**

version 13 Aug 2007

This *Abstract Book* includes the following disclaimer:  
"The abstracts in this work are not issued for the permanent scientific record."

**PLENARY TALKS**

**Plenary 1      Baker**

Progress in resolving the avian *Tree of Life*. ALLAN J. BAKER, *Dept. Nat. Hist., Royal Ontario Mus., and Dept. Evol. & Ecol., Univ. Toronto, Toronto, ON.*

Advances in molecular sequencing technologies and analytical methods are revolutionizing genetic studies of birds in population structure, species limits and phylogenetic relationships. In both population genetics and phylogenetics ornithologists are increasingly employing multilocus approaches, as the age of phylogenomics is upon us. Problems in estimating species trees from a range of incompletely sorted gene trees are also apparent at deeper branches in the avian tree of life that accompany rapid radiations in major clades. In this talk I will illustrate some of these problems and outline ways investigators are attempting to address them. Rather than being a hindrance to these studies DNA barcoding of the standardized COI sequence helps to rapidly uncover problems with introgression, incompletely sorted gene trees and post-divergence gene flow, due to its much quicker time to reciprocal monophyly than in nuclear genes. By also flagging morphologically cryptic species barcoding is also an effective complement to studies of the population genetics and phylogenetics of birds. Ultimately, DNA barcoding will help catalyze a synthesis in systematics of classifying early after divergence (phylogenetic species) versus late after divergence (biological species), and the roots of this synthesis will be found in coalescent theory. I predict the current systematic renaissance will reveal that mega-diverse avifaunas such as those in the Neotropical region will prove to harbor a rich collection of new species that have eluded us in the past.

**Plenary 2      Hansen, Phillips & Flather**

Species energy theory as a framework for tailoring conservation of biodiversity to biophysical and land use gradients. ANDREW J. HANSEN, LINDA PHILLIPS, *Dept. Ecol., Montana State Univ., Bozeman, MT,* and CURTIS H. FLATHER, *Rocky Mountain Res. Sta., USDA For. Ser., Ft. Collins, CO.*

Understanding and mapping patterns of biodiversity at continental scales has challenged ecologists for over a century. A breakthrough occurred in the 1990s with the discovery that measures of energy such as ecosystem productivity explained patterns of biodiversity better than all other factors. This discovery was possible because of the advent of satellite measurements of vegetation. Results from these studies set the broad context for understanding local controls on biodiversity and ways to effectively tailor conservation strategies to local landscapes. Using data from the new MODIS satellite and the North American Breeding Bird Survey, we found that native bird species richness is positively correlated with measures of ecosystem energy including heat and plant productivity. This suggests that available energy sets an upper limit on biodiversity potential. Human density and land use are also positively correlated with energy. Our results indicate that human activities reduce native bird species diversity below the biophysical potential. The effects of human activities on bird diversity vary across

energy gradients such that low-energy ecoregions are especially susceptible to human impacts. We illustrate these ecoregion-scale impacts and implications for conservation with case studies from the high-energy Pacific Northwest Ecoregion, the intermediate-energy mid Atlantic area, and the low-energy Greater Yellowstone Ecoregion. We conclude with guidelines for tailoring conservation strategies to local biophysical gradients.

### **Plenary 3 James**

Old bones, ancient molecules, and the march to extinction of Hawaiian birds. HELEN F. JAMES, *Dept. Vert. Zool., Natl. Mus. Nat. Hist., Washington, DC.*

The Hawaiian Islands have suffered a dramatic ecological collapse in the short time since humans discovered them. The islands were first settled by Polynesians, who arrived in sailing canoes about 1200 yr ago. Most of the archipelago's native birds have become extinct since then, and most of the surviving birds are now threatened with extinction. The prehistoric extinctions are documented by a rich fossil record, which has so far revealed roughly 55 unknown kinds of birds, including diverse flightless species, birds of prey, and songbirds. In addition, fossils provide information on the prior ranges of many endangered species. The bones often preserve indigenous biological molecules, enabling us to obtain radiocarbon dates, stable isotopic ratios, and DNA sequences from birds that died thousands of years ago. The biomolecular data can be used to reconstruct evolutionary relationships, and to trace changes in genetic diversity and diet through time as a species declines towards endangerment or extinction. The integration of these and other types of historical data (i.e., archaeological and biogeographic) is shedding light on the ecological and evolutionary processes that have shaped Hawaii's modern avifauna.

## **SYMPOSIA PAPERS**

### **S01 Barker, Burns, Klicka, Lanyon & Lovette**

Temporal and phylogenetic patterns of diversity in New World tanagers, cardinals, sparrows, blackbirds, and warblers. F. K. BARKER, *Bell Mus. Nat. Hist., Univ. Minnesota, Minneapolis, MN*, K. J. BURNS, *Dept. Biol., San Diego State Univ., San Diego, CA*, J. KLICKA, *Marjorie Barrick Mus., Univ Nevada, Las Vegas, NV*, S. M. LANYON, *Bell Mus.*, and I. J. LOVETTE, *Lab. Ornithol., Cornell Univ., Ithaca, NY*.

The nine-primaried oscines (currently classified in the families Thraupidae, Cardinalidae, Emberizidae, Icteridae and Parulidae) are one of the most diverse groups in the New World avifauna, and the focus of a massive volume of research in diverse fields of biology. However, this diversity has hampered understanding of phylogenetic relationships in the group, limiting their usefulness in comparative biology. Using molecular data from multiple loci and nearly all the genera within these families, we demonstrate that they form a monophyletic group within passerines. Furthermore, our data support 5 major groupings, roughly corresponding to the traditionally-recognized families, as well as a number of lineages more distantly related to various of these family groups. Comparison of the species richness and age of this clade as a whole to other oscine lineages indicates that it has experienced diversification rates unparalleled in the New World. Lineage diversities within the clade strongly violate constant-rates assumptions, suggesting that a number of lineages have experienced enhanced (and suppressed) diversification. The data reported here form the backbone of our species-level phylogeny for this group.

### **S02 Burns, Mauck, Sedano & Keith**

Using a phylogeny of tanagers to provide insight into classic subjects of evolutionary research. K. J. BURNS, W. M. MAUCK, R. SEDANO and R. KEITH, *Dept. Biol., San Diego State Univ., San Diego, CA*.

The tanagers (Thraupini) are a major radiation of New World birds. Species in this group show variation in plumage colors and patterns, foraging behavior, bill size and shape, geographic distributions and many other characters. In this study, we use mtDNA and nuclear data to reconstruct a phylogeny for the group. Maximum likelihood and Bayesian analyses indicate that, among nine-primaried oscines,

tanagers are most closely related to cardinals and grosbeaks (Cardinalini). A redefined Thraupini consists of about 370 different species. Within Thraupini, all but a few species fall into one of eleven strongly supported clades. Of the 37 genera of tanagers that are not monotypic and have been analyzed, 18 do not form monophyletic groups. All genera that include more than 5 species are not monophyletic. The molecular phylogeny is used to address two subjects of classic research in evolutionary biology: the evolution of feeding morphologies (bill size and shape) and the evolution of sexual dichromatism. Sexual dichromatic species are found throughout the phylogeny. Likewise, finch-billed "tanager-finches" are not each other's closest relatives and are found in each of the major clades. Comparing bill distance to genetic distance indicates that bills do not evolve at a constant rate. Instead, widespread convergence best characterizes bill evolution in the tanagers. In addition, bill size and shape have evolved much more rapidly in some clades of tanagers than in others.

### **S03 Klicka**

Biogeography of the New World sparrows (Emberizini): a tale of two continents. JOHN KLICKA, *Marjorie Barrick Mus., Univ. Nevada-Las Vegas, Las Vegas, NV.*

As a group, the new world sparrows (tribe Emberizini) have yet to receive a rigorous taxonomic assessment and a robust phylogeny that would allow the study of character evolution remains lacking. As part of this study, we sampled most of Sibley and Monroe's 156 putative sparrow species and all of their 32 genera. Complete mitochondrial cytochrome b and ND2 genes (2184 bp) were sequenced for all taxa. Four nuclear genes (RAG1, MG-12, FIB-15, ACO1-110) were additionally sequenced (ca. 5220 bp) for a subset of these taxa. Preliminary analyses of these data indicate that the Emberizini, as currently configured, is polyphyletic. Five genera currently assigned to this tribe (*Calcarius*, *Plectrophenax*, *Urocynchramus*, *Gubernatrix*, *Paroraria*) are better placed elsewhere in the songbird tree. Two genera (*Oreothraupis*, *Chlorospingus*) currently placed among the Thraupini (Tanagers) are in fact basal lineages within the Emberizini. Overall, of the 16 sparrow genera having more than one species, 10 are either para- or polyphyletic. The data also indicate that morphologically distinctive temperate and tropical sparrows are not independent lineages; rather, tropical sparrows occur throughout the sparrow tree and form clades in both basal and derived positions. Sparrows are found to be of North American origin, suggesting multiple independent colonizations of South America.

### **S04 Lovette, Winger & Hochachka**

Understanding the evolutionary ecology of wood-warblers via a whole-family phylogeny. IRBY J. LOVETTE, BEN WINGER and WESLEY M. HOCHACHKA, *Fuller Evol. Biol. Prog., Lab. Ornithol., Cornell Univ., Ithaca, NY.*

A half-century ago, Robert MacArthur famously used a set of wood-warblers (Parulidae) to explore niche differentiation among closely related, co-occurring bird species. In the years since, the wood-warblers have served as a model group in many studies of community and behavioral ecology. The generation of a robust phylogeny of this family now gives us a powerful tool for revisiting and extending research on the evolutionary biology of this group. Here, we present a complete phylogenetic reconstruction for all Parulidae species and use it to explore two complementary ecological issues in their historical contexts. First, we assess phylogenetic effects on the composition of local wood-warbler assemblages across North America, finding simultaneous evidence for competitive exclusion and phylogenetic niche conservatism. Second, we examine the geographic pattern of migration in the Parulidae, finding that migration is likely ancestral; that the wood-warbler radiation may have initiated in northern-breeding, migratory lineages, and that gains and losses of migratory states have been similar over the history of the group.

### **S05 Lanyon & Barker**

Exploring patterns of morphological evolution in the New World blackbirds. S. M. LANYON and F. K. BARKER, *Bell Mus. Nat. Hist., Univ. Minnesota, Minneapolis, MN.*

Recent research on plumage and song evolution in orioles has revealed that these character suites have experienced rampant convergent evolution. Furthermore, both suites appear to be characterized by a relatively constant rate at which novel character states evolve. The question is

whether these same evolutionary patterns (high rates of convergence and constant rate of novel character appearance) occur in less labile characters. We here report the results of an investigation of skeletal evolution and an examination of the levels of convergent evolution using a new species-level phylogeny of the New World Blackbirds derived from mitochondrial and nuclear DNA sequence data.

#### **S06 Grant**

Speciation in Darwin's Finches: the role of introgressive hybridization. B. ROSEMARY GRANT, *Princeton University*

The process of speciation in nature is generally initiated by the expansion of a population into a new environment, followed by adaptation to novel ecological conditions. For successful establishment, there has to be enough genetic variation on which selection can act to bring a population to a new adaptive norm. In this talk I will combine studies of the adaptive radiation of Darwin's Finches in the Galápagos Archipelago with an intensive investigation on one island, the small island of Daphne Major. I will show how the process of speciation involves an interaction between fluctuating ecological conditions, genetic evolution and learned, culturally transmitted, traits. I will end by exploring the question: How general is introgressive hybridization in the adaptive radiation of birds?

#### **S07 Sorenson, Shull, Sefc, DaCosta, Balakrishnan & Payne**

Recent sympatric diversification of brood parasitic indigobirds: setting an upper limit on speciation times. MICHAEL D. SORENSON, HEATHER C. SHULL, KRISTINA M. SEFC, JEFFREY M. DaCOSTA, CHRISTOPHER N. BALAKRISHNAN, *Dept. Biol., Boston Univ., Boston, MA*, and ROBERT B. PAYNE, *Univ. Michigan, Ann Arbor, MI*.

Indigobirds (genus *Vidua*) are host-specific brood parasites in which host colonization and behavioral imprinting have apparently led to sympatric speciation. Mitochondrial DNA sequences suggest that the 4 indigobird species in southern Africa evolved after indigobirds from West Africa colonized the region. Given the possibility of ongoing introgression between indigobird species, which is likely facilitated by the same behavioral mechanisms that are responsible for speciation in this system, a possible alternative explanation is that a selectively advantageous West African mtDNA lineage found its way into existing indigobird populations in southern Africa and swept to fixation, thereby obscuring a more ancient origin of the southern species. To test these alternatives, we sequenced several nuclear loci and analyzed these data using coalescent methods designed to simultaneously estimate gene flow and divergence times. Data from nuclear loci were broadly consistent with mtDNA data, indicating recent divergence of western and southern indigobirds as well as relatively low genetic diversity in the south. Coalescent analyses suggest that a small fraction of the ancestral population (~2%) gave rise to southern indigobirds on the order of  $10^5$  yr ago, after which there has been little or no gene flow between regions. Thus, 4 morphologically distinct indigobird species in southern Africa evolved within the region sometime after  $10^5$  yr ago, consistent with a model of sympatric speciation through host shift.

#### **S08 Uy, Stein & Filardi**

Sexual selection, signal divergence and speciation in tropical birds. J. ALBERT C. UY, ADAM C. STEIN, *Dept. Biol., Syracuse Univ., Syracuse, NY*, and CHRISTOPHER E. FILARDI, *Center for Biodiversity and Conservation, Amer. Mus. Nat. Hist., New York, NY*.

One of the most striking differences among closely related species is in the signals used in competing for mates. This has led many to propose that divergent sexual selection can be important in the speciation process. However, few studies have explicitly tested the role of divergent signals in species formation, especially for systems where signals of multiple sensory modalities have diverged. Combining phylogenetic, observational and experimental approaches, we ask whether signal divergence can lead to premating or behavioral isolation between closely related but morphologically and behaviorally distinct taxa. We use 2 groups of tropical birds that show striking geographic variation in mating signals: the bearded manakin (*Manacus* sp.) complex of Central America and the Chestnut-bellied Flycatcher (*Monarcha castaneiventris*) complex of the Solomon Islands. For the bearded manakins, we take advantage of a natural hybrid zone between the Golden- and White-collared manakins to understand the consequences of signal divergence when two divergent taxa come into secondary contact. For the Chestnut-bellied Flycatchers, we tested the role of divergent signals in species recognition (and hence premating isolation) between several island populations that are recently

diverged but distinct in plumage color, song structure and extent of sexual dichromatism. Finally, we present data that provide insights into the ecological and social factors that may have driven the observed divergence among populations.

### **S09 Price**

A review of hybrid zones in birds. TREVOR PRICE, *Dept. Ecol. & Evol., Univ. Chicago, Chicago, IL.*

More than 200 bird hybrid zones are known where different species or subspecies meet in zones of overlap and hybridize to produce a variety of different phenotypes. In this talk, I identify 3 kinds of hybrid zones. The first reflect the recent expansion of one species into the range of the other, usually attributed to anthropogenic disturbance. These are often very wide, but this is likely to represent a temporary state. The second are generally narrow and the hybridizing taxa are typically separated by more than 1 million years. The narrowness of these zones is likely due to strong selection against hybrids balanced by dispersal into the zone, and fit the classical conception of a hybrid zone. The third are wider and between young taxa. Both zone width and zone movement are likely to be influenced by both sexual selection and environmental conditions, which affect the fitness of not only the hybrids but also the parental species. Because inheritance, dispersal, and selection can vary among traits, a single hybrid zone may have a different width for different traits, and not all traits need move at the same rate when a hybrid zone moves. This means that distinct populations of hybrid individuals can form, and these could give rise to new taxa. Several subspecies seem to have been produced as a result of hybridization, but whether hybridization generally plays an important role in the creation of bird species remains uncertain.

### **S10 Seddon & Tobias**

Speciation in Neotropical suboscines: the role of mating signals. NATHALIE SEDDON and JOSEPH A. TOBIAS, *Edward Grey Inst. Field Ornithol., Univ. Oxford, Oxford, UK.*

The evolutionary divergence of mating signals is considered a powerful driver of avian speciation. Divergence in sympatry may strengthen reproductive isolation, while divergence in allopatry may reduce gene flow on secondary contact. We are exploring these ideas in antbirds (Thamnophilidae), a diverse radiation of Neotropical suboscine passerines which, unlike oscines, are thought to develop their songs without learning. Comparative analyses revealed that songs of sympatric sister-species were more divergent than those of allopatric sister-species, consistent with the idea that song divergence strengthens reproductive isolation. We also showed that both plumage dichromatism and song structure were strong predictors of the phylogenetic diversity of antbird genera. This suggests that mating signal divergence, perhaps mediated by sexual selection, drives antbird diversification. That song divergence in particular plays a role in the early stages of speciation was also suggested by studies of the Chestnut-tailed Antbird (*Myrmeciza hemimelaena*). A population isolated for < 3,000 yr in a natural forest island in southern Amazonia was found to be genetically and vocally differentiated from populations in nearby continuous forest. Moreover, on simulating secondary contact between isolated populations using playback, we found evidence of partial reproductive isolation by song. These studies demonstrated that behavioral and genetic divergence can occur among bird populations on small spatial scales and within short timeframes. Overall, our research implies a key role for mating signals in the diversification of suboscine birds, and we propose that song divergence is especially important because of an inability to learn or recognize divergent songs on secondary contact.

### **S11 Irwin, Brelsford & Toews**

Using contact zones to infer causes of speciation: examples from the boreal forests of Asia and North America. DARREN E. IRWIN, ALAN BRELSFORD and DAVID P. L. TOEWS, *Dept. Zool., Univ. British Columbia, Vancouver, BC.*

A fundamental question regarding speciation is whether it is driven more by natural selection or by sexual selection. We explore this question by examining post-Pleistocene contact zones, with examples from the boreal forests of Asia and North America. Contact zones allow us to determine 1) what traits have diverged between western and eastern taxa during their time in allopatry, and 2) whether the divergent taxa are reproductively isolated in sympatry and the role that various traits play in that isolation. The Greenish Warbler (*Phylloscopus trochiloides*) ring species has divergent forms in western and eastern Siberia that are reproductively isolated where they meet. The forms are similar in habitat choice and in body shape and size, but have distinct songs, calls, genetic signatures, and migratory

routes. Winter Wrens (*Troglodytes troglodytes*) in North America also consist of two reproductively isolated species that are similar ecologically and morphologically, but have divergent songs, migratory routes, and genetic signatures. Yellow-rumped Warblers (*Dendroica coronata*) provide a different situation, in which there is a relatively narrow and apparently stable hybrid zone between divergent forms. Plumage patterns, songs, and at least two small parts of the genome show steep and concordant clinal change across the hybrid zone, whereas morphometric traits and most parts of the genome show broader clines or no change between the forms. In these examples of boreal species pairs, sexual selection and adaptation to distinct migratory routes appear to have played major roles in driving speciation, with habitat-based natural selection playing a lesser role.

### **S12 Clayton, Bush & Johnson**

Host defense reinforces host-parasite cospeciation. DALE H. CLAYTON, *Dept. Biol., Univ. Utah, Salt Lake City, UT*, SARAH E. BUSH, *Nat. Hist. Mus., Univ. Kansas, Lawrence, KS*, and KEVIN P. JOHNSON, *Illinois Nat. Hist. Surv., Urbana, IL*.

Cospeciation occurs when interacting groups, such as hosts and parasites, speciate in tandem generating congruent phylogenies. Cospeciation can be a neutral process in which parasites speciate merely because they are isolated on diverging host islands. Adaptive evolution may also play a role, but this has seldom been tested. We explored the adaptive basis of cospeciation using a model system consisting of feather lice (*Columbicola*) and their pigeon and dove hosts (*Columbiformes*). We reconstructed phylogenies for both groups using nuclear and mitochondrial DNA sequences. Both phylogenies were well resolved and well supported. Comparing these phylogenies revealed significant cospeciation, as well as correlated evolution of host and parasite body size. The match in body size suggested that adaptive constraints limit the range of hosts lice can use. We tested this hypothesis by transferring lice among hosts of different sizes to simulate host switches. The results of these experiments showed that lice cannot establish viable populations on novel hosts that differ in size from the native host. To determine why size matters, we measured three components of louse fitness: attachment, feeding, and escape from host defense (preening). Lice could remain attached to, and feed upon, hosts varying in size by an order of magnitude. However, they could not escape from preening on novel hosts that differed in size from the native host. Overall, our results suggest that host defense reinforces cospeciation in birds and feather lice by preventing lice from switching between hosts of different sizes.

### **S13 Lyon & Eadie**

An obligate brood parasite trapped in the within species arms race of its hosts. BRUCE E. LYON, *Dept. Ecol. & Evol. Biol., Univ. California, Santa Cruz, CA*, and JOHN McA. EADIE, *Dept. Wildl. & Fish. Conserv. Biol., Univ. California, Davis CA*.

Brood parasitism provides a model system for investigating the dynamics of antagonistic coevolution because of the reciprocally hostile relationship between parasite and host. The Black-headed Duck is unique among avian obligate brood parasites because its precocial chicks are independent within a day of hatching and should impose few fitness costs to hosts. However, in a 4-yr study in Argentina we recorded high levels of egg rejection by the duck's 2 main host species, a prerequisite for antagonistic host-parasite coevolution. Paradoxically, we detected no costs of parasitism to hosts. Moreover, egg rejection dramatically reduced parasite fitness, but egg mimicry experiments revealed no phenotypic natural selection for more mimetic parasitic eggs. These paradoxical results were resolved by the discovery of intraspecific brood parasitism and conspecific egg rejection within the hosts themselves. The apparent arms race between species appears to be instead an incidental byproduct of within-species conflict, with little recourse for evolutionary response by the parasite. These findings raise questions about the cognitive basis of egg acceptance by the hosts and the stability of the persistence of the brood parasite.

### **S14 Temeles & Kress**

Pollinator generalization and specialization across a geographic mosaic: hummingbirds and heliconias of the eastern Caribbean. ETHAN J. TEMELES, *Dept. Biol., Amherst College, Amherst, MA*, and W.

JOHN KRESS, *Natl. Mus. Nat. Hist., Smithsonian Inst., Washington, DC.*

Thompson's (2005) *Geographic Mosaic Theory of Coevolution* predicts that the degree of specialization and interdependence between mutualistic species will vary in space and time. Here we use a geographic approach to examine how a hummingbird – *Heliconia* relationship changes across islands in the eastern Caribbean and discuss the associated changes in floral and pollinator traits. On the island of Dominica, flowers of *H. bihai* are pollinated exclusively by female Purple-throated Caribs (*Eulampis jugularis*), and have long curved flowers matching the females' long, curved bills. On Grenada, Trinidad, and Tobago, flowers of *H. bihai* are 30% shorter, yet are pollinated by as many as 5 different hummingbird species with bills ranging from 18 to 40 mm in length. Feeding experiments with natural and artificial flowers demonstrate that the long, curved flowers of *H. bihai* on Dominica are inaccessible to short-billed hummingbirds, whereas the short, curved flowers of *H. bihai* on Grenada, Trinidad and Tobago are easily accessed by short- and long-billed hummingbirds, as well as by hummingbirds with highly curved bills. We suggest that the extreme pollinator specialization on Dominica is a consequence of depauperate island flora and faunas resulting from increased geographic distance from mainland source pools, which facilitates both plant and pollinator character displacement.

### **S15 Siepelski**

The coevolution of seed dispersal mutualisms between nutcrackers and pines. ADAM SIEPELSKI, *Dept. Zool. & Physiol., Univ. Wyoming, Laramie, WY.*

Interactions between species are rarely homogenous in either space or time, and this is particularly the case for coevolving interactions. I discuss these issues using a seed-dispersal mutualism as an example. First, I present evidence that spatial variation in the presence of a pre-emptive competitor and selective agent on conifer cone structure, pine squirrels (*Tamiasciurus* spp), influence the co(evolutionary) trajectories between two bird-dispersed pines (*Pinus albicaulis* and *P. flexilis*) and their mutualistic avian seed disperser, Clark's Nutcracker, across a broad geographic landscape. Second, I discuss how temporal variation in cone production (masting) of these pines plays a critical role driving the evolution of the seed dispersal mutualism. Consideration of both spatial and temporal variation in the form and outcome of species interactions is important for understanding coevolutionary dynamics.

### **S16 Benkman & Parchman**

The importance of coevolutionary arms races in the adaptive radiation of crossbills. CRAIG BENKMAN and THOMAS L. PARCHMAN, *Dept. Zool. & Physiol., Univ. Wyoming, Laramie, WY.*

Coevolutionary arms races between crossbills (*Loxia*) and conifers vary in importance across the adaptive radiation of New World crossbills. Some taxa (e.g., South Hills and Newfoundland crossbills, call types 9 and 8, respectively) have coevolved with conifers during the Holocene, and such evolution has apparently caused these crossbills to diverge and speciate. Other crossbills have not coevolved with the conifers on which they specialize (e.g., White-winged and lodgepole pine crossbills, *L. leucoptera* and call type 5, respectively). I will discuss the main factors contributing to the diversification of New World crossbills and how differences among conifers in the size and temporal availability of seeds, and the distribution of different competitors and selective agents have influenced this adaptive radiation.

### **S17 Hutto**

The Black-backed Woodpecker habitat distribution pattern underscores the importance of maintaining severely burned forests in the northern Rockies. RICHARD L. HUTTO, *Avian Sci. Center, Biol. Sci., Univ. Montana, Missoula, MT.*

Data collected from more than 10,000 point-count locations within the northern Rockies reveal that the Black-backed Woodpecker is nearly restricted in its distribution to burned forest conditions. More intensive study within burned forests shows that the woodpecker also occurs disproportionately often in severely burned than in less severely burned patches. The presence of the Black-backed Woodpecker (along with many other bird species) in burned forests is also clearly tied to the presence of standing dead trees. The implications of these facts are profound. First, severe fires are undoubtedly natural events that have molded the evolutionary adaptations of many species, and, although the number or extent of such fires may be unusually large nowadays, severe fires per se are not "unnatural" or "catastrophic" events. Secondly, neither the Black-backed Woodpecker nor any of the other relatively

fire dependent bird species persists in the face of postfire salvage logging. These facts alone should engender a stronger appreciation of the biological value and “naturalness” of severely burned forests, and should weigh heavily in decisions about whether and how to conduct postfire timber harvesting operations on public lands.

#### **S18 Block, Hurteau & Doll**

Fire effects on breeding ecology of Western Bluebirds in the American Southwest. WILLIAM M. BLOCK, SARAH R. HURTEAU and LAURA DOLL, *Rocky Mountain Research Station, Flagstaff, AZ.*

We conducted a series of studies to understand effects of fire on the breeding ecology of Western Bluebirds in Southwestern ponderosa pine forests. Nestbox studies were initiated in 1997 following wildfires in 1996 to evaluate effects of fire severity on bluebird nest success. Nest success was significantly greater in areas that burned with moderate severity (23 - 48% nest success) compared to severely burned (9-15%) and unburned areas (8 - 16%). Population abundance and survival rates were also greater in moderately burned areas relative to severely burned and unburned areas. These results suggest that bluebird populations are dependent on fire for increased reproduction and survival. Not all secondary-cavity nesting birds responded in the same way. For example, White-breasted Nuthatches showed a positive response to moderate fire (11 - 16% nest success) but negative response to severe fire (1 - 2%), and Mountain Chickadee nest success decreased significantly following both types of fire (1 - 5% and 0 - 1% for moderate and severe fire, respectively). Other studies consisting of thinning and fire. These studies consistently documented short-term population increases by bluebirds to prescribed fire.

#### **S19 Conway & Kirkpatrick**

Effects of fire suppression, fire severity, and fire frequency on Buff-breasted Flycatchers and other montane forest birds in the Sky Island Mountain Ranges of southern Arizona. COURTNEY J. CONWAY *USGS Arizona Coop. Fish & Wildl. Res. Unit, Tucson, AZ,* and CHRIS KIRKPATRICK, *School Nat. Resources, Univ. Arizona, Tucson.*

Buff-breasted flycatchers have experienced a >90% reduction in their U.S. breeding range during the past century. Previous authors have implicated fire suppression as the cause. Coniferous forests in this region lead the nation in number of lightning-ignited fires and historically had low-severity surface fires every 2 - 12 yr. We examined whether evidence of recent fire and burn severity influenced the number of Buff-breasted Flycatchers detected during surveys within 9 mountain ranges in southeastern Arizona. Flycatchers were particularly associated with severe surface fire; 24% of the 76 survey points with flycatchers (compared to 9% of all survey points) were in areas with evidence of severe surface fire. The number of flycatchers was 3 times higher in areas with high-severity fire compared to areas with less-severe fire or no evidence of recent fire. However, areas that had experienced only one recent fire had not been recolonized by flycatchers. In contrast, flycatchers have recolonized the Rincon Mountains (after 90 yr without a record), apparently in response to frequent prescribed burning by the National Park Service. Most of the coexisting species (73%) were also positively associated with burned areas and displayed stronger associations with areas that had evidence of severe as opposed to less-severe fire. Continued suppression of high-severity forest fires in the southwestern U.S. may cause extirpation of buff-breasted flycatchers and other montane forest birds. Prescribed burning can improve conditions for these fire-dependent species, but only if burns are of high severity and/or are repeated regularly (i.e., mimic the natural fire regime).

#### **S20 Saab, Newlon & Rotella**

Early birds do it better: importance of timing for nest survival of Lewis's Woodpecker in burned and unburned habitats. VICTORIA SAAB, *USFS Rocky Mtn. Res. Station, Bozeman, MT,* KAREN NEWLON, *USFWS Red Rocks Lakes Nat. Wildl. Refuge, Lima, MT,* and JAY ROTELLA, *Dept. Ecol., Montana State Univ., Bozeman, MT*

Recently burned forests and aspen riparian woodlands represent two rare but highly valuable breeding habitats for Lewis's Woodpecker. Both habitats support a diverse cavity-nesting bird community due to an abundance of trees with soft wood for cavity excavation and plentiful arthropods.

We compared nest survival of Lewis's Woodpecker in ephemeral postfire forests, [early (< 5 yr after fire) and late (> 5 - 12 yr after fire) postfire periods] vs. relatively stable, aspen riparian woodlands. Nest survival values were higher in early postfire forests ( $0.81 \pm 0.03$ ; 95% CL 0.74, 0.86) and aspen riparian woodlands ( $0.74 \pm 0.06$ ; 95% CL 0.63, 0.85), compared with late postfire forests ( $0.63 \pm 0.03$ ; 95% CL 0.58, 0.68). In all habitats, temporal covariates had a significant influence on daily survival rates (DSR), whereas habitat covariates were less important. In aspen riparian woodlands, DSR increased with increasing temperature, whereas DSR was negatively related to both increasing temperature and precipitation in postfire habitats. Such habitat-specific data are critical for the management of Lewis's Woodpecker populations.

### **S21 Tucker, Cox & Jones**

Bachman's Sparrow as an indicator of natural fire regimes in the longleaf pine ecosystem. JAMES W. TUCKER, *Archbold Biol. Station, Avon Park, FL*, JAMES A. COX and CLARK A. JONES, *Tall Timbers Res. Station, Tallahassee, FL*.

The longleaf pine ecosystem once dominated the Coastal Plain of the se. U.S. and contains the most species-rich plant communities in North America. Frequent fires are required to maintain natural diversity within this ecosystem. Bachman's Sparrow is one of the bird species most characteristic of longleaf pine forests. Bachman's Sparrow is an obligate ground-nesting and ground-foraging species, and populations are dependent on conditions of the herbaceous ground cover. We review the ecology of longleaf pine communities and present evidence suggesting that Bachman's Sparrow is an excellent indicator of natural fire regimes in this ecosystem. Densities of breeding Bachman's Sparrows rapidly declined in longleaf pine forests > 3 yr after fire but did not differ the first 3 yr after fire. Reproductive indices mirrored densities and appeared greater  $\leq 3$  yr after fire than  $\geq 4$  yr after fire. Winter studies suggest subtle changes may occur with fire frequencies < 2 yr, but these studies suggested that season of fire did not influence density or reproductive success of Bachman's Sparrows. A study that examined site fidelity, home range characteristics, and annual survival of male Bachman's Sparrows in relation to breeding season fires did not suggest adverse effects of breeding season fires. Although studies examining the influence of breeding season fires on reproductive productivity of Bachman's Sparrows are needed, studies of Bachman's Sparrows support results from botanical studies that suggest natural fire regimes in the longleaf pine ecosystem were dominated by frequent (i.e.,  $\leq 3$  yr) growing season fires.

### **S22 Walters**

What fire means to me: testimonial from a Red-cockaded Woodpecker. JEFF WALTERS, *Dept. Biol., Virginia Tech Univ., Blacksburg, VA*.

In this paper I review evidence of various impacts of fire on the endangered, cooperatively breeding Red-cockaded Woodpecker (RCWs) and other bird species characteristic of southern pine ecosystems, especially longleaf pine savannas and flatwoods. The importance of fire-dependent aspects of habitat structure to RCWs was first postulated more than 20 yr ago as an explanation of observed abandonment of nesting habitat under fire suppression regimes. Expansion of RCW populations linked to dramatic reductions in hardwood midstory vegetation resulting from reintroduction of prescribed, growing season fire supports this hypothesis. There is also a growing body of evidence suggesting that changes in groundcover vegetation resulting from fire, specifically development of rich, diverse groundcover comprised largely of forbs and grasses, increases productivity and promotes helping behavior through impacts on the invertebrate community that increase foraging habitat quality for RCWs. The return of fire to longleaf systems has been driven by concern for the endangered RCW, but recent evidence indicates that fire-driven changes in the plant community have broad impacts on avian communities in this system. Interactions of seasonality and frequency of fire with the soil-moisture gradient appear to define the niches of bird species within these ecosystems, such that the composition of the community changes with the fire regime in predictable ways.

### **S23 Schlinger, Day & Fusani**

Hormonal control of male *Manacus* courtship. BARNEY A. SCHLINGER, LAINY DAY and LEONIDA FUSANI, *Dept. Phys. Sci., Univ. California-Los Angeles, Los Angeles, CA*.

Males of many lowland tropical bird species perform elaborate courtship displays. Visual and

acoustic signaling involves acrobatic movements and both vocal and non-vocal sound production. We describe the physiology of courtship behavior in the Golden-collared Manakin (*Manacus vitellinus*) of Panama. Males display daily, on forest lek arenas, for 6 or more months. We used high-speed video to analyze the large spectrum of courtship behaviors, including complex dance moves and snapping sounds produced by rapid wing lifts. Blood levels of testosterone (T) in males are generally elevated during this reproductive period, are basal for the remainder of the year and are low in females year round. The data suggest that T activates male courtship. T-treatment of non-reproductive birds activates several courtship behaviors. Surprisingly, T also activates male courtship behaviors in females, suggesting that hormones do not developmentally organize neural circuits underlying male manakin courtship. T likely stimulates courtship by actions on androgen receptors (AR), but estrogens seem also to play a role; two metabolites of T, estradiol and DHT, act together to fully activate courtship. AR are expressed widely in the manakin brain and spinal cord and treatments with the AR-blocker flutamide disturb normal courtship behavior. The caudal telencephalon and cerebellum may be unique sites of T action. Although T activates courtship, there is little correspondence between circulating T levels and the frequency or intensity of courtship activity.

#### **S24 Bostwick**

The evolution of sonation in *Pipra/Machaeropterus* (Pipridae). KIM BOSTWICK, *Mus. Vert., Cornell University, Ithaca, NY.*

The Neotropical Manakins, Pipridae, exhibit many features that make them ideal models for studies of intense intersexual selection. In this talk I first establish the characteristics of the Pipridae that lend themselves to research on sexual selection at a macroevolutionary scale. I then discuss the specific functional morphological system of sonation (non-vocal sound production) in the Pipridae to show how, at the family level, inferences of the evolutionary patterns of skeletal evolution indicate morphological convergence at one level, and diversification at another. I then focus on the clade *Pipra/Machaeropterus* (*sensu* Bostwick 2000, *Auk* 117:465-478; Hackett unpub. data) to examine how transitional evolutionary states in morphology, behavior, and non-vocal signal evolution can be understood using our knowledge of the phylogeny of this clade. I demonstrate that intermediate evolutionary states found in closely related taxa provide the opportunity to model the evolution of extreme novelties.

#### **S25 Anciaes**

Plumage conspicuousness and the evolution of ecological niches among manakins (Pipridae) from the *Ilicura-Corapipo* clade. MARINA ANCIAES, *Bird Collection, Instituto Nacional de Pesquisas da Amazônia (INPA), Brazil.*

Sexual selection by female choice has promoted the evolution of exaggerated male phenotypes in polygynous birds. Several competing hypotheses suggest different roles for how ecological specialization should act on mate choice. Among them, sensory drive exclusively predicts that, if sensory systems are conserved, changes in signals over evolutionary time will be associated with changes in the habitat, leading to the evolution of conspicuous male signals that favor detection by females. In order to test for the role of sensory drive mechanisms in the evolution of visual signals within a clade of manakins, I estimated plumage conspicuousness during male displays in 5 species, and compared the pattern of diversification in plumage characters to the level of ecological differentiation among species, as modeled by the ambient light used during displays and the ecological niches occupied over the species' geographical ranges. Plumage conspicuousness varied among species, whereas plumage differentiation was in general not associated with changes in their sensory environment. Instead, a correlated variation between ambient light and estimates of their ecological niches, at broader geographical scales, suggests that sexual selection has promoted plumage differentiation among species occupying relatively conserved niches. Furthermore, the main change in plumage observed in the clade corresponded to decreased plumage conspicuousness, indicating that sensory drive has not played a major role in the evolution of conspicuous plumages among the studied manakins at the species level.

#### **S26 Doucet & Mistakidis**

Geographic variation and plumage evolution in manakins: the influence of isolation by distance, environmental constraints, and species recognition. STÉPHANIE M. DOUCET and ALLISON

MISTAKIDIS, *Dept. Biol. Sci., Univ. Windsor, Windsor, ON.*

It is now well established that male-male competition and female choice play an important role in driving the evolution of sexual ornaments. However, a number of other factors may also influence the evolution of ornamental traits. In this study, we use geographic variation in the plumage coloration of *Chiroxiphia* manakins to investigate some of these factors. In particular, we test 4 hypotheses which may explain variation in sexual ornamentation in this group: 1) isolation by distance, 2) environmental constraints, 3), adaptation to different signaling environments, and 4) species recognition. We measured the plumage coloration of *Chiroxiphia* manakins throughout each species' distribution, and compared these measurements to patterns of geographic isolation, environmental variation, and sympatry versus allopatry with congeners. Using Mantel tests, we found that pairwise geographic distances were correlated with pairwise Euclidean distances in plumage coloration, supporting the isolation by distance hypothesis. Variation in plumage coloration was also predicted by variation in climatic variables, and we attribute this pattern to both environmental constraints and adaptation to new signaling environments. Finally, in two species pairs with overlapping distributions, plumage coloration diverged more in sympatry than in allopatry, supporting the influence of species recognition. Our findings reveal that, in addition to sexual selection, a complex suite of mechanisms shapes the evolution of signal design in avian plumage ornaments.

### **S27 McDonald**

How the alpha got his spot: social network models in a manakin. DAVID McDONALD, *Dept. Zool. and Prog. Ecol., Univ. Wyoming, Laramie, WY.*

Lek-mating male Long-tailed Manakins (*Chiroxiphia linearis*) form complex social networks culminating in obligate dual-male song and dance courtship displays performed by the top two males (alpha and beta) of overlapping teams of 5 - 15 males. A network metric, information centrality, predicts the probability of a young male's social rise 5 yr later. The spatial arrangement of males is only loosely related to the structure of the social network. Although proximity of males not directly linked in the network is strongly correlated with the distance between the perches at which they were sighted, spatial arrangement of perches is sometimes a poor predictor of overlap of the male teams between perches. That is, more widely separated perches sometimes share a greater proportion of males than do adjacent perches. Subnetworks of males (known as communities) do not separate cleanly along geographic lines. Successful males, of all social statuses except alpha, tend to be affiliated with more perches than do less successful males. In contrast, once a male becomes an alpha, especially if he is highly successful, he is almost never seen anywhere except his "home" perch. Network models provide a powerful method for analyzing the spatial and temporal processes that drive social organization in complex avian societies such as colonial, communal breeding and lek mating systems.

### **S28 Gibson**

Molecular genetic data and leks: questions, mistakes and answers. ROBERT GIBSON. *School Biol. Sci., Univ. Nebraska, Lincoln, NB.*

The assumption that male reproductive success is as skewed as copulation distributions observed at leks underlies several significant questions about lek evolution. These include (i) why females apparently choose males "for genes" (the "lek paradox"), (ii) why low-ranked males participate in leks (the "lek skew paradox"), and (iii) whether lek mating promotes unusually low effective population sizes. Molecular genetic data have the potential via parentage analysis to directly test the assumption of high reproductive skew. They can also be used to evaluate the suggestion that kin selection promotes lek participation by low-ranked males and to estimate effective population size. In this talk I will review critically published studies addressing two of these topics (reproductive skew and male kinship), identifying the questions that need to be addressed, evaluating the appropriateness of analytical methods used, and the degree to which definitive conclusions can be drawn from existing data. I will argue that attempts to estimate reproductive skew require larger-scale population studies than have typically been achieved so far and that, with one notable exception, there is little compelling evidence that kin selection promotes social courtship in natural populations of lekking birds.

### **S29 Ryder, Durães, Tori, Parker, Blake & Loiselle**

Spatial structure and social organization of manakins (Pipridae): potential implications for male reproductive skew. THOMAS B. RYDER, RENATA DURÃES, WENDY P. TORI, PATRICIA G. PARKER, JOHN G. BLAKE and BETTE A. LOISELLE, *Dept. Biol., Univ. Missouri-St. Louis, St. Louis, MO.*

Lekking is a promiscuous mating system in which males congregate in display arenas that females visit to mate. Males do not provide parental care and do not monopolize resources essential to females. Mate choice is believed to be driven by females, which often show marked preferences for certain males. This leads to strong sexual selection and skew in male-mating success. The degree of reproductive skew is hypothesized to vary as a function of social and ecological differences among species. Almost all species of manakins (Pipridae) lek. We compared a set of manakin species co-occurring on a site in the Ecuadorian Amazon which are very similar in some aspects of their ecology (e.g., body size and diet), but differ in spatial structure and social organization of leks. Thus, these species provide an ideal system to test the importance of these factors in influencing reproductive skew. Specifically, we predict that skew increases with female home range size, female crowding, number of males within leks, degree of male-male dominance and relatedness among males, while it is expected to decrease with inter-lek distance and distance among males within leks. In addition, the extent of associations among males within a lek is also expected to influence male reproductive variance, with males that cooperate showing the greatest skew, males that associate lesser skew, and males that do not interact the least skew. Based on these predictions, the species under study were ranked in terms of the expected degree of male reproductive skew. We then used behavioral data on female visitation at leks and molecular paternity analysis to quantify and compare male reproductive success among species and test our predictions.

### **S30 Krakauer**

Genetic similarity and male reproductive success: lessons from an almost-lekking species. ALAN H. KRAKAUER, *Sect. Evol. & Ecol., Univ. California, Davis, CA.*

In lekking species, females are thought to choose their mates in order to obtain genetic benefits for their offspring. A paradox arises if females have a similar directional preference for males of a certain genotype; over generations, genetic variation among males could diminish to the point of making female mate choice irrelevant. One explanation for the continued choosiness of females on leks is that females are somehow assessing the allelic diversity of males in an attempt to increase the heterozygosity of their offspring. I investigated the importance of relative genotypes in the Wild Turkey, a species in which females may be courted by many males simultaneously in a lek-like manner. Genetic similarity between males (relatedness) is critical in structuring the social system and has major consequences for male reproductive success. Here I explore the role of allelic diversity in mate choice in turkeys. Males that fathered offspring were slightly more heterozygous than males not detected in parentage analyses. However, I found little evidence that the mother's genotype affected her choice of mates. Females were not less closely related to the father of their offspring than to other successful males from that year. Thus females may attend to male heterozygosity and not to the dissimilarity of their mate. It is conceivable that heterozygosity could relate to male-male competitive ability as well as attractiveness. The extent to which this is relevant for classically lekking species could depend on the importance of male-male interactions, for example, in claiming prime display sites or disrupting copulations on neighboring territories.

### **S31 Gregory, Nooker, Sandercock & Wisely**

Male Greater Prairie-Chicken mating success is linked to genetic diversity. ANDY GREGORY, JACQUELINE K. NOOKER, BRETT K. SANDERCOCK and SAMANTHA WISELY, *Div. Biol., Kansas State Univ., Manhattan, KS.*

Lek breeding systems typically display high skew in male reproductive success, potentially decreasing genetic diversity which can lead to inbreeding depression. Previous studies have found as few as 20% of Greater Prairie-Chicken (GPC) males receive 80% of the copulations, and centrally located males receive more copulations than peripheral. Additionally, GPC's appear susceptible to inbreeding depression as studies have linked reductions in individual genetic diversity with reduced hatching success. To determine the role of genetic diversity, behavior, and morphology on male reproductive success, we collected individual morphometric, behavioral, and molecular data on male

GPC's over 4 breeding seasons. Observations on male location within lek, number of successful copulations, and behavior were recorded. Morphometric data on wing, tail and pinnae length, as well as total mass, and comb length and width were also recorded. Molecular data on 10 microsatellites were collected to genotype individuals. We observed a total of 125 successful male copulations. On average, males with greater heterozygosity ( $0.82 \pm 0.06$ , vs.  $0.56 \pm 0.003$ ) received more copulations ( $3.1 \pm 0.2$  vs.  $1.0 \pm 0.03$ ), and were closer to the lek center ( $<10$  m vs.  $>20$  m). Additionally spatial autocorrelation with Nei's genetic distance indicated centrally located males being more closely related to each other than to other individuals on the lek ( $r^2 = 0.47$ , 95% CI =  $0.024 - -0.019$ ). Using AIC model selection, the best models relating male reproductive success to behavior and morphology included display characteristics and mass ( $\Delta AIC < 2$ ). Male GPC size and display behavior may be a reflection of high genetic diversity which females use when choosing mates. Our results further indicate spatial genetic structuring within leks such that groups of related males may recruit together. Future work will focus on determining if behavior or mass is correlated with male GPC genetic diversity.

### **S32 Lank**

Polyandry at leks: implications for sexual selection and general functions of multiple paternity. DAVID B. LANK, *Behavioural Ecol. Res. Group, Dept. Biol. Sci., Simon Fraser Univ., Burnaby, BC.*

Studies of mixed paternity rates of females in species in which males form leks have lagged behind the huge literature available for pair bonded species. For comparative purposes, note that "mixed paternity" is more appropriate than "extra-pair paternity", since "pairing" does not occur in lekking species. Theoretical papers published in the mid-1990s expected females visiting leks to be monogamous. The potential conflict between genes from a pair male and "better genes" from other males, which is widely believed to motivate mixed paternity in pair bonded species, was not an obvious motivator for females in lekking species. Given quite free female mate choice, monogamy was predicted to minimize hypothetical costs of multiple mating. As happened with pair bonded species, however, genetic analyses documented higher than expected levels of mixed paternity. Many females of lekking species seek appropriate males, rather than "the best male", as potential fathers for their offspring, likely adding a diversifying element to sexual selection. Possible explanations include: currently unrecognized female mating constraints; that females create the possibility of cryptic choice at the sperm stage; and that increased genetic diversity of offspring per se, which is always a consequence of multiple mating, is in fact its primary function. Most generally, however, since seeking "better genes" than those of your social partner is excluded as an explanation, multiple paternity in lekking species challenges the generality of doing so as a primary function of mating with multiple males.

### **S33 DuVal & Kempnaeres**

Genetic analysis of reproductive skew on an exploded lek: sexual selection via male competition vs. female mate choice. EMILY H. DUVAL and BART KEMPNAERS, *Dept. Behav. Ecol. & Evol. Genetics, Max Planck Institute for Ornithology, Seewiesen, Germany.*

Sexual selection comprises intrasexual competition for breeding opportunities and intersexual mate choice, but the relative strength of these selective forces is difficult to quantify. Sexual selection due to female mate choice is thought to be particularly intense in lek mating systems: female preference for certain males in the absence of any pair bond results in high reproductive skew. As noted previously in this symposium, genetic data are necessary to confirm the assumption of high skew. The scope of intrasexual selection on leks is perhaps even more difficult to quantify without genetic paternity testing, as not all males hold display territories and some may adopt cryptic reproductive strategies off the lek. We examined the relative strength of inter- and intrasexual selection using genetic measures of reproductive success of males on an exploded lek of Lance-tailed Manakins (*Chiroxiphia lanceolata*). In this cooperatively-displaying species, male-male competition occurs primarily in the form of competition for alpha status, while females choose mates from among dispersed alpha males. Using 20 microsatellite loci, we assigned paternity to 93.4% of 442 chicks sampled in seven consecutive years. Reproductive success was significantly skewed among males within individual breeding seasons (Nonacs' B Index). Opportunity for selection was high among status classes of males, but relatively low among alpha males, suggesting that selection from intrasexual competition for status exceeds that from female mate choice in this species. Lance-tailed Manakins are long-lived, so the influence of

reproductive skew on individual behavior is most appropriately assessed across many years. Tenure as an alpha male was correlated strongly with cumulative reproductive success, but skew remained significant when male tenure was taken into account, suggesting that length of alpha status alone is insufficient to explain differences in reproductive success among alpha males.

## Part 2: General Papers

### 1 Shutler, Alisauskas & McLaughlin

Nutrient reserves and helminths of Lesser Snow Geese. DAVE SHUTLER, *Dept. Biol., Acadia Univ., Wolfville, NS*, RAY T. ALISAUSKAS, *Canadian Wildl. Ser. and Dept. Biol., Univ. Saskatchewan, Saskatoon, SK*, and J. DAN McLAUGHLIN, *Concordia Univ., Montreal, QC*.

Costs of parasitism are predicted to be higher with higher parasite loads, and with more virulent parasites. Greater virulence may be favored at higher host densities and with greater inter-parasite competition (diversity). We tested whether higher helminths loads were associated with reduced nutrient levels (indexed by lipids, protein, minerals, and true body mass) of host Lesser Snow Geese, *Chen caerulescens caerulescens*. As part of a larger study on nutritional ecology, 771 wintering or migrating geese were shot between Jan and May 1983 in 27 different date-locations (hereafter, samples) in a south-north gradient from mid-continental North America. Nutrient levels and parasite communities varied substantially among samples, so we analyzed data within each sample, controlling for structural body size (first principal component of 10 body size measurements), sex, and age. There was no compelling evidence that trematodes, cestodes, or helminth diversity were associated with significant variation in nutrient levels, but nematodes appeared to negatively affect fat loads. However, associations between fat reserves occurred most often in geese collected between Mar and May when nematode prevalence and intensity were lower. This suggests that the most common nematodes (*Heterakis dispar* and *Trichostrongylus tenuis*) were more virulent later in the year, that infected individuals had been chronically infected and suffered cumulative nutrient losses, or that geese became more vulnerable to effects of parasites later in the year, possibly because they redirected resources away from immunity in anticipation of reproduction.

### 2 van Riper, Super, O'Brien, Ballard & Geupel

Long-term impacts of blood parasites on productivity of birds within a California coastal scrub community. CHARLES VAN RIPER III, *USGS/SBSC, Biol. Sci. East, Univ. Arizona, Tucson, AZ*, PAUL SUPER, *AHSLC, Great Smoky Mt. Natl. Park, Lake Junaluska, NC*, CHRIS O'BRIEN, *USGS/SBSC, Biol. Sci. East, Univ. Arizona*, GRANT BALLARD and GEOFF GEUPEL, *Point Reyes Bird Observ., Stinson Beach, CA*.

In western North America, patterns of blood parasite infections in birds evolved within a landscape of heterogeneous and patchy environments. We asked the question: "What long-term impact do blood parasites have on bird populations in a California coastal scrub ecosystem?" We sampled a color-marked population of passerine birds at Point Reyes, CA, for hematozoa infections during the years 1984 - 1990, and then followed the productivity of known individuals over a 15-yr period. *Haemoproteus* and *Leucocytozoon* were the most commonly encountered infections and *Haemoproteus* transmission varied the most among all parasite groups for all years. We then compared productivity and calculated fitness between infected and non-infected individuals of each avian host species over the next 15 yr period (1990 - 2005). *Leucocytozoon* negatively impacts productivity, while infection with *Haemoproteus* did not show any long-term effect. Birds that were NOT infected with *Leucocytozoon* fledged a greater number of young, produced more eggs, hatched more young, and acquired more mates, but these same birds did not show a significant increase in number of nests or number of young recruited into the local population, when compared to infected individuals. A comparison of hematozoa epizootiology among parasite species revealed, that because of appropriate vectors, a significantly lower prevalence of certain blood parasite groups occurred within the California coastal scrub ecosystem.

### **3 vacant**

### **4 Huber**

Effects of the introduced parasite *Philornis downsi* on nestling growth and mortality in Darwin's finches. SARAH K. HUBER, *Organ. & Evol. Biol., Univ. Massachusetts, Amherst, MA.*

Invasive species have the potential to detrimentally affect native ecosystems by out competing or directly preying upon native organisms, and have been implicated in the extinction of endemic populations. One potentially devastating introduced species in the Galápagos Islands is the parasitic fly *Philornis downsi*. As larvae, *P. downsi* parasitize nestling birds and have been associated with high nestling mortality and reduced growth rates. Here I document nestling growth and mortality in a population of the medium ground finch, *Geospiza fortis*. Observations were conducted over 3 yr, and under variable ecological conditions. Parasite prevalence in nests ranged from 64% to 98%, and annual nestling mortality in nests with parasites ranged from 16% and 35%. Mortality in parasitized nests was higher under dry conditions (46% - 86%) than under wet conditions (28%). Nestling size and growth rates did not differ between parasitized and unparasitized nests. These findings are discussed in the context of ecology and host defenses.

### **5 Owen, Williams, Moore & Garvin**

Effects of migratory stress and testosterone on the recrudescence of latent West Nile virus infections in the Gray Catbird. JENNIFER C. OWEN, AMANDA J. WILLIAMS, FRANK R. MOORE, *Dept. Biol. Sci., Univ. S. Mississippi, Hattiesburg, MS,* and MARY C. GARVIN, *Dept. Biol., Oberlin Coll., Oberlin, OH.*

West Nile virus (WNV, Flaviviridae, Flavivirus) is a pathogen of health concern to human and wildlife populations. While many aspects of the ecology of WNV are well understood, the mechanism by which its annual cycle is reinitiated each spring in temperate regions is not known. One hypothesis explaining how WNV and related viruses overwinter, is spring recrudescence of latent virus in avian reservoir hosts. Field studies can only provide circumstantial evidence for such a mechanism; therefore, controlled experiments must be conducted to demonstrate that recrudescence occurs and to identify the physiological changes that induce it. We conducted controlled laboratory experiments to examine the effects of immunosuppression through exogenous hormones and artificially induced migratory disposition on cryptic WNV infections in captive Gray Catbirds. Hatching year catbirds ( $n = 60$ ) were inoculated with WNV in Sep 2006 and then held until Jan 2007, when birds were either induced to migrate via extended photoperiod and/or implanted with testosterone, or neither (non-migratory and placebos). Birds were then bled every 2 d during experimental period and tested for WNV infection via reverse transcription polymerase chain reaction (RT-PCR). We detected no active infections in any of the experimental groups. Our results suggest that the reinitiation of annual WNV transmission cycle is not due to the reactivation of chronic WNV infections in Gray Catbirds from elevated testosterone or migration.

### **6 Nemeth, Komar & Bowen**

Avian immunity to West Nile virus. NICOLE M. NEMETH, *Dept. Microbiol., Immun. & Path., Colorado State Univ., Ft. Collins, CO,* NICK KOMAR, *Centers for Disease Control & Prevention, Ft. Collins, CO,* and RICHARD A. BOWEN, *Dept. Biomed. Sci., Colorado State Univ.*

Our objectives include characterizing the duration of protective immunity to West Nile virus (WNV) in adult birds, as well as passively acquired WNV immunity in chicks. Controlled studies are in progress to characterize duration of humoral immunity to WNV in House Sparrows in which WNV-immune sparrows are monitored at 6-mon intervals for 3 yr, and birds are challenged at intervals to determine immune protection against WNV infection. Similarly, we are monitoring antibody levels of naturally-infected raptors for 4 yr. In addition, chicks from WNV seropositive chicken hens were tested for the presence of maternally-derived WNV antibodies, while documenting decay and protection provided by maternal antibodies and age-associated differences in WNV infection. Thus far, neutralizing antibody titers have persisted  $\geq 24$  mon post-inoculation in sparrows and  $\geq 44$  months in raptors, remaining protective against morbidity, mortality, and viremia. All chicks from seropositive chicken hens were WNV-maternal antibody positive and maternal antibodies were no longer detectable by 4 - 5 wk post-hatch, but remained protective against viremia until 6 weeks post-hatch. There was significantly higher viremia levels and morbidity in young, unprotected chicks vs. older chicks. These results have

implications for WNV transmission and survivability of birds re-exposed to WNV and chicks born of seropositive mothers, and should be considered in the interpretation of WNV serosurveys of free-ranging birds.

## **7 Hahn**

A model species for studying the evolution of immunity. CALDWELL HAHN, *USGS-Patuxent Wildl. Res. Center, Laurel, MD.*

We hypothesized that the Brown-headed Cowbird is a model species for testing the effect of increased exposure to parasites on the immune system. This cowbird is exposed to an unusually large number of parasite species due to the high diversity of habitats it exploits and the large number of species in whose nests it lays its eggs. We demonstrated that cowbirds are exposed to more parasites than non-parasitic songbirds by quantifying the diversity of louse species found on cowbirds and comparing it to the diversity of lice on non-parasitic birds. Cowbirds were infected by a greater diversity of lice. We also demonstrated that the cowbird showed greater disease resistance to West Nile virus and 2 other mosquito-borne viruses that cause significant disease and mortality in birds, Western equine encephalomyelitis virus and St. Louis encephalitis virus. We experimentally infected cowbirds and 3 related, non-parasitic species in the same family (Icteridae), and we compared their immune responses. The cowbirds were significantly more disease resistant to all 3 viruses than their non-parasitic relatives. We discuss life history trade-offs associated with increased investment in immune defenses and the value of the cowbirds as a model to explore the evolution of disease resistance.

## **8 Oesterle, Hall, Mooers, Carlson, McLean & Clark**

Cliff Swallows and swallow bugs: do they play a role in West Nile virus transmission? PAUL T. OESTERLE, JEFFREY S. HALL, NICOLE MOOERS, JAMES CARLSON, ROBERT G. McLEAN and LARRY CLARK, *Natl. Wildl. Res. Center, Ft. Collins, CO.*

Cliff Swallows often nest within mosquito habitat, leading to potentially high rates of exposure to West Nile virus (WNV) via infected mosquitoes. As insectivores, Cliff Swallows are also potentially exposed to WNV via the oral route. In addition, mud nests of Cliff Swallows are co-inhabited by a hematophagous parasite, the swallow bug (*Oeciacus vicarius*). These bugs have been shown to transmit WNV experimentally, and are the primary vector of Buggy Creek virus. Cliff Swallows are not known to be adversely affected by WNV, but develop viremia levels sufficient to infect mosquitoes. To investigate the role of swallows and their parasites in WNV transmission, we sampled swallow nestlings and swallow bugs from 2003 - 2006. Nestling samples are tested for the presence of WNV RNA and antibodies, while swallow bugs are tested for WNV RNA. In 2003, 22.4% (30/137) of nestlings tested positive for WNV RNA, and prevalence in swallow bugs was 1.85% (13/704) in individual bugs, but 18.9% (7/37) of the nests tested had WNV positive bugs. Since then, WNV transmission in n. Colorado has been low, and Cliff Swallow and swallow bug data have reflected these low levels. Based on these results, additional studies are planned to more closely evaluate swallow bugs as potential vectors of WNV.

## **9 Smith & Callo**

Avian malaria: testing the nest height hypothesis. CALISSA N. W. SMITH and PAUL A. CALLO, *Dept. Biol., Mary Baldwin Coll., Staunton, VA.*

We examined the prevalence of avian malaria (*Haemoproteus* and *Plasmodium*) in 2 species of neotropical migrants using PCR detection methods to examine the influence of nest height on the host-parasite relationship. By choosing 2 resident sympatric species at the Hemlock Hill Biological Research Area in nw. Pennsylvania, we were able to control for both geographic and temporal variation. The prevalence of avian malaria was not significantly different between Red-eyed Vireos (68%) and Hooded Warblers (76%). This is not supportive of the nest height hypothesis. The results also suggest that the genus of parasite infecting each bird species is different which leads to the conclusion that their infection rates should be entirely independent of one another.

## **10 Shawkey, Wang, Beissinger, Kosciuch, Liu, Loos & Rohwer**

Differential deposition of anti-microbial proteins in eggs: an unstudied maternal effect? MATTHEW D. SHAWKEY, JENNIFER M. WANG, STEVEN R. BEISSINGER, *Dept. Environ. Sci. Policy & Manage., Univ. California- Berkeley, Berkeley, CA*, KARL L. KOSCIUCH, *Dept. Biol., Kansas State Univ., Manhattan KS*, MARK LIU, *Dept. Biol. Sci., Auburn Univ. Auburn, AL*, ELIZABETH R. LOOS, *Delta Waterfowl Assoc. Portage la Prairie. MB*, and FRANK C. ROHWER, *School Renewable Nat. Res., Louisiana State Univ., Baton Rouge, LA*.

Albumen of bird eggs contains numerous antimicrobial compounds to protect embryos from microbial infection, and the activity of these compounds increases at incubation temperatures. Thus, eggs that sit unincubated in the nest are vulnerable to infection, and eggs laid early in sequence are more vulnerable than those laid later. To compensate for this vulnerability, birds might deposit more antimicrobial compounds in early-laid eggs. We measured concentrations of 3 antimicrobial proteins (ovotransferrin, lysozyme and avidin) in clutches of eggs from 9 bird species (Red-winged Blackbirds, Brown-headed Cowbirds, Green-rumped Parrotlets, Pearl-eyed Thrashers, Western Bluebirds, Tree Swallows, Violet-green Swallows, Eastern Bluebirds, and Blue-winged Teal. Thrashers deposited higher levels of ovotransferrin to earlier-laid eggs, while Violet-green Swallows deposited higher levels of avidin to later-laid eggs. Differential allocation of antimicrobials does not appear to be a widespread maternal effect in birds, perhaps because they are not physiologically costly to produce or birds can behaviorally regulate their activity through partial incubation.

## **11 Sauer, Link & Niven**

Monitoring change in biodiversity by hierarchical modeling of a collection of species. JOHN R. SAUER, WILLIAM A. LINK, *USGS Patuxent Wildl. Res. Center, Laurel, MD*, and DANIEL K. NIVEN, *Natl. Audubon Soc., Champaign, IL*.

Summary analysis of population change from a collection of indicator species has been proposed as a measure of biodiversity change in birds. These composite indices are generally constructed as means of scaled time series of estimated change of individual species, and presented a time series of composite change from a base year. We propose a hierarchical model approach for constructing composite population indices for collections of time series of population change, and apply the approach to a group of 27 grassland breeding bird species in North America using North American Breeding Bird Survey data. Collectively, the species are declining, although patterns of population change vary over time and species. The hierarchical model accommodates differences in precision of the estimated change of the component species in estimation of mean change, and permits evaluation of extreme species in the collection in the context of the group.

## **12 Siegfried & Schnell**

Predicting occurrences of individual bird species and species richness using logistic regression and GARP: a comparative analysis. DENNIS G. SIEGFRIED and GARY D. SCHNELL, *Sam Noble Oklahoma Mus. Nat. Hist. & Dept. Zool., Univ. Oklahoma, Norman, OK*.

Species-distribution models have been employed with increased frequency to predict species occurrences (both presences and absences) and sometimes species richness. We evaluated the efficiency of logistic regression and 2 forms of GARP (genetic algorithm rule-set procedure) in predicting occurrences for 209 species included in the Oklahoma Breeding Bird Atlas using 34 environmental variables. GARP(50:50) used a 0.5 cutoff similar to logistic regression and GARP(Best subset) the summed best subset to develop distribution models for each species, an approach employed by a number of previous investigators. In part, the use of GARP on actual occurrence data was to evaluate how well the procedure predicted actual current distributions. Considering all individual species occurrences, logistic regression correctly predicted correctly 89.4% of the time, GARP(50:50) 76.6%, and GARP(Best subset) 70.3%. For occurrences, logistic regression was the best predictor, irrespective of the extent of the distribution. GARP(Best subset), which consistently overpredicted presences, not surprisingly was the best predictor of presences for all but widespread species, for which it was not significantly different from logistic regression. GARP(50:50) was intermediate in predictive ability, better predicting presences than logistic regression and absences than GARP(Best subset). Summing results

for individual species, logistic regression slightly overpredicted species richness for blocks with relatively low species richness and underpredicted it for sites with relatively high species richness, such that the average was close to the actual average species richness. GARP, for both implementations, routinely overpredicted species richness, with GARP(Best subset) on average predicting over twice the actual number of species. Summing results for logistic regression for a given site provided a good estimate of species richness, although results of this technique were not particularly informative when evaluating relative species richness across localities. GARP substantially overestimated species richness for any given site and did not produce reliable estimates of relative species richness across sites. GARP as typically implemented considerably overpredicted actual species distributions.

### **13 Pérot, Villard & Haché**

Density as an indicator of habitat quality: time for a rehabilitation? AURORE PÉROT, MARC-ANDRÉ VILLARD and SAMUEL HACHÉ, *Chaire de recherche du Canada en conservation des paysages, Dept. Biol., Univ. Moncton, Moncton, NB.*

This study aimed to reassess the value of density as an indicator of habitat quality. We measured Ovenbird density and productivity in a managed forest landscape of nw. New Brunswick. Habitat quality was estimated as a function of the number of fledglings produced per unit area. From 1997 to 2006, we sampled 23 plots of 25 ha each, which were located in mature northern hardwood stands. 16 plots showed no sign of recent management whereas 7 plots had been treated 1 to 7 yr prior to the study (selection harvesting, patch or strip cutting). According to the Akaike Information Criterion approach, density was a better predictor of productivity per unit area than either of the landscape variables considered. Density and productivity both were significantly higher in untreated than in treated plots. We submit that density should be reconsidered as an indicator of habitat quality or, at least, that it should be used in combination with measures of reproductive output per unit area when assessing habitat quality. Interestingly, we found no sign of decoupling between density and productivity for recently -- treated plots, suggesting that density is a robust indicator of habitat quality in this system. However, similar analyses should be conducted on other species and systems to assess the generality of our findings.

### **14 Chalfoun & Martin**

Assessments of habitat preferences and quality depend on spatial scale and metrics of fitness. ANNA D. CHALFOUN and THOMAS E. MARTIN, *USGS Coop. Wildl. Res. Unit, Univ. Montana, Missoula, MT.*

Ecological theory predicts that habitat choices should be adaptive, such that fitness is enhanced in preferred habitats. However, studies often report mismatches between habitat preferences and fitness consequences based on a single spatial scale and/or a single fitness component. We examined whether habitat preferences of a declining shrubsteppe songbird, the Brewer's Sparrow, were adaptive when multiple reproductive fitness components and spatial scales (landscape, territory, nest patch) were considered. We found that birds settled earlier and in higher densities in landscapes with greater shrub cover and height. Yet, nest success was not higher in these landscapes. Thus, landscape preferences did not match nest predation risk. Instead, nestling mass and the number of nesting attempts per pair increased in preferred landscapes, raising the possibility that landscapes were chosen on the basis of food availability rather than safe nest sites. At smaller spatial scales (territory and nest patch), birds preferred different habitat features (i.e., density of potential nest shrubs) that reduced nest predation risk and allowed greater season-long reproductive success. Habitat preferences therefore reflect the integration of multiple environmental factors across several spatial scales, and individuals may have more than one option for optimizing fitness via habitat selection strategies. Assessments of habitat quality for management prescriptions should ideally include analysis of diverse fitness consequences across multiple, ecologically-relevant spatial scales.

### **15 Dauphine, White, Mohamed & Zalaf**

Conservation status of breeding birds in the St. Katherine Protectorate, Egypt: evidence of extirpations and population declines from recent surveys. NICO DAUPHINE, *School For. & Nat. Res., Univ. Georgia, Athens, GA*, MATTHEW L. J. WHITE, *Univ. Plymouth, UK*, ALAA E. I. MOHAMED, *S. Sinai Govt., Egypt*, and SAMY ZALAF, *Suez Canal Univ., Egypt.*

From Jun to Aug 2006, we conducted bird surveys in and around the St. Katherine Protectorate Important Bird Area (IBA) in s. Sinai, Egypt. We recorded 32 species during transect counts, of which 10 were autumn passage migrants. We detected only 22 of the 50 breeding bird species that were recorded in the area 30 yr ago; of these, 8 species were represented by only one to 3 sightings and are thus recognized as very rare or possibly accidental. We detected only 3 of the 15 birds of prey previously recognized as breeding in the Protectorate; all were very rare, and only one species (Egyptian Vulture) showed evidence of breeding. Recent extirpations and population declines of birds in the St. Katherine Protectorate coincide with significant recent increases in numbers of human residents and tourists and associated direct and indirect pressures on wildlife, including illegal hunting and habitat loss. We discuss strategies to improve prospects for area conservation.

## **16 Swift & Hannon**

Testing for threshold responses to forest cover in abundance of resident breeding birds. TRISHA L. SWIFT and SUSAN J. HANNON, *Dept. Biol. Sci., Univ. Alberta, Edmonton, AB.*

Habitat loss and fragmentation affect species persistence on landscapes. One major research concern is whether species' abundance declines linearly with habitat loss, or whether it declines more rapidly below a critical threshold of habitat amount. Strong, negative fragmentation effects are hypothesized to occur once the amount of habitat in the landscape falls below a critical level. If so, populations should initially decline in proportion to habitat loss, but decline more steeply below this threshold ("fragmentation threshold hypothesis"). We investigated this using 6 forest bird species in a forest / agricultural region of Alberta. We sampled 50 (800 x 800 m) sites ranging in forest amount (2.5 - 62%) and spatial configuration in the surrounding landscape. We fit 5 regression models for each species' abundance against forest cover: null, linear, degree-1 and degree-2 fractional polynomials, and piecewise regression. AICc weights and BIC posterior probabilities were calculated to choose the "best" model. Hairy Woodpecker, Yellow-bellied Sapsucker, White-breasted Nuthatch and Blue Jay declined linearly with decreasing forest cover. Black-capped Chickadees peaked near 34% forest, declining rapidly above and below 34%. Downy Woodpecker declines were initially shallow, but became rapid below 10 - 20% forest. Both species' nonlinear relationships were inconsistent with the fragmentation threshold hypothesis, and probably reflect positive fragmentation effects on their density in forest. Thus, thresholds were rare, and for most species fragmentation did not have large negative effects on abundance at low forest cover. Managers should focus more on retaining higher levels of forest cover than on the spatial configuration of the remaining forest.

## **17 Hochachka, Caruana, Fink, Kelling, Munson, Riedewald, Shaby & Sorokina**

Identifying spatial scales at which remotely-sensed habitat information predicts bird prevalence. WESLEY M. HOCHACHKA, *Lab. Ornithol., Cornell Univ., Ithaca, NY*, RICH CARUANA, *Dept. Computer Sci., Cornell Univ.*, DANIEL FINK, *Lab. Ornithol.*, DAVID HANNI, *Rocky Mtn. Bird Observ., Brighton, CO*, STEVE KELLING, *Lab. Ornithol.*, ART MUNSON, MIREK RIEDEWALD, *Dept. Computer Sci., Cornell Univ.*, BEN A SHABY, *Dept. Statistics, Cornell Univ.*, and DARIA SOROKINA, *Dept. Computer Sci., Cornell Univ.*

Predicting birds' distributions over large regions likely requires use of habitat information obtained from remote sensing. However, the spatial scale at which birds perceive and respond to variation in habitat structure is not the same as the spatial resolution of the available data, and different species of birds may respond perceive habitat suitability at different spatial scales. As a result, building models that accurately predict birds' distributions requires appropriate aggregation of fine-resolution spatial descriptions of habitat structure. We use standardized point-count data from across Colorado in order to identify the spatial extents over which remotely-sensed (30 by 30 m resolution National Land Cover Data) habitat classification information needs to be aggregated in order to produce the most accurate predictions of bird distributions. Data-mining analyses were used to identify the relevant spatial scales of habitat description for all available species in our data, allowing identification of general patterns across avian taxa.

## **18 Wilson & Martin**

Habitat selection, nest survival and impacts of climate warming for sympatric ptarmigan in the Yukon Territory. S. WILSON and K. MARTIN, *Centre Appl. Conserv. Res., Univ. British Columbia, Vancouver, BC.*

Climate warming will likely impact arctic wildlife through changing weather patterns, declines in certain tundra habitats, and altered trophic interactions. To predict such effects, an understanding of the habitat requirements and the key factors influencing reproductive success is needed for species in these areas. Over a 3-yr study (2004 - 2006), we examined breeding habitat segregation and nest survival of Rock, White-tailed and Willow Ptarmigan at a 9 km<sup>2</sup> alpine study site in the southwest Yukon. Logistic regression analyses indicated that elevation, slope and graminoid cover were the main variables separating breeding habitat for White-tailed and Rock Ptarmigan. White-tailed Ptarmigan nested in steeper, high alpine habitats dominated by rock and dwarf shrubs, while Rock Ptarmigan nested in low alpine meadows with more abundant graminoids and woody shrubs. The 2 species overlapped in regions where these habitat features were adjacent. Willow Ptarmigan bred in dense shrubby habitats in the upper subalpine zone and there was less overlap with the other 2 species. With further climate warming, shrub lines are expected to advance upslope, possibly increasing Willow Ptarmigan habitat in current alpine areas and reducing the alpine zone, which may increase competition between Rock and White-tailed Ptarmigan. Using program MARK, we found that daily nest survival tended to be slightly higher for White-tailed ( $0.966 \pm 0.007$ ) than Rock Ptarmigan ( $0.959 \pm 0.006$ ). Daily nest survival was higher at warmer temperatures but showed little variation by year, nest age or time of season. Nest survival also varied little across elevation or slope but tended to be higher in more rocky habitats, perhaps because these habitats are more difficult for mammalian predators to access. For all 3 species, predation was the dominant cause of failure, but predators and weather may interact to influence nest success.

#### **19 Koopman, Joyce & Flather**

A review of management recommendations for bird populations in the face of climate change. MARNI E. KOOPMAN, LINDA A. JOYCE and CURTIS H. FLATHER, *Rocky Mountain Res. Sta., USDA For. Ser., Ft. Collins, CO.*

Bird populations are facing complex and interactive stressors that collectively challenge land managers. The most challenging potential stressor may be climate change because its trajectory and impacts are so uncertain. Researchers have only recently responded with a large body of knowledge about past and potential impacts of climate change on birds and other wildlife. Unfortunately, their findings are rarely translated into language that can guide land managers. Of 48 recently published papers focused on the impacts of climate change on birds, only 18 (38%) provided management recommendations based on the trends observed in their data. Nine (19%) recommended "more research" while 21 (44%) provided no guidance. The most common management recommendations in the literature included restoration of habitat (including invasive species control), adaptive management and flexibility, protection of habitat through conservation easements and land acquisition, and effecting policy. One approach that gained the most momentum in the literature was to relieve wildlife of other stressors (land use conflicts, invasive species, disease, habitat fragmentation) in order to allow greater resilience in the face of climate change. We suggest to researchers that providing suggestions for further research is helpful for other researchers, but not for managers that need immediate guidance for preserving species threatened by a very uncertain future.

#### **20 Rappole, Blacklock & Renner**

Rapid range shift in Texas birds: response to climate change? JOHN H. RAPPOLE, *Smithsonian Natl. Zool. Park, Front Royal, VA*, GENE W. BLACKLOCK, *Coastal Bend Bays & Estuaries Program, Corpus Christi, TX*, and SWEN C. RENNER, *Smithsonian Natl. Zool. Park.*

At least 70 species of birds native to tropical, subtropical, or warm desert habitats have shown evidence of northward or eastward extension of their breeding distribution into or within Texas, ranging from a few to several hundred km over a relatively brief time period (decades). Documentation of these changes in distribution for most species is based largely on sightings rather than specimens of nests, eggs, or young. Nevertheless, the changes are in line with regional climatic warming and drying, reported by climatologists, which is predicted to have an ecological effect over the next century similar to

moving the region >160 km to the southwest. If these range shifts are occurring in birds, then they are likely to be occurring in other taxa as well. One likely result of these shifts is the breakdown of boundaries between biotic provinces, in particular, that between the Tamaulipan and Austroriparian where the border between the subtropical and temperate zones occurs. The ecological and conservation effects of such a breakdown is likely to be profound.

## 21 Richman & Loworn

Cost of diving for seaducks using wing and foot propulsion. SAMANTHA E. RICHMAN and JAMES R. LOVVORN, *Dept. Zool., Univ. Wyoming, Laramie, WY.*

Most birds swim underwater by either feet alone (most diving ducks, loons and cormorants) or wings alone (alcids and penguins). However, unlike other diving ducks which use drag-based foot propulsion, some seaducks have adopted simultaneous wing and foot propulsion as their major locomotor mode for deep diving. With respirometry, we measured the costs of surface activities (swimming and preening), and costs of diving by different swimming modes (feet only vs. feet and wings used together) in the same seaduck species, White-winged Scoters. Dive costs repaid during the recovery period after a dive bout were an important fraction of total dive costs, and removing costs of extraneous surface behaviors increased resolution of differences between dive types. Scoters using wings + feet had 13% shorter descent duration, 18% faster descent speed, 31% fewer strokes/m, and 59% longer bottom duration than with feet only. Cost underwater for dives using wings + feet was 20 to 23% lower than with feet only. When indirect methods were used to partition descent costs from costs of ascent and bottom phases, using wings + feet lowered descent cost by an estimated 58%. For birds in cold water, the large energy savings from using wing propulsion may result from both biomechanical and thermoregulatory factors. Thus, using wings + feet increases descent speed and lowers descent cost, leaving more time and energy for foraging at the bottom.

## 22 Bowlin

Phylogenetically independent contrasts show migrants have more pointed and less convex wingtips in the avian genus *Catharus*. M. S. BOWLIN, *Dept. Ecol. & Evol. Biol., Princeton, Univ., Princeton, NJ.*

It has long been argued that migratory birds have more pointed wingtips than non-migrants, and similarly, that long-distance migrants have more pointed wings than short-distance migrants. Most of the interspecific studies on this topic, however, have failed to correct for the phylogenetic non-independence of species, and intraspecific evidence for the pattern has been equivocal. Therefore, I examined the relationship between wingtip shape and migratory behavior with phylogenetically independent contrasts in the 12-species genus *Catharus*, a clade of New World thrushes that includes short-distance, long-distance, and non-migrants. In *Catharus* thrushes, species' wingtip pointedness (C2) was correlated with migratory behavior coded both categorically ( $p = 0.004$ ) and continuously, in terms of degrees latitude migrated ( $p < 0.001$ ), as was wingtip convexity (C3, categorically:  $p = 0.003$ , degrees latitude migrated:  $p = 0.006$ ). Migrants had more pointed and less convex wingtips than non-migrants. The latter result was unexpected as aerodynamic theory suggests that convex wingtips would allow birds to generate more thrust during migratory flight than concave wingtips; I will discuss several possible explanations for this discrepancy. Regardless, my data support the idea that migratory behavior places strong selective pressures on avian wingtip shape.

## 23 Hartman

Re-evaluating the habitat and flight ability of *Archaeopteryx*: information from the Thermopolis specimen. S. A. HARTMAN, *Thermopolis, WY.*

Information from the tenth specimen of *Archaeopteryx* has already shown that palatal, tarsal, and pedal morphology in *Archaeopteryx* is less derived than previously suspected. Analysis of wing impressions demonstrates that *Archaeopteryx* lacked tertial remiges, a fact confirmed by reanalysis of other specimens. Combined with recent data about ligament-based shoulder stabilization, and the absence of an ossified sternum, serious questions are raised about previous estimates of the flight ability of *Archaeopteryx*. Close examination of the pes confirms that *Archaeopteryx* did not have a retroverted

hallux, as in modern perching birds. Pelvic anatomy exhibits a strong supra-acetabular crest, confirming that *Archaeopteryx* had the normal theropod limb stance that prevents lateral extension of the femora. These data suggest *Archaeopteryx* was not as well adapted to an arboreal lifestyle as extant Passeriformes. This is consistent with the lack of an alula, and phylogenetic studies of both non-avian theropods, and analyses of bird phylogeny itself.

#### **24 Debruyne & Briskie**

A comparison of body morphology between introduced birds in New Zealand and their source populations in the United Kingdom. CHRISTINE A. DEBRUYNE and JAMES V. BRISKIE, *Dept. Biol., Univ. Canterbury, Christchurch, New Zealand.*

Over 30 avian species were introduced into New Zealand in the 19th Century by acclimatization societies. Most species were introduced from the UK, and the numbers released varied from as few as a dozen up to approximately 1000 individuals. Populations starting with such small numbers of founders (termed a population bottleneck) can reduce genetic variability by lowering heterozygosity and increasing expression of deleterious genes. As source (and presumably non-bottlenecked) populations of species introduced to New Zealand are still extant in the UK, comparisons can be made between pre- and post-bottlenecked populations. The objective of my study is to compare body size of introduced species in New Zealand to their UK source populations using various morphological traits (e.g., body mass, bill, tarsus, wing, and feather lengths) and to determine whether any changes are related to bottleneck size. My analysis revealed that some species displayed changes in body morphology. For example, male Blackbirds were heavier in the UK than in New Zealand, while the bills of Dunnocks were longer in New Zealand than the UK. However, there was no relationship between bottleneck size and any differences between New Zealand and UK populations among the traits examined. My results suggest that morphological changes have occurred among a number of introduced species in New Zealand but the reasons for these changes are not clear.

#### **25 Herring, Cook, Call & Kobza**

Food limitation and White Ibis reproductive success. HEIDI K. HERRING, MARK I. COOK, S. Florida Water Manage. Dist., West Palm Beach, FL, ERYNN C. CALL, Michigan Dept. Nat. Res., Sault Sainte Marie, MI, and R. MAC KOBZA, S. Florida Water Manage. Dist.

Wading birds attempt to maximize reproductive output by timing their breeding cycle to coincide with optimal hydrologic conditions for foraging. In the Florida Everglades, the decline of wading bird populations is believed to be related to a reduction in prey availability brought about by anthropogenic alterations to hydrologic patterns. We used a supplementary feeding experiment to investigate the existence of a causal relationship between hydrologic conditions, i.e., availability of prey, and the reproductive success of the White Ibis. Ibis chicks given supplementary fish exhibited greater growth rates and survival than controls during a breeding season when hydrologic conditions were considered poor for foraging (severe drought and periodic rain events), but there were no differences in growth and survival between groups in a year when hydrologic conditions were considered optimal for foraging. These results are consistent with the idea that prey availability is a primary factor limiting white ibis reproductive success in the Everglades system and that prey availability is strongly influenced by hydrologic conditions.

#### **26 Barton & Martin**

Is interspecific variation in provisioning strategies explained by food limitation, adult mortality, or nest predation? DANIEL C. BARTON, *Organ. Biol. & Ecol. Prog., Univ. Montana, Missoula, MT*, and THOMAS E. MARTIN, *Montana Coop. Wildl. Res. Unit., Univ. Montana, Missoula, MT.*

Determining the factors responsible for variation in life history strategies along a slow-fast gradient is central to evolutionary biology. Provisioning behavior is a key part of life histories because it presents both costs to parents and benefits to offspring, and might increase predation risk to offspring. We tested whether food limitation, adult mortality, and nest predation explain variation in provisioning behavior among 24 songbird species from Arizona, Argentina, South Africa, and Venezuela that span a

large portion of the slow-fast gradient. We tested how provisioning strategies vary among species relative to brood size. In particular, we examined inter-specific variation in the within-species relationship between per-nestling feeding rates and brood size. We extended Nur's model of the costs and benefits of provisioning strategies to an among-species context by assuming species with low adult mortality have greater residual reproductive value than species with high adult mortality. This model predicts a steeper decline in per-nestling feeding rates with increasing brood size in species with low adult mortality than in species with high adult mortality. Our results supported this model and showed that slopes were steeper in species with lower adult mortality rates. In contrast, food limitation theory predicts relatively flat slopes across species (i.e., proportional adjustment) and, this was rejected. Finally, nest predation theory predicts steeper slopes in species with lower nest predation rates (i.e., species with high nest predation are already under strong constraints) and this also was rejected. This suggests an important role for adult mortality in the evolution of provisioning strategies, which are a key component of life histories.

## **27 Maddox, Bowden & Weatherhead**

Within- and among-clutch variation of yolk hormones in Common Grackles. J. DYLAN MADDOX, *Prog. Ecol. Evol. Biol., Univ. Illinois, Urbana, IL*, RACHEL BOWDEN, *Dept. Biol. Sci., Illinois State Univ., Bloomington, IL*, and PATRICK J WEATHERHEAD, *Prog. Ecol. Evol. Biol., Univ. Illinois*.

Since androgens in avian egg yolk were first shown to be of maternal origin, several studies have demonstrated that yolk levels of androgens can positively or negatively affect offspring phenotype. However, it is still uncertain whether hormone allocation is adaptive or simply a passive consequence of female hormone levels. Here, we take an intraspecific approach by utilizing a population of Common Grackles where several maternal effects are known to vary with clutch size. In 5-egg clutches, egg size increases with laying order and the eggs hatch asynchronously, whereas in 4-egg clutches, egg size does not increase with laying order and hatching asynchrony is greatly reduced. Because hatching asynchrony places last-hatched chicks at a significant size and strength disadvantage, we predicted that hormone levels would increase with laying order to mitigate the negative effects of asynchronous hatching on last-hatched nestlings in 5-egg clutches but not in 4-egg clutches. We collected and measured eggs from 26 5-egg clutches and 16 4-egg clutches. Competitive-binding steroid radioimmunoassay (RIA) was used to measure levels of testosterone and estradiol. Preliminary results suggest that neither steroid increased with laying order in either clutch size. However, testosterone ( $93.4 \pm 4.9\text{SE ng/mL}$  vs.  $66.4 \pm 4.5\text{SE ng/mL}$ ;  $p < 0.001$ ) and estradiol ( $1.30 \pm 0.16\text{SE ng/mL}$  vs.  $0.58 \pm 0.09\text{SE ng/mL}$ ;  $p < 0.001$ ) were significantly greater in 5-egg clutches than 4-egg clutches, respectively. This may suggest that females laying 4-egg clutches are of lower quality than those laying 5-egg clutches.

## **28 Shannon & Rotenberry**

Parental attendance and food supplementation in Bald Eagles. CYNTHIA J. SHANNON and JOHN T. ROTENBERRY, *Dept. Biol., Univ. California, Riverside, CA*.

The location of a raptor's nest within an urbanizing landscape may affect, food availability and, subsequently, parental attendance at the nest. We examine the relationships between food abundance and the effects on parental nest attendance in a population of Bald Eagles on Vancouver Island, British Columbia. Three lines of evidence show that the abundance of food and specific prey type in the landscape clearly influences parental nest attendance. (1) We found parents that bring a greater variety of prey to the nest, spend more time at the nest. (2) In a food supplementation experiment using Before-After Control-Impact (BACI) design, we found significantly increased parental attendance at fed nests. (3) We found increased prey delivery also increased the intensity of nest attendance, with parents guarding significantly more in the nest (without feeding). We suggest this indicates an increased intensity of guarding the food for the nestlings by the parents. Further evidence for this suggestion comes from natural prey delivery rates and parental behaviors in a non-supplemented year. We found parents to engage significantly more in guarding and defensive behaviors, such as chasing and calling, as prey delivery rate increased. Furthermore, we found significant correlations between prey delivery rate and defensive behaviors by parents toward other adults. Knowledge gained concerning nest location and nest success can be used in managing this species as well as other raptors with similar reproductive ecology.

### 29 Dreitz

Comparative brood-rearing behavior of Mountain Plovers in eastern Colorado. VICTORIA J. DREITZ, *Colorado Div. Wildl., Ft. Collins, CO.*

The Mountain Plover is a migratory shorebird which breeds primarily on the xeric tablelands of Colorado, Wyoming, and Montana. Continental population trends suggest a steady decline over the past century. Colorado is considered the stronghold for Mountain Plovers, as over half of the world's population is believed to breed in the eastern half of the state. In order to develop conservation strategies for Mountain Plovers, we must adequately assess the relative value of the different habitats used by Mountain Plovers for breeding activity. I estimated brood-rearing success of Mountain Plovers on 3 habitats - grassland, grassland with prairie dogs, and agricultural fields - in eastern Colorado and the daily probability of moving from one habitat to a different habitat. Habitat quality was investigated by comparing diversity, density, and biomass of prey resources on each habitat during the brood-rearing period. Field data were collected from 2004 - 2006. A total 214 transmitters were placed on adults to monitor brood survival and a total of 13,140 samples on prey resource availability were collected during the field study. The results suggest that daily chick survival rates decreased each year of the study from 0.979 (0.976 - 0.982, 95% Bayesian credible intervals) in 2004 to 0.947 (0.943 - 0.950) in 2006. Our analysis of daily movement probabilities suggested that broods on rangeland moved off the habitat at a much higher rate than broods on prairie dog or agricultural fields. The results suggest that the value of which habitat is more productive for Mountain Plover brood-rearing activity varies through time and is dictated by climatic events during and prior to breeding activity. Information from this study will be used to identify and resolve potential conflicts between Mountain Plover conservation efforts and private, agricultural practices.

### 30 Johnson, Johnson & Brubaker

How male House Wrens discover that their eggs have hatched. L. SCOTT JOHNSON, BONNIE G. P. JOHNSON and JESSICA L. BRUBAKER, *Dept. Biol., Towson Univ., Towson, MD.*

In many passerines, females alone incubate the eggs, but both parents feed hatchlings. How males in such species discover that the eggs have hatched remains largely a mystery, especially in cavity-nesters. We continuously videotaped 22 House Wren nests before, during, and after hatching to test 4 hypotheses regarding how males might learn of hatching: 1) females signal this to males; 2) males deduce this from observing their mate's behaviour (e.g., change in incubation rhythm and/or the carrying of eggshells from, or food into, the nest); 3) males hear hatchling vocalizations from outside the nest; and 4) males enter the nest cavity and observe hatchlings directly. On average, males began feeding hatchlings regularly 2.7 h (range: 41.9 min to 5.5 h) after the first egg hatched. We saw no evidence that females signaled males that hatching had begun. At only 3 of 22 nests did males appear to begin food delivery to the nest as a result of either observing their mate carrying eggshells or food or hearing hatchlings from outside the nest. At all other nests, males only began food delivery after they themselves had entered the nest cavity and presumably sensed the presence of hatchlings through sight, sound and/or touch. Some males began feeding regularly after just one nest inspection whereas other males made multiple inspections before they began feeding. We discuss possible reasons that most males do not begin delivering food to nests until after they have direct contact with hatchlings.

### 31 Riegner

Parallel evolution of plumage pattern and coloration in birds: implications for defining avian morphospace. MARK F. RIEGNER, *Environ. Stud. Prog., Prescott Coll., Prescott, AZ.*

I studied the recurrence of similar plumage pattern elements in distantly related taxa across the Class Aves and examined whether such pattern elements are associated with morphological features, such as body size and anterior emphasis, and with age class and habitat type in selected examples. The identification of recurrent plumage pattern elements across a wide array of taxa can be interpreted as evidence for parallel evolution and thus for shared developmental pathways. Developmental constraint, therefore, may serve to both generate and delimit the diversity of avian plumage patterns, which are subsequently presented to selection. By examining hundreds of examples of avian plumages from the literature, I derived a plumage pattern trajectory that can be used as a theoretical model to identify

associated morphological trends within various taxonomic contexts of comparison. For example, when comparing species within a clade, as body size increases, plumage pattern often shifts along a trajectory from countershading through streaks, bars, uniform/bold color patches to reverse countershading. Moreover, the trajectory is recursive at various taxonomic levels. The recursive nature of the trajectory, in which morphological and chromatic elements recur in modified configurations, has perhaps contributed to an underestimate of parallel evolution in birds. I assert that a recognition of pervasive recursion enables one to predict evolutionary trends in a hypothetical spectrum of potential form and plumage pattern and thus serves to define both the limits and possibilities of avian theoretical morphospace.

### **32 Olsen, Greenberg, Liu, Felch & Walters**

Interactions between sexual and natural selection in the plumage divergence of the Coastal Plain Swamp Sparrow. BRIAN J. OLSEN, *Dept. Biol. Sci., Virginia Tech, Blacksburg, VA*, RUSSELL GREENBERG, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC*, IRENE A. LIU, *Dept. Biol., Univ. Maryland, College Park, MD*, JOSHUA M. FELCH, *Dept. Fish. & Wild. Sci., Virginia Tech*, and JEFFREY R. WALTERS, *Dept. Biol. Sci., Virginia Tech*.

Signals should vary across environments due to the differential sexual and natural selection. Coastal Plain Swamp Sparrows (CPSS) possess blacker crowns relative to inland subspecies similarly to many tidal-marsh vertebrates. This suggests that CPSS coloration results from environmental selection. Swamp sparrow crowns, however, are sexually dichromatic and thus may be under sexual selection. To understand the roles of sexual and natural selection on CPSS crowns, we investigated ties between crown color and fitness in dark CPSS males versus a rustier inland subspecies. Across both subspecies male cap rustiness correlated positively with parental care and negatively with aggression. Blacker foreheads of both subspecies correlated positively with aggression. Subspecific differences in male crowns can be explained by differential sexual selection alone. CPSS produced more aggressive calls, were more territorial, sang more frequently, and were more vigilant than inland birds. Further, blacker crowns correlated with coastal offspring production, while rustier crowns correlated with inland fledglings. Subspecific crown differences are larger between females. Female color has likely diverged by differential natural selection, whereas male crown color has diverged by sexual selection. Increased sexual dichromatism among coastal plain swamp sparrows provides a clear example of the interplay between sexual and natural selection in divergence.

### **33 Hofmann, Cronin & Omland**

The contribution of carotenoids and melanins to sexual dichromatism in New World orioles. CHRISTOPHER M. HOFMANN, T. W. CRONIN and K. E. OMLAND, *Dept. Biol., Univ. Maryland, College, Park, MD*.

Several recent studies have investigated how different proximate mechanisms of color production contribute to avian sexual dichromatism. These studies suggest that carotenoid pigments "which are frequently subject to sexual selection" are more strongly associated with sexual dichromatism than melanins. This reasoning implicitly assumes that increased male elaboration leads to sexual dichromatism. However, sexual dichromatism can be generated through multiple evolutionary pathways, including decreases in female elaboration. Thus, we examined whether evolutionary changes in carotenoid- and melanin-based plumage were correlated within New World orioles, a genus where male elaboration is ancestral and only female elaboration varies. We found a significant correlation between evolutionary changes in the degree of carotenoid and eumelanin sexual dichromatism. These findings differ from those of previous comparative studies and suggest that there may be interesting differences when different evolutionary pathways "such as changes in male versus female coloration" lead to sexual dichromatism.

### **34 Burt, Schroeder, Smith, Sroka & McGraw**

Differently colored parrot feathers are differentially resistant to bacterial degradation. EDWARD H. BURTT, Jr., *Dept. Zool., Ohio Wesleyan Univ., Delaware, OH*, MAX R. SCHROEDER, *Dept. Botany-Microbiol., Ohio Wesleyan Univ.*, LAUREN A. SMITH, *Dept. Zool., Ohio Wesleyan Univ.*, JENNA

E. SROKA, *Dept. Botany-Microbiol., Ohio Wesleyan Univ.*, and KEVIN J. MCGRAW, *School Life Sci., Arizona State Univ., Tempe, AZ.*

The brilliant red, orange, and yellow colors of parrot feathers are the product of psittacofulvins, which are synthesized in the follicle of the developing feather at the time of molt. Psittacofulvins are found in all 3 families of parrots, but are restricted to parrots. Feathers with red psittacofulvins degraded at about the same rate as those with melanin and more slowly than white feathers, which lacked these pigments. Feathers with orange and yellow psittacofulvins degraded at rates intermediate between those of red or black and white. Blue feathers, which depend on the structural arrangement of melanin, also degraded at a rate intermediate between that of red or black feathers and white. However, green, which combines structural blue and yellow psittacofulvins degraded at a rate similar to red. These differences in resistance to bacterial degradation of differently colored feathers suggest that color patterns within the Psittaciformes may have evolved for functions in addition to communication.

### **35 Frame, Gunderson, Forsyth & Swaddle**

Autoclave sterilization may confound the observed effect of feather degrading bacteria. ALICIA M. FRAME, ALEX R GUNDERSON, MARK H. FORSYTH and JOHN P SWADDLE, *Dept. Biol., Coll. of William & Mary, Williamsburg, VA.*

Recent studies of feather-degrading bacteria suggest that feather pigmentation, such as melanins or carotenoids, may influence the rate of bacterial degradation. The prevailing hypothesis is that the presence of melanin inhibits degradation, and therefore may be a defense against degradation (Goldstein et al. 2004, *Auk* 121: 656-659). However, other work suggests that melanized feathers actually degrade more quickly than unpigmented feathers (Grande et al 2004, *Ardeola* 51: 375-383). Because of these conflicting results, we replicated previous research using *Bacillus licheniformis* and *Kocuria rhizophila*. *B. licheniformis* yielded the same pattern of degradation as in Goldstein's 2004 experiment, but *K. rhizophila* consumed dissolved proteins already present in solution, rather than degrading the feathers. We hypothesized that high initial protein levels led to repressed keratinase production in *K. rhizophila*. We found that prior to inoculation, unpigmented feathers had significantly higher initial dissolved protein concentrations in solution than melanized feathers. We believe this is an effect of autoclave sterilization. Previously published work has stated that autoclaving may be necessary for degradation of feathers (Williams et al, 1990, *Appl. & Environ. Biol.* 56: 1509-1515). The effects of autoclaving may suggest that melanized feathers are more resistant to bacteria, when they are actually more resistant to the autoclave. The difference between dissolved protein concentrations is consistent with a fundamental difference in durability between melanized and unpigmented feathers, regardless of the presence of bacteria. We are currently conducting trials to investigate whether this durability difference persists under other sterilization techniques and whether feather-degrading bacteria are still able to degrade feathers in the absence of autoclave sterilization.

### **36 McGraw, Lee & Lewin**

The effect of stress on carotenoid-based coloration in Zebra Finches. KEVIN J. MCGRAW, KRISTEN B. LEE and AMIR LEWIN, *School Life Sci., Arizona State Univ., Tempe, AZ.*

Environmental stress occurs in various forms (e.g., predators, food, climate) and can have widespread effects on animal phenotypes and fitness. Biologists have shown recent interest in the role that environmental stressors play in modulating sexually selected traits in animals, both at the activational and organizational levels. The colors of animals, especially birds, have proven to be valuable subjects for such mechanistic investigations, because there are clear effects of stressors such as food access and parasitism on color expression and because we can trace the molecules by which colors are produced in the body to determine the true physiological effects of the stressor on the trait. Chronic behavioral (or social) stress has received less attention than most stressors in this context, though it is known to affect signal expression in animals that can rapidly change color (e.g., chromatophores in fishes, amphibians, and reptiles). To date, no study has investigated how chronic behavioral stress (e.g., capture/restraint stress, as might occur by predator presence) influences the expression of elaborate colors, either plumage- or bare-part-based, in birds. We used a traditional capture/restraint technique to examine the effect of handling stress on the expression of

carotenoid-dependent orange/red beak coloration in male and female Zebra Finches (*Taeniopygia guttata*) -- a known sexually selected signal of quality in this species. We found in both sexes that birds who were subjected to daily, 10-min handling treatments for a 4-wk period displayed deeper orange/red beak coloration than did controls. Stressed males lost body mass during the experiment and decreased significantly in concentrations of carotenoids circulating through blood; it is plausible that capture stress quickly mobilized and drained adipose tissue and blood carotenoid supplies, hence increasing substrates of yellow xanthophyll carotenoid available for synthesis of red pigments at the beak. It is also possible that a shift in metabolism could have acted to increase pigment transformation in the beak itself. In contrast, stressed females maintained orange beak color, while control birds faded in color. We believe this occurred because control females continued producing eggs (hence allocating carotenoids to yolk), while stressed females did not. This study highlights sex- and pigment-specific mechanisms by which stress may temporarily enhance the expression of sexual traits, but at the expense of other key fitness traits (body maintenance, reproduction). More work is needed on wild Zebra Finches and other species to determine how widespread and influential this effect is for the mate competition and honest signaling systems of avian and other taxa.

### **37 Beck, Schwabl & Webster**

Is plumage coloration a sexually selected indicator of quality in male and female Prothonotary Warblers? M. L. BECK, H. SCHWABL and M. WEBSTER, *School Biol. Sci., Washington State Univ., Pullman, WA.*

Elaborate secondary sexual characteristics are thought to act as honest signals of quality that are used for mate choice. Bright plumage coloration is one such signal and much work has focused on male coloration, but in many songbirds females also express bright plumage coloration that could signal quality. We examined plumage coloration of male and female Prothonotary Warblers to determine if it is used in mate choice or is a reliable signal of provisioning ability. We chose to analyze data separately for young and old females because they may have different strategies when selecting a mate and investing in offspring. We found that young females paired assortatively by color but, within these pairs, plumage color was unrelated to typical measures of reproductive success for both males and females. For pairs with an after-second year female, we found that the birds did not pair assortatively by plumage color. But, within these pairs greater spectral purity of males was associated with earlier nest initiation, larger clutch size, and higher fledging success. Female plumage color was unrelated to reproductive success. To determine if plumage color reliably signals direct benefits to offspring, we video taped nests when nestlings were 8 d of age to measure parental provisioning rates. These results will be available at the meeting.

### **38 Dugas**

The role of nestling mouth coloration in begging. MATTEW B. DUGAS, *Dept. Zool., Univ. Oklahoma, Norman, OK.*

Nestling birds are entirely dependent on parental care and rely on a suite of adaptations to extract resources from parents. In addition to vocalizing and adopting a characteristic posture, nestlings greet their parents with brightly colored mouth parts. Recently, these mouth colors have attracted attention as a potential means by which parents might assess the relative quality of their offspring and adaptively adjust resource allocation. I examined the relationship between carotenoid-based mouth coloration and nestling quality in house sparrows and present evidence that mouth color reveals nestling condition and might inform parental allocation decisions.

### **39 Webster, Varian & Karubian**

Plumage color and fitness in a polymorphic bird, the Red-backed Fairy-Wren. MICHAEL WEBSTER, CLAIRE VARIAN, *School Biol. Sci., Washington State Univ., Pullman, WA,* and JORDAN KARUBIAN, *Inst. Environ., Univ. California-Los Angeles, Los Angeles, CA.*

Intrasexual color polymorphism is common in birds, and is often associated with age ("delayed plumage maturation"). In many such species females appear to prefer bright males as mates, raising the question: why do some males breed in dull plumage? With respect to fitness, dull males may be better

able to sire extra-pair offspring by intruding on the territories of other males, or dull males may have higher survival because their cryptic coloration leads to reduced aggression from conspecifics and/or reduced predation rates. We examined the fitness consequences of plumage coloration in the Red-backed Fairy Wren (*Malurus melanocephalus*), an Australian passerine in which some males breed in dull female-like plumage and others breed in bright nuptial plumage. Field experiments showed that dull males received less aggression from conspecifics. However, male plumage color was not associated with male survival or the probability of being cuckolded, and dull males were less likely, rather than more likely, to sire extra-pair offspring. These effects were independent of age and appear to be a direct consequence of plumage coloration. Thus, our results indicate that dull breeding males do not directly benefit from their plumage color, suggesting instead that they are constrained to breed in dull plumage by other factors.

#### **40 Parker, Griffith, Barr & Wilken**

Environmental variance but little evidence for condition dependence in a sexual signal. TIMOTHY H. PARKER, *Dept. Biol., Whitman Coll., Walla Walla, WA*, SIMON C. GRIFFITH, *Centre Integrative Study Anim. Behav., Macquarie Univ., Sydney, Australia*, IAIN R. BARR, *Dept. Biol. Sci., Univ. East Anglia, Norwich, UK*, and TEDDY A. WILKEN, *Dept. Zool, Oxford Univ., Oxford, UK*.

In the Blue Tit (*Cyanistes caeruleus*), multiple studies have convincingly demonstrated that both UV/blue and yellow plumage reflectance correlate with age and sex. In our study population and others, between-year repeatability of color is low and color shows very little genetic variance. This evidence seems to suggest that color in blue tits is the stereotypical condition-dependent sexual signal. However, through several lines of investigation we have failed to identify aspects of the environment that influence variation in adult color. Several habitat variables on our study site influence fitness and condition related aspects of blue tit phenotype including laying behavior, chick quality, and chick recruitment. These habitat variables include oak density, estimated territory size, habitat type, distance to edge, and altitude. However, none of these variables predict current color of adults, nor do they predict the future adult color of chicks. These are robust results based on very large sample sizes. Furthermore, a brood size manipulation with strong effects on chick quality and recruitment did not influence recruited chicks' adult color ( $n > 100$  recruited chicks). The lack of evidence for condition dependence of adult color suggests that environmental determinants of color need not be aspects of the environment associated with fitness. In other words, environmental variance may not equal condition dependence. However, it remains possible that we have not measured relevant fitness-related environmental variables.

#### **41 Moyle, Fuchs, Pasquet & Marks**

Molecular systematics of pygmy kingfishers (Alcedininae). ROBERT G. MOYLE, J. FUCHS, E. PASQUET and B. D. MARKS, *Nat. Hist. Mus., Univ. Kansas, Lawrence, KS*.

We studied the phylogenetic relationships among pygmy kingfishers (Alcedininae) using nuclear and mitochondrial DNA sequences. We found strong support for paraphyly of *Alcedo* and *Ceyx*. Reliance on plumage and feeding behavior as taxonomic characters in this group has led to unnatural groupings of species. In contrast, a character that has not been used to define taxonomic groups for several decades, toe count, is congruent with our phylogenetic results. A taxonomic revision based on 4 genera is proposed.

#### **42 Walker, Naugle, Doherty & Cornish**

West Nile virus infection rates in a wild sage-grouse population. BRETT L. WALKER, DAVID E. NAUGLE, KEVIN E. DOHERTY, *Wildl. Biol. Prog., Univ. Montana, Missoula, MT*, and TODD E. CORNISH, *Wyoming State Vet. Lab., Laramie, WY*.

West Nile virus infection rates (i.e., exposure) in wild bird populations remain unknown, and estimates of seroprevalence are confounded by mortality of infected individuals. Greater Sage-Grouse in western North America have a high mortality rate following infection with West Nile virus (WNV). We used rates of WNV-related mortality and seroprevalence from radio-marked females to estimate infection rates in a wild population in the Powder River Basin (PRB) of Montana and Wyoming from 2003 - 2005.

WNV-related mortality ranged from 2 - 29%. All birds in 2003 and 2004 tested seronegative. In spring 2005 and spring 2006, 10% and 2% of females tested seropositive for WNV. Annual infection rates ranged between 4 - 29%. Low to moderate WNV-related mortality followed by low seroprevalence the following spring in all years suggests that most sage-grouse in the PRB have not yet been exposed to WNV. Impacts of WNV in the PRB appear to depend on annual variation in temperature and changes in vector distribution. Management to reduce impacts of WNV should focus on eliminating man-made water sources in sage-grouse habitat that support breeding mosquitos, particularly coal-bed natural gas ponds. Our findings also underscore problems with the widespread practice of using seroprevalence as a surrogate for infection rate in highly susceptible species.

#### **43 Naugle, Doherty, Walker, Holloran & Rinkes**

Greater Sage-Grouse population response to energy development. DAVID NAUGLE, KEVIN DOHERTY, BRETT WALKER, *Wildl. Biol. Prog., Univ. Montana, Missoula, MT*, MATTHEW HOLLORAN, *Wyoming Wildlife Consultants, Laramie, WY*, and TOM RINKES, *BLM, Lander, WY*.

Modification of landscapes due to energy development may alter both habitat use and vital rates of sensitive wildlife species. Greater Sage-Grouse are experiencing widespread, rapid changes to their habitat due to the recent surge in energy development. In the Powder River Basin in eastern Wyoming and Montana, only 38% of leks remained active within coal-bed natural gas fields, compared to 84% of leks outside gas fields. Leks inside gas fields had, on average, 46% few males per active lek than active leks outside of energy development. After controlling for habitat loss, lek persistence also was negatively influenced by the extent of energy development within 3.2 km, with a 2 - 4 yr lag time between energy development and lek loss. In winter, sage-grouse in the Powder River Basin were 1.3 times less likely to use otherwise suitable habitats once they were developed for energy. In the Pinedale Anticline Project Area in southwest Wyoming, male lek attendance decreased with distance to the nearest drilling rig, with no males at leks within 2 km of a drilling rig, and negative effects that were apparent out to 5 km. Number of males also declined when the lek was located downwind from a drilling rig, indicating that noise from energy development was likely a contributing factor. Leks that became inactive did so within 3 - 4 yr of development. Increased mortality of adult females in the Pinedale Anticline Project Area suggests that sage-grouse expiration near energy development is a combination of behavioral avoidance and a true population decline. Maintaining sage-grouse populations in areas with energy development may require a shift in strategy toward spatial, rather than temporal restrictions on development, and rapid, widespread implementation of improved mitigation standards. Findings also emphasize the need for government agencies to set population goals and conduct landscape-scale conservation planning for sensitive species prior to energy development.

#### **44 Anfinson & Bednarz**

Abnormalities in songbirds in northeastern Arkansas: a comparison of findings between farm and reference sites. JANE O. ANFINSON and JAMES C. BEDNARZ, *Dept. Biol. Sci., Arkansas State Univ., Jonesboro, AR*.

An unusually high frequency of abnormalities found in passerine birds (7.4%, n = 1298 birds) in ne. Arkansas farm fields prompted us to investigate further, and we continued to find high incidences of abnormalities. Songbirds with abnormalities were significantly more frequent in farm fields than reference sites managed for wildlife ( $Z = 4.97$ ,  $P < 0.001$ ). 17 species showed feather loss, irritated skin, swelling of the oil gland or cloaca, body cysts, or crossed bills. We hypothesized that birds with abnormalities were affected by agricultural chemical application or other disturbances in farm fields, either directly or indirectly. To test this hypothesis we assayed plasma cholinesterase, a bioindicator of organophosphate pesticide exposure, characterizing the predominant type for 4 species, and comparing activity rates. Red-winged Blackbird females had lower acetylcholinesterase activity rates than males (n = 362,  $F = 6.31$ ,  $P = 0.013$ ). Red-winged Blackbirds and Indigo Buntings showed significant differences of rates among crop types. We sampled for topical microbes related to skin irritation and feather degradation. Birds without abnormalities had more fungal genera present than abnormal birds (n = 67,  $X^2 = 56.2$ ,  $P < 0.001$ ), and presence of several genera corresponded to specific crop types.

#### **45 Durst, Paxton & Sogge**

Estimating survivorship in a migratory passerine: effects of spatial and temporal scales. SCOTT L.

DURST, EBEN H. PAXTON and MARK K. SOGGE, *USGS-SBSC, Colorado Plateau Res. Sta., Northern Arizona Univ., Flagstaff, AZ.*

From 1996 to 2005, we conducted a large-scale demographic study of the federally endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) at multiple breeding sites in central Arizona, USA. We estimated average adult survivorship of 64%, but observed substantial yearly variation in survivorship (53 - 73%), suggesting that the duration of the study might influence average survivorship. To explore the influence of temporal scale we used series of sequential and overlapping blocks of 2- to 10-yr intervals and estimated survivorship for each interval to determine parameters had our study covered less than 10 yr. Because survivorship estimation methods cannot distinguish between mortality and permanent emigration, and our study covered a large geographic area, we explored how our estimates would change if our study had been conducted at smaller spatial scales. Meaningful spatial scales in our study ranged from 52 discreet patches, to sub-sites defined as collections of 7 - 16 patches along a single river drainage (covering 12 - 77 km), to sites which were collections of adjacent sub-sites, to 2 metapopulations found 90 km apart, to an overall study area that encompassed both metapopulations and any movements detected from these metapopulation sites by collaborating researchers (up to 450 km). We calculated survivorship estimates at each spatial scale by considering only birds that did not move outside of that spatial scale (i.e., permanent emigration) to be "alive." This study of the Southwestern Willow Flycatcher was unusual in its spatial and temporal extent and we provide recommendations on the appropriate spatial and temporal extent that a study should be conducted to obtain robust survivorship estimates for this species, recommendations which should have wide application to many studies of migratory passerines.

#### **46 Williams, Fasina & Peterson**

Modeled distribution of highly pathogenic H5N1 transmission in Nigeria and West Africa. R. A. J. WILLIAMS, F. O. FASINA and A. T. PETERSON, *Nat. Hist. Mus. and Biodiversity Res. Center, Univ. Kansas, Lawrence, KS.*

Highly pathogenic H5N1 Avian Influenza (HPH5N1) is an emerging virus that is assumed to have evolved in birds, and is particularly associated with Galliformes, Anseriformes and Charadriiformes. It is notable for causing mass mortality in poultry and wild birds. Humans are occasionally infected, with mortality rates of about 60%. There is considerable speculation that this influenza strain will cause a global human pandemic. However, at present it is primarily a bird virus. The mechanism for the spread of HPH5N1 is widely debated, with some claiming that the virus is spread by poultry movements and others arguing that the disease is spread by migrating birds. Originally detected in s. China in 1996, it became widespread in East Asia by 2004, and then spread rapidly to Europe and Africa in 2005 and 2006. HPH5N1 was first detected in Nigeria in Feb 2006, in poultry. It has since been detected throughout the country in poultry, wild birds and one human. Here we analyzed HPH5N1 cases in Nigeria, 2006, building ecological niche models to associate case occurrences with ecological and environmental parameters. In almost all tests, we found high predictivity of HPH5N1 case distributions, suggesting that one or more elements in the transmission cycle have strong ecological determination. Models trained on Nigeria have been projected to West Africa to build a predicted distribution for HPH5N1 throughout the region, and presence was predicted in all the countries of the region which have detected the virus: Burkina Faso, Cameroon, Ghana, Ivory Coast and Niger.

#### **47 vacant**

#### **48 Filardi**

Effects of a recent tsunami on the islet avifaunas of Vonavona Lagoon, Solomon Islands. CHRISTOPHER E. FILARDI, *Center Biodivers. & Conserv., Am. Mus. Nat. Hist., New York, NY.*

The birds of the Solomon Islands comprise one of the most distinctive avifaunas on earth. Exceptional levels of endemism and striking inter-island variation made the area famous among evolutionary thinkers of the last century, and more recent molecular work on Solomon birds continues to highlight the region as one of the world's great natural laboratories for the study of the role of geography in avian population differentiation. On 2 Apr 2007, a powerful earthquake measuring 8.1 on the Richter Scale rocked the Western Solomon Islands. Within minutes of the quake, a series of associated tsunamis swept across hundreds of low-lying islands within the New Georgia island group.

Additionally, numerous islands were either lifted or depressed during the quake thereby shifting many island characteristics, including freshwater availability and the extent of non-inundated or tidal forest. One area that was significantly depressed is the Vonavona Lagoon, a large complex of coralline islets scattered across the warm shallow waters separating north New Georgia Island from the Kolombangara volcano. Ongoing field studies of islet birds in the area enable rough comparisons of pre- and post-tsunami bird assemblages on many islands. At the time of abstract submittal, the author was in the Solomons surveying numerous islands that had been repeatedly visited prior to the event. This paper will present an initial assessment of impacts of these geological phenomena on the islet avifaunas of the Vonavona lagoon with an eye toward research opportunities as a result of the earthquake and its aftermath.

#### 49 Herring & Gawlik

Constraints of landscape level prey availability on physiological condition and productivity of the Great Egret and White Ibis in the Florida Everglades. GARTH HERRING and DALE E. GAWLIK, *Florida Atlantic Univ., Boca Raton, FL*.

Food availability is one of the primary limitations to avian populations, particularly during the breeding season (Lack 1954, **Natural regulation**, Clarendon; 1966, **Population studies**, Clarendon; Ricklefs 1968, **Proc. Nat. Acad. Sci.** 61: 847-851). Subsequently declines in breeding success and populations of wading birds in the Florida Everglades may be linked to reduced prey availability as result of historic water management practices. Understanding the linkage between prey availability and physiological condition of adults may be critical to understanding how hydrology affects nesting and population patterns in the Florida Everglades, and essential in future restoration efforts. We studied the White Ibis and Great Egret, as they represent searcher and exploiter foraging strategies and exhibit different population trends. Results in 2006 suggested that adult Great Egrets utilized an endogenous reserve strategy, while white ibis used an exogenous strategy during periods of high prey availability, leading up to breeding. Physiological parameters suggested some fundamental differences between both adults and chicks of these species for mass gain, growth and physiological condition. Differences were consistent with the pattern of nesting success and likely stem from the same reason, suggesting Great Egret chicks were buffered against prey availability changes. These physiological differences may be linked to the apparent difference in population changes, associated with foraging behavior and to the system wide loss of short hydroperiod wetlands in the Everglades that provide important early breeding season foraging habitat for searcher species like the White Ibis.

#### 50 Lantz & Gawlik

The effects of water depth and submerged aquatic vegetation density on wading bird foraging site selection in the Everglades. SAMANTHA M LANTZ and DALE E GAWLIK, *Dept. Biol. Sci., Florida Atlantic Univ., Boca Raton, FL*.

We investigated the effects of water depth and submerged aquatic vegetation (SAV) on wading bird foraging site selection in the Everglades during 2 experiments in Jan and Apr 2007. Six 10 x 10 m enclosures were established within the Loxahatchee Impoundment Landscape Assessment project, an experimental facility at the A. R. M. Loxahatchee National Wildlife Refuge that is designed to mimic the physical features of the Everglades. Treatment variables included water depth (10 cm and 25 cm) and bladderwort density (*Utricularia* sp., 0, 2, and 5 L/m<sup>2</sup>; empty, light, and heavy vegetation densities, respectively). Numerical response data, analyzed using Manly's standardized selection index, suggests that birds prefer shallow water for foraging compared to deep water. This trend was exaggerated as the breeding season progressed; in the first experiment birds used all treatment combinations, selecting shallow treatments over deep treatments ( $B_{\text{shallow}} = 0.581$ ,  $B_{\text{deep}} = 0.419$ ), while in the second experiment wading bird site selection was limited to shallow treatment enclosures ( $B_{\text{shallow}} = 1.0$ ,  $B_{\text{deep}} = 0.0$ ). Foraging site selection across vegetation treatments varied more than selection across water depths, suggesting that water depth is the more important environmental cue. Birds selected the heavy vegetation treatment in the first experiment ( $B_{\text{empty}} = 0.143$ ,  $B_{\text{light}} = 0.186$ ,  $B_{\text{heavy}} = 0.252$ ), while in the second experiment the birds showed the least preference for this density ( $B_{\text{empty}} = 0.318$ ,  $B_{\text{light}} = 0.477$ ,  $B_{\text{heavy}} = 0.204$ ).

### **51 Anderson, Ricca, Miles, Barnum & Spring**

Avian use of a constructed saline wetland complex at the Salton Sea, California. THOMAS W. ANDERSON, M. A. RICCA, A. K. MILES, D. A. BARNUM and S. E. SPRING, *USGS Salton Sea Sci. Office, LaQuinta, CA.*

Constructed, shallow saline wetlands are currently being considered as a major component of wildlife habitat restoration for the Salton Sea in se. California. The concept utilizes a mixture of hypersaline Salton Sea water and agricultural runoff to create a series of impoundments with salinities ranging from 20,000 mg/l to 200,000 mg/l. We are currently conducting analyses of inflows, water quality, sediment chemistry, aquatic invertebrates, bird use, bird nesting, post-hatch survival and contaminant risk at a 50 ha site. Results of these investigations will be provided to restoration program managers to assess the suitability of this concept for migratory birds. From Jul through Dec of 2006 bird use was monitored at the saline habitat ponds (SHP) and 3 reference sites at the Salton Sea. Bird densities differed from the SHP by -50%, -56%, and +27% although species diversity was similar among sites. Of 78 Black-necked Stilt nests evaluated May through Jul, overall egg hatching success was 43%, while that of full term nests (n = 38) was 88% with 17% lost to deprecation. Continued research will provide information on nesting success for BNST, post-hatch survival estimates and an ecological evaluation of potential contaminant risks for birds using this habitat.

### **52 Rush, Cooper, Woodrey & Fisk**

The ecology niche of Clapper Rails in Mississippi's tidal marshes. SCOTT A. RUSH, ROBERT J. COOPER, *Warnell School For. & Nat. Res., Univ. Georgia, Athens, GA*, MARK S. WOODREY, *Coastal Research & Extension Center, Mississippi State Univ., Biloxi, MS*, and AARON T. FISK, *Univ. Windsor, Windsor, ON.*

Despite the rapid loss of tidal marsh along the Gulf Coast of the U.S., within these systems the ecology of marsh birds such as the Clapper Rail remains largely unknown. In an effort to further our understanding of the ecological niche of Clapper Rails during the summers of 2005 to 2007, we studied the spatial and trophic ecology of this species within 2 of Mississippi's tidal marshes. Spatial distributions were studied using standardized marsh bird surveys and radio-telemetry. Trophic ecology of this species was addressed using ecological tracers in the forms of stable isotopes and metals, such as Mercury. Across our focal systems we found differences in the densities of Clapper Rails. However, densities were not found to be correlated with large-scale landscape characteristics and did not experience significant change in the wake of the natural perturbation of tropical storms and hurricanes. Based on stable isotope and element analyses Clapper Rails appear to hold a mid to upper trophic position with a diet that may vary spatially. Synthesis of this information will not only further our understanding of the ecology of the Gulf Coast's tidal communities but also find application in the effective management and restoration of these tidal systems.

### **53 Lombardo & Thorpe**

Breeding experience and reproductive performance in Tree Swallows. MICHAEL P. LOMBARDO and PATRICK A. THORPE, *Dept. Biol., Grand Valley State Univ., Allendale, MI.*

The conventional wisdom is that reproductive performance improves with breeding experience in birds. Our aim was to test this idea using data collected from 1993 - 2002 at our study site in west Michigan. Because subadult and adult female Tree Swallows typically differ in reproductive performance, we tested the following hypotheses on adult female-breeding pairs. (1) Female reproductive performance was positively associated with breeding experience. (2) Females aided by more experienced mates had better reproductive performance than females aided by less experienced mates. (3) Pairs with more combined breeding experience had greater reproductive performance than did pairs with less combined breeding experience. Contrary to the conventional wisdom, breeding experience was not consistently associated with greater reproductive performance. Female breeding experience was not significantly associated with the mean date of clutch initiation, clutch size, or the number of fledglings produced. The amount of breeding experience of a female's mate was not significantly associated with the date of clutch initiation or the number of fledglings produced. However, females mated to males with more experience laid larger clutches. Mated pairs with more combined

total breeding experience began laying eggs earlier in the season, but did not produce larger clutches or more fledglings. These results suggest that for our study site, breeding experience may have little impact on Tree Swallow reproductive performance.

#### **54 DiLuzio, Stanback, Mercadante & Olbert**

Effects of the threat of predation on nest site abandonment in Eastern Bluebirds. NICK DiLUZIO, MARK STANBACK, AUSTIN MERCADANTE and JEAN OLBERT, *Dept. Biol., Davidson Coll., Davidson, NC.*

Nest predation is the single largest source of nest failure in most passerine birds. Consequently, passerines should be very sensitive to the vulnerability of their nests to predators. We wanted to determine experimentally whether the presence of a nest predator at the nest site prior to the completion of nest-building would induce Eastern Bluebirds to abandon their nesting attempt. We provided bluebirds with nest boxes (in pairs 10 m apart). Once we detected the onset of nest-building, we placed either a 2 m rubber Black Rat Snake (n = 25 trials) or a model female Northern Cardinal (n = 25 trials) on the focal nest box for 10 minutes and recorded the responses of the resident pair of bluebirds. We returned 4 days later to determine whether the presence of the snake/cardinal had an effect on the nest site choice of the bluebirds. We predicted that the presence of an alternative nest site would allow the bluebirds to switch nest sites when they observed a visitation by a snake.

#### **55 Camfield, Martin & Pearson**

Trade-offs among breeding season duration, annual fecundity and survival in two Horned Lark populations. ALAINE F. CAMFIELD, KATHY MARTIN, *CACR, Forest Sci., Univ. British Columbia, Vancouver, BC,* and SCOTT F. PEARSON, *Washington Dept. Fish & Wildl., Olympia, WA.*

Most iteroparous species fall along a continuum from high-reproductive species (high fecundity and low survival) to survivor species (low fecundity and high survival). We investigate patterns of life history variation between 2 Horned Lark sub-species in central British Columbia (BC, *Eremophila alpestris articola*), and in the Puget lowlands in Washington (WA, *E. a. strigata*). Breeding season duration in WA was more than twice as long as in BC and the mean initiation date for first nests was 16 days earlier in WA while both clutch size and the proportion of eggs that hatched were higher in BC. Overall, twice the number of fledglings were produced per egg laid in BC compared to WA. However, due to the long breeding season in WA and therefore the opportunity for multiple broods, annual fecundity in WA was 4.25 female fledglings/female compared to 2.28 female fledglings/female in BC. There was a non-significant trend toward higher adult survival in BC compared to WA. The trend toward higher survival for adult Horned Larks in BC in conjunction with lower annual fecundity suggests that this population demonstrates more of a survivor life history strategy while the WA population tends toward a high reproductive life history strategy.

#### **56 Yoon, Ghalambor & Sillett**

Climatic variation and reproductive behavior of Orange-crowned Warblers on Santa Catalina Island. JONGMIN YOON, CAMERON K. GHALAMBOR, *Dept. Biol., Colorado State Univ., Fort Collins, CO,* and T. SCOTT SILLETT, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington DC.*

In territorial bird species food availability is thought to be determined by the interaction between environmental productivity (e.g., rainfall, primary production) and the social setting (neighbor density, intraspecific competition). This interaction results in variation in territory size and quality and is the major environmental source of differences among individuals in the ability to produce and provision offsprings. For the past 5 yr we have been studying the breeding ecology of orange-crowned warblers (*Vermivora celata sordida*) on the California Channel Islands. During this time we have observed the driest and wettest years in recorded history and quantified the timing of breeding, breeding density, insect abundance, reproductive output, and nestling provisioning rates to test the relationship between these variables. Results to date show highly plastic breeding strategies; in favorable years most individuals double-brooded whereas in the driest year most individuals skipped breeding completely. Breeding density increases and territory size decreases in mesic habitats where food availability is greater. We suggest that food limitation driven by rainfall and temperature play a critical role in shaping the length of the breeding season, and in turn have cascading effects on the breeding ecology of this species.

**57 Sofaer, Ghalambor, Yoon & Sillett**

Can differences in age-specific mortality rates account for life history differences between Orange-crowned Warbler populations? H. R. SOFAER, C. K. GHALAMBOR, J. YOON, *Colorado State Univ., Ft. Collins, CO*, and T. S. SILLETT, *Smithsonian Migratory Bird Center, Washington, DC*.

Understanding life history diversification has been a central question in avian evolutionary ecology, yet no consensus exists to explain how ecological conditions interact to affect reproductive behavior and investment. Differences in age-specific mortality rates are likely to be important in driving evolution in life history strategies. Theory predicts that high adult mortality should promote the evolution of faster life history strategies, while high juvenile mortality should favor the evolution of slower life histories. Yet although nest predation has long been recognized as an important force in avian life history evolution, factors that affect adult mortality rates, such as migration distance, have received less attention. Using Orange-crowned Warblers as a model system, I test life history theory by comparing populations from Alaska and California that vary in both age-specific demographic rates and in life history strategies. I examine incubation patterns, feeding rates, and growth rates in these populations and ask if differences in age-specific mortality rates can account for the observed differences in reproductive behavior and investment. Further, I discuss how other ecological conditions may interact with age-specific mortality rates to affect avian life history evolution.

**58 Ghalambor, Huizinga, Sofaer, Yoon & Torres-Dowdall**

The comparative context of brood manipulation studies: variation along the slow-fast continuum. CAMERON K. GHALAMBOR, MERIBETH HUIZINGA, HELEN R SOFAER, JONGMIN YOON and JULIAN TORRES-DOWDALL. *Dept. Biol., Colorado State Univ., Ft. Collins, CO*.

Life history theory is based on the general assumption that a trade-off exists between reproduction and survival. A large body of empirical research has attempted to test this trade-off by manipulating the costs of reproduction. In birds, a common experimental approach has been to manipulate brood the number of offspring that parents must raise. The implicit assumption of these experiments is that parents will increase their reproductive effort by “working harder” and thus incur a greater cost of reproduction. However, species with different life histories may vary in their willingness to adjust reproductive effort. For example, species with slow life histories may be less willing to incur greater reproductive costs compared to species with fast life histories. We tested this hypothesis by reviewing studies of brood manipulation in passerines. As predicted by theory, we found that the willingness of parents to increase effort increased with increasing clutch size (measured as the difference in body mass between nestlings from control broods versus enlarged broods). These results suggest that future studies using brood manipulation should temper the expected results based on where along the slow-fast life history continuum the study species occurs.

**59 Price, Friedman & Omland**

Song and plumage evolution in the New World orioles show similar lability and convergence in patterns. J. JORDAN PRICE, NICHOLAS R. FRIEDMAN, *Dept. Biol., St. Mary's Coll. Maryland, St. Mary's City, MD*, and KEVIN E. OMLAND, *Dept. Biol. Sci., Univ. Maryland-Baltimore Co., Baltimore, MD*.

Both song and color patterns in birds are thought to evolve rapidly and exhibit high levels of homoplasy, yet few previous studies have compared the evolution of these traits systematically using the same taxa. Here we reconstruct the evolution of song in the New World orioles (*Icterus*) and compare patterns of vocal evolution to previously reconstructed patterns of change in plumage evolution in this clade. Vocal characters exhibit high levels of homoplasy on the oriole phylogeny, similar to the high levels of homoplasy found in oriole plumage patterns using the same taxa, but strikingly dissimilar to the conservative patterns of change seen in the songs of oropendolas (*Psarocolius*, *Ocyalus*), a group closely related to the orioles. Oriole song is also similar to oriole plumage in exhibiting repeated convergence in overall patterns, with some distantly related taxa sounding remarkably similar. Thus, both song and plumage in orioles are highly labile between taxa yet highly conserved within the genus. Our results provide new insights into the tempo and mode of evolution in sexually selected traits within and across clades.

## 60 Taft

Geographic and temporal variation in Tree Swallow song repertoires: evidence for adult song learning. BENJAMIN N. TAFT, *Biol. Dept., Univ. Massachusetts. Amherst, MA.*

There is a large body of work about natural and sexual selection on Tree Swallows, but nothing is known about song learning in this species. Two types of observations can provide information about how Tree Swallows develop their songs. Geographic patterns of syllable sharing at local scales would suggest that Tree Swallows learn their songs. Temporal patterns of repertoire change within a breeding season would indicate that males can learn new songs as adults. To test these predictions, I recorded Tree Swallows singing from their nest boxes at 4 sites: Dryden, NY (n = 12); Turners Falls, MA (n = 6); Deerfield, MA (n = 6); and Amherst, MA (n = 65). I recorded birds in Amherst throughout the 2005 breeding season. I classified syllables using a novel quantitative approach incorporating hierarchical clustering and discriminant function analysis. The mean repertoire size was 7.6 syllables (range 1 - 26). Repertoire similarity was significantly higher between birds at the same site than between birds at different sites (Mantel test,  $P = 0.016$ ), but distance between sites had no effect on sharing. There was also a significant correlation between repertoire similarity and physical distance between nests in Amherst (Mantel test,  $P = 0.0369$ ). The repertoires of several birds in Amherst changed during the spring of 2005. Three birds added new syllables to their repertoires and showed significant improvement in their performance of those songs during the spring. Taken together, this geographic and temporal variation in Tree Swallow syllable repertoires suggests that they do learn their songs, and can do so as adults.

## 61 Tobias & Seddon

Congruent songs and interspecific territories in two sympatric antbirds. JOSEPH A. TOBIAS and NATHALIE SEDDON, *Dept. Zool., Univ. Oxford, Oxford, UK.*

Evolutionary theory predicts that mating signals of closely related species differ in sympatry through selection against maladaptive hybridization. However, some bird species have unexpectedly similar songs in sympatry or at contact zones. Six hypotheses have been forwarded to explain these congruent/convergent acoustic signals: (1) recent contact, (2) heterospecific copying, (3) acoustic adaptation to shared environments, (4) hybridization, (5) interspecific competition, or (6) chance. To investigate these hypotheses, we studied 2 congeneric antbird species, *Hypocnemis subflava* and *Hypocnemis peruviana* (Thamnophilidae), which have broadly overlapping Amazonian ranges and non-diagnostic songs. We analyzed the structure of male and female songs in a zone of sympatry, and used playback to test levels of intra- and interspecific discrimination. We found greater overlap in song structure between species than between sexes: discriminant function analysis correctly classified 96% of songs by sex, and only 80% by species. Playback elicited strong sex-specific territorial responses within and between species. Male *H. subflava* responded more aggressively to conspecific than heterospecific same-sex songs, while male *H. peruviana* did not discriminate between species, suggesting an asymmetry in response behavior. Despite their near-identical songs, we found no evidence of hybridization. Our findings are not consistent with hypotheses 1 - 4, and we conclude that song similarity is either non-adaptive in this system, or an adaptive byproduct of interspecific competition. Our study provides the strongest evidence to date that interspecific territoriality can give rise to congruent acoustic signals, and is the first to show interspecific territoriality mediated by the songs of both sexes.

## 62 Mennill

Duets are multifunction signals in Rufous-and-white Wrens: spatial and temporal analyses of variation. DANIEL J. MENNILL, *Dept. Biol., Univ. Windsor, Windsor, ON.*

In many tropical birds, male and female breeding partners combine their songs to produce vocal duets. Here I evaluate vocal duetting in neotropical Rufous-and-white Wrens (*Thryothorus rufalbus*) using 2 approaches. (1) I evaluate seasonal variation in the frequency of male songs, female songs, and duets. (2) I use an 8-microphone Acoustic Location System (ALS) to passively triangulate the position of birds while they perform duets. Results from recordings of 17 breeding pairs sampled throughout the year reveal substantial seasonal variation in solo and duet singing behaviour. Female song output is

greatest prior to the rainy season and females are less likely to create duets as the breeding season progresses. In contrast, male singing activity is greatest at the onset of the rainy season (a time when females become fertile) and males become increasingly likely to create duets as the breeding season progresses. Results from ALS recordings of 20 breeding pairs reveal that birds duet across tremendously variable distances; as close as 0.4 m and as distant as 144.3 m. Birds perform duets throughout their territories and duets are not given closer to territory boundaries than expected by chance. During song bouts containing multiple duets, partners approach one another significantly more often than they retreat. The results from both long-term and ALS recordings support the idea that duets are multi-function signals.

### **63 Reichard & Price**

Vocal recognition of conspecifics in Northern Mockingbirds. DUSTIN G. REICHARD and J. JORDAN PRICE, *Dept. Biol., St. Mary's Coll. Maryland, St. Mary's City, MD.*

Mimic thrushes such as Northern Mockingbirds and Brown Thrashers produce large repertoires of song syllables including imitations of other species. Despite such remarkable versatility, these birds are distinguishable in the field by their syllable repetition patterns, with mockingbirds sequentially repeating their syllables more times than thrashers. In this study, we used playback experiments to investigate whether Northern Mockingbirds use repetition patterns or another cue in recognizing the songs of conspecifics. We altered recordings of mockingbird and thrasher songs to produce 4 treatments in which either mockingbird syllables or thrasher syllables had either a standardized mockingbird repetition pattern (5 repetitions) or a standardized thrasher pattern (2 repetitions). Mockingbird subjects responded significantly more strongly to songs with mockingbird syllables and mockingbird repetition pattern than to songs with thrasher syllables and either repetition pattern. Responses to mockingbird syllables with a thrasher repetition pattern were intermediate between responses to the other treatments. Thus, mockingbirds can distinguish conspecific syllables from heterospecific syllables regardless of repetition pattern, but repetition pattern still appears to play a role in recognizing conspecifics. Furthermore, thrashers use significantly wider range of frequencies than mockingbirds, which provides a potential cue for discriminating between the two.

### **64 Greig & Pruett-Jones**

Honest signaling with a predator-induced call: a study of vocalization communication in Splendid Fairy-Wrens (*Malurus splendens melanotus*). EMMA I. GREIG and STEPHEN PRUETT-JONES, *Dept. Ecol. & Evol., Univ. Chicago, Chicago, IL.*

We studied an unusual vocalization, the Type II call, given by the cooperatively breeding Splendid Fairy-Wren (*Malurus splendens*). Type II calls were given almost exclusively by males as either an independent vocalization in response to avian predators or as a suffix to their song, the latter most often during the dawn chorus. Both primary and helper males gave Type II calls and the predator that most frequently elicited the vocalization was the Grey Butcherbird (*Cracticus torquatus*). We tested two alternative hypotheses concerning the function of Type II calls: 1) that they indicate male quality and; 2) that they function as an alarm to warn kin. Using playbacks and observational data on natural call rates we found that males tended to give Type II calls more frequently early in the breeding season and there was no difference in the tendency to give Type II calls between helper males who were related to the breeding female in their group and helper males who were unrelated to the breeding female. There was a significant negative relationship between the maximum frequency of a male's Type II call and cloacal protuberance size. These findings suggest that the Type II call may function as an honest indicator of male quality.

### **65 Nadeau & Conway**

Is distance sampling valid in the context of aural avian point-count surveys? CHRISTOPHER P. NADEAU, *School Nat. Res., Univ. Arizona, Tucson, AZ,* and COURTNEY J. CONWAY, *USGS Arizona Coop. Fish & Wildl. Res. Unit, Univ. Arizona.*

We tested two of the assumptions of distance sampling. We modeled the distance function

curve for over 34,000 distance estimations taken during surveys using the North American Marsh Bird Monitoring Protocol to test the shape criteria assumption. The shape criteria assumption was met and we showed no evidence of evasive movements of birds prior to detection. However, rounding to convenient distances was common. We conducted point count simulations in the field to test the assumption that distances are estimated accurately. The error associated with distance estimates varied from -167 to 236 m, with a mean error of -9 m. Errors increased as distance from the observer to the simulated bird call increased, were smaller if the observer could see the area where the simulated call was coming from, were larger if the simulated bird call was directed away from the observer, and were affected by the volume of the simulated call. We also found a significant difference among observers in their ability to estimate distances to real birds. The errors in distance estimations caused an overestimation in density of 31% and an underestimation in detection probability of 30%. Our results suggest that distance sampling may not be appropriate for use with aural point-count surveys without evaluating and correcting for biases which may violate assumptions of this technique.

#### **66     Eттerson, Niemi & Danz**

Estimating avian population trends using a detection-corrected abundance model. MATTHEW A. EттERSON, GERALD J. NIEMI and NICHOLAS P. DANZ, *Natl. Resources Res. Inst., Univ. Minnesota Duluth, Duluth, MN.*

We use a removal model to estimate avian density corrected for imperfect and heterogeneous detection probability. We demonstrate with an application to 15 species using 15 yr of monitoring data on 3 national forests in the upper Midwest. We also compare the removal estimates of abundance to previous LOESS analyses of counts performed on the same data. Trends in detection-corrected abundance disagreed with smoothed LOESS trends in 24% of cases and the count statistic appeared to be a positively biased index of abundance, probably due to the imposition of minimum detection criteria prior to LOESS analysis. Detection probabilities varied widely among years even for common and purportedly conspicuous species. In most cases, the best model(s) selected for each species included interactions between habitat type and national forest and different rates of population change in each national forest. Several species were found to be simultaneously increasing in one forest and decreasing in another. In one species a negative trend in detectability was sufficient to convert a positive trend in abundance into a negative trend in smoothed counts, which highlights the potential for biased inference when relying on the index assumption.

#### **67     Winter, Hochachka & Charif**

Using continuous sound recordings to quantify variation in birds' availability for detection. MAIKEN WINTER, WESLEY M. HOCHACHKA and RUSS CHARIF, *Lab. Ornithol., Cornell Univ., Ithaca, NY.*

Monitoring birds is complicated by the fact that individuals may not sing during the time of a survey. Because most terrestrial passerine monitoring relies on vocalizations for detection, these surveys will always under-estimate the number of birds present. While various census and statistical methods have been developed to correct for varying and incomplete detection, no clear idea exists of the greatest source(s) of variation in birds' availability for detection. We investigated singing patterns of the Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*), an endangered subspecies of the Grasshopper Sparrow in North America. Units that recorded sound automatically were set up within multiple known territories for 6 wk in early spring 2006. We used these recordings to determine the probability of detecting birds under standard sampling protocols at sites where birds are known to be present. We specifically contrasted the amount of variance in probability of singing at 4 levels: among individual birds; between pairs of consecutive, short-duration sampling periods; across time within a day; and among days. The two greatest sources of variation in singing probability were changes with time of day and autocorrelation between consecutive sampling periods, indicating that census and analysis methods must be designed with these sources of variation in mind.

#### **68     Cook, Newman, Hagerthey & Kobza**

Restoring avian communities in nutrient enriched areas of the Florida Everglades: an experimental approach. MARK I. COOK, SUE NEWMAN, SCOT E. HAGERTHEY and R. MAC KOBZA, *S. Florida Water Manage. Dist., West Palm Beach, FL.*

Decades of anthropogenic nutrient inputs have caused extensive changes in the structure and function of the Everglades marsh. Phosphorus enriched areas are readily evidenced by over 14,000 ha of monotypic cattail *Typha* spp. stands which have replaced open-water slough habitat. In enriched areas, a key constraint in ecosystem function is the high density of the vegetation, which limits access to foraging wading birds and reduces production of aquatic prey. A landscape-scale experiment, using 15 6.25-ha plots, was initiated to test our ability to restore *Typha* areas. The two primary objectives are to assess whether creating openings in dense *Typha* areas will sufficiently alter trophic dynamics such that wading bird diversity and abundance is increased and, determine to what extent the functions of these created open areas compare to the natural Everglades. Initial data show that densities of aquatic prey species were significantly greater in the open plots than in the control and natural plots. Moreover, after controlling for water level, open plots supported considerably greater wading bird foraging and species diversity than control and natural plots. However, cattail plots supported a greater density and diversity of secretive marsh birds than open and natural plots. We discuss these results in terms of Everglades food web dynamics and restoration options.

#### **69 Niemuth, Estey, Loesch & Reynolds**

Gadwalls vs. godwits: landscape-level effects of waterfowl conservation on non-game birds in the U.S. Prairie Pothole Region. NEAL D. NIEMUTH, MICHAEL E. ESTEY, CHARLES R. LOESCH and RONALD E. REYNOLDS, *U.S. Fish & Wildl. Serv., Bismarck, ND.*

Waterfowl conservation efforts in North Dakota and South Dakota have contributed to the conservation of approximately 1.3 million ha of land through fee-title acquisition or perpetual easements. Money for these efforts has come primarily from the Migratory Bird Conservation Fund, or Duck Stamps. We used spatially explicit habitat models and GIS data showing conserved lands to assess benefits of lands conserved for waterfowl to breeding grassland birds, waterbirds, and shorebirds in North Dakota and South Dakota. Our models demonstrate significant correlation ( $P < 0.001$ ) between priority landscapes for waterfowl and target waterbird and shorebird species. The models also demonstrate that waterfowl conservation activities have permanently protected considerable ( $> 50\%$ , in some counties) habitat for waterbirds, shorebirds, and grassland birds. In many cases, lands protected through waterfowl conservation efforts are those predicted to have highest occupancy by non-game birds. However, much habitat for both waterfowl and non-game birds is unprotected, and additional efforts will be required to stem ongoing loss and degradation of habitat for both groups. Criticisms that waterfowl conservation efforts are not optimal for non-game species are often based on misconceptions and false dichotomies that pit wildlife species groups against each other, divert attention from more important issues such as habitat loss, and devalue conservation efforts that benefit many species.

#### **70 Stanley & Skagen**

Estimating the breeding population of Long-billed Curlew in the United States. THOMAS R. STANLEY and SUSAN K. SKAGEN, *USGS Ft. Collins Sci. Center, Ft. Collins, CO.*

Long-billed Curlew is a species of special concern in North America due to apparent population declines. We undertook a 2-yr study with the goals of determining present Long-billed Curlew distribution and breeding population size in the U.S., and providing recommendations for a long-term monitoring protocol. A stratified random sample of survey routes in 16 western states was selected for sampling in 2004 and 2005, and count data from these routes were analyzed to estimate detection probabilities and abundance. In addition, we evaluated habitat within 400 m of roadsides to determine how well roadsides represented habitat throughout the sampling units. We estimated there were 164,515 (SE = 42,047) breeding Long-billed Curlews in 2004, and 109,533 (SE = 31,060) breeding individuals in 2005. These estimates far exceed currently accepted estimates based on expert opinion. We determined habitat along roadsides was representative of Long-billed Curlew habitat in general.

#### **71 Diggs, Cooper & Marra**

Consequences of a diet shift in wintering Hermit Thrushes. NORA E. DIGGS, ROBERT J. COOPER, *Univ. Georgia, Athens, GA,* and PETER P MARRA, *Smithsonian Migratory Bird Center, Washington, DC.*

Previous studies have linked fruit to Hermit Thrush abundance, although these studies did not assess arthropod availability or measure the consequences of food availability on bird body mass or fat

stores. The objective of my research was to examine how overall food availability and a diet shift from fruit to insects influences body condition in wintering Hermit Thrushes. I predicted that thrushes preferentially consume insects, when available, over fruit. Birds with a greater proportion of insects in their diet will maintain higher body mass and fat stores overwinter. Insect and fruit availability was monitored at regular intervals throughout the winter. Diet was assessed in same individuals at the same intervals using fecal sampling and stable carbon isotopes from blood. Fruit availability declined more than 90% from Nov to Jan in 2005. The  $\delta^{13}\text{C}$  values reflected the diet shift, which become significantly more enriched as the winter season progressed, resulting from the reduced fruit resources. Birds that lost more mass overwinter, also tended to exhibit larger changes in  $\delta^{13}\text{C}$  values. Results from 2007 are pending. Understanding the value of fruit as a fall and winter food resource is important in the conservation and management of wildlife in temperate regions.

## **72 Marzot & Dufty**

Early food restriction and phenotypic development in captive American Kestrels. VITTORIA G. MARZOT and ALFRED M. DUFTY, Jr., *Dept. Biol., Boise State University, Boise, ID.*

Captive American Kestrels maintained on a short-term, moderately restricted diet (80% ad libitum) as nestlings were similar to birds maintained on a control diet (ad libitum) with respect to body size, hematocrit, baseline plasma corticosterone levels, cell-mediated immunity, and tail-band width. However, nestlings reared on the restricted diet had elevated heterophil:lymphocyte (H:L) ratios and duller contour plumage when compared to control nestlings. In addition, there was a significant difference in the temporal pattern of corticosterone release in response to handling stress throughout the putative migratory period (9 Aug - 11 Oct 2005). Birds fed the restricted diet exhibited significantly elevated corticosterone levels 30 min after the onset of stress induced by capture and handling during the first (9 Aug), second (30 Aug), and fourth (11 Oct) weeks of the sampling period, whereas corticosterone levels at 30 min in control birds were similar to baseline levels. Although it remains unclear whether these birds would have actually migrated, our findings suggest that early food restriction can inhibit modulation of the adrenocortical response during later life stages. Moreover, these results suggest that there may be pervasive effects of poor nutrition on survival and fitness despite the apparent ability of food-restricted nestlings to compensate for moderate levels of food restriction in some respects.

## **73 Anderson, Loworn, Esler & Boyd**

The value of herring spawn to Pacific scoters. ERIC M. ANDERSON, JAMES R. LOVVORN, *Dept. Zool., Univ. Wyoming, Laramie, WY*, DANIEL ESLER, *Centre for Wildl. Ecol., Simon Fraser Univ., Burnaby, BC*, and W. SEAN BOYD, *Canadian Wildl. Ser., Delta, BC.*

As with other sea ducks, declines in scoters have been severe: most winter and breeding censuses indicate continental declines of about 60% over the past 30 -50 yr. Scoters and other marine birds congregate in dramatic numbers to consume spawn along the Pacific Coast. To determine whether changes in local herring stocks may be related to scoter declines, we are studying the influence of spawn consumption on condition of scoters in late winter and spring. Censuses at 12 spawning areas in Puget Sound, WA, indicate that Surf Scoters respond in greater numbers and likely travel greater distances to spawning events than White-winged Scoters. Tissue analyses (stable isotopes, fatty acids) from scoters captured in the Strait of Georgia, BC, during late winter and early spring migration suggest that for both species the amount of spawn consumed is positively related to body mass. Collections of Surf Scoters during late spring migration in se. Alaska suggest condition (as measured by body mass, plasma metabolites) during this period is endogenously regulated independent of spawn consumption. However, relative to bivalves (a typical coastal food), spawn also (1) has a higher content of fats assumed important for meeting the energy requirements of migration (particularly 18:1 fatty acids), and (2) reduces foraging time, presumably due to enhanced acquisition and digestibility.

## **74 Belinsky**

Multi-modal signaling in a complex system: color and song in Chestnut-sided Warblers. KARA LOEB BELINSKY, *Grad. Prog. Organ. & Evol. Biol., Univ. Massachusetts, Amherst, MA.*

Why do so many songbirds invest in multiple, multi-modal, sexually selected traits such as colorful plumage and elaborate song? Two hypotheses explain the evolution of multiple sexually selected traits: 1) The “Redundant Signals” hypothesis, which states that multiple traits broadcast overlapping information, either to amplify the signal, or to compensate for unreliable signals, and 2) The “Multiple Messages” hypothesis, which states that each trait broadcasts different information. I tested the redundant signals and multiple messages hypotheses by assessing multiple color and song traits in a colorful migratory songbird, the Chestnut-sided Warbler. For each warbler, I measured 3 plumage patches: chestnut stripes, black facial masks, and yellow caps. I also measured 8 singing performance parameters for each of the 2 categories of songs sung by each male. In addition, I assessed the quality of each male's territory by measuring the density of nest-site vegetation. My results indicate that stripe area, mask area, and singing performance may be redundant signals of male quality. However, my results also support the multiple messages hypothesis because stripe and mask area are inversely related to cap area, which is correlated with territory quality. Altogether, these results suggest that both the redundant signals and the multiple messages hypotheses describe the evolution of multi-modal sexually selected traits in Chestnut-sided Warblers.

## **75 Fletcher**

Nontarget effects from social cue manipulation: everybody hates a flycatcher. ROBERT J. FLETCHER, Jr., *Div. Biol. Sci., Univ. Montana, Missoula, MT.*

Artificially creating social stimuli may be an effective conservation tool for facilitating settlement by rare and/or declining species into suitable habitat. However, the potential consequences for other community members have not been explored and should be considered when evaluating the overall utility of using such strategies. I report on nontarget, community-wide effects that occurred when manipulating social cues of 2 competitors that are species of concern in the western U.S., the dominant Least Flycatcher and the subordinate American Redstart. The experiment consisted of surveying birds during a pretreatment year, which allows for the control of baseline communities, and a treatment year, in which treatments were applied just prior to settlement by migratory birds. Treatments included broadcasting songs of flycatchers and redstarts, and were compared to controls. While the addition of redstart cues resulted in no observed changes in community structure, the addition of flycatcher cues reduced species richness of migratory birds and altered overall avian community composition. These patterns were driven by small-bodied migrants not colonizing sites with added flycatcher cues rather than by local extinctions occurring from manipulations. I conclude by identifying under what situations nontarget effects are likely to occur and emphasize that conservationists and managers should carefully weigh the potential consequences of simulating social cues for species conservation prior to implementation.

## **76 Edwards, Liu, Prito, Brumfield & Balakrishnan**

A species tree approach to avian phylogenetics and phylogeography. SCOTT V. EDWARDS, L. LIU, P. PRITO, R. BRUMFIELD and C. BALAKRISHNAN, *Dept. Organ. & Evol. Biol., Harvard Univ., and Mus. Comp. Zool., Cambridge, MA.*

With the dominance of mitochondrial DNA in avian systematics over the past 15 yr, and the lack of phylogenetic methods that effectively deal with the sometimes conflicting signals from multilocus DNA sequence data, avian systematics has largely focused on a ‘gene tree’ approach to phylogenetics and phylogeography. In this paradigm, concatenated gene trees are generally assumed to represent the tree of populations or species, and there is often not an explicit reference to a ‘species tree’ in which gene trees are embedded. We have recently presented a novel and statistically consistent Bayesian method for estimating species trees as distinct from gene trees in situations where incomplete lineage sorting is the basis for conflicts among individual gene trees. Here we apply this method to several avian data sets involving 4 - 8 species and from 5 - 30 anonymous nuclear or intron loci. Across data sets, there is a correlation between the confidence in and consistency among individual gene trees and the confidence (posterior probability) of the estimated species tree. We show that the method works well in (1) phylogeographic settings in which gene tree discordance is high; (2) higher-level data sets with substantial sequence divergence and low gene tree discordance and (3) cases in which concatenation of sequences will positively mislead phylogeny estimation. We suggest that a species tree approach to

avian systematics has the advantage of integrating systematics and population genetics and focuses attention on the parameter of interest, the species tree, rather than on gene trees or their concatenated products.

**77 Peer, Harper, Rivers, Frick, Benson, Anderson, Blackwell, Eshedagho, Raabe, Wall & Wear**  
Dickcissels, DDT, and cowbirds: an evolutionary equilibrium? BRIAN D. PEER, R. G. HARPER, J. W. RIVERS, J. W. FRICK, M. D. BENSON, M. ANDERSON, B. BLACKWELL, T. ESHEDAGHO, J. RAABE, B. WALL and E. WEAR, *Dept. Biol., Western Illinois Univ., Macomb, IL.*

Relatively few hosts of the parasitic Brown-headed Cowbird reject cowbird eggs. One possible explanation for this enigma is that the costs involved in the rejection of cowbird eggs exceed the benefits. Dickcissels breed in the grasslands of North America where they are frequent hosts of the cowbird and they winter in Venezuela where they are poisoned by farmers that consider them agricultural pests. We found that Dickcissels reject cowbird eggs at an intermediate frequency and regularly damage their own eggs in the process. We also found numerous organochlorines present in Dickcissel eggs such as DDT and its metabolite DDE. There was a significant negative relationship between eggshell thickness and levels of total organochlorine compounds (minimum - maximum levels: 0 - 2,349 ppb) and there was a significant negative relationship between total organochlorine levels and eggshell brightness. We discuss the effects of organochlorines on Dickcissels, including whether thinning of their eggshells exacerbate the costs of cowbird egg removal.

**78 Strum, Sandercock, Hooper, Alfaro, Johnson, Lanctot, Torres-Dowdall & Zaccagnini**  
Monitoring migratory shorebird exposure to cholinesterase-inhibiting pesticides. KHARA M. STRUM, BRETT K. SANDERCOCK, *Dept. Biol., Kansas State Univ., Manhattan, KS*, MICHAEL J. HOOPER, *TIEHH, Texas Tech Univ., Lubbock, TX*, MATILDE ALFARO, *Sec. Ocean., Fac. de Cien., Univ. de la Rep., Montevideo, Uruguay*, KEVIN A. JOHNSON, *Dept. Chem., Southern Illinois Univ., Edwardsville, IL*, RICHARD B. LANCTOT, *U.S. Fish & Wildl. Ser., MBM, Anchorage, AK*, JULIAN TORRES-DOWDALL, *Dept. Biol., Colorado State Univ., Ft. Collins, CO*, and MARÍA ELENA ZACCAGNINI, *IRB, INTA-CIRN, Castelar, (Buenos Aires) Argentina.*

Monitoring programs indicate that shorebird populations are declining globally. In the Western Hemisphere, at least 27 shorebird species are species of high concern and 7 are highly imperiled. One factor influencing populations may be exposure to cholinesterase-inhibiting chemicals on the non-breeding grounds. Organophosphate (OP) and carbamate (CB) pesticides are commonly used chemicals in the Americas. These pesticides have caused mortalities in other migratory birds and produce adverse physiological effects in studies of laboratory birds. Migratory shorebirds use a variety of habitats during migration through the Great Plains of the U.S. and while over-wintering in temperate South America. Habitats where risk of exposure is high include rice fields and sod farms. Cholinesterase (ChE) is a specific biomarker for OP and CB exposure and can be measured using standard laboratory procedures. Lower levels of absolute cholinesterase activity and recovery to higher levels after 2-PAM (for OPs) or spontaneous (for CBs) reactivation, indicative of poisoning, are expected in shorebirds using rice fields and sod farms. In 2006, we sampled shorebirds in 3 states in North America during north- and south-bound migration and 3 countries in South America during austral spring, characterizing and measuring ChEs in all species. Preliminary results indicated that butyryl- and acetyl-ChE had an inverse relationship with body size. Acetyl-ChE activity shows less inter-species variation and represents the neurotransmitter most likely to produce symptoms when inhibited. We will discuss our estimates of exposure and make recommendations for conservation of neotropical migrants.

**79 Evers**  
Monitoring mercury in wildlife. D. C. EVERS, *BioDiversity Res. Inst., Gorham, ME.*

Recent findings show that the availability of methylmercury to wildlife is more pervasive than once thought. In addition to elevated mercury levels in piscivorous birds, new and compelling findings also indicate that insectivorous birds are at high risk. Identification of biological mercury hotspots through field sampling and modeling is needed to assist with local and regional landscape management and policy decisions. To monitor changes of mercury deposition and availability to wildlife, such as

insectivorous birds, a standardized national program has been developed. Legislation for this program is now pending in Congress.

## **80 Cristol**

Mercury contamination escapes from an aquatic ecosystem and accumulates in insectivorous birds. DANIEL A. CRISTOL, *Dept. Biol., Coll. William & Mary, Williamsburg, VA.*

Piscivorous birds are often used as sentinels for mercury contamination because they biomagnify methylmercury from their fish prey. While mercury in birds is currently considered a problem of aquatic, piscivorous species, export of aquatic mercury to adjacent terrestrial ecosystems through insect emergence or deposition on floodplains is also possible. We found that along the mercury-contaminated South River in Virginia 12 of 13 terrestrial bird species tested had elevated blood mercury levels, including several that were higher than their aquatic or piscivorous counterparts. Other cases of mercury contamination in terrestrial birds have been from diffuse atmospheric sources, and have been below generally accepted lowest observed adverse effects levels. In contrast, birds inhabiting the riparian forests along the South River had blood mercury levels comparable to those reported for impacted aquatic birds. Our results demonstrate that mercury can escape from contaminated waters into nearby terrestrial habitats, where it biomagnifies in a number of songbird species to levels of concern. Schemes utilizing birds as bioindicators should broaden to include terrestrial species that eat invertebrates, even in situations where pollution was initially aquatic.

## **81 McFarland, Rimmer & Taylor**

A historical record of mercury contamination in Bicknell's Thrush. KENT P. McFARLAND, CHRISTOPHER C. RIMMER, *Conserv. Biol. Dept., Vermont Inst. Nat. Sci., Quechee, VT*, and ROBERT J. TAYLOR, *Trace Element Res. Lab., Texas A&M Univ., College Station, TX.*

Recent studies have documented methylmercury (MeHg) burdens in terrestrial songbirds in the ne. U.S. Bicknell's Thrush, a montane fir forest specialist, was found to have some of the highest concentrations. Investigations of historic mercury (Hg) accumulation in Northeast lake sediments have found rates increasing near the end of the 19th Century with peak values occurring after 1970. Previous examinations of feathers from museum specimens have been used to document historical changes in mercury accumulation in several aquatic species. We obtained contour feather samples for 83 Bicknell's Thrush specimens ranging from 1881 to 1980 from over a dozen museum collections across North America. We compared these historic samples to those obtained from individuals mist-netted on the breeding grounds in 2006. Results will provide perspective on historic Hg deposition and bioaccumulation in Bicknell's Thrush.

## **82 Grenier, Hunt & Collins**

Passerines as biosentinels for mercury in tidal wetland restoration projects of the San Francisco Bay Estuary. J. LETITIA GRENIER, JENNIFER HUNT and JOSHUA COLLINS, *San Francisco Estuary Inst., Oakland, CA.*

Mercury becomes a problem when it accumulates in food webs to concentrations that adversely affect humans or wildlife. Mercury is already elevated in many fish and bird species around the San Francisco Bay Estuary, and there is concern that extensive wetland restoration could exacerbate the problem. Biosentinel species are a cost-effective method of directly monitoring mercury in food webs at the temporal and spatial scales of interest. Biosentinel studies can be used to track spatial and temporal trends in mercury as well as to identify habitat features and management regimes that minimize mercury bioaccumulation, which is useful in ecosystem restoration design. The vast wetland restoration projects that are planned around the Bay create a need for biosentinel monitoring of mercury in and near restoration areas, before and after restoration. We are developing a suite of habitat-specific biosentinels to monitor change in the South Bay Salt Pond Restoration Project area and elsewhere in the San Francisco Estuary. The rate at which mercury enters the food web can vary with the changing biogeochemical conditions of different habitats, so biosentinel species are chosen to be habitat-specific. Obligate tidal marsh Song Sparrows endemic to the Estuary are the biosentinels for the tidal marsh plain habitat. Results from sampling sparrows and other songbirds from marshes in North and South San

Francisco Bay during 2006 indicate clear patterns of mercury bioaccumulation among species and marshes.

### **83 Hames, Trocki, Fink & Nacci**

Using freely-available data to predict the effects of mercury and acid deposition on populations of birds breeding in the eastern U.S. RALPH S. HAMES, *Lab. Ornithol., Cornell Univ., Ithaca, NY*, CAROL L. TROCKI, *US-EPA/NHEERL, Narragansett, RI*, DANIEL FINK, *Lab. Ornithol.*, and DIANNE E. NACCI, *US-EPA/NHEERL*.

Acid rain has been linked to declines in populations of bird species in Europe and North America. Recent work showed patterns of decreased probability of Wood Thrush breeding attempts in the e. U.S. in the presence of acid rain, and where calcium-rich invertebrates were less abundant. Mercury contamination, often associated with acid rain, has also been documented in terrestrial ecosystems and birds in this region. Using freely-available, environmental data and spatially-explicit population trend estimates from the Breeding Bird Survey, we tested the predictions that Wood Thrush population trends would be negative where low soil pH, acid rain, and mercury deposition occurred, and also at higher elevations. We divided the breeding range of the Wood Thrush into 10 x 10 km grid cells, and used thresholds in soil pH data from the Natural Resource Conservation Service, acid rain, and mercury deposition data from the National Atmospheric Deposition Program, to predict whether each cell showed negative or non-negative population trends. Overall, soil pH, the pH of wet acid deposition, and wet deposition of mercury all performed adequately as classifiers or predictors, alone and in combination. Performance of these classifiers showed substantial regional variation, suggesting that other factors, or different regional relationships between our predictors, were drivers of this variation.

### **84 Hylton & Simons**

Mercury contaminating high elevation songbirds in Great Smoky Mountains National Park. REBECCA A. HYLTON and TED R. SIMONS, *USGS Coop. Res. Unit, Dept. Zool., North Carolina State Univ., Raleigh, NC*.

Mercury contamination is a primary threat to Great Smoky Mountains National Park due to its high deposition rates, tendency to bioaccumulate, and because relatively little is known about its role in the terrestrial system. This was the first of 3 yr of study investigating the status and effects of mercury toxicity to high elevation songbirds in the Southern Appalachians. We collected 223 feather samples from 21 species of songbirds passively mist netted at 6 high elevation sites in summer 2006. Feathers collected in 2006 had an average total mercury load of 476  $\mu\text{g}/\text{kg}$  (range 18 - 1,548  $\mu\text{g}/\text{kg}$ ,  $n = 219$ ). Total mercury loads were significantly higher in juvenile versus adult birds when all species were combined ( $p = 0.02$ ). Feather mercury loads (mean  $\pm$  SE) in juvenile Dark-eyed Juncos ( $557 \pm 44 \mu\text{g}/\text{kg}$ ,  $n = 53$ ) were significantly higher compared to adults ( $351 \pm 28 \mu\text{g}/\text{kg}$ ,  $n = 50$ ,  $p < 0.0001$ ). Feather mercury levels in juveniles of 10 high elevation resident species ( $528 \pm 32 \mu\text{g}/\text{kg}$ ,  $n = 99$ ) were not significantly higher than those in juveniles of 11 high elevation migrant species ( $455 \pm 17 \mu\text{g}/\text{kg}$ ,  $n = 43$ ,  $p = 0.18$ ). Species with the highest feather mercury loads ( $>1000 \mu\text{g}/\text{kg}$ ) included Winter Wrens, Veery, Dark-eyed Junco, Canada Warbler, Golden-crowned Kinglet, Song Sparrow, Black-throated Blue Warbler, and Brown Creeper. Understanding the role of mercury in terrestrial systems could have world-wide implications as data on this topic are extremely limited, and could provide the basis for establishing new environmental thresholds.

### **85 Condon & Cristol**

Mercury levels in independent fledgling songbirds. ANNE M. CONDON and DANIEL A. CRISTOL, *Dept. Biol., Coll. William & Mary, Williamsburg, VA*.

Adult song birds breeding along the contaminated South River, VA, have elevated blood mercury compared with birds on reference sites. However, nestling blood mercury levels are an order of magnitude lower than adult levels. It has been suggested that mercury levels in nestling birds are low because circulating mercury enters growing feathers; however, direct demonstrations of this

phenomenon in free-living birds on a contaminated site are lacking. We hypothesized that there would be an increase in blood mercury levels after fledging, when feather growth is complete and plumage can no longer serve as a reservoir for toxic mercury. We predicted that the rise in mercury would be due to the completion of feather growth, and not the result of a dietary shift to a higher trophic level. Here, we report mercury levels for repeatedly sampled independent hatch-year Eastern Bluebirds as feather growth ceased. As predicted, blood mercury rose steadily after fledging, reaching a peak value when there was no visible feather growth. Birds that were sampled after the onset of first prebasic molt exhibited declining blood mercury levels. This is the most direct demonstration yet that feather growth reduces blood mercury. The fitness effects of the increase in mercury post-fledging requires further study, and will impact species differently depending on their dispersal habits and molt schedule.

#### **86 Cristol & Evers**

Discussion: research priorities for the study of mercury in avian food webs. DANIEL A. CRISTOL, *Dept. Biol., Coll. William & Mary, Williamsburg, VA*, and D. C. EVERS, *BioDiversity Res. Inst., Gorham, ME*.

No abstract

#### **87 Vitz & Rodewald**

Does habitat use influence survival of post-fledging mature-forest birds? ANDREW C. VITZ and AMANDA D. RODEWALD, *School Environ. & Nat. Res., Ohio State Univ., Columbus, OH*.

Although mortality rates during the post-fledging period can be extraordinarily high, selection of habitat providing dense cover may substantially increase survivorship. From 2004 - 2006, we radio-tagged 50 Worm-eating Warblers and 52 Ovenbirds from the nest in se. Ohio. In addition, we radio-tagged and experimentally translocated 85 independent juvenile Ovenbirds captured in regenerating clearcuts. We found that post-fledging survivorship was 69% for Ovenbirds (51 d) and 73% for Worm-eating Warblers (31 d), with the overwhelming cause of mortality being depredation. Fledglings of both species used habitat with more saplings than either nest or random locations, presumably a result of selecting protective cover to maximize their survival probability. Furthermore, survival for both species was positively associated with sapling density at documented bird locations. In contrast to young fledglings, little mortality (<5%) occurred on independent juvenile Ovenbirds. Despite this, there is some evidence that habitat use influences their survivorship. Independent juveniles tended to move extensively across the landscape using forests in a range of seral conditions. Our results, in accord with studies on other songbirds, indicate high post-fledging mortality. In addition, this research suggests that managing for specific vegetative characteristics of post-fledging habitat has the potential to increase juvenile survivorship.

#### **88 Rush, Cooper & Klaus**

Fire on the mountain: upland fire and its effects on songbirds in the southern Appalachian Mountains. SCOTT A. RUSH, ROBERT J. COOPER, *Warnell School For. & Nat. Res., Univ. Georgia, Athens, GA*, and NATHAN KLAUS, *Georgia Dept. Nat. Res., Atlanta, GA*.

Within the se. U.S., where fire regimes are well understood in such systems as the longleaf pine (*Pinus palustris*) ecosystem, fire has been demonstrated to play a vital role in sustaining community diversity and in providing habitat for wildlife. However, within upland hardwood ecosystems the historic frequency of fire remains less understood, leaving restoration of fire regimes controversial and effects on wildlife largely unknown. As a result, questions such as appropriate fire intensity, season, and return interval remain. Our research attempts to address how fire intensity and fire frequency affects songbirds in the Southern Appalachians. Through point count surveys and vegetation measurements we identified changes in species abundance and habitat use in relation to fire intensity and time since the occurrence of fire. Our results suggest that early successional songbirds, a group currently showing declines, such as the Eastern Towhee and Golden-winged Warbler, benefit from intense fire. For mature forest species, such as the Ovenbird, Worm-eating Warbler and Wood Thrush, fire effects varied by species. Drawing reference from our study, we will discuss the implications of fire on habitat change and species-specific response, thus providing insight into the development of fire regimes given current conservation strategies.

## 89 Stodola, Zehnder, Cooper & Hunter

Bird predation on oak herbivores along an environmental gradient. KIRK W. STODOLA, *Warnell School For. & Nat. Res., Univ. Georgia, Athens, GA*, CARALYN B. ZEHNDER, *Inst. Ecol., Univ. Georgia*, ROBERT J. COOPER, *Warnell School For. & Nat. Res., Univ. Georgia*, and MARK D. HUNTER, *Dept. Ecol. & Evol. Biol., Univ. Michigan, Ann Arbor, MI*.

We explored relationships among foliar quality of oak trees, herbivore densities, and bird predation on a gradient in elevation in the southern Appalachians. In particular, we were interested in whether bottom-up effects (foliar quality), top-down effects (bird predation), site-specific effects, or their interactions primarily drive herbivore abundance. We used an information-theoretic approach to investigate alternative models associated with our major hypotheses. Six sites were selected at periodic intervals along an elevational gradient (783 - 1566 m) in w. North Carolina. At each site, we chose 20 red oak (*Quercus rubra*) saplings. Ten trees were randomly assigned to the bird enclosure treatment using cages constructed from PVC and bird netting and ten were uncaged controls. Counts of insectivorous birds showed potentially greater bird predation pressure at higher elevations. Treatment effects varied by site, time, and arthropod group. Cage effect carried a substantial amount of weight of evidence in the phloem feeder models but not in models for leaf chewers and arthropod predators. Overall, there was more support for models with bottom-up effects than top-down effects. The notion of birds as significant drivers of tritrophic relationships in deciduous forests was inconsistent at best.

## 90 Stoleson & Nuttle

Assessing the conservation impacts of forest management on avian communities: what metrics do we use? SCOTT H. STOLESON, *USFS Northern Res. Sta., Irvine, PA*, and T. NUTTLE, *Natl. Aviary, Plttsburgh, PA*.

Population declines in many forest birds have prompted numerous studies to assess the impact of forest management practices on avian communities. Results of those studies typically report the standard community metrics, such as abundance, species richness, and diversity indices. But not all species are of equal conservation concern, therefore none of these metrics adequately gauges conservation impacts of management. We apply the concept of conservation value index (CVI), a ranking based on PIF scores used as a weighting for abundance, to a study of the effects of partial harvest (shelterwood) in an Appalachian oak forest. Shelterwoods supported more individuals and more species than did uncut controls; CVI was even more divergent between communities than other metrics. By partitioning out the conservation value among individual species, we found the species contributing most to CVI differed between treatments, which suggests that the CVI of forests in this region may be maximized by maintaining a mosaic of partially harvested and uncut stands.

## 91 Stutchbury, Eng, Moore, Rush & Burke

Fledgling survival in forest songbirds: going down the drain. BRIDGET J. M. STUTCHBURY, MARGARET ENG, LEVI MOORE, *Dept. Biol., York Univ., Toronto, ON*, SCOTT RUSH, *Warnell School For. & Nat. Res., Univ. Georgia, Athens, GA*, and DAWN BURKE, *Ontario Min. Nat. Res., London, ON*.

Using radiotelemetry, we determined post-fledging survival for 2 species of forest songbird, the Hooded Warbler and the Rose-breasted Grosbeak. We evaluated whether habitats were sources or sinks by estimating annual recruitment as the average number of female offspring fledged from nests per female per season multiplied by post-fledging survival and survival on the wintering grounds (0.68) based on other species. This is conservative, since it does not include mortality during migration. For Hooded Warblers in Pennsylvania, only 19% of fledglings survived to independence. Fragment size did not affect fledgling survival, but annual recruitment was very low (0.20) even in large fragments. In a fragmented landscape in s. Ontario, Hooded Warbler fledgling survival rate was estimated at 70% with the highest survival occurring in the heavy cut logging sites and the lowest in the selection sites. Annual recruitment in this study area was only 0.30, due to low nesting success, which is still not high enough to offset adult mortality. For Rose-breasted Grosbeaks in s. Ontario, fledgling survival rate was 62% and was unaffected by fragment size or logging treatment. Annual recruitment was estimated at 0.38 female young per female. Our estimates of recruitment represent a best case scenario because we did not include migration mortality in our calculation, and we conclude that for both species most sites in these

fragmented landscapes are population sinks.

## 92 Kaiser, Kershner & Garcelon

Importance of boxthorn to nesting San Clemente Sage Sparrows. SARA A. KAISER, ERIC L. KERSHNER, *Inst. Wildl. Stud., San Diego, CA*, and DAVID K. GARCELON, *Inst. Wildl. Stud., Arcata, CA*.

Conservation of critical habitat for threatened and endangered species is essential for their long-term protection and management. The San Clemente Sage Sparrow (*Amphispiza belli clementeae*) is a federally threatened, non-migratory subspecies endemic to San Clemente Island and confined to the lower marine terraces along the western shore when breeding. Their critically low population size was attributed to browsing pressure of their nesting habitat by introduced feral grazers and predators. 20 yr ago, prior to the eradication of goats in 1993 and the initiation of a predator control program in the early 1990's, 31 nests in a single breeding season were found in boxthorn (*Lycium californicum*). From 1999 through 2006, we located 870 San Clemente Sage Sparrow nests in 26 different substrates; 73% in boxthorn. We examined which nest site characteristics influenced nest failure rates and compared nest survival among nest substrates. The risk of nest failure varied annually and was significantly reduced when pairs nested in boxthorn and placed their nests near the center of the shrub. However, we found no significant difference in daily nest survival rates among all nest substrates. Mayfield's nest survival estimate was 65% for nests in boxthorn and 58% for all other non-boxthorn nests. Three times as many nests were built in boxthorn compared to nests built in all other substrates combined. These results suggest that the availability of boxthorn as nesting habitat may be an important factor limiting the distribution and growth of the population.

## 93 With, King & Jensen

Grassland birds are not viable in the largest remaining tallgrass landscape. KIMBERLY A. WITH, *Div. Biol., Kansas State Univ., Manhattan, KS*, ANTHONY W. KING, *Env. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN*, and WILLIAM E. JENSEN, *Dept. Biol., Emporia State Univ., Emporia, KS*.

The Flint Hills of Kansas and Oklahoma -- the largest remaining tallgrass landscape in North America -- is also a heavily managed grassland that supports a major cattle industry. We determined the conservation value of the Flint Hills for several grassland birds (Dickcissels, Grasshopper Sparrows and Eastern Meadowlarks) through an analysis of regional viability. We surveyed populations and monitored nest success at 36 sites encompassing the major management practices of the region. Daily nest-survival rates were used to derive fecundity estimates in an age-structured matrix population model that projected annual population growth rates ( $\lambda$ ) for each species by management type. These local-scale estimates were translated into a region-wide estimate of viability using Monte Carlo simulations that weighted the contributions of different management types and bird habitat preferences to produce probability distributions and likelihood of viability for each species across the region. Based on current trends, Dickcissels are projected to be declining by 20 - 29%/yr, Grasshopper Sparrows by 16 - 27%/yr, and Eastern Meadowlarks by 12 - 24%/yr in the Flint Hills. Current management practices geared toward sustaining the economic viability of this region thus do not support viable populations of these grassland birds.

## 94 Gutzwiller, White, Barrow, Johnson-Randall, Cade & Zygo

Does a landscape's dominant vegetation define the spatial distribution of avian richness? Conservation implications. KEVIN J. GUTZWILLER, JOSEPH D. WHITE, *Dept. Biol., Baylor Univ., Waco, TX*, WYLIE C. BARROW, Jr., LORI JOHNSON-RANDALL, *USGS, Natl. Wetlands Res. Center, Lafayette, LA*, BRIAN S. CADE, *USGS, Ft. Collins Sci. Center, Ft. Collins, CO*, and LISA M. ZYGO, *Magnolia, TX*.

Through effects on abiotic conditions and the resource base for various populations, spatial patterns of a landscape's dominant vegetation are believed to dictate the distributions of the rest of the biota in a system. We tested whether broad-scale patterns of shrubland, the dominant vegetation at 70 Chihuahuan Desert sites, strongly influenced avian richness. Effects were assessed during winter, when resources and abiotic conditions are often limiting for birds. We studied these influences across 2 spatial

extents (1- and 2-km radius areas) during 3 consecutive years. Confidence intervals (90%) for negative-binomial regression coefficients revealed that biologically significant (greater than 20%) changes in richness were associated weakly with major (20%) changes in percent cover, patch density, and in one year-extent combination, patch size variation, but not with major changes in edge density or mean patch size. The broad-scale patterns of shrubland we considered played little or no biologically important role in defining the spatial distribution of avian richness. In our system during winter, information about effects of landscape conditions other than those we studied is needed to inform decisions about landscape-level habitat acquisition, planning, and management.

#### **95 Dingle, Halfwerk & Slabbekoorn**

Geographic variation in song of the Gray-breasted Wood-Wren in relation to habitat-dependent acoustic properties. CAROLINE DINGLE, *Zool. Dept., Univ. Cambridge, Cambridge, UK*, WOUTER HALFWERK, and HANS SLABBEKOORN, *Inst. Biol., Leiden Univ, Leiden, Netherlands*.

Geographic variation in bird song can theoretically reduce or eliminate gene flow between divergent populations, either through male-male competition or female mate choice. Variation in song among populations of a single species can arise due to different environmental selection pressures across habitat types. In particular, differences in ambient noise patterns and sound transmission properties have been shown to shape both temporal and spectral characteristics of song. Here we combined analyses of genetic and vocal divergence with measurements of habitat characteristics, to examine whether song divergence among 2 subspecies of the Gray-breasted Wood-wren (*Henicorhina leucophrys leucophrys* and *H. l. hiliaris*) is related to habitat-dependent selection pressures. Our results confirm that the 2 subspecies are genetically distinct and that their songs differ in both temporal and spectral song characteristics. Although we found no significant differences in transmission properties of the habitats occupied by the 2 subspecies, ambient noise patterns did differ significantly. In habitats occupied by *H. l. hiliaris*, we recorded loud cicada choruses in the high frequency ranges used by *H. l. leucophrys* but not by *H. l. hiliaris*, suggesting that ambient noise patterns have reduced the frequency range with which *H. l. hiliaris* can effectively communicate. Our study provides the first evidence that environmental selection has driven song divergence between 2 genetically distinct subspecies and thus highlights the potential role for ecology in reducing hybridization between divergent populations, a process which may ultimately lead to speciation.

#### **96 Kesler & Walters**

Sex-biased sensitivity to landscape features and social-biased dispersal distance in Red-cockaded Woodpeckers. DYLAN C. KESLER and JEFFREY R. WALTERS, *Biol. Sci. Dept., Virginia Tech, Blacksburg, VA*.

We studied timing, movement distances, and landscape characteristics along dispersal paths used by Red-cockaded Woodpeckers. Dispersal strategies differed among sexes and social classes. Although both sexes made extraterritorial movements that preceded dispersal, males were more likely to return to natal areas after foraging. Extraterritoriality was most frequent during September and October after fledging and in the spring months preceding breeding. Juveniles of both sexes dispersed similar distances, which were greater than distances moved by helpers. Social class differences in dispersal distance are congruent with cooperative breeding hypotheses prescribing that juveniles seek breeding vacancies in the greater environment, whereas helpers delay dispersal to obtain higher quality breeding resources in the natal neighborhood. We also evaluated the influence of forest stand characteristics and landscape features between natal territories and dispersal destinations. Female juveniles and helpers used paths with more forested area and smaller forest gaps, whereas no such effects were identified for males. We suggest that female sensitivity to forest gaps may increase fitness in the vast majority of individuals that disperse as juveniles, and that males might be hindered by sensitivities to landscape features because most disperse as helpers. We further suggest that dispersal that is impeded by forest gaps has the potential to negatively influence population dynamics in managed populations of endangered Red-cockaded Woodpeckers.

**97 Liu & Hill**

A risky position in the early life - hatching failure in relation to laying sequence in Eastern Bluebirds. MARK LIU and GEOFFREY E. HILL, *Dept. Biol., Univ. Auburn, Auburn, AL.*

Most birds start to incubate their eggs right after they complete their clutch. When laying more than one egg in the nest, the earlier laid eggs are exposed to a longer unattended period than the later laid eggs. The earlier laid eggs are exposed to the ambient temperature longer and this causes them to suffer from higher hatching failure. The death of an egg in the early incubation period may be caused by unstable incubation temperature. The sub-optimal and unstable incubation temperature may further induce unsynchronized tissue growth, abnormal development and mortality (Deeming & Ferguson 1992, **Egg incubation**, Cambridge). We are interested in the hatching failure variation among brood as well as the difference among different eggs within the same clutch. In this study, we investigated: 1) the relationship between incubation temperatures and hatching failure. 2) egg laid position and the hatching failure in that specific position. 3) nestling size in relation to hatching asynchrony. The preliminary results indicated that the hatching failure were the highest in the first laid egg and decreased with the laying sequence. We also will address some issues in our presentation, including the seasonal effect in hatching success and the fitness consequence among nestlings in different positions.

**98 Rensel & Schoech**

Nestling stress: correlates and influence on short and long-term survival in the Florida Scrub-Jay. MICHELLE A. RENSEL and STEPHAN J. SCHOECH, *Dept. Biol., Univ. Memphis, Memphis, TN.*

Stress during the nestling period in altricial birds can have important consequences for survival and future reproduction. The aim of this study was to identify patterns associated with physiological stress in nestling Florida Scrub-Jays by measuring baseline levels of the primary avian stress hormone, corticosterone (CORT), in 11-d-old nestlings. We investigated the relationships between CORT and gender, body condition, brood size, hatch order, and hatching span. Approximately one-third of all nestlings sampled had un-detectable CORT levels. Among those individuals with detectable CORT, only body condition at day 11 showed a significant relationship with baseline CORT. Nestlings in better body condition had lower baseline CORT than those in poorer condition. This indicates that individuals in poor condition were physiologically more stressed than those in good condition. Although there was no relationship between CORT and survival to fledging or independence, stressed nestlings were less likely to survive over-winter than nestlings with low baseline CORT. The results of this study suggest that general body condition is an important factor in the determination of stress levels in nestling Florida Scrub-Jays. In addition, stress during development can negatively affect survival.

**99 Huber**

Temporal breeding/molt overlap in Barn Swallows breeding in Argentina and New York. G. H. HUBER, *Cornell Univ., Ithaca, NY.*

Barn Swallows typically initiate and undergo a complete molt on their winter grounds. While some after-hatch-year individuals initiate molt on the summer grounds, there have been no reports of a breeding/molt overlap in Barn Swallows. Research in Argentina shows that such an overlap is widespread in the Argentine breeding population, and that it is significantly correlated with wing aspect ratio variation. These data will be compared with data on molt-breeding overlap from late-breeding-season captures in New York, and the patterns and causes of molt-breeding overlap and its variation in swallows will be reviewed.

**100 Linkhart, Feierabend & Silverman**

A long-term trend toward earlier breeding in Flammulated Owls. BRIAN D. LINKHART, DASHIELL S. FEIERABEND and MAKENDRA N. SILVERMAN, *Dept. Biol., Colorado Coll., Colorado Springs, CO.*

In recent decades, several studies of European birds have documented advances in breeding phenology, and authors have reported strong correlations between these changes and global changes in temperature. However, relatively few studies of North American birds have reported long-term changes in the timing of breeding, perhaps because there are relatively fewer longitudinal studies on this

continent. We examined the long-term variation in the onset of incubation in the Flammulated Owl in central Colorado from 1981 - 2005, in an attempt to elucidate the relationship between changes in breeding phenology and climate change in this migratory species. An examination of data from 110 nests revealed that the Julian date of the onset of incubation declined significantly by 12.2 d over 25 yr, and the mean annual Julian date declined significantly by 10.7 d. These changes were associated with a significant trend during the study period toward increased mean temperatures for the month of May in Colorado, a time period that coincides with the onset of territory defense and courtship in the owls on the study sites. Data from this and other studies suggest that further investigation is warranted to increase understanding of the effects of climate change on the ecology of avian communities.

#### **101 Kaler, Sandercock & Ebbert**

Demography of a recently restored population of Evermann's Rock Ptarmigan. ROBB S. A. KALER, BRETT K. SANDERCOCK, *Dept. Biol., Kansas State Univ., Manhattan, KS*, and STEVE E. EBBERT, *Alaska Maritime Natl. Wildl. Refuge, Homer, AK*.

Translocations are a useful management tool for restoring wildlife species to their native ranges, but require post-release monitoring to determine project success. We report results of a 4-yr study to reestablish a breeding population of Evermann's Rock Ptarmigan on Agattu Island in the Aleutian Archipelago. This endemic subspecies was extirpated from most of the Near Islands by introductions of arctic fox by fur traders, and natural recolonizations did not occur after fox eradication. We translocated 75 ptarmigan from Attu to Agattu over 2003 - 2006, and monitored 35 radio-marked birds (15 resident and 20 translocated) in 2005 - 2006. Transplanted birds quickly moved to the highest elevation sites on the island, and a few birds (<8%) died shortly after release. All surviving transplanted females attempted to nest but initiated clutches later in the season and laid fewer eggs than resident females. Productivity was high; 75% of 28 nests successfully hatched. Brood survival varied among years and was reduced by adverse weather conditions in 2006. Survival rates of radio-marked females from 2005 - 2006 were low (38%) but a majority of the mortalities were among birds translocated in 2005. Returning birds showed strong site fidelity and nested with 300 m of their nest site in the previous year. We conclude that translocations are an effective technique for reestablishing island populations of Rock Ptarmigan. Release site had little effect on translocation success, but we recommend that birds be released near suitable habitat. Our results are encouraging for reestablishment of endemic populations of ptarmigan and landbirds elsewhere in the Aleutian Islands.

#### **102 Pearce**

Historical and contemporary population dynamics of North American merganser species: the value of combining mark-recapture and genetic data. JOHN M. PEARCE, *U.S. Geol. Surv., Alaska Sci. Center, Anchorage, AK*.

Little is known about the habits and ecology of Common, Red-breasted, and Hooded Mergansers. While trend data suggests that all species are stable, if not increasing in North America, our understanding of population status for these species is limited. The 3 species of merganser have different distributions across North America likely because of species-specific nesting habits, rates of dispersal, and responses to the retreat of glaciers 20,000 yr ago. Here, we describe patterns of historical and contemporary population dynamics and show that all 3 merganser species are suitable models for illustrating the benefit of combining mark-recapture and genetic data for examining the following predictions: (1) a high rate of philopatry equals population genetic differentiation, (2) molting and wintering flocks are demographically independent units, (3) reciprocal monophyly is correlated with non-migratory behavior, and (4) survival rates, clutch size, and genetic divergence are possible indicators of past life history strategies.

#### **103 Sandercock, Jensen, Williams & Applegate**

Demographic sensitivity of population change in the Northern Bobwhite: a life-stage simulation analysis. BRETT K. SANDERCOCK, *Div. Biol., Kansas State Univ., Manhattan, KS*, WILLIAM E. JENSEN, *Dept. Biol. Sci., Emporia State Univ., Emporia, KS*, CHRISTOPHER K. WILLIAMS, *Dept. Entomol. Wildl. Ecol.,*

*Univ. Delaware, Newark, DE, and ROGER D. APPLGATE, Tenn. Wildl. Res. Agency, Nashville, TN.*

The Northern Bobwhite is an economically important gamebird that is currently undergoing widespread population declines. Despite numerous field studies, there have been few attempts to model the population dynamics of bobwhites to determine the contributions of different demographic parameters to the variance of the finite rate of population change ( $\lambda$ ). We conducted a literature review to summarize available estimates of demographic parameters for bobwhite and located 320 estimates of nine demographic parameters in 42 field studies. To identify demographic parameters that might be important for management, we used life-stage simulation analysis (LSA) to examine the sensitivity of  $\lambda$  to simulated variation in nine demographic parameters for female bobwhite. Unexpectedly for a short-lived bird, winter survival of adults made the greatest contribution to variance in  $\lambda$  ( $r^2 = 0.44$ ), followed by summer survival, survival of chicks, and the probability of nest success (0.08 to 0.15). Population change was not sensitive to total clutch laid, egg hatchability or to 3 parameters associated with the number of nesting attempts ( $< 0.02$ ). Bobwhite populations were not sustainable for survival rates reported from most field studies and radio-transmitters may have a negative impact on bobwhite survival. Our simulation results indicate that management practices that improve survival from independence to the following breeding season will have the greatest potential benefit for population recovery.

#### **104 Sillett, Peluc, Yoon & Ghalambor**

Annual and seasonal survival of Orange-crowned Warblers breeding on the Channel Islands. T. SCOTT SILLETT, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC*, SUSANA I. PELUC, *Dept. Biol., Univ. California, Riverside, CA*, JONGMIN YOON and CAMERON K. GHALAMBOR, *Dept. Biol., Colorado State Univ., Ft. Collins, CO*.

Statistically rigorous population studies of passerine birds require several years of data because of interannual variation in weather and avian demographic rates. Here, we present a mark-recapture analysis of 5 yr survivorship data for Orange-crowned Warblers (*Vermivora celata sordida*) breeding on Catalina Island, California. Annual rainfall varies dramatically on the Channel Islands, due in part to forcing from the El Niño Southern Oscillation. Annual survival of warblers on Catalina Island covaried with annual rainfall from 2003 - 2007, being lower in dry years and higher in wet years. However, survival during the breeding season did not vary strongly with rainfall. Our results suggest that *V. c. sordida* populations could be at risk from predicted drying and shifts in rainfall regime on the Channel Islands due to climate change.

#### **105 Ruiz-Gutierrez, Gavin & Dhondt**

Effect of sex and forest patch size on survival of the White-ruffed Manakin in southwestern Costa Rica. VIVIANA RUIZ-GUTIERREZ, *Dept. Ecol. & Evol. Biol., Cornell Univ., Ithaca, NY*, THOMAS A. GAVIN, *Dept. Nat. Res., Cornell Univ.*, and ANDRE A. DHONDT, *Lab Ornithol., Cornell Univ.*

Habitat loss and fragmentation are the primary causes for worldwide population declines and species extinctions. In order to make stronger inferences, fragmentation research has shifted to factors directly linked to fitness of populations. These studies have mainly focused on reproductive success in temperate regions. But, reproductive success might not be the main driver of population change in tropical regions, where certain taxa like birds tend to be longer lived. To address these questions, we analyzed the effects of sex and patch size on survival for the White-ruffed Manakin *Corapipo altera* in sw. Costa Rica. All individuals were marked and recaptured in 6 forest fragments from 1994 until 2006. Capture data was analyzed using transient models in MARK software. We expected apparent survival to be higher in males than females given that this is a lekking species. We also expected apparent survival to increase with patch size. We found no significant effect of sex on survival or capture probabilities, suggesting that in disturbed landscapes, males experience increased sources of mortality. We then tested for group effects on survival estimates for all individuals captured in forest patches versus continuous forest. We found that individuals caught in continuous forest had significantly different survival rates from individuals captured in forest patches ( $X^2 = 9.3440$ ;  $df = 1$ ;  $P = 0.002$ ). To further test this effect, we found that patch size significantly increases as a function of apparent survival, with patch size explaining 88% of the variability in survival ( $R^2 = 0.88$ ;  $F = 24.47$ ;  $df = 8$ ;  $P = 0.002$ ).

#### 106 Garvin, Swinnerton, Vanderwerf, Vetter & Breniser

Survival estimates of the endangered Maui Parrotbill *Pseudonestor xanthophrys* and the Maui Alauahio *Paroreomyza montana* in high elevation rainforest of East Maui, Hawaii. JULIA C. GARVIN, KIRSTY J. SWINNERTON, *Maui Forest Bird Recov. Proj., Makawao, HI*, ERIC A. VANDERWERF, *Honolulu, HI*, JOHN P. VETTER and HALEY E. BRENISER, *Maui Forest Bird Recov. Proj., Makawao, HI*.

Hawaiian honeycreepers have suffered serious decline due to habitat loss and degradation and the effects of mosquito-borne diseases, avian malaria and avian pox, such that most populations now only exist in wet and mesic forests above 1500 m elevation. Since 1980 estimates of population size have been derived from point count data, but this survey technique deals poorly with rare species at low densities with variable detectability and spatial abundance. The goals of this study were to estimate survival rates in the endangered Maui Parrotbill and Maui Alauahio using mark-recapture models generated in program MARK, and to develop protocols for collecting data needed for survival analysis as a complementary tool for identifying demographic changes. Annual survival of Maui Parrotbill was higher in adults ( $0.75 \pm 0.03$ ) than juveniles ( $0.47 \pm 0.24$ ). Annual survival of Maui Alauahio was lower ( $0.64 \pm 0.05$ ), reflecting their different life-history pattern that includes higher fecundity. Survival and possibly resight probability of both species varied annually, but temporal patterns were somewhat obscured by variable resighting effort among years. These results provide important baseline data for 2 species of honeycreeper, and the analysis process identified improvements needed in research design for long-term monitoring of these populations.

#### 107 Hobson, Greenberg & Mettke-Hofmann

Historical population shifts and a migratory divide in Rusty Blackbirds. KEITH A. HOBSON, *Environ. Canada, Saskatoon, SK*, RUSS GREENBERG and CLAUDIA METTKE-HOFMANN, *Smithsonian Inst., Washington, DC*.

Rusty Blackbird (*Euphagus carolinus*) populations have declined dramatically in North America but causes for their decline are not clear. We investigated the historical population distributions of breeding Rusty Blackbirds by determining feather deuterium ( $\delta D$ ) values ( $n = 199$ ) for museum specimens spanning the last hundred years. We then compared this distribution with current breeding origins from birds sampled across their wintering grounds ( $n = 150$ ) in 2005 and 2006. A clear shift in breeding or natal origins from the southern boreal to the northwest has occurred. In addition, birds wintering on the east side of the Appalachians in South Carolina originated from breeding sites in ne. U.S. and se. Canada confirming a putative migratory divide. Our study demonstrates the utility of retrospective sampling using stable isotope methods and we discuss the conservation implications of these results.

#### 108 Ross & Bouzat

Philopatry and the migratory divide: does geographic isolation matter to long-distance migrants? JEREMY D. ROSS and JUAN L. BOUZAT, *Bowling Green State Univ., Bowling Green, OH*.

Geographic variation in quantifiable traits can be used to infer past and present evolutionary processes within natural populations. Often this information serves to resolve taxonomic uncertainty and to guide conservation efforts. For many Neotropical migrant passerines such comparisons are complicated by recent speciation and temporal mixing of populations, most obviously during migration. In this study, we examine species history and infer conservation needs within the Lark Sparrow through the incorporation of multiple lines of evidence. We analyzed neutral genetic, morphological and territorial song measures for concordant signatures of structuring within the species, particularly amongst putative migratory flyways. Partitioning of mitochondrial control region variation was non-random, with significant  $F_{ST}$  values observed between flyways (W vs C = 0.078; C vs E = 0.025; W vs E = 0.078). Morphology supported flyway divergence, with discriminant function analysis showing significant differentiation between flyways ( $P < 0.0001$  all comparisons), a finding supported by analysis of museum specimens. Finally, song analysis indicated much greater sharing within flyways ( $47 \pm 3\%$  sharing) than between flyways ( $3 \pm 1\%$ ) suggesting regional dialects. Overall, all traits measured showed significant structuring within *C. grammacus* supporting a hypothesis of restricted interchange amongst flyways. This finding is relevant to the conservation of the species within the eastern flyway, where it has declined over the past century. Finally, our findings indicate that capability for long-distance flight does not necessarily

equate to widespread dispersal, a finding relevant to understanding the evolution and conservation of migratory species.

**109 Washburn, Neiman, Taylor, Norris-Caneda, Strand & Meyer**

Is cryptic cladogenesis facilitated by migration in the Swallow-tailed Kite? AUDREY WASHBURN, *Dept. Wildl. Ecol. Cons., Univ. Florida, Gainesville, FL*, MAURINE NEIMAN, *Dept. Biol., Univ. St. Thomas, Saint Paul, MN*, DOUGLAS R. TAYLOR, *Dept. Biol., Univ. Virginia, Charlottesville, VA*, KIM NORRIS-CANEDA, *South Carolina Center Birds of Prey, Charleston, SC*, ALLAN E. STRAND, *Dept. Biol., Coll. Charleston, Charleston, SC*, and KENNETH D. MEYER, *Avian Res. Cons. Inst., Gainesville, FL*.

In spite of great vagility, extensive interaction throughout their trans-equatorial range, and morphologic monotypy, there are deep genetic divisions in the Swallow-tailed Kite (STKI). Using neutral mitochondrial and nuclear markers we found no evidence of gene flow among populations that could be attributed to migratory behavior. STKI populations have apparently maintained their isolation throughout glacial cycles and accompanying range changes, eventually resulting in a distribution where a large neotropical population composed of residents and short-distance migrants is bordered to the north and south by smaller temperate-breeding populations of long-distance migrants. This study supports the hypothesis that long-distance migration can enable speciation and demonstrates that migratory behavior does not necessarily hinder differentiation or result in panmixia. We consider potential isolating mechanisms and constraints to gene dispersal when population interaction is common, interbreeding is possible (one event documented), and natal philopatry appears too weak to produce genetic divisions within, let alone among, populations. Our results suggest that a cryptic pattern of genetic divergence can arise in long-distance migratory species whereby movements and breeding locations are flexible as migration patterns evolve, gene flow ceases as migratory patterns become specialized, populations continue to interact, and morphologic distinctions do not develop. Long-distance migration would facilitate divergence by allowing (1) displacement of populations in space and/or time for part of the year, (2) stabilizing selection that limits behavioral plasticity during migration, precluding gene flow and (3) interaction among populations that reinforces mating discrimination.

**110 Cibois, Thibault & Pasquet**

Divergent colonizations of a remote Pacific archipelago by two passerine families. ALICE CIBOIS, *Nat. Hist. Mus., Geneva, Switzerland*, JEAN-CLAUDE THIBAUT, *Nat. Reg. Park, Corsica, France*, and ERIC PASQUET, *Natl. Nat. Hist. Mus., Paris, France*.

Very few groups of landbirds have successfully colonized one of the most remote archipelagos of the Pacific Ocean, the Marquesas (French Polynesia). Only 2 groups of passerine birds inhabit these islands today: reed-warblers (Acrocephalidae) and monarch flycatchers (Monarchidae). Both groups have colonized all the main islands of the archipelago, although several populations of monarchs are now extinct. We present here the evolution pattern of both groups based on molecular phylogenies. First, our results suggest that monarchs derived from a single colonization event followed by speciation in the different islands. The timing of monarch evolution was moreover consistent with the sequential appearance of the Marquesas islands (from 5.8 to 1.3 Ma). This scenario contrasts with the evolutionary pattern found for Acrocephalus reed-warblers, which have successfully colonized the archipelago at least twice. Our data indicate that 2 independent reed-warblers lineages have reached the archipelago more or less simultaneously at ca. 0.6 Ma, much more recently than the islands' formation. Thus, the endemic reed-warblers and monarch flycatchers have colonized the archipelago at a completely different pace and no general trend has emerged from the history of the 2 groups.

**111 Bowie & Fjeldså**

Comparative phylogeography of Eastern Arc Mountain (Tanzania) birds. RAURI C.K. BOWIE, *Mus. Vert. Zool. and Dept. Integrat. Biol., Univ. California, Berkeley, CA*, and JON FJELDSÅ, *Zool. Mus., Univ. Copenhagen, Copenhagen, Denmark*.

The Eastern Arc Mountains of Tanzania represent one of the main centres of endemism for

African birds. Thanks to an intensive collecting effort in recent years it is now possible to study processes of coalescence and gene flow within and among populations. Our studies reveal a complex pattern of population structure at many levels of evolutionary time. Certain lineages may predate the montane uplift of the upper Miocene, whereas for others, dating suggests a much more recent differentiation, with no single coherent geographical pattern of vicariance. However, most datasets do support a north-south divide, between the Usambara and Nguru Mts. Many traditionally recognised species are comprised of genetically distinct lineages, suggesting high population persistence in certain areas of climatic stability and topographic diversity, and rather rare opportunities for interchange between areas. Implications for our understanding of the role of climatic cycles in generating species diversity are discussed in the context of African montane biogeography.

#### **112 Spellman, Cicero, Winker & Klicka**

Clarifying the evolutionary history of a morphologically diverse species: phylogeography of the Steller's Jay. GARTH M. SPELLMAN, *Biol. Dept., Black Hills State Univ., Spearfish, SD*, CARLA CICERO, *Mus. Vert. Zool., Berkeley, CA*, KEVIN WINKER, *Univ. Alaska Mus., Fairbanks, AK*, and JOHN KLICKA, *Barrick Mus. Nat. Hist., Univ. Nevada, Las Vegas, NV*.

Throughout its distribution in the coniferous and mixed-coniferous forests of western North America, the Steller's Jay (*Cyanocitta stelleri*) exhibits considerable geographic variation in phenotype. Instances of overlap and integration of the described forms of Steller's Jay has confounded subspecific classification (currently 16 subspecies are recognized) and hindered the development of hypotheses to explain the processes that have contributed to the evolution of morphological diversity within the species. We present a phylogeographic study of mitochondrial DNA (ND2) variation of the Steller's Jay throughout its range to clarify its evolutionary history. Phylogenetic analyses reveal 4 reciprocally monophyletic clades suggesting that a considerable amount of morphological evolution in the Steller's Jay is the result of allopatric divergence. Bayesian estimation of divergence times indicates the deepest of these splits (3.53 million years ago; 95% C.I. 4.55 - 2.62 MYA; average uncorrected p-distance = 7.13%) predates the onset of the late-Pliocene and Pleistocene glacial cycles. Genetic variation within clades is generally shallow (average within clade nucleotide diversity = 0.00139) suggesting that morphological divergence of populations within clades has occurred recently and rapidly.

#### **113 Lelevier, Miller, Winker, Klicka & Bermingham**

Phylogeography and systematics of a widespread hummingbird genus (*Anthracothorax*). MICHAEL J. LELEVIER, MATHEW J. MILLER, KEVIN WINKER, *Dept. Biol. & Wildl., Univ. Alaska, Fairbanks, AK*, JOHN KLICKA, *Barrick Mus., Univ. Nevada, Las Vegas, NV*, and ELDRIDGE B. BERMINGHAM, *Smithsonian Tropical Res. Inst., Panama City, Panama*.

*Anthracothorax* hummingbirds consist of 7 species which range from s. Mexico to the lowlands of South America as well as most of the West Indies. Mitochondrial DNA (mtDNA) sequence variation from a geographically broad sampling of the genus-wide distribution, suggests many changes to the group's taxonomy, with interesting biogeographic consequences. The West Indian endemic genus *Eulampis* is deeply nested within *Anthracothorax*, and our phylogeny indicates that diversification within *Anthracothorax* may have originated in the West Indies, resulting in subsequent colonization of mainland Central and South America. Black-throated Mango (*A. nigricollis*) and Green-breasted Mango (*A. prevostii*), which have the most extensive distributions in the genus, show extremely low levels of sequence divergence (< 0.002%) between geographically distant populations. Finally, we discuss the taxonomy of the enigmatic Veraguan Mango (*Anthracothorax veraguensis*). Specimens of this species did not have unique mtDNA haplotypes; instead these haplotypes were paraphyletic with respect to *A. prevostii* clade. We discuss the possible implications for species limits considering our recent collections in sw. Panama.

#### **114 Chesser, Isler & Reed**

Comparative phylogeography in three species of Amazonian *Myrmotherula* antwrens. R. T. CRESSER, *USGS Patuxent Wildl. Res. Center, and Natl. Mus. Nat. Hist., Washington, DC*, M. L. ISLER, *Bird Div., Natl. Mus. Nat. Hist., Washington, DC*, and J. L. REED, *USGS Patuxent Wildl. Res. Center, Washington*,

DC.

Patterns of genetic variation were studied in 3 species (or species groups) of *Myrmotherula* antwrens: *M. longipennis*, *M. menetriesii*, and *M. guttata/hauxwelli*. These species are largely endemic to and widely distributed in Amazonian rainforest, their ranges extending north to the Guianan Shield. Current taxonomy recognizes 6 subspecies within *M. longipennis*, 5 within *M. menetriesii*, and 3 within *M. guttata/hauxwelli*, with most subspecific boundaries demarcated by major rivers. Preliminary results indicate that *M. longipennis* and *M. guttata/hauxwelli* show a similar general pattern of differentiation: in both, populations in the Guianan Shield and ne. Amazonia, north of the Amazon, are sister to and highly divergent from all other sampled populations. In *M. menetriesii*, genetic divergence is lower and the pattern of genetic variation appears to differ. Comparisons to current taxonomy indicate that populations represented by most subspecies are probably genetically distinct and that there may be further unrecognized genetic units. Results will be compared to those of other phylogeographic studies of Amazonian birds and implications for the generation of avian diversity in Amazonia will be discussed.

### 115 Barrowclough, Groth & Jablonski

Phylogeography of the Tepui Brush Finch (*Atlapetes personatus*): Tepuis as islands. GEORGE F. BARROWCLOUGH, JEFF G. GROTH and BARTEK JABLONSKI, *Am. Mus. Nat. Hist., New York, NY*.

The Tepui Brush Finch has a fragmented distribution in upper tropical and temperate vegetation on tepuis and similar geological structures in Venezuela and adjacent regions of Brazil and Guyana. Unsuitable habitats, such as tropical lowland forest and savannah grasslands, separate the populations. We sequenced 4 mitochondrial genes to determine the extent of isolation and genetic divergence between population samples. The finches were composed of 3 divergent genetic clades whose geographical distributions were concordant with major subspecies groups based on morphology; these represent 3 species. Gene flow between populations within the subspecies groups was essentially non-existent for samples more than 100 km apart. The geographical origin of the Tepui Brush Finch is uncertain due to heterogeneity of base composition in these mitochondrial genes.

### 116 Wilson & Arcese

Patterns of genetic structure among island populations of Song Sparrows. A. G. WILSON and P. ARCESE, *Centre Appl. Conserv. Res., Univ. British Columbia, Vancouver, BC*.

Relatively little is known about the extent of genetic divergence of species on North Pacific Coast islands. In fact, there are several endemic avian subspecies on Vancouver Island, yet to date there have been no studies explicitly evaluating the genetic distinctiveness of Vancouver Island avifauna from the mainland populations. Vancouver Island is connected to the mainland by 2 archipelagos: the Southern Gulf Islands and Broughton Archipelago. These archipelagos provide an island matrix, allowing stepping-stone migration, which reduces the necessary distance of open sea crossings. Even if the archipelagos allow for an immigration rate that is sufficient to prevent divergence, the stepping-stone colonization route should still have genetic consequences. We collected genetic samples from 500 birds across populations on Vancouver Island, British Columbian mainland and multiple islands in the Haro Strait, and genotyped these individuals at 8 microsatellite loci. Using a standardized measure of genetic differentiation, the divergence of Vancouver Island from the mainland was approximately  $\Phi_{CT} = 0.02$ . Compared to the British Columbian mainland populations, allelic richness on Vancouver Island declined by 4%, while allelic richness in populations on small islands in the Southern Gulf Islands declined by 13% to 16%, as compared to Vancouver Island and the British Columbia mainland respectively. We also present results on patterns of spatial genetic structure.

### 117 Skrade & Dinsmore

Movement of Mountain Plovers within and between breeding seasons. PAUL D. B. SKRADE and S. J. DINSMORE, *Dept. Nat. Res. Ecol. & Manage., Iowa State Univ., Ames, IA*.

The Mountain Plover breeds on Black-tailed Prairie Dog (*Cynomys ludovicianus*) colonies in Phillips Co., Montana. They have an unusual mating system that raises questions about sex-specific movements within and between breeding seasons as they relate to nest fate. We studied nesting plovers

from 1995 - 2006, determined the fate of >1300 nests, and examined movements of plovers that nested in successive years. A total of 48 plovers moved within years and another 166 moved between years. Within years, mean distance moved was 5.35 km (SD = 9.86) for females and 7.08 km (SD = 12.69) for males and did not differ ( $t = -0.53$ ,  $P = 0.60$ ). Between years, mean distance moved was 4.54 km (SD = 8.53) for females and 2.13 km (SD = 5.05) for males and differed ( $t = -3.07$ ,  $P < 0.01$ ). By fate, unsuccessful nesters moved farther than successful nesters the next breeding season ( $t = 2.92$ ,  $P < 0.01$ ). These results provide insight into the relationship between nest fate and fidelity and relate these to gender in a species with unusual parental roles.

#### **118 Doherty & Heath**

Factors affecting Piping Plover hatching success on Long Island. PAUL J. DOHERTY, *Biol. Dept., Hofstra Univ., Hempstead, NY*, and JULIE A. HEATH, *Dept. Biol., Boise State University, Boise, ID*.

Piping Plovers nesting on many Long Island beaches have poor hatching success (63% of eggs) compared to historic records (91%; Wilcox 1959, *Auk* 76: 129 -152) and, despite management efforts and population increases, overall productivity has failed to reach population recovery goals. We evaluated whether egg viability or nest disturbance affected hatching success and whether cause of egg failure varied by nest fate. Un-hatched eggs from abandoned nests were viable, but un-hatched eggs from mixed-fate nests tended to be infertile or not properly developed. Plover pairs at abandoned nests experienced significantly higher nocturnal disturbance, but not diurnal disturbance, than successful pairs. These results indicate that nest abandonment may be a result of an elevated stress response to predation risk within close proximity to the nest (e.g., a fox circling an enclosure) not human activity outside of string fenced buffers. In 2006, we did not find plover parental behavior patterns, such as changes in nest attendance or defense behavior that would indicate the ultimate fate of a nest. In 2007, we will continue our study and use infrared digital video cameras to film plover nests at night. We will examine nocturnal incubation behavior and hope to document the interactions that result in plover nest abandonment. Results thus far are intriguing and have implications regarding enclosure use and exploring possible routes of environmental contamination.

#### **119 Aldredge, Bowman, Boughton, Bridge & Schoech**

Scrub-jays vary onset of incubation to minimize hatching failure. ROBERT A. ALDREDGE, REED BOWMAN, RAOUL K. BOUGHTON, *Archbold Biol. Sta., Lake Placid, FL*, ELI S. BRIDGE and STEPHAN J. SCHOECH, *Univ. Memphis, Memphis, TN*.

Hatching failure may significantly reduce fitness in birds, affecting approximately 10% of all avian eggs. The egg viability hypothesis predicts that prolonged exposure to ambient temperatures prior to incubation increases hatching failure. We studied the effect of differences in ambient temperature and clutch size on hatching failure between Florida Scrub-Jay populations in suburbs and wildlands. The suburban site was warmer, and suburban jays lay larger clutches with higher rates of hatching failure. We tested two predictions of the egg viability hypothesis: 1) hatching failure should be greatest in first-laid eggs and this pattern should be strongest in the suburbs where temperatures are warmer and clutch sizes larger and 2) hatching failure should increase as the season progresses because of a concurrent increase in ambient temperatures. We found that first-laid eggs in the suburbs had higher hatching failure than in the wildlands; however, hatching failure did not increase with advancing season but stayed relatively constant. At both sites, jays initiated incubation earlier as the season progressed, possibly to reduce exposure of first-laid eggs to warmer ambient temperatures. Hatching failure was negatively correlated with onset of incubation, independent of clutch size. Thus, the egg viability hypothesis helps explain variation in hatching failure between sites, but females appear to alter their incubation behavior to minimize hatching failure.

#### **120 Allen, Nuechterlein & Buitron**

Wave effects on Western Grebe nest survival. JOSEPH H. ALLEN, GARY L NUECHTERLEIN and DEBORAH BUITRON, *Dept. Biol. Sci., North Dakota State Univ, Fargo, ND*.

Western Grebes commonly nest in wetlands subject to high wave action causing substantial nest losses. We studied a colony of western grebes in western Minnesota. Wave action was the most

important factor in determining nest success in our study site. Location within the colony was best predictor of nest survival. Nests located in the center and away from the prevailing wave direction were more likely to survive strong storms and hatch young. Vegetated distance between the nest and the outer most impacted edge of the colony was the most important predictor of nest survival following a wind storm. Density of bulrush surrounding the nest in itself was not an important predictor. Storm frequency can strongly impact overall colony success. We found nearly a 50% decline in nest success when comparing a year of low windstorm frequency to one of high storm frequency. The importance of bulrush wave attenuation and nest platform survival also was verified in a separate wind-exposure experiment using artificial nests.

### **121 Kuehn, Tewksbury & Segal**

Do male Yellow Warblers tradeoff parental effort for mating effort? MICHAEL J. KUEHN, *Dept. Ecol., Evol. & Marine Biol., Univ. California, Santa Barbara, CA*, JOSHUA J. TEWKSBURY, *Dept. Biol., Univ. Washington, Seattle, WA*, and MAX T. SEGAL, *Dept. Ecol., Evol. & Marine Biol., Univ. California, Santa Barbara*.

Male parents can increase their seasonal reproductive output in two ways; by increasing the survival of their current offspring with parental effort, or by increasing their number of offspring with additional mating effort. Male Yellow Warblers often have opportunities to obtain extra-pair fertilizations (EPFs) while providing parental care at the nest they share with their social mate. Theory predicts that lower levels of male care should occur when the benefit of pursuing EPFs is sufficiently high. We assessed levels of parental care by male warblers (mate-feeding rates) and nest attentiveness (% of time spent incubating) of their female mates once on the first day of incubation and again 4 d later. We found that male mate-feeding rates were negatively correlated with the number of fertile (i.e., nest-building or egg-laying) female neighbors at both sample points. In addition, female nest attentiveness was positively correlated with the mate-feeding rate of their male. We also assessed changes in the mate-feeding rates of male warblers between the early and middle incubation period and found that males tended to increase mate-feeding rates when there was a reduction in mating opportunities over this period. Our results support a tradeoff between parental effort and mating effort in this species, whereby reduced parental effort by male warblers may be costly, but male willingness to accept these costs increases as the benefits associated with the pursuit of alternative reproductive strategies increase.

### **122 Coe**

Male provisioning may buffer incubating females from the influence of low temperatures on nest attendance. SHARON J. COE, *Dept. Biol., Univ. California, Riverside, CA*.

Incubation of eggs can impose a high energetic cost. Male provisioning of the female at the nest in species with female-only incubation is considered to be an important contribution to the energetics of the female (female nutrition hypothesis), since it has been positively correlated with the proportion of time a female spends on the nest, and negatively correlated with the length of the incubation period. Male provisioning rate also has been inversely related to ambient temperature. In 2005, Mountain Chickadees breeding in nestboxes ( $n = 26$ ) were recorded for a 4-hr period during incubation. Average temperatures in nestboxes during this period ranged between 5° C and 20° C. Unlike prior studies, mean on-bout duration of incubating females was not significantly correlated with nestbox temperature, nor with the frequency of male incubation feeding ( $P > 0.10$ ). However, the frequency of male feeding and nestbox temperature were inversely correlated ( $P = 0.04$ ). Furthermore, an overall regression model relating female mean on-bout duration to nestbox temperature, provisioning rate, and their interaction was significant ( $P = 0.009$ ), as was the interaction term ( $P = 0.004$ ). The interaction explained approximately 30% of the variation in mean on-bout length. These results suggest that male incubation feeding may be compensatory, allowing the female to remain on the nest longer during periods of low temperature.

### **123 Bakermans, Rodewald & Rengifo**

Migratory birds in shade coffee plantations and primary forest in the Venezuelan Andes – with an emphasis on Cerulean Warbler. MARJA H. BAKERMANS, AMANDA D. RODEWALD, *Environ. & Nat.*

*Res., Ohio State Univ., Columbus, OH. and C. RENGIFO, Dept. Biol., Univ. of the Andes, Venezuela.*

The foothills of the Andes Mountains are one of the most rapidly deforested zones in the Neotropics, decreasing available habitat to migrants at astounding rates. At the same time, one agricultural land use, shade coffee plantations, may provide high quality habitat to overwintering migrants. Indeed, studies have documented high use of migratory birds in shade coffee plantations during the nonbreeding season. Few studies, however, have compared the suitability of shade coffee compared to primary forest for migratory birds. Our research examines density, flock membership, and condition of wintering Neotropical migrants in both shade coffee plantations and primary forest. We placed additional emphasis on Cerulean Warblers as a focal species and examined its overwinter persistence and return rate in shade coffee plantations. Data were collected during the winters of 2005 - 2006 and 2006 - 2007 on the western slope of the Venezuelan Andes. Preliminary results !

indicate that migrant density in shade coffee plantations was 3 - 11 times higher than in primary forest. In particular, Cerulean Warblers had 11 times greater densities in shade coffee plantations ( $D = 2.10$  birds/ha) compared to primary forest ( $D = 0.18$ ). Furthermore, Cerulean Warblers exhibited high condition, overwinter persistence, and site fidelity indicating that shade coffee plantations may provide vital wintering habitat for Cerulean Warblers and other Neotropical migrants.

#### **124 Chandler, King, Arce Chavez, Chandler, Raudales & Trubey**

Evaluation of a novel coffee cultivation system, "Integrated Open Canopy", on avian species richness, composition and condition in Costa Rica. RICHARD B. CHANDLER, *Dept. Nat. Res. Conserv., Univ. Massachusetts, Amherst, MA*, DAVID I. KING, *USDF For. Ser. Northern Res. Sta., Amherst, MA*, VICTOR JULIO ARCE C., *Cooperativa Montes de Oro, Miramar, Costa Rica*, CARLIN C. CHANDLER, *Dept. Nat. Res. Conserv., Univ. Massachusetts, Amherst, MA*, RAUL RAUDALES and RICH TRUBEY, *Mesoamerican Develop. Inst., Lowell, MA*.

Shade coffee has been promoted as an agricultural practice that can mitigate the negative impacts of forest conversion. However, species composition typically differs between shade coffee and intact forest, many species that occur in shade coffee depend upon adjacent unprotected forest, and many species of conservation concern do not occur in shade coffee. Fitness can also be lower in disturbed habitats such as shade coffee compared to intact forest. Preliminary data from research in Costa Rica suggest that conservation and economic limitations of shade coffee may be overcome by growing coffee in small patches with no shade requirement adjacent to preserved forest, a practice we term "Integrated Open Canopy" (IOC) coffee. This method of coffee cultivation is already being practiced in Mesoamerica because coffee yield is high, labor costs are low, and the microclimatic conditions created by the retention of surrounding forest enhances coffee health. We measured bird species richness and physical condition among primary forest, commercial polyculture shade coffee, and IOC coffee at 21 sites during Nov - Mar, 2006 and 2007. We capture 1564 individuals of 127 species. Species richness was similar between IOC and shade coffee, but the latter hosted fewer forest-dependent species. These results indicate that the conservation and restoration of native habitats should be a top priority in tropical agricultural landscapes. If IOC coffee were to receive "environmentally friendly" certification, this would add to the incentives of higher yields and lower costs of IOC coffee while benefiting migrant and resident bird populations via forest conservation.

#### **125 Boyle**

Does food limitation explain altitudinal migration of manakins? W. ALICE BOYLE, *Dept. Ecol. & Evol. Biol., Univ. Arizona, Tucson, AZ*.

The causes of bird migration are well-studied at proximate levels but poorly understood at ultimate levels. Among tropical frugivorous birds, migration is thought to have evolved in the context of exploiting peaks in fruit abundance among locations and seasons. However tests of this hypothesis have used inappropriate metrics to compare fruit production among locations and seasons, and have failed to explain why some but not all individuals migrate. I tested two hypotheses based on fruit and protein limitation to explain both uphill and downhill migratory movements of a Costa Rican understory frugivorous bird, the White-ruffed Manakin (*Corapipo altera*). I also examined variation in migratory behavior among individuals by comparing diets, sex ratios, and body conditions of *C. altera* at 3 different

elevations throughout the year. My results are consistent with the hypothesis that *C. altera* migrate uphill to exploit seasonal and spatial peaks in fruit availability, and are inconsistent with the protein limitation hypothesis. However, differences in food abundance among elevations cannot explain downhill migration in this species. These results, combined with rainfall patterns, evidence for sex-biased migration, and differences between sexes in body condition of migrants and residents suggest that limited foraging opportunities could explain why birds migrate downhill. Most importantly, this study is the first to provide a conceptual and empirical link between interspecific and intraspecific explanations for bird migration.

#### **126 Gasner, Rabenold, Kyle, Jankowski & Ciecka**

Prospects for change in endemic populations within a tropical highland community. MATTHEW R. GASNER, KERRY N. RABENOLD, KEILLER O. KYLE, *Dept. Biol., Purdue Univ., West Lafayette, IN*, JILL E. JANKOWSKI, *Dept. Zool., Univ. Florida, Gainesville, FL*, and ANNA L. CIECKA.

Climate change is expected to drastically affect biotic communities within tropical montane regions. A lack of basic population-level data prevents assessment of the severity and timing of this change. We gathered population-level data during a 6 yr regional survey on the Pacific slope of the Tilarán mountains, Costa Rica, to assess extinction risk. 35% of 103 forest-interior species detected during our 2003, 2006, and 2007 point-count surveys are endemic to Central America. Endemics are not only geographically restricted, but tend also to occupy few sites and have low abundance in our study area. The lower range limits of many endemics are concentrated in a poorly protected transition zone between cloudforest and rainshadow forest. Data suggest endemics and other highland species will be sensitive to changes in climate creating conditions similar to edge-effects within interior forests. Consequently, projections of response to 100-yr changes in temperature illustrate 63% of species endemic to Central America, and 90% of Costa Rica and Panamá endemics will become locally extinct if current temperature-distribution patterns are followed. Extinctions may occur earlier if the local climate system rapidly decreases moisture deposition via cloud-bank lifting. Variability in measured densities suggest some species are threatened even in extensive primary forest. Compounding factors imply that conservation efforts in tropical highland areas deserve renewed attention.

#### **127 Stouffer, Strong & Bierregaard**

Twenty years of understory bird extinctions from Amazonian rainforest fragments: consistent trends and landscape-mediated dynamics. PHILIP C. STOUFFER, *Louisiana State Univ., Baton Rouge, LA*, CHERYL STRONG, *San Francisco Bay Bird Observ., Alviso, CA*, LUCIANO N. NAKA, *Louisiana State Univ.*, and RICHARD O. BIERREGAARD, Jr., *Univ. North Carolina, Charlotte, NC*.

Near Manaus, Brazil, 11 rainforest fragments were isolated beginning in 1979, then sampled periodically through 2000. Here we consider local extinctions between 1992 and 2000. 42 forest species disappeared from at least one fragment between 1992 and 2000. The assemblage present in at least nine fragments included only 6 species: 3 gap specialist antbirds (*Thamnophilus murinus*, *Hypocnemis cantator*, and *Percnostola rufifrons*), 2 omnivores common in second growth (*Pipra pipra* and *Mionectes macconnelli*), and 1 small woodcreeper (*Glyphorhynchus spirurus*). As expected, extinction rate was higher in 1-ha fragments (30%) than in 100-ha fragments (5%). Local extinction followed a predictable pattern: most species lost from 100-ha fragments between 1992 and 2000 were already lost from smaller fragments by 1992. Species also recolonized fragments between 1992 and 2000. Fragments surrounded by old second growth had both higher numbers of species and lower extinction rates than expected based on fragment size alone. Our results suggest that predictable local extinctions have occurred for at least 20 yr. These extinctions are likely to continue in 100-ha fragments. At the same time, species assemblages in 1- and 10-ha fragments mostly reflect second-growth dynamics by 20 yr after isolation.

#### **128 Mortensen & Curry**

Effects of habitat loss and fragmentation associated with resort development on the social and conservation ecology of the St. Lucia White-breasted Thrasher. JENNIFER L. MORTENSEN and

ROBERT L. CURRY, *Dept. Biol., Villanova Univ., Villanova, PA.*

The White-breasted Thrasher (*Ramphocinclus brachyurus*) is an endangered mimid endemic to the islands of St. Lucia and Martinique. Field study in 2002 - 2004 (H. Temple et al.) established that the population comprises ~600 breeding pairs, 80% of which inhabit dry forest along the east coast of St. Lucia in 2 subpopulations, near Praslin and further north near Petite Anse. This work also revealed that the thrasher is a facultative cooperative breeder. A major resort now under construction is destroying and fragmenting habitat containing up to 37% of the global thrasher population. We have examined the effects of habitat loss associated with resort construction on White-breasted Thrasher social ecology and reproductive success since 2006. We found that cooperatively breeding groups increased from 34% of the population in 2002 - 2004 to 71% in 2006, with group size increasing from 2.4 to 2.9 birds. Mayfield nest success estimates in 2006 were highest in the site adjacent to the resort development, intermediate in fragment nests on the development site, and lowest at a control site ~2 km away. Ongoing study focuses on the role of indirect mechanisms in magnifying overall impacts of habitat loss, as well as the degree of site fidelity of thrashers living in fragments on the development site, and the effects of fragment size on their tendency to maintain territories and group stability. This research advances our understanding of White-breasted Thrasher status and threats on St. Lucia.

### 129 Mercer & Haig

Population genetic structure in the Double-crested Cormorant. DACEY M. MERCER and SUSAN M. HAIG, *USGS-FRESC and Oregon State Univ., Corvallis, OR.*

Management of Double-crested Cormorants (*Phalacrocorax auritus*) varies widely across North America according to local perceptions rather than relative population status. An understanding of population genetic structure is necessary for delineating appropriate management units. 4 subspecies of Double-crested Cormorants have been described: *P.a. auritus* breeds in the interior and northeast; *P.a. cincinatus* breeds in Alaska; *P.a. albociliatus* breeds along the Pacific coast from British Columbia to Baja California; and *P.a. floridanus* is resident in the southeast. We examined genetic structure of Double-crested Cormorants in North America to quantify variation within and among breeding areas and to test for presence of distinct populations. Sequences from the mitochondrial control region were analyzed for 167 individuals from 16 breeding areas. The mtDNA data provided evidence that genetic variation is high across breeding areas. Population genetic analyses indicated the presence of genetic structure: (1) global estimates of  $F_{ST}$  and its analogs were significant; (2) many estimates of  $F_{ST}$  for pairwise comparisons involving western and eastern areas were significant; (3) comparisons between Alaska and all other areas were significant; and (4) a priori groupings of sites were supported by AMOVA. Results suggest regional population differentiation and indicated the Alaskan breeding area as distinct.

### 130 Cheviron & Brumfield

Environmental correlates of population genetic structure in *Zonotrichia capensis*: incongruent patterns of geographic variation between mitochondrial and nuclear markers. ZACHARY A. CHEVIRON and ROBB T. BRUMFIELD, *Mus. Nat. Sci., Louisiana State Univ., Baton Rouge, LA.*

Determining the extent to which population genetic structure is associated with ecological and environmental factors is fundamental to understanding microevolutionary processes in natural populations. We tested for correlations between environmental variables and levels of genetic differentiation among populations of Rufous-collared Sparrows (*Zonotrichia capensis*) distributed along elevational and latitudinal gradients on the west slope of the Peruvian Andes. We sampled 239 individuals from 27 sampling localities and assessed genetic differentiation using DNA sequence data from one mitochondrial gene, 2 nuclear introns, and 4 autosomal microsatellite loci. Using step-wise multiple regression analyses, we identified environmental correlates of population genetic structure in *Z. capensis* that differed among the marker classes. For the mitochondrial dataset, genetic divergence was best explained by the difference in elevation and climatic variables between populations. Conversely, for the nuclear dataset (introns and microsatellites), linear distance and the degree of habitat fragmentation between populations were the best predictors of population genetic divergence. The incongruent mitochondrial and nuclear patterns are not due to differences in effective population sizes or mutational processes among the marker classes, nor to limited dispersal of females relative to males.

Instead, these results suggest that natural selection on the mitochondrion is shaping geographic patterns of mtDNA haplotype variation.

### **131 Outlaw & Ricklefs**

Molecular phylogenetics of avian malaria parasites. DIANA C. OUTLAW and ROBERT E. RICKLEFS, *Dept. Biol., Univ. Missouri-St. Louis, St. Louis, MO.*

The number of lineages of avian malaria parasites appears to parallel the diversity of their hosts. Molecular assessment of this diversity and the delimitation of parasite species is the first step towards a broader understanding of patterns of speciation within malaria parasites. Here, we present a molecular phylogeny of malaria parasites based on nearly complete mitochondrial cytochrome b and cytochrome oxidase I sequences. As in previous analyses, these data support 2 major clades of parasites, representing the apicomplexan genera *Plasmodium* and *Haemoproteus*. Within each clade, parasites are widely distributed in terms of both geography and host taxonomy. However, many lineages and/or well-supported clades are confined to host species, genera, or families, and to geographic areas. Relationships among parasites within each clade suggest that speciation often follows host-switching. We are additionally sequencing nuclear and apicoplast genes of malaria parasites to determine species limits using a criterion of linkage disequilibrium.

### **132 Steenhof & Peterson**

Natal dispersal and inbreeding in American Kestrels. KAREN STEENHOF and BRIT PETERSON, *U.S. Geol. Surv., For. & Range. Ecosys. Sci. Center, Snake River Field Station, Boise, ID.*

From 1986 to 2006, we studied a marked population of kestrels nesting in artificial boxes in sw. Idaho. A preliminary analysis, based on locally produced young that entered the local nesting population suggested that males that returned to nest in the study area moved an average of 5.3 km (approximately 5 territory widths) from their natal box to their first breeding location, and females moved an average of 9.8 km (approximately 10 territory widths). Males that hatched earlier in the nesting season tended to move less far than those hatched later. In contrast, distances moved by females were inversely but not significantly related to their hatching dates. We found no relationship between natal dispersal distance and productivity in the first year of nesting, or number of young produced over an individual's lifetime. During the study, we recorded 3 cases of mother-son pairings and one pairing of siblings. 3 of the 4 pairings produced young that fledged, including 2 young that were later recruited into the nesting population. Based on nesting attempts in which we were able to confirm or rule out inbreeding of close relatives, full sibling pairings occurred in 1% of pairings, and mother-son pairings occurred in 3%. We compare our findings to results of other studies and discuss the implications.

### **133 Stiver, Apa, Remington & Gibson**

Skewed male mating success and female breeding failure reduce effective population size in the lekking Gunnison Sage-Grouse. JULIE R. STIVER, *School Biol. Sci., Univ. Nebraska-Lincoln, Lincoln, NE*, ANTHONY D. APA, *Colorado Div. Wildl., Grand Junction, CO*, THOMAS E. REMINGTON, *Colorado Div. Wildl., Denver, CO*, and ROBERT M. GIBSON, *School Biol. Sci., Univ. Nebraska-Lincoln.*

Populations with small effective sizes are at risk for inbreeding depression. Theoretically, variance in reproductive success in either sex reduces effective population size ( $N_e$ ) below the population size ( $N$ ). We investigate the effects of skewed male mating and variation in female breeding success on the effective size of the second largest Gunnison Sage-Grouse population. During a 2-yr field study, we recorded male mating success at leks and the reproductive success of radio-tagged females. Using these data and assuming that lek observations accurately characterized variation in male mating success, we used a demographic method to estimate  $N_e$  for the population. Estimated  $N_e$  (41) was below the level at which inbreeding depression is observed in captive breeding studies. Extrapolation of our results to other populations of this species suggests that 6 of the 7 extant populations may have effective sizes low enough to induce inbreeding depression. If so, translocations would be needed to supplement genetic diversity.

### 134 Fedy, Martin & Ritland

An apparent paradox: high inbreeding in small populations does not result in strong population differentiation or low genetic diversity in White-tailed Ptarmigan. B. C. FEDY, *Montana Coop. Wildl. Res. Unit, Univ. Montana, Missoula, MT*, K. MARTIN and C. RITLAND, *Dept. For. Sci., Univ. British Columbia, Vancouver, BC*.

Decreased gene flow between small, subdivided populations often leads to increased inbreeding and decreased genetic diversity. Unlike most previous studies in population genetics of subdivided populations, this study examines a species which has evolved in naturally patchy and successional stable habitats. We used microsatellite markers to examine the population genetics of a high-elevation grouse species, White-tailed Ptarmigan on Vancouver Island, BC. All populations demonstrated high levels of diversity (mean HE = 0.78) combined with high  $F_{IS}$  values (significant heterozygote deficiencies) across all 10 loci. A brief analysis of population subdivision revealed weak genetic structure among populations. An apparent paradox exists in that high inbreeding within populations did not result in strong genetic differentiation among populations or decreased genetic diversity. Two scenarios could potentially explain these unique patterns. First, sampling may have captured a snapshot of a group of populations progressing towards severe isolation; suggesting that population isolation may have existed long enough to increase inbreeding, but not long enough for drift to result in strong differentiation and decreased diversity. The second scenario evokes a pattern of infrequent dispersal between populations sufficient to maintain high levels of diversity, combined with low densities and limited mate choice resulting in the relatively quick accumulation of homozygosity within populations.

### 135 Nicodemus & Curry

Dominance interactions and social patterns in a chickadee hybrid zone. AMANDA NICODEMUS and ROBERT L CURRY, *Dept. Biol., Villanova Univ., Villanova, PA*.

Black-capped and Carolina chickadees hybridize extensively along their contact zone, but mechanisms of mate choice remain incompletely understood. Previous work has shown that the contact zone is moving northward, and that males with Carolina-like genotypes are preferred as extra pair sires. It has been suggested that Carolina males may be favored as mates because they are socially dominant over Black-capped males. To evaluate this hypothesis, we investigated social relationships within hybrid flocks in se. Pennsylvania in the winters of 2004 - 2006. Males tended to associate more with males and females associated with females. Known social pairs did not have high association index values during the winter months. Males participated in more social interactions than did females, but average dominance rank of males was not significantly higher than that of females. The winter of 2005 - 2006 was an irruption year in which we were able to observe the interactions between pure Black-caps and local hybrids. Both phenotypes were present simultaneously at feeders, but dominance interactions were uncommon; local birds interacted more with other residents. When irruption chickadees interacted with local birds, the former were usually subordinate. While we were unable to control for differences in residence status, these results are consistent with the generalization that Carolina-like hybrids are able to assert dominance over larger Black-capped Chickadees. Coupled with hypothesized mate preference associated with social rank, dominance asymmetry could help explain recent and ongoing northward shifts in the position of the hybrid zone, with Carolina Chickadees gaining at the expense of Black-capped Chickadees.

### 136 Krosby & Rohwer

A multi-locus test of historical zone movement vs species paraphyly as the underlying cause for discordant clines between hybridizing warblers. MEADE KROSBY and SIEVERT ROHWER, *Burke Mus. and Dept. Biol., Univ. Washington, Seattle, WA*.

Hermit Warbler (*Dendroica occidentalis*) and Townsend's Warbler (*D. townsendi*) are sister-species that hybridize in narrow zones of contact in Washington and Oregon. While populations of Townsend's Warbler east of the coastal mountain ranges of the Pacific Northwest exhibit mitochondrial DNA (mtDNA) haplotypes that are distinct from those found in Hermit Warbler, coastal populations of Townsend's Warbler from Washington to Alaska feature mtDNA haplotypes found in both species. This pattern has been interpreted to reflect incorporation of Hermit mtDNA into coastal populations of Townsend's Warbler as their hybrid zone has moved south, replacing Hermits with Townsend's along the

coast. However, previous evidence has been unable to distinguish this scenario from an alternative possibility: that coastal populations of Townsend's Warbler are in fact more closely related to Hermit Warbler than to interior populations of Townsend's Warbler, i.e., that Townsend's Warbler is paraphyletic with respect to Hermit Warbler. With a data set consisting of ND2 mtDNA sequence and 16 nuclear microsatellite markers from 250 Hermit and Townsend's warblers from across their ranges, we used the Isolation with Migration model, as applied by the program IM, to evaluate the 2 evolutionary scenarios.

### 137 Brelsford & Irwin

Reproductive isolation in the Yellow-rumped Warbler hybrid zone. ALAN T. BRELSFORD and DARREN E. IRWIN, *Zool. Dept., Univ. British Columbia, Vancouver, BC.*

Hybrid zones between recently diverged taxa are "natural laboratories" for speciation research, allowing study of the genes and traits that contribute to incipient reproductive isolation. By examining patterns of polymorphism and divergence at 11 nuclear loci across a hybrid zone, we show that 2 subspecies of the Yellow-rumped Warbler (*Dendroica coronata*) are partially reproductively isolated, providing a promising system for the discovery of genomic regions that contribute to speciation. One sex-linked and one autosomal site show reduced variation within subspecies and fixed differences between subspecies, suggesting linkage to loci that have evolved separately under selection. Despite the abundance of hybrids in the contact zone, linkage disequilibrium between these markers indicates that gene flow between populations is reduced, at least at these 2 loci. Thus, Myrtle and Audubon's Warblers are distinct evolutionary groups carrying genes for divergent adaptive peaks, and this situation appears relatively stable. As a result, the taxonomic status of the Yellow-rumped Warbler complex may merit reassessment.

### 138 Carling & Brumfield

A multilocus approach to testing introgression hypotheses in *Passerina* buntings. MATT D. CARLING and ROBB T. BRUMFIELD, *Mus. Nat. Sci., Louisiana State Univ., Baton Rouge, LA.*

Secondary hybrid zones, formed when differentiated populations interbreed after a period of geographic isolation, are thought to play an important role in speciation. Particularly, hybrid zones are promising natural laboratories for uncovering genes important in maintaining species integrities and perhaps, the genes important in the generation of biological diversity. We investigate patterns of differential introgression in the *Passerina cyanea* / *Passerina amoena* contact zone, 2 species that hybridize where their breeding ranges overlap in the Great Plains. Specifically, we test the prediction that both mtDNA and z-linked loci should show reduced levels of gene flow, relative to nuclear autosomal loci, across the *Passerina* hybrid zone. For 181 individuals sampled across the contact zone, we collected DNA sequence data from 3 genetic markers, one mtDNA locus, one nuclear autosomal intron and one z-linked intron. Interestingly, no *P. amoena* haplotypes are found east of the contact zone, regardless of the type of genetic marker analyzed. In contrast, nuclear autosomal haplotypes, but not mtDNA or z-linked haplotypes, characteristic of *P. cyanea* are found in populations of *P. amoena* west of the contact zone, including as far west as Washington. These results are consistent with theoretical predictions regarding patterns of differential introgression of mtDNA, nuclear autosomal and z-linked markers.

### 139 vacant

### 140 Ludwick, Fedynich, Perrigo & Schwertner

Range expansion in the White-winged Dove and Eurasian Collared-Dove and the potential for nest site competition. TIMOTHY J. LUDWICK, ALAN M. FEDYNICH, *Caesar Kleberg Wildl. Res. Inst., Texas A&M Univ.-Kingsville, Kingsville, TX*, GLENN H. PERRIGO, *Dept. Biol., Texas A&M Univ.-Kingsville*, and T. WAYNE SCHWERTNER, *Texas Parks & Wildl. Dept., Mason, TX.*

In s. Texas, 2 notable avian range expansions are currently underway in the populations of the White-winged Dove and the Eurasian Collared-Dove. Both dove species are mainly pioneering urban

areas as their populations expand. As both of these species expand into the same areas, scientists are interested in possible interspecific competition as well how each species will utilize the urban environment. We are investigating the potential for nest site competition between these 2 species within urban areas. During the 2006 field season, we located 446 White-winged Dove nests and 68 Eurasian Collared-Dove nests in 5 study areas in s. Texas. The most commonly utilized tree species by White-winged Doves was netleaf hackberry (27 %) and the most commonly utilized tree species by Eurasian Collared-Doves was green ash (45 %). There was no significant difference ( $p$  value range 0.109 - 0.774) between dove species in any of the 6 variables that we used to categorize the nest site, suggesting the 2 species are, to some extent, habitat generalists, but in relation to each other are selecting similar structural elements within a tree despite utilizing different tree species.

#### **141 Seifert, Schwabl & Webster**

Sex ratios in Barn Owls: do Fisher or Myers predict parental investment? MEGAN L. SEIFERT, HUBERT SCHWABL and MICHAEL S. WEBSTER, *School Biol. Sci., Washington State Univ., Pullman, WA.*

Fisher proposed that parents should be selected to invest equally in sons and daughters, such that, in sexual size dimorphic species, we would expect an offspring sex ratio biased toward the less costly sex. We tested Fisher's hypothesis in the Barn Owl, which is a species with reversed sexual size dimorphism; at fledging, females are 33% heavier than males. We predicted that the sex ratio at fledging is male biased to account for the differences in costs to raise sons or daughters. Sex ratio was male-biased at laying, but not at fledging. A potential factor in determining primary and secondary sex ratio is the food resources available to a female before and during nesting. Breeding barn owls are completely reliant on their mates for food from a few days before egg laying until 30 d into the nestling phase. We predicted that females whose males delivered more food produce and fledge more daughters. Primary sex ratio was not correlated with male food delivery during egg laying while secondary sex ratio at fledging was correlated with male food provisioning with higher provisioning males tending to fledge more female offspring. We conclude barn owls do not show Fisherian selection because the sex ratio at fledging did not differ from parity.

#### **142 Shizuka & Lyon**

Mechanisms of parental manipulation in American Coots. DAIZABURO SHIZUKA and B. E. LYON, *Dept. Ecol. & Evol. Biol., Univ. California-Santa Cruz, Santa Cruz, CA.*

Parent offspring conflict theory predicts that parents should control how resources are allocated within the family to optimize their parental investment, sometimes without regard for offspring demand. In this field study, we investigated 2 potential mechanisms of parental manipulation - brood division and parental aggression. Brood division occurred at all nests, and was associated with increased feeding to late-hatched offspring. Parental aggression was not used to cull chicks or enforce brood division. Rather, parents used aggression toward early-hatched chicks. Parents seemed to use brood division and aggression to allocate more resources toward younger chicks to counteract the effects of hatching asynchrony.

#### **143 Wilcoxon, Schoech, Bridge & Boughton**

Old guys still have it: an investigation of male age, provisioning, and physiological costs in Florida Scrub-Jays. TRAVIS E. WILCOXEN, STEPHAN J. SCHOECH, ELI S. BRIDGE, *Dept. Biol., Univ. Memphis, Memphis, TN,* and RAOUL K. BOUGHTON, *Ornithol. Lab, Archbold Biol. Sta., Venus, FL.*

Life-history theory predicts that as animals age, they should increase the energy expended towards the care of offspring while investing less in themselves, for they face decreased probability of survival to the next breeding attempt. Therefore, the tradeoff between current and future reproduction should be skewed towards current effort in older individuals. If such tradeoffs occur, then we predict that, when compared with younger males, older male Florida Scrub-Jays will: 1) provision their brooding mate and nestlings at greater rates; 2) exhibit a decreased immune function; 3) be in poorer body condition; and 4) be more 'stressed,' as characterized by higher corticosterone (CORT) levels. We observed male breeder provisioning behavior and quantified the amount of food delivered to the nest over time. We

used an in vitro test of the ability of whole blood to kill a bacterial strain to assess immune function. Body condition was estimated using a standard process that regresses multiple linear size measures against mass. Male age was positively correlated with both provisioning rate and immune capability; however, there were no detectable patterns linking age and the other two measures. Neither were there relationships between provisioning, CORT, or body condition. Our data suggest that older birds are not compensating for increased provisioning rates at the cost of other physiological functions.

**144 Stanback, Mercadante, DiLuzio, Olbert, Ray, Jameson, Grunwald, Burke & Hindsley**

Nest temperature, hatching failure, and chick condition in Eastern Bluebirds. MARK STANBACK, AUSTIN MERCADANTE, NICK DILUZIO, JEAN OLBERT, GRAHAM RAY, REBECCA JAMESON, DOUG GRUNWALD, HOWELL BURKE and CHARLOTTE HINDSLEY, *Dept. Biol., Davidson Coll., Davidson, NC.*

Hatching failure in Eastern Bluebird nests increases as the breeding season progresses and as one moves further south. While higher temperatures are the most obvious culprit, it is also true that factors other than temperatures vary between spring/summer and North/South. To control for such confounding factors, we compared hatching success and chick condition in dark (hot) and light (cool) boxes at a single location over the course of 2 breeding seasons. Hatching success rates for nests with at least one hatching egg were similar in spring but differed significantly in summer, when only 75% of eggs within successful dark boxes hatched. Even more dramatic were the differences in rates of total hatching failure. Dark and light boxes were similar in spring, but in summer nearly 40% of nests in dark boxes failed outright (compared to only 10% of summer nests in light boxes). Chick condition did not differ significantly in spring, but summer chicks in dark boxes were in significantly poorer condition than were those in light boxes. Temperature measurements revealed that in the summer, dark and light boxes spent similar amounts of time above physiological zero (26° C), but that dark boxes spend significantly more time at extreme temperatures (>40° C).

**145 Skipper & Kim**

Feeding rate, prey availability, and dietary composition of nestling Grasshopper Sparrows. BEN R. SKIPPER, *Dept. Biol. Univ. Nebraska-Kearney, Kearney, NE,* and DANIEL H. KIM, *Platte River Whooping Crane Trust, Wood River, NE.*

We quantified feeding rates, primary prey availability, and nestling diet composition for 38 Grasshopper Sparrow nests during 2005 and 2006 (13 and 25 nest/yr respectively). We filmed provisioning on day 6 (hatch day = 0). Parental provisioning rate exhibited an inverse relationship to lepidopteron larvae abundance in both years ( $r^2 = 0.35$  and  $0.76$  for 2005 and 2006 respectively). Provisioning was weakly correlated with orthopteran abundance in both years ( $r^2 = 0.009$  and  $0.26$  for 2005 and 2006 respectively). Lepidopteron abundance declined markedly as the breeding season progressed (2005 ANOVA,  $P < 0.05$ ; 2006 Kruskal-Wallis,  $P < 0.05$ ), while orthopteran abundance remained constant (2005 ANOVA,  $P = 0.058$ ; 2006 Kruskal-Wallis,  $P = 0.05$ ). Nestling diet composition was 25% and 55% orthopterans, and 57% and 27% unidentified in 2005 and 2006 respectively. Lepidopteron larvae comprised 18% of nestling diet in both 2005 and 2006. Whereas lepidopteron larvae composed only a modest proportion of grasshopper sparrow nestling diet, parents preferentially fed these items to young disproportionately to their availability in 2006 ( $X^2 = 392$ ,  $df = 2$ ,  $P < 0.001$ ). No disparity in provisioning preference was detected in 2005.

**146 Ardia, Perez & Clotfelter**

The effect of experimental heating during incubation on Tree Swallows: female behavior, egg temperature and offspring condition. DANIEL R. ARDIA, *Dept. Biol., Franklin & Marshall Coll., Lancaster, PA,* JONATHAN H. PEREZ and ETHAN D. CLOTFELTER, *Dept. Biol., Amherst Coll., Amherst, MA.*

Allocation of resources to competing life history stages can be influenced by both individual quality and environmental conditions. We tested whether investment in incubation was set by individual strategies or whether female investment was governed, in part, by environmental conditions. We

experimentally heated nests during incubation by 6° C to test for changes in incubation behavior and effects on offspring. Heated females increased time spent incubating, indicating that female ability to gather resources and not maximal temperature conditions was driving incubation constancy. Females incubating in heated nests maintained higher on-bout and off-bout egg temperatures, as well as maintained eggs with less variation in temperature. We found individual variation in female responses. Incubation constancy increased as the season progressed in both treatment groups, but later-laying heated females showed a greater increase in incubation constancy than earlier-laying heated females. We cross-fostered nestlings and found that heating had positive effects on both females and offspring. Early in the nestling period, nestlings in broods heating during incubation had higher body mass and body condition. However, later in the nestling period, nestlings in broods with parents that experienced heated conditions during incubation were larger and in higher condition, even if they experienced control conditions during incubation. Heated females made more feeding visits to nestlings than did control females.

#### **147 Bowman, Boughton, Feswick & Woolfenden**

Brood reduction increases across an urban gradient: adaptive response or an unselected consequence of food limitation. REED BOWMAN, RAOUL K. BOUGHTON, APRIL FESWICK and GLEN E. WOOLFENDEN, *Archbold Biol. Sta., Lake Placid, FL*.

Many avian omnivores feed nestlings exclusively arthropods. Arthropod abundance decreases as urbanization increases, but anthropogenic foods, an abundant and predictable resource, increase. The diet of Florida Scrub-Jay nestlings in suburbs is 15 - 30% anthropogenic foods. More than 70% of successful nests in suburbs suffer brood reduction; less than 30% do so in wildlands. Brood reduction occurred more often in the suburbs for all brood sizes except for broods of 5. Regardless of habitat, broods of 5 always experienced some loss, suggesting that this brood size may be beyond an upper limit for which parents can successfully provide. Among nests experiencing brood reduction, more nestlings were lost as brood size increased in suburbs, but the number was constant across brood sizes in wildlands. In contrast to Lackian hypotheses, brood reduction in suburbs tended to occur late rather than early in the nestling period. In addition, reduced nests had significantly lower brood masses than nests that did not suffer loss. These patterns suggest that high rates of brood reduction in suburbs are an unselected consequence of food limitation rather than an adaptive response. As predicted by this conclusion, both the presence of helpers and the experimental provisioning of arthropods had a larger influence on reducing brood reduction in suburbs than in wildlands.

#### **148 Smith-Castro & Rodewald**

Impacts of recreational trails on avian nest attendance and nest predation in urban riparian forests. JENNIFER R. SMITH-CASTRO and AMANDA D. RODEWALD, *School Environ. & Nat. Res., Ohio State Univ., Columbus, OH*.

Recreational trails have traditionally been viewed as benign to animal communities, although ecologists are learning that disturbance of this type may have long-lasting negative impacts on wildlife and may ultimately compromise the value of protected areas. We studied the nesting success of Northern Cardinals in 5 mature riparian forest stands in Columbus, OH. From Apr - Aug 2006, we monitored the fate of cardinal nests, measured habitat characteristics surrounding nests and in random locations, and estimated trail usage with Wildview Digital Scouting cameras. We predicted that increased recreational trails in riparian forests associated with urban landscapes would reduce passerine nest survival due to one of 3 possible mechanisms: (1) disturbance by humans, (2) modification of habitat, or (3) trail use by predators. Using logistic exposure models on 147 cardinal nests, we examine the relative importance of distance from trail, human usage of trail (activity levels), and parental attendance at nests, on daily nest survival rate. Contrary to our original expectations, results indicate a negative relationship between time spent on nest and distance to trail and a positive correlation between nest attendance and trail use intensity which implies increased habituation. Nest attendance rates were found to be positively associated with nest survival. These findings suggest that trail use may affect parental behavior of nesting birds.

#### 149 Dooley, Sanders & Doherty

Mallard response to human disturbance along the South Platte River in Colorado. JOSH L. DOOLEY, *Dept. Fish, Wildl. & Cons. Biol., Colorado State Univ., Ft. Collins, CO*, TODD A. SANDERS, *U.S. Fish & Wildl. Serv., Portland, OR*, and PAUL F. DOHERTY, Jr., *Dept. Fish, Wildl. & Cons. Biol., Colorado State Univ.*

Management of public hunting areas using closed, resting periods is a common practice, but the appropriate length of such closures is unknown. We administered 154 disturbance treatments (i.e., walk-in, shooting) on radio-marked mallards in ne. Colorado to investigate behavioral response to simulated hunting disturbance. Post-disturbance, detection probabilities at the location of disturbance were lower for radio-marked mallards exposed to shooting treatments than walk-in treatments, and both were lower than controls for the day of disturbance. Effects between treatment groups were minimal after one day. This information will be used by the Colorado Division of Wildlife to optimally manage public hunting properties in ne. Colorado.

#### 150 Morgan & Schoech

Effects of road proximity on behavior and prey consumption in Florida Scrub-Jays. GINA M. MORGAN and STEPHAN J. SCHOECH, *Dept. Biol., Univ. Memphis, Memphis TN*.

Disturbances associated with roads and human activity can cause behavioral modifications in many species, including birds. These modifications include avoidance of, or attraction to, roads and engaging in anti-predator behavior at the expense of other important activities. These findings are of special concern for threatened species such as the Florida Scrub-Jay, whose specific habitat is already diminishing due to development and fire suppression. We studied the effects of road proximity on Florida Scrub-Jay behavior and overall food intake. We compared scrub-jay behavior in territories bisected by a road with jays whose territories were contained within natural scrub habitat. We conducted focal watches and quantified the amount of time spent foraging, on sentinel, at rest, and in territorial interactions. We also recorded the quantity and type of prey consumed to assess potential between-habitat differences in prey utilization and foraging efficiency (amount of food taken per time). Roadside jays spent less time foraging and their foraging efficiency was greater than interior jays. Prey type also differed: scrub-jays from road territories consumed less plant matter and more human-source foods, such as peanuts and dog food presumably cached earlier in the season. Our findings show that there are foraging differences between roadside and interior jays that may be attributable to the 'edge-effect' of the roadside. However, the increased reliance on human-source foods by roadside jays is a confounding factor.

#### 151 Shultz & Bowie

A 93-year study on the effects of moderate urbanization on an avian community. ALLISON J. SHULTZ and RAURI C.K. BOWIE, *Mus. Vert. Zool. and Dept. Integrat. Biol., Univ. California, Berkeley, CA*.

The effects of urbanization are an important influence to investigate if achieving effective conservation goals are to be met. Long-term studies are essential if meaningful trends in species increases, declines and persistence in response to urbanization are to be accurately elucidated. The lower campus of the University of California, Berkeley, provides a unique opportunity to look at the increasing effects of urbanization on bird community structure. During the last century the campus has experienced a general loss of open areas, seen the establishment of many exotic plantings and the maturation of many large trees, and seen a translocation of the taxonomically diverse botanical gardens. Recognizing the importance of these trends researchers at the MVZ have at 3 time periods conducted extensive but comparable surveys of lower campus (1913 - 1918, 1938 - 1939 and 2006 - 2007). Despite the significant changes in habitat, bird species present on Berkeley's lower campus have stayed fairly constant over the last 93 yr (1913 - 45 species; 2007 - 49 species). In contrast, avian community composition has changed considerably: our most significant observation is the complete disappearance from campus of: Wrentit, American Kestrel, California Quail, American Pipit, and Spotted Towhee. These species and those that have significantly declined ( $p < 0.001$ ) are generally ground feeding and/or chaparral associated. We also compare our results to Blair's (1996, *Ecol. Appl.* 6:506-519) proposed categories of urbanization sensitivity. Although some of the taxa designated into specific categories are

well supported, others seemed out of place in our study.

### **152 Smith & Parrish**

Dine and dash? Linking foraging behaviors and habitat use of Common Mergansers on a managed reservoir. JOANNA L. SMITH and JULIA K. PARRISH, *School Aquat. Fish. Sci., Univ. Wash., Seattle, WA*.

The alteration of rivers for hydroelectric power and adjacent shoreline development creates fragmented landscapes with substantial changes to the riverine ecosystem. The structure of predator-prey communities may be affected if altered habitats concentrate prey in novel habitats and increase foraging opportunities for visual predators. The Common Merganser is a large, fish-eating duck that breeds throughout North America. This species is known to consume substantial quantities of salmon and has been implicated in their decline where they co-occur. In this study, we examine the spatial pattern of merganser abundance, behavior and habitat use during 3 life history stages: pairs, females with chicks, and fledglings. We used weekly transects and focal animal sampling on the Rocky Reach reservoir during 2 breeding seasons, 2003 - 2004, to collect abundance and behavior data, respectively. A detailed habitat map was created for the entire 68 km length of the reservoir and analyzed in a geographical information system. To date, the results of our analyses show that mergansers foraged more than expected in riprap-rock dominated habitats, areas that potentially aggregate juvenile salmon. Also, females with chicks were most strongly associated with the largest, vegetated shoreline fragments. In general, this species demonstrated spatially explicit site fidelity on the reservoir, particularly to loafing and foraging sites in close proximity to each other. Our analyses suggest that modified riverine habitats may create favorable foraging conditions for the Common Merganser.

### **153 Oh & Badyaev**

The ontogeny of mate preferences: does juvenile experience matter? KEVIN P. OH and ALEXANDER V. BADYAEV, *Dept. Ecol. & Evol. Biol., Univ. Arizona, Tucson, AZ*.

In evolutionary models, mate preferences are commonly represented as fixed and strictly inherited traits. On the contrary, evidence from captive studies suggests that adult preferences are often influenced by exposure to potential mates during juvenile periods through imprinting or learning. Yet little is known about how such processes operate in natural populations where subadults encounter pools of potential mates that vary in composition across time, space or contexts. Here we examined patterns of mate choice among first-year breeding female House Finches in relation to previous experience with males during the nonbreeding season. In this system, males differ in both elaboration of sexual plumage ornamentation and genetic relatedness to female. We show that both female preference and choosiness were related to the mean and variance of male traits sampled during specific periods of the nonbreeding season. The results are discussed in relation to the evolution of preference acquisition periods and mate choice strategies.

### **154 Dunn, Lifjeld & Whittingham**

Multiple mating by female Tree Swallows improves offspring quality. P. O. DUNN, J. T. LIFJELD and L. A. WHITTINGHAM, *Dept. Biol. Sci., Univ. Wisconsin-Milwaukee, Milwaukee, WI*.

There is mounting evidence in a variety of taxa that females increase offspring viability by mating with multiple males. In birds, however, few studies have explicitly examined the benefits of mating with several different males; instead, the focus has been on extra-pair mating (some or none) and its adaptive significance remains controversial. If females have few phenotypic cues to the genetic quality of males, then females may mate with a number of different extra-pair males to increase the probability that at least one of them supplies a superior genotype. In this case, it may be the maximum performance of extra-pair offspring, rather than the mean, that is most important to female fitness. We examined this hypothesis in Tree Swallows, which have one of the highest levels of multiple paternity in birds (83% of nests with 2 or more extra-pair young had at least 2 extra-pair sires). We found that the maximum immune response and heterozygosity of extra-pair young increased with the number of extra-pair sires and the proportion of extra-pair young in a brood. The relative immune response and heterozygosity (difference between the maxima of extra-pair and within-pair young) of nestlings also

increased with multiple mating. However, the nestlings with stronger immune responses were not the same ones that were more heterozygous, which suggests independent effects of multiple mating on immune response and heterozygosity. This is the first evidence in birds to suggest that mating with more males, rather than simply mating with an extra-pair male (some/none), improves offspring quality. Furthermore, it suggests that females may not be maximizing their fitness by increasing the quality of their entire brood, but the probability that at least one of their extra-pair offspring will survive and reproduce.

#### **155 Rowe & Pruett-Jones**

Mechanisms and dynamics of sperm competition in the Splendid Fairy-Wren: male investment in sperm numbers and quality. MELISSAH ROWE and STEPHEN PRUETT-JONES, *Dept. Ecol. Evol., Univ. Chicago, Chicago, IL.*

In birds, the outcome of sperm competition is influenced by: 1) the timing of inseminations, relative to competitive matings, fertilization, and oviposition; 2) sperm numbers; and 3) the differential fertilizing capacity of ejaculates. To date, however, these factors have been studied in relative isolation. In this study, we examined male investment in sperm numbers and fertilizing capacity in the Splendid Fairy-Wren (*Malurus splendens melanotus*). This species exhibits relatively high rates of extra-pair paternity and several morphological adaptations associated with intense sperm competition. Across males, the size of the cloacal protuberance was positively correlated with both the number of stored sperm and the number of sperm in ejaculates. Additionally, the motility of sperm was positively related to the number of sperm in ejaculate samples suggesting males may invest in both the quantity and quality of sperm. We discuss potential trade-offs in reproductive effort and the relationship between male investment and paternity success.

#### **156 Angelier, Moe, Clement-Chastel, Bech & Chastel**

Corticosterone levels in relation to change of mate in the Black-legged Kittiwake. F. ANGELIER, *Centre d'Etudes Biologiques de Chizé, Villiers en Bois, France, and Smithsonian Inst., Washington, DC*, B. MOE, *Dept. Biol., Norwegian Univ. Sci. & Tech., Trondheim, Norway*, C. CLÉMENT-CHASTEL, *Centre d'Etudes Biologiques de Chizé, Villiers en Bois, France*, C. BECH, *Dept. Biol., Norwegian Univ. Sci. & Tech., Trondheim, Norway*, and O. CHASTEL, *Centre d'Etudes Biologiques de Chizé, Villiers en Bois.*

In birds, changing mates generally results in decreased breeding success. Although costs and benefits of pair break-up have been well studied, endocrine mechanisms associated with mate change are poorly known. We measured baseline and stress-induced corticosterone levels in relation to mate change in Black-legged Kittiwakes. Baseline corticosterone levels were higher in kittiwakes breeding with a new mate than in kittiwakes that did not change mate. Stress-induced corticosterone levels were not influenced by change of mate. Elevated baseline corticosterone levels in birds breeding with a new mate could result from the social stress associated with pair break-up or mirror a higher energetic demand resulting from a lack of coordination between new pair members. Our results emphasize the usefulness of corticosterone levels in elucidating the effects of mate change on the energetic demands of reproduction in free-living birds.

#### **157 Tori, Loiselle, Blake & Parker**

Do females choose males with high genetic diversity as reproductive partners? WENDY P. TORI, BETTE A. LOISELLE, JOHN G. BLAKE and PATRICIA PARKER, *Dept. Biol. and Whitney R. Harris World Ecol. Center, Univ. Missouri-St. Louis, St. Louis, MO.*

The hypothesis of mate choice based on heterozygosity suggests that females select highly heterozygous males as reproductive mates to increase the heterozygosity of their offspring. Heterozygous young are expected to have more vigor and, thus, to have improved survival and reproduction. This hypothesis predicts that sexually selected traits (e.g., ornaments, display characteristics) signal male individual heterozygosity and that females use these signals as cues for mate selection. Here we test the heterozygosity hypothesis of female mate choice for the White-crowned Manakin (*Pipra pipra*). We measured male mating success using behavioral (i.e., female

visits) and molecular techniques (i.e., paternity analysis of offspring using microsatellites) and we correlated these estimates with the degree of male heterozygosity. Additionally we examined the relationship between heterozygosity and spatial and behavioral characteristics of males (e.g., lek attendance, calling rate, territory size and position). We found that females mated with males with significantly higher heterozygosity than expected by chance. Visitation rate of males with low heterozygosity tended to be lower. Moreover, we found that male heterozygosity predicts territory position in the lek (heterozygous male had more central territories), suggesting that this characteristic can potentially act as a cue of male heterozygosity in female mate choice.

**158 Casey, Sandercock, Jones & Wisely**

Multiple alleles cause molecular sexing errors in a monomorphic shorebird. ASHLEY E. CASEY, BRETT K. SANDERCOCK, KEN L. JONES and SAMANTHA M. WISELY, *Div. Biol., Kansas State Univ., Manhattan, KS.*

Correct assignment of sex is essential for addressing questions in population biology and behavioral ecology. Many species of shorebirds are difficult to sex in the field due to monomorphic body size and plumage, absence of intromittent organs, and lack of behavioral differences between the sexes. Consequently, the use of molecular markers is widely used to sex monomorphic avian species. We have optimized laboratory protocols for genetic sexing of the monomorphic Upland Sandpiper using 2 independent sets of primers to amplify regions of the sex-linked CHD-Z and CHD-W genes. Blood samples were collected in the field, DNA was extracted, and PCR reactions were carried out with primers P2/P8 (Griffiths et al. 1998, *Mol. Ecol.* 7:1071-76) and 2550F/2718R (Fridolfsson & Ellegren 1999, *J. Avian Biol.* 30:116-21). We unexpectedly discovered a polymorphism in the region of the CHD-Z intron amplified by the primers P2/P8 which caused 4 males to be misidentified as females. We have isolated, cloned and sequenced the 3 CHD-Z alleles in our population. The Z allele is 335 base pairs (bp) in length, while Z' has a 4 bp deletion and Z'' has a separate 5 bp deletion. Homozygous (ZZ) males show one band in agarose gel analysis and are easily differentiated from females, which show 2 bands. However, heterozygous (Z'Z'') males show 2 bands in the same pattern as that for females due to an interaction between the 2 alleles. While the Z' and Z'' fragments are only 330 and 331 bp long, they interact together and form a band that appears as an approximately 400 bp fragment. Our results indicate that the P2/P8 primers can lead to mis-sexing of monomorphic shorebirds and polymorphisms may be difficult to detect if they occur at low frequency within a population.

**159 Panjabi, Gonzalez Rojas, Ruvalcaba Ortega & McCreedy**

Abundance, distribution, and habitat use of wintering grassland birds in Chihuahuan desert grasslands in northern Mexico. ARVIND O. PANJABI, *Rocky Mountain Bird Observ., Ft. Collins, CO*, JOSE IGNACIO GONZALEZ ROJAS, IRENE RUVALCABA ORTEGA, *Universidad Autonoma de Nuevo Leon, Monterrey, Mexico*, and ROBERT MCCREEDY, *The Nature Conservancy, Bainbridge, WA.*

Grassland birds are among the highest avian conservation priorities in North America. Most migratory species breeding in the western Great Plains over-winter in the Chihuahuan desert of the sw. U.S. and n. Mexico, making this region globally important for grassland birds. Few studies have focused on the non-breeding ecologies of grassland birds even though some species' populations may be limited by factors during the non-breeding period. Loss of native grasslands in the region is accelerating rapidly, especially in Mexico, yet little or no data on the distribution, habitat use, movements, and local abundance of wintering grassland birds in this region exist to guide conservation efforts. We surveyed wintering grassland birds in 7 priority conservation areas identified by the Nature Conservancy in 5 states in n. Mexico in 2007 using line transects conducted on foot and from vehicles. We detected 41 grassland-dependent species in these priority areas, including 17 priority species, and estimated local and regional non-breeding densities for 23 species. We discuss the conservation implications of our findings, the efficacy of our methods, and future directions for research, monitoring, and conservation in the region.

**160 Ripper, Gallagher & Vercauteren**

Conservation of shortgrass prairie birds on private land in Colorado and Wyoming. DANA L. RIPPER, SETH W. GALLAGHER and TAMMY VERCAUTEREN, *Rocky Mountain Bird Observatory, Ft. Collins, CO.*

Great Plains grasslands support one of the most threatened avian guilds, the shortgrass prairie suite of birds (Partners in Flight 2005). More than 80% of the shortgrass prairie of e. Colorado and se. Wyoming; thus, landowner involvement in habitat conservation efforts is essential to the future of grassland wildlife. Rocky Mountain Bird Observatory's Prairie Partners program has successfully engaged 38 ranchers and farmers in conservation, restoration, and enhancement projects affecting over 24,000 ha. Projects implemented include playa lakes restorations, riparian and upland livestock grazing management, tamarisk control, and interseeding CRP lands for Prairie-Chicken management. We currently have funding from the National Fish and Wildlife Foundation to enhance wildlife habitat on additional 2,800 ha of private land in e. Colorado and se. Wyoming, targeting at-risk species Mountain Plover, Ferruginous Hawk, Burrowing Owl, and Long-billed Curlew. These funds can be used to leverage further habitat restoration and enhancement dollars, with the intended long-term effect of landscape-level results. The keys to successful project implementation are (1) the voluntary, proactive cooperation of private landowners, and (2) funding partnerships with state, federal, and local agencies. We will share our experiences with landowner outreach, partnership building, and project development.

### **161 Piper**

Male Common Loons – but not females – become familiar with breeding territories through control of nestsite placement. WALTER H. PIPER, *Dept. Biol. Sci., Chapman Univ., Orange, CA.*

Using data from 98 marked territorial pairs in n. Wisconsin over 14 yr, we examined the “win-stay, lose-switch rule” for nestsite placement (if eggs hatch, reuse nestsite; if predator takes eggs, move nestsite) to determine: 1) if Common Loons gain site familiarity, and 2) any fitness consequences of site familiarity. We also tracked use of the rule when pair membership changed to learn whether females, males or both control nestsite placement. By reusing nesting sites where they hatched chicks in the past and avoiding sites where predators consumed their eggs, male common loons accumulated adaptive site familiarity that increased nesting success by 41% between their first and third years on a territory. In contrast, female identity had no impact on nest location, and females exhibited no increase in nesting success with longer territorial tenure. Our findings show that an animal's knowledge of biotic features can have a large impact on fitness in nature, suggesting that familiarity with a space itself, in addition to familiarity with conspecifics within or near that space (i.e., the “dear enemy effect”), can make site fidelity adaptive. Owing to adaptive site-familiarity, male loons that claim a new territory face a considerable “familiarity deficit” compared to established breeders. The familiarity deficit probably explains why established breeders of many species remain on familiar territories rather than moving to territories of higher intrinsic quality when they become available.

### **162 Sharpe & Garcelon**

Bald Eagle restoration on the California Channel Islands. PETER SHARPE and DAVID K. GARCELON, *Inst. Wildl. Stud., Arcata, CA.*

Bald eagles disappeared from the 8 California Channel Islands by the early 1960s, due largely to the effects of DDE contamination. We began bald eagle restoration on the islands in 1980, releasing 33 eagles from hacking towers on Santa Catalina Island between 1980 and 1986. Breeding pairs formed, but all the eggs laid broke in the nest and analyses indicated that DDE was the cause of failures. Since 1989, the population on Catalina has been maintained through a program of nest manipulations and hacking. We have released 109 Bald Eagles on Catalina through 2007, resulting in 5 breeding pairs and a population of approximately 20 - 25 eagles. In 2002, we began a second release program on Santa Cruz Island and released 61 eagles from hacking towers between 2002 and 2006. Eagles from the 2 release programs have visited all of the Channel Islands and, in 2006, 2 pairs successfully bred on Santa Cruz for the first time in over 50 yr. In 2007, 2 pairs on Catalina were allowed to keep their eggs, and each successfully hatched 2 chicks. Although DDE contamination continues to plague these eagle populations, recent nesting success indicates that conditions may be improving for bald eagles in the Southern California Bight and future restoration efforts will focus largely on searching for and monitoring known pairs with reduced human manipulation efforts.

### 163 Hartman & Oring

Lower survival probability for Long-billed Curlew broods abandoned by females: why do females desert? C. ALEX HARTMAN, *Prog. Ecol., Evol. & Conserv. Biol., Univ. Nevada, Reno, NV*, and LEWIS W. ORING, *Dept. Nat. Res. & Environ. Sci., Univ. Nevada, Reno, NV*.

As in many shorebirds, female Long-billed Curlews often abandon their broods before the chicks fledge. We investigated the impact brood desertion by female curlews had on brood survival rates. We monitored 62 Long-billed Curlew broods from hatch to fledging or death. During each brood encounter we recorded whether the brood was under biparental or male-only care. We used a known-fate analysis to model the daily survival probabilities of curlew broods under biparental and male-only care. After correcting for brood age and hatching date, the daily survival rate of Long-billed Curlew broods was lower when under male-only care than when under biparental care. Thus, broods deserted by females at a young age were less likely to fledge than broods deserted by females when they were older. In the Long-billed Curlew female desertion imparts a significant survival cost to the brood. On the other hand, deserting their broods allow females to gather into post-breeding flocks and depart the breeding grounds early in the season. Therefore, brood desertion by female curlews is likely a trade-off between current reproductive success and future reproductive potential. Benefits of brood desertion to female curlews, including early arrival to the wintering grounds will be discussed.

### 164 Atamian, Sedinger & Heaton

Greater Sage-Grouse brood rearing habitat at a landscape scale. MICHAEL T. ATAMIAN, JAMES S. SEDINGER, *Nat. Res. & Environ. Sci., Univ. Nevada-Reno, Reno, NV*, and JILL S. HEATON, *Dept. Geog. Univ. Nevada-Reno*.

Declines in Greater Sage-Grouse populations are believed to be due, in part, to reduced chick survival, which is linked to the loss and degradation of habitat. A fixed kernel density estimator was used to create 95% density polygons (brood rearing areas) around locations of radio tagged sage grouse hens with broods. Using the landcover data from the SWReGAP we describe both early and late brood rearing habitat at a landscape scale. Big Sagebrush Shrubland is the dominant landcover in early brood rearing areas composing 56% of the area on average. For late brood rearing areas Montane Sagebrush Steppe and Big Sagebrush Shrubland are the dominant landcovers, composing 34% each on average. Early brood rearing areas were marginally different from random ( $T_2 = 44.14$ ,  $F_{20,39} = 1.71$ ,  $p = 0.0803$ ), but late brood rearing areas were significantly different ( $T_2 = 97.35$ ,  $F_{20,25} = 2.77$ ,  $p = 0.0086$ ). A higher percentage of Montane Sagebrush Steppe was the greatest difference between late brood rearing habitat and random samples. Early brood rearing areas were not significantly different from late areas; however, in a posteriori comparison where stationary broods were removed, early areas were significantly different from late ( $T_2 = 119.63$ ,  $F_{20,19} = 3.82$ ,  $p = 0.0030$ ). Late brood rearing habitat differed from early brood rearing in having a larger percentage of Montane Sagebrush Steppe and Semi-Desert Grassland, and a smaller percentage of Big Sagebrush Shrubland. The results support the use of the SWReGAP landcover data as the habitat variable in a predictive model for late brood rearing areas and possibly for early areas. The use of such a predictive model would supply land managers with an effective means to focus their limited budgets on high quality brood rearing habitat and a way to guide their searches for new/unknown brood rearing areas.

### 165 Tuff, Cruz, Walsh & Chace

Differential parasitism frequencies in two suitable cowbird hosts in the Colorado Front Range. TY TUFF, ALEXANDER CRUZ, JOHN WALSH, *Dept. Ecol. Evol. Biol., Univ. Colorado, Boulder, CO*, and JAMESON F. CHACE, *Dept. Biol., Salve Regina Univ., Newport, RI*.

The Brown-headed Cowbird is an obligate, generalist brood parasite that reduces the reproductive success of many of its hosts. The variability in parasitism frequency that can occur among hosts in the same location and habitat may depend on factors such as host quality, abundance, and the behavior of a host at or in the vicinity of the nest. We examined the breeding biology of Western Wood-Pewees and Plumbeous Vireos and their interactions with cowbirds in Colorado Front Range Ponderosa Pine habitat. These 2 species often nest in close proximity, but yet sustained different levels of parasitism (< 1% and 51%, respectively). We examined egg acceptance via experimental parasitism,

aggression at the nest using cowbird and control models, and nest attentiveness to account for the differences in parasitism frequencies. Pewees accepted all eggs placed into the nests, and both species were aggressive towards cowbird models, pewees being significantly more aggressive towards the cowbird model than the control (House Sparrow). Pewees and vireos exhibited significantly different patterns of nest attentiveness. Pewees were usually found foraging 10 to 20 m from the nest and vireos were often 30 m or greater from the nest for extended periods. Aggressive nest defense and pattern of nest attentiveness may serve as effective parasite defense for the pewee.

#### **166 Kim & Anderson**

Factors influencing female Brown-headed Cowbird home range size in a central Nebraska grassland. DANIEL H. KIM, *Platte River Whooping Crane Trust, Wood River, NE*, and BRIANNA L. ANDERSON, *Dept. Biol., St. Cloud State Univ., St. Cloud, MN*.

We calculated home ranges for 23 female Brown-headed Cowbirds using radio telemetry and observations of colored-banded individuals from a central Nebraska grassland during summer 2006. We also examined the relationship among host and cowbird densities using constant effort capture data. Overall home range size averaged 9.0 ha (range 1.0 - 49.6 ha) with noticeable differences between breeding (4.9 ha) and foraging (20.3 ha) home ranges. Our data imply cowbirds are not perch limited in this grassland habitat, furthermore, all 23 female cowbirds roosted overnight in open grassland habitat rather than trees, despite the close proximity (<1 km) of adequate wooded sites. While the host community comprised mainly 5 species, cowbird densities were significantly associated with densities of Bobolink and Red-winged Blackbirds, but not densities of other grassland breeding birds despite the high parasitism rates experienced by these species. Grassland bird management strategies employing prescribed burns and livestock grazing within the Great Plains must account for regional abundance of cowbirds as well as both landscape context and content.

#### **167 Rose**

Does day length matter? A comparative study of the latitudinal clutch size gradient in temperate Tree Swallow populations. ALEXANDRA P. ROSE, *Ecol. & Evol. Biol. Dept., Univ. California, Santa Cruz, CA*.

One of the first mechanisms proposed for the latitudinal gradient in avian clutch size was the day length hypothesis -- Hesse (1924) and Lack (1947) suggested that birds breeding at high latitudes have more hours of light which they use to provision more offspring than their lower latitude conspecifics. Surprisingly, this intuitively appealing mechanism remains largely untested. I am conducting a comparative study of the effects of day length, foraging rates, and prey availability on clutch size and chick rearing success in 2 breeding populations of Tree Swallows across a large latitudinal gradient within the temperate zone. My preliminary results show several interesting trends. The approximately 5 additional hours of daylight available to Alaskan birds at the peak of nestling growth does translate into additional time provisioning their young. Alaskan birds spend approximately 11% more time feeding their chicks each day than Californian birds ( $t_{(87)} = 14.9$ ,  $p < 0.001$ ). This difference in time used per day corresponds well to the difference in clutch size I observed this year; birds in Alaska had clutches which were 13.4% larger than clutch sizes in California. The average rate at which parents feed chicks in the 2 populations is greater in Alaska than it is in California, however the duration of time that birds spend foraging accounts for at least as much if not more variation in the total number of feeding visits as the rate at which parents feed chicks. These findings suggest that variation in day length may explain, in part, the latitudinal gradient in avian clutch size.

#### **168 Mercadante & Stanback**

Hatching asynchrony and chick condition in Purple Martins: an experiment. AUSTIN MERCADANTE and MARK STANBACK, *Dept. Biol., Davidson Coll., Davidson, NC*.

We manipulated brood composition in Purple Martins to test the effects of differing hatching patterns on chick condition. We created "core" broods containing 4 large (core) and 1 small (marginal) chick and "marginal" broods containing 4 marginal and 1 core chick. After documenting that alpha (longest-winged) chicks are typically in better condition than omega (shortest-winged) chicks within the same broods, we tested whether the numbers of core and marginal chicks influence competitive

interactions in the brood. If core chicks have a greater impact on the fate of the brood, one would predict that the condition of the largest chick in the brood would be poorer in core vs. marginal broods with similar total hatching spread. We found no difference, suggesting that rank may be more important in determining condition than membership in an arbitrary subclass within the brood. We then performed a similar test using the smallest chick in core vs. marginal broods. Contrary to the situation with alpha chicks, omega chicks in core broods were in poorer condition, demonstrating that core/marginal composition does influence chick condition. Finally, we compared the condition of third-ranked (middle) chicks in core vs. marginal broods. There was no difference; contrary to expectations, marginal chicks were not in poorer condition than core chicks. Our results suggest that while the number of core chicks appears to impact the last-hatched chick, rank (rather than core/marginal status) better explains the condition of most chicks within Purple Martin broods.

### **169 Wiebe & Slagsvold**

Hatching asynchrony and early nestling mortality: the feeding constraint hypothesis. KAREN L. WIEBE, *Dept. Biol., Univ. Saskatchewan, Saskatoon, SK*, and TORE SLAGSVOLD, *Dept. Biol., Univ. Oslo, Oslo, Norway*.

Asynchrony sometimes appears to cause unnecessary starvation of the youngest nestlings. We present a solution to the paradox of early nestling death by suggesting that the need to provide smaller nestlings with small and soft food items while at the same time to satisfy the greater food demands of larger nestlings causes a conflict resulting in the starvation of junior siblings. We examined the hypothesis in a field experiment where Pied Flycatchers (*Ficedula hypoleuca*) were video filmed while provisioning synchronous and asynchronous broods. Prey size and load size increased with nestling age suggesting that larger prey were more profitable to bring to the nest than smaller prey. We observed that parents sometimes tried to feed small nestlings but the prey did not fit into the gapes and so the prey was subsequently given to larger siblings. Although small nestlings had difficulty swallowing large prey, parents of asynchronous broods brought large items suitable for the size of the older nestlings. Hence, junior nestlings of such broods suffered from reduced growth and increased mortality.

### **170 Roche & Cuthbert**

Assessing the relative fitness of captive-reared Great Lakes Piping Plovers. ERIN A. ROCHE, *Conserv. Biol. Prog., Univ. Minnesota, St. Paul, MN*, and FRANCIE J. CUTHBERT, *Dept. Fish. & Wildl., Univ. Minnesota*.

Since 1992, efforts to recover the federally endangered Great Lakes Piping Plover have included population supplementation with captive-reared young. We used banding data collected from 1993 - 2006 to assess fitness of captive-reared individuals relative to the wild population. We used program MARK to estimate survival rates and measured reproductive success by estimating mean number of eggs hatched, chicks fledged and chicks returning to nest per male wild parent and per captive-reared parent. Values were compared using 2-sample t-tests of unequal variance. The best supported MARK model indicated wild-reared juveniles ( $n = 837$ ,  $\psi = 25.8\%$ ,  $\psi \text{ SE} = 2.4\%$ ) had higher survival rates than captive-reared chicks ( $n = 83$ ,  $\psi = 9.1\%$ ,  $\psi \text{ SE} = 4.3\%$ ) but did not support differential > 1st year survival. Captive-reared parents averaged 2.67 (SE 0.31) hatched eggs and 0.96 (SE 0.44) chicks fledged; wild-reared male parents averaged 2.97 (SE 0.19) hatched eggs and 1.83 (SE 0.23) fledged chicks per breeding season. The difference in mean number of chicks hatched was not significant. Wild-reared male parents fledged significantly more chicks per breeding season than captive-reared parents ( $p$ -value < 0.1). Our results suggest captive-reared individuals are less fit than their wild counterparts. Successful captive-rearing of precocial species like the Piping Plover may require attention to the development of predator-response behavior.

### **171 Gratto-Trevor & White**

Survival of captive-reared and natural fledged Saskatchewan Piping Plovers from 2005. CHERI L. GRATTO-TREVOR, *Prairie & Northern Wildl. Res. Centre, Env. Canada, Saskatoon, SK*, and CORIE L. WHITE, *Saskatchewan Watershed Authority, Regina, SK*.

In Canada, Piping Plovers are listed as endangered. Up to 360 birds nest at Lake Diefenbaker,

SK, but periodically, many nests there are washed out by flood waters. In an early flood in 2005, eggs were collected and chicks captive-reared, with 107 fledged young released at nearby Chaplin Lake. Each chick was marked with a unique combination, using the same banding scheme as 52 natural fledged young marked in other areas of Saskatchewan. To test the effectiveness of the captive rearing technique, we compared 'survival' of the captive-reared versus natural fledged young. 21% (22) of the captive-reared and 15% (8) of the natural fledged birds were reported during the winter of 2005 - 2006; and 11% (12) versus 12% (6) during the winter of 2006 - 2007. During the summer of 2006, 16% (17) of captive-reared birds were recorded, compared to 17% (9) of wild fledged birds. Overall, 25% (27) of the captive-reared, versus 25% (13) of the natural fledged birds were seen a year later. Only one of 107 captive-reared birds was observed with a nest in 2006, compared to 3 of 52 natural fledged birds. To date, no significant different in survival and breeding propensity has been measured, but further data will be collected.

### **172 Reynolds, Vekasy, Breeden, Seavy, Klavitter & Laniawe**

Post release demography of endangered island ducks translocated to Midway Atoll. MICHELLE H. REYNOLDS, MARK S. VEKASY, JAMES BREEDEN, NATHANIEL E. SEAVY, *U.S. Geol. Surv., Pacific Island Ecosys. Res. Center, Kilauea Field Sta., Hawaii Natl. Park, HI*, JOHN L. KLAUITTER and LEONA LANIAWE, *U.S. Fish & Wildl. Serv., Midway Atoll Natl. Wildl. Refuge*.

Translocation is a conservation tool often used to restore endangered species. However, most translocations lack post-release monitoring needed to assess population establishment or failure. To reduce high extinction risks to the species, we translocated 42 wild Laysan Ducks (*Anas laysanensis*) to a portion of its presumed prehistoric range. We monitored fate of translocated birds using radio telemetry for 2 yr after the first release. Post-release survival of founders was 0.857 (95% CI 0.86 - 0.98). Two years post-release, the effective founding female population ( $N_e$ ) was 13 of 18. Successful breeding males are more difficult to identify, yet 13 of 24 male founders appeared to form pair bonds with successfully breeding females. In 2 breeding seasons, 17 of 18 founding hens attempted breeding, producing 46 nests with > 318 eggs. The 2005 F1 generation's survival from fledgling to 1-yr post-fledge was 0.90 (95% 0.71 - 1.0, n = 11). This conservation experiment provided new demographic parameters for the species at low densities, contrasting with those of the source population, which is near carrying capacity. The nascent population size increased to >100 birds after only 2 yr post-release. We compare demographic and habitat use plasticity between Laysan and Midway, and discuss population projections after 10 yr.

### **173 vacant**

### **174 vacant**

### **175 Hallworth & Reitsma**

Habitat use of territorial Louisiana Waterthrushes overwintering along streams in the Caribbean National Forest, Puerto Rico. MICHAEL HALLWORTH and LEONARD R. REITSMA, *Dept. Biol., Plymouth State Univ., Plymouth, NH*.

Neotropical migratory warblers are known to exhibit site fidelity to both temperate breeding and tropical nonbreeding territories, but less research has been done in their tropical overwintering grounds. We used telemetry and GPS to map individual territories of neighboring Louisiana Waterthrushes during the nonbreeding season in the Caribbean National Forest, Puerto Rico. In 3 successive years, we attached transmitters to 7 or 8 individuals along 2 streams in the same watershed. Birds were followed and locations were marked at 5-min intervals for a minimum of 100 locations per bird (avg = 156). Returns of marked birds were low (2 of 8 in the second year and 2 of 7 in the third year). Adaptive kernel analysis indicated that 2/3 of the birds spent >50% of their time foraging along streams. All birds foraged on the ground in moist substrate, and several capitalized on small drainages with high arthropod abundance. Younger birds had larger home ranges. Birds sometimes spent several hours in small areas

with high arthropod abundance. There was no significant pattern to territory positions along more or less disturbed sections of the streams with respect to age or sex. These data indicate this riparian species is not restricted to, but most often associated with, streams or rivers.

#### **176 Francis, Ortega & Hansen**

Nest site selection and success of three common piñon-juniper birds in response to a chronic industrial noise disturbance. CLINTON D. FRANCIS, *Dept. Ecol. & Evol. Biol., Univ. Colorado, Boulder, CO*, CATHERINE P. ORTEGA, *San Juan Inst. & Dept. Biol., Ft. Lewis Coll., Durango, CO*, and JOHN HANSEN, *BLM Farmington Field Office, Farmington, NM*.

We isolated noise experimentally to determine its effects on nest density, nest site selection, and nest success of breeding birds in piñon (*Pinus edulis*)-juniper (*Juniperus osteosperma*) woodlands. Our study sites included piñon-juniper habitat surrounding natural gas wells with noisy compressors as experimental treatment sites and wells without compressors (noiseless) as control sites. No differences in nest densities existed between treatment sites and control sites for the avian community as a whole. However, the Black-chinned Hummingbird and House Finch nested almost exclusively on noisy treatment sites, whereas the number of Chipping Sparrow nests did not differ on treatment and control sites. Brown-headed Cowbirds parasitized Chipping Sparrow nests significantly more on control sites than treatment sites. Among nests of all 3 species, nests exposed to higher noise levels experienced higher daily success rates, lower predation, and no parasitism compared to nests exposed to lower noise levels. Noise pollution appears not only to influence nesting patterns of birds common to piñon-juniper woodlands, thereby altering the avian community, but also to influence nest success through changes to predation and parasitism patterns.

#### **177 Lehnen & Rodewald**

The importance of patch area to shrubland birds in southeastern Ohio. SARAH E. LEHNEN and AMANDA D. RODEWALD, *School Environ. & Nat. Res., Ohio State Univ., Columbus, OH*.

Population declines of shrubland birds in the eastern U.S. have been attributed to decreasing amounts of early-successional habitat. Understanding the sensitivity of shrubland birds to patch characteristics is important given that shrubland habitats are often ephemeral and patchily distributed. However, studies of area-sensitivity in shrubland birds have been equivocal. We tested the extent to which patch area was related to shrubland bird density, annual survival, and productivity by examining capture rates, apparent annual survival, and adult-female-to-juvenile ratios of shrubland birds in se. Ohio. Identical 3 x 3 mist-netting grids were set at each of 13 clearcut patches (4 - 18 ha) and each patch was visited once per week between Jun and Aug of 2002 - 2006. We banded 1,536 juveniles and 2,110 adults of 7 shrubland species. Yellow-breasted Chat was the only species with significantly higher capture rates in larger sites ( $p = 0.035$ ); however this difference was not significant when adjusted for availability for capture ( $p = 0.203$ ) which accounted for bird movements leading to more birds being available for capture at larger sites. Apparent annual survival estimates and adult-female-to-juvenile ratios did not differ significantly by patch size for any species. Overall, we detected little evidence of area-sensitivity by shrubland birds in our study. However, favoring the creation of fewer, larger patches of early-successional habitat may be beneficial for mature forest birds.

#### **178 Poulin, Villard, Goulet, Edman & Eriksson**

Thresholds in nesting habitat requirements of a mature forest specialist, the Brown Creeper. JEAN-FRANÇOIS POULIN, MARC-ANDRÉ VILLARD, PIERRE GOULET, *Dept. de biologie, Univ. de Moncton, Moncton, NB*, MATTIAS EDMAN, *Dept. Wildl., Fish & Env. Stud., Swedish Univ. Agr. Sci., Umeå, Sweden*, and ANNA-MARIA ERIKSSON, *Dept. Nat. Sci., Mid Sweden Univ., Sundsvall, Sweden*.

Many bird species respond to forestry, even at moderate intensities. In New Brunswick, the Brown Creeper exhibits a negative, threshold response to harvesting intensity. This study aimed to determine whether (a) the threshold found in creeper occurrence is lower than eventual thresholds in its nesting requirements, and whether (b) the conservation of this species could be achieved through moderate-intensity harvest systems. Creepers are particularly sensitive to forestry because they nest on

snags with peeling bark and they mainly forage on large-diameter trees. In northern hardwood stands, we compared habitat structure at nest sites and at sites not used by creepers at local ( $r = 80$  m) and meso ( $r = 250$  m) scales. Over 2 yr, 76 nests were found, 66 of which were paired with unused sites. Densities of trees  $>30$  cm dbh and snags  $>10$  cm dbh, and the probability of presence of potential nest sites were significantly higher near nests at the local scale. At the meso scale, the area of untreated mature forest was significantly higher around nests. Variance decomposition indicated that habitat variables at the local scale accounted for the majority of explained variation in nest-site selection. There were also significant thresholds in the densities of large trees (127/ha) and snags (56/ha) and in the area of mature forest (10.4 ha). The conservation of breeding populations of Brown Creepers thus requires much higher densities of large trees than those associated with its probability of presence. Such a target seems to be incompatible even with moderate-intensity harvesting.

### **179 Reitsma, Hallworth, Benham & Lambert**

Canada Warbler breeding ecology in young forest stands compared to red maple swamp. LEOANRD R. REITSMA, MICHAEL HALLWORTH, PHRED M. BENHAM and J. DANIEL LAMBERT, *Biol. Dept., Plymouth State Univ., Vermont Inst. Nat. Sci., Quechee, VT.*

Canada Warblers occur in several forested habitat types with thick understories and dense shrub layers. We examined whether their breeding ecology differed between a red maple swamp with a thick naturally occurring understory and a 20-yr-old clearcut with residual tree retention. We mapped male territories in 2 consecutive years (2005 - 2006) to determine differences in habitat, territory size, site fidelity, and reproductive success. We found little difference in most vegetative characteristics, such as overall stem density, number of song perches, and canopy height. Species composition and shrub size classes did differ. Individual males used 40 - 50% less area in the red maple swamp. However, site fidelity and reproductive success was similarly high in both habitats. These results are significant for this warbler species in decline in the Northeast. Specific timber harvest strategies resulting in thick sub-canopy layers and with residual tree retention for song perches can be implemented to promote Canada Warbler breeding success and potentially reverse declines.

### **180 McDonald**

Changes in Kentucky Warbler preferred habitat choice at a long-term study site in north-central Virginia. M. VICTORIA McDONALD, *Smithsonian Conserv. & Res. Center, Front Royal, VA.*

Habitat preferences and choices in migratory birds are traditionally considered to be static attributes of species, subspecies, or demes. But what if the habitat changes during the lifetime of an individual or cohort? A logical (and usually implicitly assumed) result is that the birds will move on to choose the next best alternative, analogous to when an individual bird finding that his or her territory occupation has been pre-empted by an adversary who can not be displaced. In my long-term research at the Conservation and Research Center near Front Royal, Virginia, I have traced habitat choice and territory occupation of Kentucky Warbler since 1979. Shifts in territory occupancy have occurred, as one might expect, due to gradual successional habitat change. As the population has shrunk, then some traditionally-occupied territories have been deserted altogether. In some cases aggressive invasive plants have drastically changed the physiography of the habitat and

### **181 Blanc & Walters**

Snag management for cavity-nesters in southern pine forests: what is a 'quality' snag? LORI A. BLANC and JEFFREY R. WALTERS, *Dept. Biol. Sci., Virginia Tech Univ., Blacksburg, VA.*

Snags are a critical component of forested landscapes for cavity-nesting species, however relatively little attention has been given to snag management in pine forests of the se. U.S. Despite wide-ranging and intensive silvicultural practices, no regulatory guidelines presently exist for snag management in southern pine forests. There is a particular need to define snag 'quality' for these pine forests, as snag quality may be more important than quantity in maintaining a rich and abundant cavity-nesting community. When snags are in short supply, as they often are in managed pine forests, nest-site selection may not reflect preferred snag characteristics and thus limit our ability to assess 'quality'. In this 4-yr study, we monitored the nests of 13 cavity-nesting species in a Florida longleaf pine

forest. Because this forest experienced a recent pulse in tree mortality due to fire re-introduction, we had a unique opportunity to document cavity-nest site selection in a pine forest with an abundance of cavity resources in a diverse range of sizes and types. Here, we present characteristics of snags selected for cavity-nests as a means to develop a definition of snag 'quality' and discuss the implications for snag management guidelines.

**182 Smith, Warkentin & Moroni**

Snag availability for cavity nesting birds and other wildlife over a chronosequence of post-harvest landscapes in western Newfoundland. CARYN SMITH, *Cognitive & Behav. Ecol., Memorial Univ. Newfoundland, St. John's, NL*, IAN WARKENTIN, *Environ. Sci., Memorial Univ. Newfoundland, Corner Brook, NL*, and MARTIN MORONI, *Nat. Res. Canada - Canadian For. Serv., Atlantic For. Center, Corner Brook, NL*.

We examined the availability and quality of standing dead trees (snags) for nesting habitat following harvest across a chronosequence in balsam fir (*Abies balsamea*) dominated boreal forests in western Newfoundland. Snag density declined substantially 10 to 15 yr following harvest then increased to reach its highest level in 81 - 100 yr-old forests that had become senescent. The majority (55%) of 1337 snags present was balsam fir; 41% of the 108 cavities identified were in snags of this species. Diameter at breast height (dbh) was the best predictor of cavity presence in a snag, followed by decay class, time since harvest, height and snag species. Based on dbh, less than 40% of snags available throughout the chronosequence were large enough for cavity nesters. Downy Woodpeckers were responsible for 47% of all cavities identified, using balsam fir ~50% of the time. Two larger cavity nesters present, Northern Flickers and Three-toed Woodpeckers were more likely to use snags of White birch (*Betula papyrifera*) a non-merchantable and relatively large diameter species. Given the prominent role played by flickers in cavity-nesting communities, managing for its preferred species (white birch) could have implications for the broader community present.

**183 Bednarz, Huss, Benson & Varland**

Status of experimental fungal inoculations to establish heart-rot and promote cavity nests and wildlife habitat in managed forests in Washington. JAMES C. BEDNARZ, MARTIN J. HUSS, THOMAS J. BENSON, *Dept. Biol. Sci., Arkansas State Univ., Jonesboro, AR*, and DANIEL E. VARLAND, *Rayonier, Hoquiam, WA*.

Because of short timber-harvest rotations, relatively few trees in managed forests are infected with the heart-wood decaying fungi, which softens wood and enables excavation by primary-cavity nesters. A lack of woodpecker activity and resulting deficiency of available nest and roost cavities limits the diversity and abundance of many cavity-using wildlife species. We implemented an innovative experimental management approach wherein a wood-decaying fungus, the red-belted conk (*Fomitopsis pinicola*), and blank controls were introduced into selected trees in 1997 and 1998 to enhance the suitability of managed forests for woodpeckers. In 2006, we revisited 598 trees that were inoculated experimentally and inspected each tree for the presence of fungal growth and signs of woodpecker activity. A significantly higher proportion of treatment trees displayed *F. pinicola* conks (0.165) and mycelia (0.049) than did control trees (0.044 conks, 0.015 mycelia). Also, western hemlocks (*Tsuga heterophylla*) had a higher proportion of conks (0.179) and mycelia (0.035) than Douglas-fir (*Pseudotsuga menziesii*) trees (0.040 and 0.022, respectively). Importantly, we observed more evidence of woodpecker excavations associated with the fungal inoculations (3.9% of treatment trees) than at control trees (1.0%,  $P = 0.056$ ). This pattern does suggest that inoculations may enhance habitat for primary-cavity excavating birds over the long term. Although the incidence of woodpecker excavations of treatment trees was still relatively low 8 - 9 yr after inoculation, we suggest that woodpecker use will likely increase as fungi become more established in future years.

**184 vacant**

**185 Houde**

Emergent phylogenetic signal from Neoavian DNA sequences. PETER HOUDE, *Dept. Biol., New Mexico State Univ., Las Cruces, NM.*

I report phylogenetic analysis of ca. 15 kilobases of DNA sequence data assembled from 11 nuclear loci for 100 avian families, representing essentially all neoavian nonpasserine families. The analysis supports the hypothesis originally proposed on the basis of a single locus that Neoaves consists of 2 clades, Metaves and Coronaves. These are analogous to marsupial and placental mammals in familial diversity and ecological convergence, and both occupy virtually all adaptive zones. Phylogenetic structure within each of these clades is refined. In particular, shorebirds are recovered here as members of a clade of primarily aquatic birds, one of 2 major divisions of Coronaves. About a third of currently recognized avian orders are found to be polyphyletic or paraphyletic. In contrast to the 2 clades of Coronaves that are relatively homogeneous ecologically, morphological gaps between differentially specialized Metaves suggest that prehistoric avian diversity is greatly underestimated. The omission of these ecological intermediates has confounded morphological phylogenetic analyses and biased taxon sampling in molecular studies.

#### **186 Brown & Mindell**

Nuclear and mitochondrial DNA agree on the age of Neoaves. JOSEPH W. BROWN and DAVID P. MINDELL, *Dept. Ecol. & Evol. Biol. and Mus. Zool., Univ. Michigan, Ann Arbor, MI.*

Genetic data provide the ability to yield estimates for dates of diversification within a phylogeny. Investigators interested in such questions want to use genetic markers that yield both reproducible and precise estimates. Inferred dates of diversification between nuclear and mitochondrial genomes could potentially differ because of differences in lineage splitting time (related to effective population size differences) or degree of mutational saturation (leading to obfuscation of historical information). Using multilocus nuclear and mitochondrial DNA data sets from 57 avian families (8288 total aligned base pairs), we show that mean inferred dates of diversification within Neoaves derived from these 2 genomes agree quite closely (< 5 million year difference), although the latter estimates are less precise (standard deviation on date estimate being on average ~4 million years larger). Given the small discrepancy, inferences derived from alternative genomes are unlikely to support different macroevolutionary models.

#### **187 Fleischer, James, Driskell & Olson**

What is a Hawaiian honeyeater? ROBERT FLEISCHER, HELEN JAMES, AMY DRISKELL and STORRS OLSON, *Natl. Zool. Park, Smithsonian Inst., Washington, DC.*

The Hawaiian honeyeaters (genera *Moho* and *Chaetoptila*) have been classified in the avian family Meliphagidae, but their affinities within the family have been unclear. Unfortunately, all described species of Hawaiian honeyeaters are extinct, with most species having disappeared by about a century ago, and one species (*Moho braccatus* of Kauai) blinking out only during the past 30 yr. In this talk, we evaluate, using nuclear and mitochondrial DNA isolated from museum specimens collected in the 1800s, the phylogenetic position of the Hawaiian honeyeaters. We find support for the monophyly of the group, but with the genus *Moho* paraphyletic. Most surprising, we find no support for the placement of this group within the family Meliphagidae, nor within the "pre-Corvida" of songbirds in which Meliphagids belong. In contrast, both genera of Hawaiian honeyeaters are well-supported members of the "Passerida". Our analysis reveals that the Hawaiian honeyeaters form a divergent lineage within an unusual clade containing 3 other avian families: waxwings, silky flycatchers and the monotypic palm chat (of *Hispanola*). Our findings indicate that the Hawaiian honeyeaters are unique taxonomically, perhaps to the level of family; are not likely derived from South Pacific ancestors; and are highly convergent in morphology, behavior and ecology with Australasian honeyeaters.

#### **188 Humphries & Winker**

Working through polytomies: auklets revisited. ELIZABETH M. HUMPHRIES and KEVIN WINKER, *Univ. Alaska Mus. and Inst. Arctic Biol., Fairbanks, AK.*

Polytomies, or phylogenetic "bushes", are the result of a combination of internodes that cover a short period of evolutionary time and data that do not contain enough of the correct phylogenetic information. In this study, we used the *Aethia* auklet polytomy to explore the effectiveness of different

methods - mitochondrial DNA gene choice, number of individuals per species sampled and use of AFLP loci - for breaking polytomies. We generated a fully-resolved phylogeny using NADH dehydrogenase subunit 2 (ND2) sequence data under a 2 different Bayesian models; when we applied the same models to previously-published cytochrome b, NADH dehydrogenase subunit 6 and partial cytochrome oxidase sequences, we failed to resolve the polytomy. Phylogenetic resolution in our mitochondrial ND2 data set peaked when we sampled a minimum of 3 individuals per auklet species, and fully 20% of the subsampled data sets failed to return the correct phylogeny when we sampled only 1 or 2 individuals per auklet species. Additionally, we did not recover a resolved phylogeny using our AFLP data. However, when we examined to conflict in this data set, we discovered that 3 different topologies are supported supported by the data, suggesting that the AFLP polytomy is the result of lineage sorting.

### 189 James & Pourtless

Has cladistics been misleading studies of the origin of birds? FRANCES C. JAMES and JOHN A. POURTLESS IV, *Dept. Biol. Sci., Florida State Univ., Tallahassee, FL.*

The hypothesis that the origin of birds is among the maniraptoran theropod dinosaurs has become widely accepted by both scientists and the general public. Criticism has usually been dismissed because no alternative has been presented with cladistic methodology in a full phylogenetic context. We reanalyzed a standard matrix from a recent paper by James Clark, Mark Norell and Peter Makivicky that contained only theropods and birds and we did find statistical support for a bird/maniraptoran clade. However, this statistical support for the limited question of which theropods are most like birds is not fully adequate to separate the standard hypothesis from the hypothesis that several maniraptoran groups are birds more advanced toward modern birds than *Archaeopteryx* and so the origin of birds must lie elsewhere in the Theropoda or among non-dinosaurian archosaurs. We constructed a new matrix of 79 taxa and 235 characters that includes representatives of the entire Archosauria. Analyses using PAUP\*, bootstrap values, and successive pruning suggested that neither the Theropoda nor the Maniraptora is monophyletic, so the bird-maniraptoran clade must belong elsewhere in Archosauria. Our analysis of the full body of current evidence shows that the origin of birds is unclear at this time, but that it is unlikely to be in the Dinosauria.

### 190 Burns & Racicot

Molecular phylogenetics of a radiation of lowland tanagers (genus *Tachyphonus*) and relatives. KEVIN J. BURNS and RACHEL A. RACICOT, *Dept. Biol., San Diego State Univ., San Diego, CA.*

A complete-species phylogeny of the genus *Tachyphonus* and their relatives, a group of wide-ranging neotropical tanagers, was reconstructed to investigate the biology and biogeography of the group. Phylogenetic relationships were inferred using *cyt b* and ND2 sequence data. Analyses were performed using Maximum Parsimony, Maximum Likelihood, and Bayesian Inference methods implemented in PAUP and MrBayes. Species for which more than one individual was sampled were recovered as monophyletic. All analyses found a monophyletic group containing *Tachyphonus*, *Ramphocelus*, *Trichothraupis*, *Eucometis*, *Lanio*, *Coryphospingus*, and *Rhodospingus*. Within this clade, 2 strongly-supported sister clades that each include species of *Tachyphonus* along with related species were recovered. One clade includes 3 species of *Tachyphonus* and all recognized species of *Ramphocelus*. The second lineage contains the remaining *Tachyphonus* species and *Trichothraupis*, *Eucometis*, *Lanio*, *Coryphospingus*, and *Rhodospingus*, rendering *Tachyphonus* as traditionally described non-monophyletic. In addition, the traditional classification of *Coryphospingus* and *Rhodospingus* as emberizine finches is not supported here. The allopatric distribution of sister species in this group implies that vicariant speciation was likely the predominant mode of speciation. Many of the species studied are widespread, complicating reconstructions of ancestral distribution patterns for early divergences. Isolation between certain zoogeographic regions, however, may have been important for recent speciation patterns.

### 191 Smith & Klicka

Comparative approaches for inferring divergence times in a well-resolved Cardinalid clade. BRIAN T. SMITH and JOHN KLICKA, *Barrick Mus. Nat. Hist., Univ. Nevada Las Vegas, Las Vegas, NV.*

The purpose of our study was to compare single locus and multi-locus estimates of divergence

times in a monophyletic Cardinalid clade comprised of the genera *Cardinalis*, *Carythraustes*, *Rhodothraupis*, and *Periporphyrus*. Criticisms of single locus divergence time estimates have focused on large confidence intervals and on the overestimation of species divergence times. The latter is thought to be particularly problematic for more recent diversification events, due to the greater retention of ancestral polymorphisms. To examine the effects of using single and multiple loci we used a Bayesian coalescent model to estimate divergence times for all nodes in our topology. As expected, confidence intervals around divergence times decreased with the addition of loci. Consistent with theoretical predictions, both methods provided similar divergence time estimates for older nodes; but, estimates for nodes joining terminal taxa were younger according to the multi-locus method. Divergence times in the *Cardinalis* clade were reduced by 0.5 and 1.2 MY by using multiple loci. Our study demonstrates that the use of multiple loci improves divergence time estimates of more recently derived taxa while reducing the size of associated confidence intervals. These findings have implications for biogeographic inference particularly around dating events.

### 192 Fuchs, Bowie, Irestedt, Fjeldsa, Couloux & Pasquet

Molecular phylogeny of African bush-shrikes and allies: tracking the colonisation history and evolution of foraging behaviour. JEROME FUCHS, *Muséum national d'Histoire naturelle, Paris, France*, RAURI C. K. BOWIE, *Mus. Vert. Zool., Berkeley, CA*, MARTIN IRESTEDT, *Naturhistoriska riksmuseet, Stockholm, Sweden*, JON FJELDSA, *Zoologisk Mus., Univ. Copenhagen, Copenhagen, Denmark*, ARNAUD COULOUX, *Genoscope, Evry, France*, and ERIC PASQUET, *Muséum national d'Histoire naturelle*.

The African bush-shrikes and allies represent a behaviorally and morphologically highly diversified clade of corvid passerine as some taxa behave as flycatchers (batises), as shrikes (bush-shrikes) or as large foliage-gleaners (helmet-shrikes). The phylogenetic relationships among the main lineages of bush-shrikes and allies has received much attention these latter years, with the clarification of the relationships of some odd African genera (Fuchs et al. 2004, **Mol. Phylogenet Evol**, 33:428-439) and the adding of peculiar Indo-Malayan taxa among the African lineages (e.g., *Hemipus*, Fuchs et al. 2006, **Zool. Script** 35: 375-385). Yet, these studies also highlighted the occurrence of conflicts between mitochondrial and nuclear gene for the relationships of the atypical genus *Lanioturdus* or a lack of resolution among the three main bush-shrike and allies lineages (e.g., lineages defined by their foraging behaviour). To decipher if this lack of resolution is attributable to a soft polytomy (lack of character sampling) or hard polytomy (radiation), we used sequence data gathered from 7 autosomal, 1 Z-linked and 2 mitochondrial loci for all main African lineages as well as from their closest Indo-Malayan and Australasian relatives. Using a relaxed clock dating method and paleontological data, we tracked back the colonization history of Africa by this lineage and address its diversification history.

### 193 Mauck & Burns

Phylogenetics and evolution of nectar specialization in flowerpiercers (genera: *Diglossa* and *Diglossopsis*). WILLIAM M. MAUCK III and K. J. BURNS, *Dept. Biol., Univ. California, San Diego, CA*.

Flowerpiercers are nectar feeding tanagers ranging from the Mexican highlands through the Andes and Tepuis to nw. Argentina. Flowerpiercers are commonly referred to as "nectar thieves" because they use the hook at the end of their maxilla to obtain nectar without transferring pollen. The first comprehensive molecular based phylogeny was inferred using mitochondrial DNA to examine the relationships among flowerpiercers. Based on this phylogeny, the genus *Diglossopsis* is not monophyletic. However, the 4 species complexes within *Diglossa* are monophyletic. To examine how variations in hook size has evolved among flowerpiercers, approximately 650 specimens were photographed and examined for 8 bill and hook measurements. A principal components analysis indicated that Factor 1 represents a contrast between hook size relative to bill size. Thus, birds with low scores have larger bills with small hooks, and birds with high scores have small bills with large hooks. These scores were converted into discrete characters and mapped onto the phylogeny using step-matrix gap-weighting parsimony. The ancestral state of all flowerpiercers was inferred to have an average hook size relative to bill size. From this state, a proportionally larger hook evolved in 2 independent lineages. A biogeographical analysis of flowerpiercers, using Dispersal-Vicariance Analysis, inferred a northern Andean or northern central Andean origin. Dispersals out of the northern Andes occurred 7 times. Dispersals to Central America and the Tepuis of Venezuela each occurred once and 5 independent

dispersal events occurred in the Central Andes.

**194 Gebhardt, Waits, Powell & Brightsmith**

Genetic diversity and genetic structure of 4 large parrots in the Peruvian Amazon. KARA J. GEBHARDT, LISETTE P. WAITS, *Dept. Fish & Wildl., Univ. Idaho, Moscow, ID*, GEORGE POWELL, *WWF, Washington, DC*, and DONALD J. BRIGHTSMITH, *Dept. Vet. Path., Texas A&M Univ., College Station, TX*.

Very little is known about parrots in the Amazon rainforest because their habitats can be remote and inaccessible. In addition, many parrots are at risk of extinction due to high rates of habitat degradation, hunting and harvesting for the pet trade. Southeastern Peru contains some of the most pristine rainforest remaining in the Amazon basin yet is faced with impending development with the construction of a highway connecting the western Amazon with the Pacific Ocean. In order to document the current genetic status of parrot populations, we used mitochondrial DNA sequence analysis and nuclear DNA microsatellite analysis to measure genetic diversity and population structure of Blue-and-yellow Macaw (*Ara ararauna*), Scarlet Macaw (*Ara macao*), Red-and-green Macaw (*Ara chloropterus*) and Mealy Parrots (*Amazona farinosa*), sampled from 3 locations in Peru. We found that genetic diversity of all 4 species in Peru is high. Additionally we found that Blue-and-yellow Macaw in Brazil and Peru have comparable levels of genetic diversity despite the increased habitat fragmentation in Brazil. We also present data describing the genetic structure of each species across the 3 locations in the Peruvian Amazon. This increases our basic biological knowledge of these species and provides a baseline for monitoring these populations as they respond to future changes.

**195 Dor & Lotem**

Low genetic heritability of nestling begging intensity in the House Sparrow. ROI DOR and ARNON LOTEM, *Dept. Zool., Tel-Aviv Univ., Tel Aviv, Israel*.

Evolutionary theory of parent-offspring conflict assumes that nestling begging and parental response to begging are heritable, at least to some degree, and are therefore subjected to selection and co-evolution. However, very few empirical studies attempted to assess the genetic heritability of these behaviors. In this study we used artificial selection, sibling analysis, and 3 generations of cross-fostered captive House Sparrow nestling to estimate the heritability of nestling begging intensity and to compare it with the heritability of wing length and body mass. We found no significant differences in begging intensity between breeding groups selected for high and low begging intensities. There was also no correlation between begging intensity of nestlings and their biological offspring in the following year, or between begging of successive broods of the same biological parents (although similar analysis for adult wing length and body mass showed significant heritability in both cases). A highly significant correlation in begging intensity was found between nestlings that shared the same brood. The results suggest that most variation in begging intensity among house sparrow nestlings is phenotypic (or epistatic), and cannot be explained by genetic origin. In this light, genetic control of begging behavior may be indirect, and possibly related to the mechanisms that adjust begging in relation to phenotypic or environmental conditions.

**196 Maley & Winker**

Testing hypotheses of divergence between Snow and McKay's buntings: evidence for founder effect speciation. JAMES M. MALEY, *Mus. Nat. Sci., Louisiana State Univ., Baton Rouge, LA*, and KEVIN WINKER, *Univ. Alaska Mus., Fairbanks, AK*.

McKay's Buntings are the highest latitude endemic songbird, and their global range is restricted to the region known as Beringia. Their closest relative, the Snow Bunting, has a Holarctic distribution and breeds in tundra habitat surrounding the island breeding range of McKay's Buntings. This species pair provides an excellent opportunity to investigate speciation at high latitudes in a region known to be impacted by Pleistocene climatic oscillations. We sequenced 1123 bp of mtDNA for 40 individuals of each species from the Beringian region; we also analyzed 580 AFLPs for 57 individuals. We found significant genetic differences between the 2 species using both marker types. Coalescent analysis of

mtDNA data indicated that they diverged when the island breeding range of McKay's was a hill on the Beringian steppe (~20,000 to ~80,000 ybp), suggesting that Snow Buntings may have been restricted to lower latitudes by ice sheets. Morphological divergence between them, apparently limited to plumage characters, appears to have occurred rapidly in isolation. Effective population size estimates support a founder event in McKay's Buntings. After the founder event, there is evidence that population expansion occurred, followed by a subsequent reduction. This reduction is apparently coincident with rising sea levels and asymmetric hybridization from McKay's Buntings into Snow Buntings. Testing for AFLP loci linked to or under selection suggests that the divergence was not driven by strong selection. This recent, high-latitude speciation event best fits a model of founder effect peripatric speciation driven by genetic drift acting on a small founding population.

#### **197 Parchman, Benkman & Mezquida**

Coevolution between Hispaniolan crossbills and pine: does more time allow for greater phenotypic escalation at lower latitude? THOMAS L. PARCHMAN, *Dept. Biol., New Mexico State Univ., Las Cruces, NM, and Dept. Zool. & Physiol., Univ. Wyoming, Laramie, WY*, CRAIG W. BENKMAN, *Dept. Zool. & Physiol., Univ. Wyoming*, and EDUARDO T. MEZQUIDA, *Ecol. & Edaphology Unit, Polytech. Univ. Madrid, Madrid, Spain*.

Crossbills (Aves: *Loxia*) and several conifers have coevolved in predator-prey arms races over the last 10,000 yr. However, the extent to which coevolutionary arms races have contributed to the adaptive radiation of crossbills or to any other adaptive radiation is largely unknown. Here we extend our previous studies of geographically structured coevolution by considering a crossbill-conifer interaction that has persisted for a much longer time period and involves a conifer with more variable annual seed production. We examined geographic variation in the cone and seed traits of 2 sister species of pines, *Pinus occidentalis* and *P. cubensis*, on the islands of Hispaniola and Cuba, respectively. We also compared the Hispaniolan crossbill (*L. megaplaga*) to its sister taxa the North American White-winged Crossbill (*L. leucoptera leucoptera*). The Hispaniolan crossbill is endemic to Hispaniola while Cuba lacks crossbills. In addition and in contrast to previous studies, the variation in selection experienced by these pines due to crossbills is not confounded by the occurrence of selection by tree squirrels (*Tamiasciurus* and *Sciurus*). As predicted if *P. occidentalis* has evolved defenses in response to selection exerted by crossbills, cones of *P. occidentalis* have scales that are 53% thicker than those of *P. cubensis*. Cones of *P. occidentalis*, but not *P. cubensis*, also have well-developed spines, a known defense against vertebrate seed predators. Consistent with patterns of divergence seen in crossbills coevolving locally with other conifers, the Hispaniolan Crossbill has evolved a bill that is 25% deeper than the White-winged Crossbill. Together with phylogenetic analyses, our results suggest that predator-prey coevolution between Hispaniolan Crossbills and *P. occidentalis* over approximately 600,000 yr has caused substantial morphological evolution in both the crossbill and pine. This indicates that cone crop fluctuations do not prevent crossbills and conifers from coevolving. Furthermore, because the traits at the phenotypic interface of the interaction apparently remain the same over at least several hundred thousand years, divergence as a result of coevolution is greater at lower latitude where crossbill-conifer interactions have been less interrupted by Pleistocene events.

#### **198 Santisteban, Benkman & Keenan**

Life history strategies of a resident crossbill (*Loxia curvirostra* complex). LEONARD SANTISTEBAN, *Dept. Biol., New Mexico State Univ., Las Cruces, NM*, CRAIG W. BENKMAN and PATRICK C. KEENAN, *Dept. Zool. & Physiol., Univ. Wyoming, Laramie, WY*.

Life history theory is central to understanding biological processes such as selection, adaptation, evolution, and more specifically ecological speciation. During ecological speciation the processes of local adaptation and reproductive isolation are linked to adaptive changes in the life history of the organism undergoing speciation. The objective of this study is to describe the life history of a resident crossbill population, the South Hills crossbill (*Loxia curvirostra* complex). We also explored the hypothesis that exceedingly stable pine cone production in the South Hills drives the evolution of a life history that differs from nomadic crossbills. Consistent with a stable food resource, the density of crossbills (ca. 188 birds/km<sup>2</sup>) has remained relatively stable over the last several years, and, based on

mark-recapture efforts from 1998 - 2006, there is little evidence to suggest significant annual variation in adult survival rates. Clutch size (3 eggs) does not differ between this resident population and nomadic crossbills. Results suggest that the South Hills crossbill exhibits a life history that has evolved in a stable environment with predictable food resources.

#### **199 Tomback, Chipman & McKinney**

Is white pine blister rust influencing Clark's Nutcracker population trends? DIANA F. TOMBACK, *Univ. Colorado Denver and Health Sci. Center, Denver, CO, and Whitebark Pine Ecosys. Found., Missoula, MT*, KATIE G. CHIPMAN, *Univ. Colorado Denver and Health Sci. Center*, and SHAWN T. MCKINNEY, *Coll. For. & Conserv., Univ. Montana, Missoula, MT*.

Invasive, exotic disease may disrupt species interactions and alter ecosystem function through loss of foundation species. White pine blister rust has spread nearly rangewide in whitebark pine, a high elevation foundation species, and damage and mortality are highest in the nw. U.S. and sw. Canada. Whitebark pine is an obligate seed dispersal mutualist of Clark's Nutcracker, although nutcrackers also eat and cache seeds of other conifers. Losses of whitebark pine may diminish carrying capacity for nutcrackers more severely in some regions than others, potentially leading to reduced populations and shifts in distribution. We examined Audubon Christmas Bird Count (CBC) data, stratified by blister rust infection level, to test for trends. Preliminary analysis did not indicate significant declines in nutcracker populations in high blister rust areas except Glacier National Park, but the coarse scale of CBC data may not yet reflect the scale of effect. Shifts in nutcracker foraging may be more apparent through surveys and monitoring at a landscape scale, where ecological consequences are already apparent. We advocate yearly monitoring for nutcrackers on permanent transects in whitebark pine community types and present a draft protocol to assess important population correlates. Declines in local nutcracker populations will affect natural regeneration, and require management intervention for whitebark pine.

#### **200 McKinney, Fiedler & Tomback**

Is the Clark's Nutcracker - whitebark pine mutualism threatened by white pine blister rust? SHAWN T. MCKINNEY, CARL E. FIEDLER, *Coll. For. & Conserv., Univ. Montana, Missoula, MT*, and DIANA F. TOMBACK, *Dept. Biol., Univ. Colorado Denver and Health Sci. Cen., Denver, CO*.

Crucial ecological interactions, such as seed dispersal mutualisms, can be threatened by invasive species. Whitebark pine relies upon Clark's Nutcracker for dispersal of its large, wingless seeds. Nutcrackers are sensitive to rates of energy gain and emigrate from subalpine forests during periods of cone shortages. Blister rust has caused 90% mortality in some whitebark forests and now occurs throughout the pine's range. To evaluate the risk of mutualism disruption, we quantified forest conditions and ecological interactions between the bird and pine in 3 Rocky Mountain ecosystems that differ in levels of rust infection. Nutcracker occurrence and probability of seed dispersal were significantly affected by whitebark pine cone production, which was positively correlated with basal area (BA), and negatively correlated with tree mortality and rust infection. Results indicate that a threshold level of 1,000 cones/ha – which is met by forests with BA > 5 m<sup>2</sup>/ha – is needed to ensure seed dispersal. The risk of mutualism disruption is greatest in the Northern Rockies, where mean cone production and BA were below threshold levels, and Nutcracker occurrence, seed dispersal, and whitebark pine regeneration were the lowest of the 3 ecosystems. Managers can use these threshold values to differentiate between sites requiring restoration planting of rust-resistant seedlings and sites where Nutcracker seed dispersal is still expected.

#### **201 vacant**

#### **202 Bonaccorso**

Biogeography and speciation of the Neotropical jay genus *Cyanolyca*. ELISA BONACCORSO, *Nat. Hist. Mus., Univ. Kansas, Lawrence, KS*.

Phylogenetic relationships were studied in the genus *Cyanolyca*, an assemblage of Neotropical jays that represents one of the 2 corvid lineages that reached South America. Analyses were based on 3 mitochondrial and 2 nuclear markers. Different optimization criteria produced trees that were congruent

and highly robust at the terminal and deep nodes of the phylogeny. *Cyanolyca* comprises 2 major clades: one contains the Mesoamerican “dwarf” jays, and the other consist of 2 main groups -- one containing *C. cucullata* + *C. pulchra*, and the other containing the “core” South American species. High levels of genetic differentiation within *Cyanolyca* contrast with those observed in other Andean montane forest lineages studied to date. With only one exception, diverging lineages (sister species, as well as sister clades) are distributed on either side of potentially effective barriers to gene flow, suggesting the importance of allopatry in the diversification of the group. Character optimization techniques reconstructed Mesoamerica as the ancestral area for the genus. Implications of these results are discussed in the context of the biogeography of Neotropical montane avifaunas.

### **203 Balakrishnan & Edwards**

Founder effect speciation in the Zebra Finch. CHRISTOPHER N. BALAKRISHNAN and SCOTT V. EDWARDS, *Dept. Organ. & Evol. Biol., Harvard Univ., Cambridge, MA.*

The Zebra Finch (*Taeniopygia guttata*) has long been a model system for studies of avian behavior and neurobiology. With the production of a BAC and EST libraries and the forthcoming complete genome sequence, the Zebra Finch is now also a model system for genomics. Despite this, little is currently known about how genetic variation is distributed among Zebra Finch populations. We analyzed 6 populations of Zebra Finches including both recognized subspecies, *T. guttata castanotis* from mainland Australia, and *T. guttata guttata* from the Lesser Sunda Islands. We genotyped individuals using a panel of 30 genetic markers, including anonymous nuclear loci and both autosomal and Z chromosome-linked introns. Patterns of polymorphism in the Zebra Finch genome suggest a history of population expansion on the mainland. Furthermore we have found genetic evidence of dramatic loss of diversity and the predicted increase in levels of linkage disequilibrium following colonization of the Lesser Sunda Islands. Genetic differentiation of island and mainland populations, in combination with published behavioral and morphological differences, suggest that Zebra Finch subspecies may deserve full species status, and that this may represent a case of founder effect speciation.

### **204 Houde & Fain**

Paraphyly of the plovers and rails (Aves). P. HOUDE and M. G. FAIN, *Dept. Biol., New Mexico State Univ., Las Cruces NM.*

Phylogenetic analysis of multiple genetic loci demonstrate that plovers (Charadriiformes: Charadriidae) are paraphyletic with respect to stilts and oystercatchers (Recurvirostridae and Haematopodidae, respectively) and that rails (Gruiformes: Rallidae) are paraphyletic with respect to finfoots and adzebills (Heliornithidae and Aptornithidae, respectively). All of these are currently recognized as distinct monophyletic families. Examples of paraphyly are becoming abundant in traditional avian classification with the application of molecular analyses to increasingly comprehensive taxon sampling. Identification of paraphyletic relationships rely critically on the inclusion of key taxa in studies. This underscores the process of lineage sorting by which paraphyletic groups become mutually monophyletic clades through extinction of those key taxa.

### **205 Warnock, Gill, Battley & Tibbitts**

Using satellite telemetry to track the movements of Bar-tailed Godwits in the Pacific region. N. WARNOCK, R. E. GILL, P. BATTLEY and L. TIBBITTS, *Point Reyes Bird Observ., Conserv. Sci., Petaluma, CA.*

There are limits to what can be concluded from indirect measurements of shorebird migration patterns. In particular, methods that rely on observations (e.g., band recoveries or resightings) are limited by where and when ornithologists are in the field and by their ability to detect focal birds, so an absence of records often cannot be taken as a true absence of birds. For birds that migrate at altitude and over open ocean, once they depart on migration they become unknown and unobservable. Eastern Bar-tailed Godwits (*Limosa lapponica baueri*) are a species where these gaps in knowledge are acute. Evidence suggests that birds must be migrating directly across the Pacific Ocean from Alaska to New Zealand on southward migration in what is arguably the longest individual migratory flight of any birds,

but until recently there has been no way to test whether this is true and to evaluate birds' use of winds over such a flight. Likewise there is uncertainty about whether godwits migrate direct from New Zealand to eastern Asia on northward migration or make stopovers at currently unknown sites. We used satellite telemetry as an attempt to determine the flight lengths and migration strategies of godwits in their journeys between Alaska and New Zealand. We will discuss the successes and failures of these tracking attempts and show that use of satellite tracking can provide answers for birds the size of godwits that could not be gathered with any other method.

#### **206 Torres-Dowdall, Farmer, Strum, Alfaro, Macchi & Sandercock**

Spatial age segregation of White-rumped Sandpiper in non-breeding grounds. J. TORRES-DOWDALL, A. FARMER, K. STRUM, M. ALFARO, L. MACCHI and B. SANDERCOCK, *Dept. Biol., Colorado State Univ., Ft. Collins, CO.*

Most migratory bird species show some kind of differential spatial distribution by sex or age in the non-breeding grounds. The White-rumped Sandpiper is widely distributed in its non-breeding grounds in South America. We examined how this species segregates by age across Argentina and Uruguay. Juveniles were identified by 2 methods: 1) by plumage early in the season when juvenile characters were still identifiable; and 2) by determining the hydrogen stable isotopes values. Due to molting schedule South-American signatures are expected in adults while North-American signatures are expected in juveniles. Juveniles are dominant in northern. Two strategies were proposed for shorebirds in the Northern Hemisphere. Juveniles can migrate as far south as possible and spend their first boreal summer there skipping first year reproduction; or juveniles can stay close to the breeding grounds and migrate north the first year to breed. In those species that cross the equator, juveniles can be both, in the closer areas to the breeding grounds, and in the warmer habitats. Therefore, these 2 strategies could be very difficult to separate. Meanwhile, other factors, like climate stability, or order even of habitat encounter could be playing a role in the observed age segregation pattern.

#### **207 Wolfe & Ralph**

Effects of the El Niño Southern Oscillation on nearctic-neotropical migrant condition in Central America. JARED D. WOLFE, *Dept. Wildl., Humboldt State Univ., Arcata, CA*, and C. JOHN RALPH, *U.S. For. Serv., Pacific Southwest Res. Sta., Redwood Sci. Lab., Arcata, CA.*

El Niño induced climatic changes are thought to have drastic impacts on biological systems; however, effects of these climatic changes on multi-trophic interactions remain poorly understood. Here, we have examined the physiological response of Nearctic-Neotropical migrant birds to weather-induced trophic cascades during spring migration in Costa Rica. This study is the first of its kind to monitor effects of El Niño on multiple migrant species that represent different dietary guilds (i.e., primarily insectivorous versus frugivorous). One insectivore showed improved physiological condition whereas frugivorous migrants experienced reduced physiological condition in response to El Niño. Our results indicate that migrant responses to the El Niño Southern Oscillation cycle could influence demographics. Our conclusions coupled with recent climate models which predict exacerbated El Niño Southern Oscillation cycles in response to climate change should be considered when developing future conservation strategies for Nearctic-Neotropical migrants.

#### **208 Macchia, Bednarz & Grippo**

Effects of communication towers on migrating birds during spring in Arkansas. ERIN T. MACCHIA, *Environ. Sci. Program, Arkansas State Univ., Jonesboro, AR*, JAMES C. BEDNARZ and RICHARD S. GRIPPO, *Dept. Biol. Sci., Arkansas State Univ.*

The loss of birds due to collisions at communication towers and other tall, lighted structures has been documented for more than 50 yr. General conclusions derived from the scientific literature associate mass kill events (>100 individuals affected) with inclement weather at relatively tall (~300 m) tower structures. Systematic investigations at multiple towers of other seasonal and environmental factors, as well as tower attributes, that affect the incidence of avian collisions are nearly non-existent. We searched multiple tower sites for bird carcasses for 20 d during peak spring migration in Arkansas in 2005 - 2007. Our results indicated that the number of bird carcasses recovered per search day from tall towers (>150 m, n = 5) were significantly greater (mean = 0.91 birds/d) than recovered from short (< 140

m, n = 14) towers (mean = 0.06). Other tower attributes, including tower location (physiographic region), tower lighting system, and the presence of guy wires, did not appear to affect the number of birds found. Measures of searcher efficiency reveal that < 20 - 30% of birds are collected by tower searchers, on average. Further, estimates of scavenging or predation of bird carcasses at tower sites showed that carcasses persisted within the survey area surrounding the tower for an average of 10 d (n = 72 trials).

### **209 Gehring**

Making progress on a 50-year-old avian conservation issue: the potential positive impacts of changing communication tower lighting systems at a landscape scale. JOELLE L. GEHRING, *Michigan Natural Features Inventory, Lansing, MI.*

It is estimated that 4 - 50 million birds/yr collide with communication towers in the US. Recent research has demonstrated that the frequency of avian collisions with towers can be significantly reduced by 50 - 70% via altering tower lighting systems to eliminate non-blinking lights at night. Although reducing tower height and eliminating guys wires also reduces avian collisions these alterations are not typically possible on existing towers. The Federal Communications Commission (FCC), the licensing agency of towers, has proposed an official rulemaking in the interest of avian conservation that would require communication towers to be lit with only blinking lights at night. If a large-scale change in tower lighting systems occurs via an FCC rulemaking or by industry choice, the decrease in avian fatalities would be dramatic. Using Michigan communication towers as a case study, I quantified the number of avian fatalities that would be prevented annually. Current red tower lighting systems require both blinking and non-blinking red lights. Although towers lit with white blinking lights are not required to have non-blinking lights, retrofitting towers from red to white lighting systems is very cost-prohibitive to the tower industry. Future conservation efforts should focus on expanding opportunities for the tower industry to change lighting systems in a cost-effective way; thereby, providing greater incentive and opportunity to comply with the Migratory Bird Treaty Act.

### **210 Rodewald & Shustack**

Urban flight: understanding individual and population-level responses of Nearctic-Neotropical migratory birds to urbanization. AMANDA D. RODEWALD and DANIEL P. SHUSTACK, *Sch. Enviro. & Nat. Res., Ohio State Univ., Columbus, OH.*

In an effort to understand the processes that govern an apparent avoidance of urban landscapes by many Nearctic-Neotropical migratory birds, we examined population and individual-level responses of the Acadian Flycatcher to urbanization within the landscapes surrounding 35 riparian forest stands in Ohio. From May - Aug 2001 - 2006, we surveyed birds, banded 175 territorial flycatchers to estimate condition and survival, tracked nest initiation dates, monitored success of 387 nests and estimated annual reproductive productivity of 163 breeding pairs. Neither apparent annual survival of adults nor daily survival rates of nests were related to the amount of urban development within the landscape. In contrast, reproductive productivity was negatively related to the amount of urbanization surrounding riparian forests, perhaps in part due to the greater incidence of brood parasitism and fewer numbers of nesting attempts made by pairs in urban compared to rural forests. Forests within urban landscapes experienced higher levels of turnover in site occupancy, and birds settling in urban areas initiated nests later, had marginally smaller body sizes, and exhibited lower return rates following nest predation than birds in more rural landscapes. In this way, behavioral processes governing settlement and site fidelity likely contributed to the lower productivity in urban landscapes. This study provides evidence that the negative association between Acadian flycatchers and urbanization results from both population- and individual-level responses to urbanizing landscapes surrounding their riparian forest habitats.

### **211 Franzreb**

Intersexual differences in foraging behavior of Red-cockaded Woodpeckers. KATHLEEN E. FRANZREB, *Southern Res. Sta., Dept. For., Wildl. & Fish., Univ. Tennessee, Knoxville, TN.*

I examined intersexual habitat partitioning by foraging Red-cockaded Woodpeckers at the Savannah River Site, SC. The habitat largely consisted of young forest stands (< 50 yr-old) in contrast to the majority of earlier foraging behavior studies that focused on more mature forests. A total of 6,383

observations on 7 groups of Red-cockaded Woodpeckers were taken over a 3-yr period. I also compared habitat availability (e.g., tree species, tree height, tree dbh, tree age) to actual foraging use. For both sexes, niche breadth was most narrow in substrate used, tree species selection, and tree condition. The most striking differences in foraging between the sexes occurred in the location, substrate used, and foraging height from the ground as evidenced by low niche overlap values. Niche overlap between males and females was high (>96%) for tree species, tree condition, and tree height. Although the habitat at the Savannah River Site was considerably younger than what has been studied at almost all other locations, the pattern of intersexual habitat partitioning that I observed is similar to what has been documented elsewhere within the range.

#### **212 Hill, Mennill, Rolek, Ligon, Hill, Swiston, Odom & Hicks**

Further evidence suggesting that Ivory-billed Woodpeckers exist in Florida. GEOFFREY E. HILL, *Dept. Biol. Sci., Auburn Univ., Auburn, AL*, DANIEL J. MENNILL, *Dept. Biol., Univ. Windsor, Windsor, ON*, BRIAN R. ROLEK, RUSTY LIGON, JAMES R. HILL, III, *Auburn Univ.*, KYLE A. SWISTON, KARAN ODOM, *Univ. Windsor*, and TYLER L. HICKS, *Western State Coll., Gunnison, CO*.

From Nov 2006 through May 2007 we searched for Ivory-billed Woodpeckers along the Choctawhatchee River in nw. Florida. A team of 13 searchers lived in 2 camps about 15 km apart and intensively searched about 31 km<sup>2</sup> of forested wetlands. Four additional biologists deployed remote listening stations and set and watched the images from 24 remote cameras. This search effort yielded 2 convincing sightings of Ivory-billed Woodpeckers and numerous recordings of putative double knocks and putative kent calls (finally tallies are not available as this abstract is submitted). We will also present a video taken in May 2006 of a bird that has plumage features consistent with Ivory-billed Woodpecker. As this abstract is being prepared, we do not have definitive evidence for the existence of Ivory-billed Woodpeckers in Florida.

#### **213 Rolek, Ligon, Hill & Mennill**

A comparison of large woodpecker cavity morphology in the Choctawhatchee River bottomlands and other southern forests. BRIAN W. ROLEK, RUSSELL LIGON, GEOFFREY HILL, *Dept. Biol., Auburn Univ., Auburn, AL*, and DANIEL J. MENNILL, *Dept. Biol. Univ. Windsor, Windsor, ON*.

The existence of Ivory-billed Woodpeckers in the forested wetlands along the Choctawhatchee River is supported by sight records, sound recordings, bark scaling, and large cavities reported to be larger than the cavities excavated by Pileated Woodpeckers. The assertion that cavities in this area are larger than expected in forest in the se. U.S. is supported by scant data. We compared the morphology and size of cavities measured near the Choctawhatchee River to cavities measured in Alabama and Georgia. We found that cavities measured along the Choctawhatchee River average larger in entrance height and width and have a greater maximum size. These findings support the claims that Ivory-billed Woodpeckers reside within the floodplain of the Choctawhatchee River.

#### **214 Noel & Bednarz**

Home range size and movements of the Pileated Woodpecker in eastern Arkansas. BRANDON L. NOEL and JAMES C. BEDNARZ, *Dept. Biol. Sci., Arkansas State Univ., State University, AR*.

One significant obstacle to the recovery of the Ivory-billed Woodpecker (IBWO) is the lack of information about this species biology and ecology in the bottomland hardwood forests and swamps of eastern Arkansas, Florida, and elsewhere in the se. U.S. Given the dire conservation situation of this species, and extreme void in our knowledge of its biology and ecology, we have begun an intensive 4-yr study on the foraging and breeding ecology of the Pileated Woodpecker (PIWO) in the Big Woods area to provide reliable data on large woodpecker ecology in the bottomland habitats of eastern Arkansas that can be used to make management decisions and possibly prevent the extinction of the IBWO. Contrary to historical observations at the Singer Tract, where IBWOs used higher bottoms associated with sweetgum and oak tree species, the Cornell Laboratory of Ornithology recently recorded IBWOs in the lower bottomland habitats. Therefore, we are comparing habitat use ecology of PIWOs in both the cypress-tupelo swamps (low bottoms) versus the sweetgum-oak hardwood (high bottoms) bottomland

areas. Specifically, we are comparing home-range sizes, feeding rates at nests, reproductive success, and survival. Preliminary results will be presented.

**215 Cooper, Mordecai, Conroy, Peterson, Moore & Mattsson**

Design and implementation of a region-wide search for the Ivory-billed Woodpecker with the objective of estimating occupancy and related parameters. ROBERT J. COOPER, RUA S. MORDECAI, *Univ. Georgia, Athens, GA*, MICHAEL J. CONROY, JAMES T. PETERSON, *USGS Georgia Coop. Fish & Wildl. Res. Unit and Univ. Georgia*, CLINTON T. MOORE, *Patuxent Wildl. Res. Center, Univ. Georgia*, and BRADY J. MATTSSON, *Univ. Georgia*.

Until recently, the search for the Ivory-billed Woodpecker mostly focused on relatively few areas that are believed to have the greatest probability of containing the bird (best areas). A major problem associated with only searching the best areas is that, because of a lack of randomization, it is not possible to build predictive habitat and population models, or learn in a systematic, repeatable way from the data collected how to improve the search. We describe a survey design, which was implemented in 2006 - 2007, for the search effort that will (1) allow estimation of occupancy, use, and detection probability for habitats at multiple spatial scales within the species' former range, and (2) assess relationships between occupancy, use and habitat characteristics at those scales. The design features randomization of search locations weighted by prior belief of their suitability and results from prior searches, such that most but not all effort is still expended in the best locations. Data are being entered into a web-accessible central database that will allow frequent model updating in an adaptive framework. We view this approach as a template for developing occupancy-based surveys of other rare species.

**216 vacant**

**217 McCusker, Ward & Brawn**

The effects of invasive bush honeysuckle (*Lonicera* spp.) on wintering avian communities. COURTNEY E. McCUSKER, *Dept. Nat. Res. & Environ. Sci., Univ. Illinois, Urbana, IL*, MICHAEL P. WARD, *Illinois Nat. His. Survey, Champaign, IL*, and JEFFREY D BRAUN, *Dept. Nat. Res. Environ. Sci., Univ. Illinois*.

Invasive bush honeysuckle (*Lonicera* spp.) has invaded forested areas in the e. U.S., including central Illinois. Negative ecological effects of invasive honeysuckle have been well documented and these studies have precipitated the removal of honeysuckle, however little attention has been given to the effect this plant may have on the abundance and distribution of birds in an area. Several studies have investigated the dispersal of honeysuckle and have concluded that birds are the primary consumers of fruits and that they consume them late in the fall and winter when other food sources are scarce. If this is the case then birds may be attracted to sites with invasive honeysuckle. The purpose of this study is to determine the composition of the avian communities in sites with an infestation of honeysuckle and compare them to sites containing only native shrubs. Results indicate that the density of birds in winter is higher in sites containing honeysuckle. While the removal of honeysuckle has obvious benefits for native plant communities, birds that depend on fruits to survive the winter may be forced to disperse to new sites and may experience higher mortality rates. The expansion of honeysuckle throughout forests may also have facilitated the range expansion of several birds species.

**218 Murphy, Shaffer, Grant, Rubin, Ryba, Kerns & Derrig**

Influence of extent and management of woody plant invasion on survival of sparrow nests in northern mixed-grass prairie. ROBERT K. MURPHY, *Univ. Nebraska at Kearney, Kearney, NE*, TERRY L. SHAFFER, *USGS-Northern Prairie Wildl. Res. Center, Jamestown, ND*, TODD A. GRANT, *U.S. Fish & Wildl. Ser., Upham, ND*, CORY S. RUBIN, ADAM J. RYBA, *U.S. Fish & Wildl. Ser., Kenmare, ND*, COURTNEY K. KERNS, *Univ. Missouri, Columbia, MO*, and JAMES L. DERRIG, *Univ. Wisconsin-Stevens Point, Stevens Point, WI*.

Land managers routinely use prescribed fire to reverse invasion by woody vegetation on northern mixed-grass prairies that have been set aside mainly as breeding habitat for migratory birds, but are uncertain whether effects of shrub and tree reductions on bird nest survival outweigh effects of fire

on nests. During the 2001 - 2003 breeding seasons, we studied influences of prescribed fire and the extent of woody vegetation on the survival of 434 nests of Clay-colored Sparrow and 141 nests of Savannah Sparrow in mixed-grass prairie at Des Lacs National Wildlife Refuge in nw. North Dakota (12 management units studied; 35 - 150 ha/unit). We used logistic exposure and an information-theoretic approach to assess importance of the following to nest survival: 1) prevalence of trees and tall (> 1.5 m) shrubs in the landscape and of low (< 1.5 m) shrubs near nests, and 2) time (i.e., number of growing seasons) lapsed since prescribed burning. Survival of Clay-colored Sparrow nests declined as patches of trees and tall shrubs within 100 m increased. There was no evidence of a relationship between survival of Savannah Sparrow nests and this variable, however. There also was no evidence that frequency of low shrubs near nests or number of growing seasons since burning influenced survival of nests of either species. Our data suggest that in at least some northern mixed-grass prairies, prescribed fire does not influence the survival of grassland bird nests and its use is warranted for reducing scattered patches of tall woody cover to enhance the survival of nests of certain bird species.

### **219 Wunder & Knopf**

Geographic structure and dynamics in Mountain Plover. MICHAEL B. WUNDER, *Colorado State Univ, Ft. Collins, CO*, and FRITZ L. KNOPF, *USGS-BRD, Ft. Collins, CO*.

A large portion of the global population of mountain plovers winters in the highly agricultural landscape of Imperial Co., CA, but nothing is known about the compositional structure of breeding origins among individuals wintering there. We used color band relocations across 12 yr to suggest the general connectivity structure. Applying a novel modeling approach based on stable hydrogen isotopes in feathers and precipitation, we quantified the structural dynamics of the composition of breeding origin for birds wintering in Imperial Co. during 4 winters. We found evidence for widespread breeding population mixing during winter and for rapid geographic turnover in the compositional structure of the adult population that is driven by drought-induced recruitment of young in response to the El Niño Southern Oscillation.

### **220 Johnson & Cariveau**

Migratory bird use of playa wetlands in eastern Colorado. LACRECIA A. JOHNSON and ALISON BANKS CARIVEAU, *Rocky Mountain Bird Observatory, Ft. Collins, CO*.

Migrating wetland-dependent birds must navigate an arid landscape with few wetlands through much of the Central Flyway. Playas are the most numerous wetlands in the southern Great Plains and provide critical migratory stopover habitat. These shallow, depression wetlands are filled only following unpredictable heavy rainfall events. Prior to this project, playa wetlands in Colorado were relatively unstudied. Over 3 yr, we have visited over 1000 playas in e. Colorado. In the fall of 2006, we conducted 688 bird surveys of 171 wet playas. We documented 42,863 birds of 95 species, including a number of conservation need. Shorebird abundance declined during our sample period, while waterfowl peaked late in the season. The abundance of birds in all guilds was positive related to the percent of wet habitat available in playas. There was a trend for greater abundance of birds in playas surrounded by farmland than in grassland. We will also discuss avian responses to habitat variables including wetland size, percent cover by vegetation, and landscape variables such as proximity to other wetlands. This study addresses a critical need to understand how playas function to support regional migratory bird populations.

### **221 Heredia, Chávez-Ramírez & Scott-Morales**

Comparison of nesting sites of Dickcissel in grasslands with different stages in restoration in the Platte River Valley, Nebraska. F. J. HEREDIA, F. CHÁVEZ-RAMÍREZ and L. SCOTT-MORALES, *Linares, Nuevo Leon, Mexico*.

We measured nest site characteristics for Dickcissels nesting in oldpastures at different ages since restoration in the Platte River Valley, Nebraska. Preliminary results found differences between random and nest sites within each field ( $P > 0.05$ ), but not among fields despite time since restoration. Dickcissel's required specific vegetation characteristics for nesting and the comparison between nests occurring in pastures from 4 periods of restoration were not differences. We believe Dickcissels look for nesting sites in grasslands with variable characteristics including recent open areas, independently of the

age and complexity of the vegetation and not necessarily looks for sites as of a certain period of restoration, rejecting the hypothesis that Dickcissels prefer grasslands sites with greater vegetation structure. Our results imply recently restored grasslands also provide adequate nesting sites for Dickcissels

### **222 Ellison, Ribic & Sample**

Effects of removing wooded fencerows on grassland birds and their predators. KEVIN ELLISON, *Dept. Wildl. Ecol., Univ. Wisconsin, Madison, WI*, CHRISTINE A. RIBIC, *USGS Wisconsin Coop. Wildl. Res. Unit, Madison, WI*, and DAVID W. SAMPLE, *Wisconsin Dept. Nat. Res., Madison, WI*.

Due to dramatic population declines associated with habitat loss, grassland birds are a conservation priority. Fragmentation of grassy habitats by wooded fencerows has been suggested as a factor in the declines. Woody fencerows effectively reduce the area of quality breeding habitat, as several species avoid edges where they suffer higher nest predation. To determine the effects of wooded fencerows on birds nesting in Conservation Reserve Program cool-season grass fields, we are conducting a fencerow vegetation removal experiment in sw. Wisconsin. We randomly assigned 3 of 6 sites bisected by wooded fencerows for vegetation removal. Before and after treatment, we measured avian density, territory dispersion, nesting success, and nest predator activity both near (within 100 m) fencerows and in the field interiors. Prior to treatment, both abundance and nest survival for 8 obligate grassland bird species were lower near the fencerows. Following removal, bird abundance increased up to threefold within 100 m of where the fencerows used to be. On treatment sites, activity of the predators associated with woody vegetation effectively ceased after removal. However, within 100 m of where the fencerow used to be, improvement in nesting success was minimal (5%, n = 30 nests); thirteen-lined ground squirrel activity increased; and nest predation by snakes remained high (41%, n = 34 predation events). Based on the first year of data following treatment, the effects of removing wooded fencerows on grassland birds appear mixed.

### **223 McGowan & Corwin**

Results from the second New York Breeding Bird Atlas. KEVIN J. MCGOWAN, *Lab. Ornithol., Cornell Univ., Ithaca, NY*, and KIMBERLEY CORWIN, *New York Dept. Environ. Conserv., Albany NY*.

Bird distributions are dynamic, changing constantly. New York is the first state to complete 2 Breeding Bird Atlas projects (1980 - 1985 and 2000 - 2005), and these 2 datasets allow investigation of changes over a 20 yr period in the distributions of more than 250 species breeding in the state. Although the breeding ranges of many species stayed more or less constant over the last 20 yr, 73 species increased their range by more than 25% of reporting block and 50 species decreased by 25% or more. Some range changes in New York reflect nationwide trends, while others are more regional. One third of the declining species breed in grasslands, but the assemblage of increasing species is harder to explain. Six new species were confirmed breeding that were not found in the first Atlas; of these, Merlin and Black Vulture now have significant breeding populations in New York. Six species disappeared, but only Loggerhead Shrike represents a significant loss. Change will be the focus of the new Breeding Bird Atlas publication, due out in 2008. It will include, for each species, a current distribution map, a map indicating change, and discussion of the changes on a broad and localized scale.

### **224 Blakesley, Hanni, Hutton & Lukacs**

Monitoring Colorado's landbirds: evaluation of methods to estimate population status and trend.

JENNIFER A. BLAKESLEY, D. HANNI, K. HUTTON, *Rocky Mountain Bird Observ., Ft. Collins, CO*, and P. M. LUKACS, *Colorado Div. Wildl., Ft. Collins*.

We conducted a state-wide program to monitor landbirds in Colorado from 1998 - 2007 using point and line transects stratified by habitat type. Using empirical density estimates, detection probabilities and encounter rates, we estimated the power to detect trends for 107 avian species in up to 11 habitat types. We would be able to detect an average 3% population change within 30 yr for at least 82 different species in one or more habitat types. We evaluated the field methods employed (distance, double observer, and removal sampling) with respect to precision of estimates, power to detect trends,

and ease of implementation. Applications to avian conservation include state-wide estimates of population status and trend, and spatially-explicit modeling of the effects of habitat management.

## **225 Garcia & Conway**

Influence of repeated video probing on nesting success of Burrowing Owls. VICTORIA GARCIA and COURTNEY J. CONWAY, *USGS Arizona Coop. Fish & Wildl. Res. Unit, School Nat. Res., Univ. Arizona, Tucson, AZ.*

Inserting video probes into nest cavities and burrows has greatly expanded the quality and quantity of information that can be gathered from burrow- and cavity-dwelling animals, especially cavity-nesting birds. However, although researchers have reported that probing nests did not seem to affect the nest occupants, the influence of video probes on reproductive parameters has not been examined. Potential ill effects include nest abandonment and interruptions in egg laying or incubation. We examined whether inserting infrared video probes inside Burrowing Owl nests every 10 d throughout the nesting season influenced nesting success or number of young fledged. We searched for Burrowing Owl nests in e. Washington in 2001, and randomly assigned each nest to one of 2 groups: 1) repeated use of video probe, or 2) control (no video monitoring). We probed 36 nests every 7 - 10 d during the breeding season and never probed 44 control nests, but we visited each control nest every 7 - 10 d during the breeding season. The proportion of nests that fledged >1 offspring was similar for nests which were repeatedly examined using the video probe (78%) and control nests (75%). The maximum number of offspring seen above ground was similar for nests which were repeatedly examined using the video probe ( $3.5 \pm 0.4$  offspring) and control nests ( $3.9 \pm 0.4$  offspring). We did not detect differences in nesting success or number of young fledged between Burrowing Owl nests that were repeatedly probed and those that were not probed.

## **226 Stolen**

Factors affecting foraging success and habitat selection in piscivorous wading birds. ERIC D. STOLEN, *Dynamac Corp., Kennedy Space Center, FL.*

Among the many factors influencing foraging success, prey density is often the one that natural resource managers focus on. However, foraging theory places more emphasis on factors affecting prey availability in understanding the foraging success of individuals. Among birds, piscivorous members of the family Ardeidae provide a good model system to study factors influencing prey availability, both simple (e.g. water depth, habitat structure) and more subtle (e.g., prey behavior, social interactions). I investigated such factors for Great Egret, Snowy Egrets and Tricolored Herons foraging on a low diversity community of fish in shallow impounded salt marsh habitat in Florida. Prey were highly clumped, and density and biomass varied substantially both spatially and temporally. All 3 wading bird species preferred unvegetated to vegetated habitat and strongly preferred the area within 0.5 m of the boundary between types. Prey density had a strong effect on wading bird habitat use in unvegetated but not in vegetated wetland sites. Foraging sites had higher biomass (but not density) than the average level available throughout the landscape. Foraging groups occurred at the sites with higher prey density (but not biomass) than solitary foragers. Great Egrets benefitted from foraging in groups, Snowy Egrets and Tricolored Herons did not. Foraging success can be a useful metric of habitat utility, provided that underlying assumptions can be tested.

## **227 Zimmerman, Kendall & Moser**

Reward band reporting probabilities for North American geese. GUTHRIE S. ZIMMERMAN, *U.S. Fish & Wildl. Serv., Patuxent, MD*, WILLIAM L. KENDALL, *USGS Patuxent Wildl. Res. Center, Laurel, MD*, and TIMOTHY J. MOSER, *U.S. Fish & Wildl. Serv., Minneapolis, MN.*

Management of North America's numerous goose populations relies heavily on the assessment of legband recovery data to estimate population-specific harvest rates. However, goose legband reporting probabilities, which are essential to estimating harvest probabilities, have never been evaluated. We conducted a reward band study of North American geese to estimate reporting probabilities for populations and geographic units. Our estimated mean reporting probability for zero-dollar legbands ( $\lambda = 0.73$ , SE = 0.68, 0.77) for geese was similar to previous estimates for other

waterfowl. Estimated reporting probabilities varied from 0.51 to 0.92 among the 16 populations/colonies that we monitored. Estimates of Canadian hunter reporting probabilities ( $\lambda = 0.70$ , 95% CI = 0.58, 0.82) were slightly lower than estimates for the U.S. ( $\lambda = 0.73$ , 95% CI = 0.68, 0.78), and estimates within 12 geographic harvest regions varied from 0.54 to 0.93. However, confidence intervals overlapped considerably and model selection did not support spatial differences with the exception of a minor difference between Canada and the U.S. (AICc for model with "country" was  $\leq$  AICc of best model). Our estimated reporting probability averaged across goose populations indicated that goose bands are reported at approximately the same rate as mallards, black ducks, and wood ducks. Our results provide managers with first opportunity to empirically estimate goose legband reporting probabilities and unbiased harvest probabilities.

## **228 Norris, Martin, Chades, Arcese, Marra & Possingham**

Optimal conservation of migratory species: integrating stable isotopes and decision models. D. RYAN NORRIS, *Dept. Integrative Biol., Univ. Guelph, Guelph, ON*, TARA M. MARTIN, *Dept. Forest Sci., Univ. British Columbia, Vancouver, BC*, IADINE CHADES, *Unité Biométrie et Intelligence Artificielle, Castanet-Tolosan, France*, PETER ARCESE, *Dept. Forest Sci., Univ. British Columbia*, PETER P. MARRA, *Smithsonian Migratory Bird Center, Washington, DC*, and HUGH POSSINGHAM, *Ecol. Centre & Dept. Math., Univ. Queensland, Australia*.

Designing effective conservation strategies for migratory animals presents formidable challenges. Population abundance of migratory species is influenced by multiple events between areas that are often separated by thousands of kilometres and cross international borders. Here, we take a decision theoretic approach using dynamic optimization to address the problem of how to allocate resources for habitat conservation for a Neotropical-Nearctic migratory bird, the American Redstart, whose winter habitat is under threat. Our first conservation strategy used the acquisition of winter habitat based on land cost, relative bird density, and the rate of habitat loss to maximize the abundance of birds on the wintering grounds. Our second strategy added the constraint of maintaining a minimum percentage of birds within each breeding region in North America using information on how wintering populations are geographically connected to breeding populations as estimated from stable-hydrogen isotopes in feathers. We show that maximizing migratory bird abundance across the entire winter range resulted in a 98% reduction of one breeding region because this strategy only incorporated estimates from the winter regions and failed to account for where populations were spending the remainder of the year. Results based on the second strategy dramatically changed where and when winter habitat was to be purchased. We demonstrate that conservation strategies for migratory animals depend critically upon 2 factors: knowledge of migratory connectivity (which exists for only a small percentage of species) and the correct statement of the conservation problem.

## **229 Packett & Dunning**

Stopover habitat selection by migrant landbirds in a fragmented forest-agricultural landscape. DIANE L. PACKETT and JOHN B. DUNNING, Jr., *Dept. Forestry & Nat. Res., Purdue Univ., West Lafayette, IN*.

It is now recognized that stopover habitat is as important to the survival of Nearctic-Neotropical migratory birds as are breeding and wintering habitats. There is currently little quantitative data concerning stopover habitat selection by migratory landbirds in the Great Lakes basin, an ecologically rich but highly fragmented landscape. There is a need for data on the effect of forest patch isolation on migrant use, and use of riparian versus upland habitat patches. This study examines the use of upland forest woodlots in the forest-agricultural landscape of nw. Indiana as stopover habitat, to determine whether migrants use habitat patches at close proximity to riparian forest corridor more than isolated habitat patches, and whether there are seasonal variations in woodlot use. In one spring and 2 fall seasons we performed 288 surveys in 12 small woodlots (less than 9 ha) at 3 different levels of isolation from a riparian forest corridor. We detected 2,916 migrants of 76 species, compared to only 15 species during the breeding season. We detected no difference in migrant abundance between distance classes in either fall ( $P = 0.779$ ) or spring ( $P = 0.260$ ). The 3 northernmost, most isolated, woodlots hosted ~50% of all southbound migrants in both 2005 and 2006, while in spring 2006, the migrants were more evenly distributed in all the study sites. There was no detectable difference in species richness between distance classes. Our results indicate that isolated forest patches are heavily used during migratory

stopovers and may be important conservation targets in fragmented landscapes.

### **230 Farnsworth, Rosenberg, Hames & Powers**

Nocturnal passerine migration across the northeastern United States, as documented by automated recording of night flight-calls. ANDREW FARNSWORTH, KENNETH V. ROSENBERG, RALPH S. HAMES and MICHAEL E. POWERS, *Lab. Ornithol., Cornell Univ., Ithaca NY*.

During Oct 2005, a stalled frontal boundary produced a unique combination of favorable winds and poor visibility conditions, spawning a week of spectacular fallouts and concentrations of migrant passerines across the entire New England and mid-Atlantic coast region. As part of a multi-year study of migration using acoustic monitoring, we recorded flight-calls of migrating birds on all the nights of this spectacular fallout period across almost the entire region in which these fallouts occurred. We used digital autonomous recording units bioacoustic software (Raven, XBAT) to sample flight-calls from roughly 4,000 hr of recordings at 7 sites along a 650-km transect from Fort Drum in n. New York to the southern end of Chesapeake Bay. Temporal patterns of flight-call frequencies, both within nights at each site and across nights and locations, revealed species-specific migration behaviors across the region. We compared these patterns of nocturnal migration with diurnal observations of grounded migrants during the weather event, corresponding with peak migration for several sparrows, thrushes, and warblers. Although radar images revealed the magnitude and timing of regional migration at that time, only acoustic monitoring can reliably document the species composition of nocturnal migration. This study is part of a larger effort to apply new acoustic technologies to monitor bird migration, with the goal of developing a continental network of fully automated recording stations.

### **231 Rodewald**

Forest patch use by migrant landbirds near Lake Erie in Ohio: importance of local habitat, patch area, and distance to lakeshore. PAUL G. RODEWALD, *School Environ. & Nat. Res., Ohio State Univ., Columbus, OH*.

In the Western Basin of Lake Erie, stopover migrants are concentrated into remnant forest patches within agricultural landscapes. These forests likely are important for migrants, but little is known about patch and local habitat attributes associated with high-use sites. From mid-Apr through May 2003 - 2005, we studied stopover habitat use in 14 mature inland forests (0.4 - 5 km from lake), 7 dogwood shrubland sites (1 - 5 km), and 7 mature beach ridge forests (on lakeshore). Point-counts were conducted at 28 sites (5 - 6 visits/yr) and mist netting occurred at 12 sites on 8 d per site/yr. Point counts indicated that 14 of 21 species (67%) had greatest abundance within beach ridges, with inland forest having more individuals than in dogwood shrub habitat. In mistnet surveys, 12 of 16 migrants (75%) exhibited differences among habitats, and 10 of 12 species (83%) had higher capture rates in beach ridge forest. Across habitats, the model that best explained variation in migrant abundance included lake distance, trees 23 - 38 cm in dbh, and stem density 2 -3 m in height. Sites closer to lakeshore had more migrants, as did sites with mature trees and developed understory vegetation. In the 14 inland forest sites, each 1 km increase in distance from lakeshore resulted in an 18.7% decline in migrant abundance. Results from additional analyses including patch area and connectivity measures will be discussed.

### **232 Wunder**

Generalized spatial resolution limits for inferring geographic origin from stable hydrogen isotopes. MICHAEL B. WUNDER, *Colorado State Univ., Ft. Collins, CO*.

Stable hydrogen isotopes are increasingly used for estimating geographic origins for migratory birds. This approach uses continental-scale predictions for hydrogen isotopes of precipitation. Promising results derive from some but not all studies and there are no consistent patterns to suggest when and where to expect good results. Most studies fail to address known sources of uncertainty; most simply report measurement error rates and the degree of local variance but then ignore them in subsequent modeling efforts. Often the degree of uncertainty is of the same magnitude of the effect size reported. Because of this, there has been no clear sense of the general spatial resolution we can expect from this approach. I introduce a flexible simulation approach using a hierarchical error structure to explore the question of spatial resolution. I offer an odds-based risk analysis inferential framework that allows a tradeoff between spatial precision and accuracy. Without further study-system-specific

refinements, this approach is likely to work best in North America; differences between individual samples will need to be about 50‰ to reliably distinguish them as having distinct origins.

### **233 Wunder & Jehl**

Ranges of stable isotope values in Eared Grebe feathers grown under extreme natural constraints. MICHAEL B. WUNDER, *Colorado State Univ., Ft Collins, CO*, and JOSEPH JEHL, Jr., *Smithsonian Inst. Washington, DC*.

Stable isotopes have long been used in studies of trophic ecology and they are increasingly used to infer seasonal linkages in migratory bird studies. Most efforts rely on assumptions that remain untested under field conditions. We took advantage of a unique moult-migration scenario to explore the variation in isotope values for carbon, nitrogen, hydrogen, and oxygen in feathers and food items under constrained non-manipulated conditions. Eared Grebes migrate to Great Salt Lake where they exploit a single food resource to grown new flight feathers and add fat for migration. Thus, resources presumably used for feathers are both geographically and trophically localized. We therefore suspected our results would define the low end of the range in variation expected for natural systems. We found relatively wide ranges in isotope values for C (16 per mil), N (11 per mil), H (134 per mil), and O (20 per mil) measured in freshly grown feathers. We discuss 1) relationships among values for feathers, diet, meteoric water, and local surface water, 2) possible explanations for observed variation and 3) important implications for food web and migration studies that use natural variation in isotope compositions.

### **234 Krementz**

Survival of Sora during fall migration in Missouri. DAVID G. KREMENTZ, *Arkansas Coop Unit, Univ. Arkansas, Fayetteville, AR*.

Little information on basic life history and vital rates of North American rails has hampered management. I estimated mid-Sep to late-Oct 2003 and 2004 survival rates of Soras using radio telemetry at the Four Rivers Conservation Area in western Missouri. I documented only 3 mortality events. Model selection suggested that 3 models were plausible; constant survival, age-specific survival, and year-specific survival. The constant period survival rate (6-wk) was 0.884 (95% CI 0.697 - 0.962). This estimate was not different from a similarly derived estimate for Soras from the Pacific Flyway. These high survival rates suggest that current management practices at Four Rivers are meeting the needs of fall migrating Soras there.

### **235 Rigby & Haukos**

Survival and home range of breeding female Mottled Ducks on the Upper Texas Gulf. ELIZABETH A. RIGBY and DAVID A. HAUKOS, *Dept. Nat. Res. Manage., Texas Tech Univ., Lubbock TX*.

The Mottled Duck is a non-migratory indicator species of coastal marsh along the Gulf of Mexico. Limited survey data indicate declining numbers of Mottled Ducks in Texas since the mid-1990s. Due to their restricted range, Mottled Duck breeding ecology is poorly understood and under-studied. Our objectives were to estimate hen survival, home range, and movements during the breeding and brood-rearing seasons (Feb - Jul) to better evaluate the influence of survival and recruitment on population dynamics and develop land management recommendations for breeding Mottled Ducks. We tracked 13 radio-tagged female Mottled Ducks from Feb to Jul 2006 and 10 females from Feb to Jul 2007 to estimate weekly survival during the breeding season. Weekly survival was estimated with the Known Fate procedure in Program MARK. Additionally, by obtaining visual location data and using triangulation from remote data, we estimated the home range for each female using minimum convex polygons and kernel polygons. For the model with time held constant, the 2006 survival estimate for all 17 weeks of the breeding season was 77.0%, with a weekly survival estimate of 98.5%. Breeding season survival was greater for 2007 because of improved habitat conditions compared to 2006. Minimum convex polygon analysis showed females in 2006 had a mean home range of 24.8 km<sup>2</sup>, with a median of 4.8 km<sup>2</sup>. Kernel analysis gave similar results, with a mean home range of 27.0 km<sup>2</sup> and a median of 5.0 km<sup>2</sup>. Home ranges were smaller in 2007 due to a greater proportion of hens with broods and improved habitat conditions near initial capture sites as compared to 2006.

### 236 White & Davis

Reproductive ecology of Piping Plovers at Chaplin Lake, Saskatchewan. CORIE L. WHITE, *Saskatchewan Watershed Authority, Regina, SK*, and STEPHEN K. DAVIS, *Environ. Canada, Canadian Wildl. Ser., Regina, SK*.

Low reproductive success is considered the primary cause of the piping plover population decline across its breeding range. Reproductive success has been documented at relatively few alkali lakes, despite the fact that alkali lake habitat supports a large proportion of the Northern Great Plains breeding population. Reproductive success was monitored at Piping Plover nests at Chaplin Lake, Saskatchewan, from 2001 - 2004. A total of 219 nests were located and monitored. Nesting was found to be synchronous in each year however; the median nest initiation date differed between years. Nest success was relatively high (range 33% - 77%) but varied among years, being lowest in 2004 as a result of high predation rates. Video monitoring nests during incubation also allowed for the identification of nest predators in addition to revealing accidental parental egg removal as a source of partial clutch reduction. Fledging rates increased from 0.69 chicks/pair in 2002 to 0.86 chicks/pair in 2004. Despite relatively high nest success in 3 of the 4 yr fledging rates continued to remain below the Canadian recovery goal of 1.25 chicks/pair.

### 237 Anich, Benson & Bednarz

Factors influencing home-range size of Swainson's Warblers in eastern Arkansas. NICHOLAS M. ANICH, THOMAS J. BENSON and JAMES C. BEDNARZ, *Dept. Biol. Sci., Arkansas State Univ., Jonesboro, AR*.

Examining home range can provide important information about the spatial use requirements of a species, and measuring variation in home-range size can help elucidate factors related to habitat quality. Understanding habitat requirements is especially important for species of conservation concern, such as Swainson's Warbler. Swainson's Warblers breed in thickets and canebrakes in the se. U.S.; however, much of the forested habitat in this region has been altered or lost. In 2005 and 2006, we obtained 1851 telemetry locations on 37 male Swainson's Warblers at St. Francis National Forest (SFNF) and White River National Wildlife Refuge (WRNWR) in e. Arkansas. 95% fixed kernel home ranges varied in size from 3 - 31 ha, and several habitat variables were good predictors of home-range size. At SFNF, density of understory vegetation was the best predictor, and showed an inverse relationship with home-range size. At WRNWR, density of vine stems was the best predictor of home range size, with a positive relationship. Models that included a measure of variation in understory density and models involving stem counts of vines, cane (*Arundinaria gigantea*), and shrubs were good predictors of home-range size at both sites. Home ranges with more vines tended to be larger, while home ranges with more cane tended to be smaller. Our results suggest managing for cane may improve habitat quality for Swainson's Warblers.

### 238 Renner & Rappole

New aspects of the biology of the recently discovered Naung Mung Scimitar-Babbler from northern Kachin State, Burma/Myanmar and a new subspecies of *Tesia* from Southeast Asia. SWEN C. RENNER and JOHN H. RAPPOLE, *Natl. Zool. Park, Smithsonian Inst., Front Royal, VA*.

From recent field trips to n. Burma/Myanmar, we discovered at least 2 new taxa. A new species of the timaliid genus *Jabouilleia* was discovered near Naung Mung, Myanmar in Feb 2004. During subsequent trips to the area, the song was recorded, stomach contents were obtained, and a new locality for the species was documented in temperate rain forest, 24 km south of Naung Mung. We propose and discuss the range for *J. naungmungensis*; we consider the range extends along the forested slopes bordering the Nam Ti and Nam Tisang rivers and their tributaries from about 27° 42' N southward to perhaps 27° 04' N. Also, we collected several individuals of the Slaty-bellied *Tesia*. Subsequent comparison of these with *T. olivea* from nw. India and n. Thailand revealed that, while our ne. Myanmar birds were similar to those from northwestern India, both were distinctly different from specimens from Chiang Mai Province of n. Thailand and from n. Vietnam. We recognize the latter populations as members of a new subspecies by analyzing cytochrome b, NAD2, morphometric, plumage, and song variation.

### **239 Benson & Bednarz**

Body condition of Swainson's Warblers breeding at three sites in eastern Arkansas. THOMAS J. BENSON and JAMES C. BEDNARZ, *Dept. Biol. Sci., Arkansas State Univ., Jonesboro, AR.*

Determination of the ecological factors affecting the condition of adult birds is important for understanding population dynamics. This is especially critical for species, such as Swainson's Warbler, which are recognized as species of conservation concern. Although typically associated with bottomland hardwood forests and historically thought to be closely associated with giant cane (*Arundinaria gigantea*), these warblers can occupy a range of habitat types. However, little is known about the relative quality of alternative habitats, especially with respect to condition or survival of adults. In 2005 and 2006, we captured 163 adult male Swainson's Warblers at 3 sites in eastern Arkansas, collected data on size and mass of individuals, and used these data to investigate variation in body condition among sites. We found that body condition of males increased throughout the breeding season (slope = 0.01). Body condition was greatest (0.24) at a site that was transitional between bottomland and upland habitats and dominated mainly by shrubs and vines, lowest (-0.16) at an exclusively bottomland site dominated by a mixture of cane and vines, and intermediate (0.03) at a site with active timber management. These results suggest that transitional bottomland/upland forests and actively-managed bottomland forests may contain suitable habitat for Swainson's Warblers to maintain favorable body condition. Surprisingly, the mature forest site with cane as a dominant component of the understory seemed to support birds in relatively poor condition.

### **240 Stanback, Mercadante, Burke, Jameson, Grunwald, Ray & Olbert**

Eastern Bluebird exclusion results in competitive release of Brown-headed Nuthatches. MARK STANBACK, AUSTIN MERCADANTE, HOWELL BURKE, REBECCA JAMESON, DOUG GRUNWALD, GRAHAM RAY and JEAN OLBERT, *Dept. Biol., Davidson Coll., Davidson, NC.*

Recent declines in Brown-headed Nuthatch numbers are commonly attributed to the inability of this habitat specialist to thrive in the modified habitats of the Southeast. We hypothesized that expanding Eastern Bluebird populations play a critical role in limiting nuthatch populations. Bluebirds dominated in disputes over contested nestboxes significantly more often than did nuthatches. To determine whether bluebird exclusion could result in competitive release, we performed an experiment using nest boxes on 6 suburban golf courses near Davidson, NC. When one-third of the nest boxes on 3 courses were fitted with smaller (bluebird-proof) entrance holes, numbers of nuthatches increased dramatically and continued to increase for all 3 yr of the experiment. Nuthatches remained rare on control courses. In 2007 we assessed neophobia in both species to test whether nuthatches, as old-growth specialists, are more disturbed by anthropogenic changes near their nest. We found no difference in their latency to enter their nest box when a novel item was attached to it. and found that nuthatches are significantly less neophobic than bluebirds. These results suggest that interspecific competition, rather than habitat specialization, may be responsible for population declines of brown-headed nuthatches. In 2008, bluebird-friendly entrance holes will be returned to 2 of the 3 experimental courses and effects on bluebird and nuthatch numbers observed.

### **241 Powell, Kempema & Schacht**

Grassland bird community response to vegetation composition and structure on private grasslands in the Nebraska Sandhills. LARKIN A. POWELL, SILKA L. F. KEMPEMA, *School Nat. Res., Univ. Nebraska-Lincoln, Lincoln, NE,* and WALTER H. SCHACHT, *Dept. Agron. & Hort., Univ. Nebraska-Lincoln.*

We used transect surveys to evaluate grassland bird communities on grazed, private lands in the Nebraska Sandhills during 2003 - 2004. Our prior research indicated species-specific responses to grassland habitat structure and composition; thus, our goal was to investigate similar effects on community dynamics. Duration of pasture occupation by cattle, and associated grazing pressure and grazing distribution, in rotational grazing systems are key factors influencing habitat structure and plant species composition. We recorded 60 bird species during our study (53 in 2003, 49 in 2004). Long- and medium-duration grazing systems had greater species richness (35 and 34 species) than short-duration grazing systems (28 species). We constructed similarity matrices between communities. Heterogeneity

of vegetation structure (visual obstruction readings) best explained similarity of bird communities, and heterogeneity of vegetation structure was greatest on long-duration grazing systems. Litter depth, which varied between years of the study, also explained variation in bird community similarity. Last, more proximal pairs of study sites tended to have more similar bird communities. Our data provides evidence that grazing systems, through effects on vegetation composition and structure, can affect grassland bird community composition.

#### **242 Koper, Walker & Champagne**

Avoidance of habitat edges by Sprague's Pipits. NICOLA KOPER, *Nat. Res. Inst., Univ. Manitoba, Winnipeg, MB*, DAVID WALKER, *Dept. Environ. & Geog., Univ. Manitoba*, and JANESSA CHAMPAGNE, *Nat. Res. Inst., Univ. Manitoba*.

It is unclear why Sprague's Pipit populations are declining more rapidly than populations of other grassland songbirds. Loss of prairie habitats has been significant, and much of the remaining prairies are fragmented by roads, croplands, reservoirs, and other anthropogenic features. We hypothesized that effects of habitat loss on Sprague's Pipit populations may be compounded by edge avoidance. We used nonlinear regression and information theory to determine effects of habitat edges on Sprague's Pipit relative abundances. Surveys were conducted in 34 mixed-grass prairies in s. Alberta, 2000 - 2002. We used a GIS to determine the proportion of grassland habitat that was influenced by edge effects. Sprague's Pipits experienced a decline of at least 10% in their relative abundances within 1377 m of croplands and 470 m of wetlands, but did not avoid roads. Their relative abundance declined by more than 25% within 902 m of croplands, and 340 m of roads. The majority of the grassland habitat on the landscape was influenced by at least one edge type. Higher nesting success closer to cropland edges suggests that edge avoidance may historically have been adaptive, but is now maladaptive. Sprague's Pipit populations may be declining, in part, because their strong avoidance of habitat edges exacerbates effects of habitat loss.

#### **243 Bock, Bock, Kennedy & Jones**

Response of summer birds to wildfire in grazed versus ungrazed grasslands in southeastern Arizona. CARL E. BOCK, JANE H. BOCK, *Ecol. & Evol. Biol., Univ. Colorado, Boulder, CO*, LINDA KENNEDY, *Research Ranch, Natl. Audubon Soc., Elgin, AZ*; and ZACH F. JONES, *Biol. Dept., Colorado Coll., Colorado Springs, CO*.

We studied the separate and combined effects of fire and livestock grazing on summer birds in an Arizona mesquite-grassland, by comparing numbers on grazed versus ungrazed sites, both before and after a 2002 wildfire that covered the entire study area. The fire caused a proportionally larger reduction in grass cover on ungrazed than on grazed areas for 2- to 3-yr post-burn. This in turn resulted in a temporary decline in the combined abundance of a suite of grass-dependent birds that otherwise dominated ungrazed areas: Grasshopper Sparrow, Cassin's Sparrow, Botteri's Sparrow, and Eastern Meadowlark. At the same time, combined counts of species usually more common in grazed areas temporarily increased in ungrazed areas following the burn. This group included Mourning Dove, Horned Lark, Northern Mockingbird, and Lark Sparrow. Flycatchers as a group (especially Western and Cassin's Kingbird) temporarily increased after the fire on both grazed and ungrazed sites. Results of this study suggest that ground cover is a critical variable for many birds of southwestern grasslands, such that fire-caused reductions in ground cover in ungrazed areas increased avifaunal similarities between grazed and ungrazed grasslands for 2 to 3 post-fire growing seasons.

#### **244 Riffell, Burger, Hamrick, Puckett & Smith**

Bird response to native grass buffer habitats in Mississippi. SAM RIFFELL, L. WES BURGER, RICK HAMRICK, HEIDI PUCKETT, *Dept. Wildl. & Fish., Mississippi State Univ., Mississippi State, MS*, and MARK SMITH, *School For. & Wildl. Sci., Auburn Univ., Auburn, AL*.

The Conservation Reserve Program allows agricultural producers to voluntarily retire productive cropland into various conservation practices. In 2004, the USDA Farm Service Agency created a native grass habitat buffer practice (CP33) to provide habitat for Northern Bobwhite and other

grassland-associated birds. Participating states are required to monitor bird response to these buffers, and we report on the first year of monitoring in Mississippi. 40 CP33 fields were randomly selected from the pool of available contracts and paired with a control field of similar cropping system and adjacent habitats within the same landscape context. We surveyed singing males at the field margin twice during summer 2006. We used Poisson regression to test for effects of CP33 buffers, but first we controlled for effects of weather and surrounding land use (derived from USDA National Agricultural Statistics Service Cropland data). Dickcissel, Northern Bobwhite, Northern Mockingbird, Red-bellied Woodpecker, and Red-winged Blackbird were significantly more abundant ( $P < 0.10$ ) on CP33 bordered fields. Because native-grasses were not yet fully-established (buffers were in the 1st or 2nd growing season), these initial results are promising. This suggests that in agricultural landscapes, CP33 field buffers have the potential to increase available habitat for not only grassland species, but also a variety of other species. The Conservation Reserve Program has great potential to contribute to regional conservation objectives and to help reduce current population declines for grassland- and edge-associated species. Continued monitoring of existing practices is necessary to refine CRP practices and increase the program's habitat benefits.

#### **245 Ruth, Gordon & Stanley**

Wintering bird-habitat associations and responses to grazing in Arizona semidesert grasslands. JANET M. RUTH, *USGS Arid Lands Field Sta., Albuquerque, NM*, CALEB E. GORDON, *Univ. Arizona, Tucson, AZ*, and THOMAS R. STANLEY, *USGS Ft. Collins Sci. Center, Ft. Collins, CO*.

Recent studies have expanded our knowledge about the breeding ecology of grassland birds, yet little is known about the winter (non-breeding) ecology of most grassland species. We studied wintering associations and grazing effects on bird habitats in the semidesert grasslands of se. Arizona. We modeled associations between bird abundance and vegetation variables, and the effects of grazing on vegetation variables. We then developed mechanistic inferences about the effects of grazing on bird abundance, based on these results. For a suite of birds including Baird's, Grasshopper, and Vesper sparrows and Sprague's Pipit, we found that measures of shrub density, grass structure, bare ground, dead litter, and native grass, were associated with abundance of various individual species. We found causal and non-causal associations between grazing and several of these vegetation characteristics. Our mechanistic inferences suggest that grazed sites would be associated with less Vesper and Total sparrows, and possibly less Grasshopper Sparrows. For other species, inferences about grazing effects on abundance were not possible.

#### **246 vacant**

### **Part 3: Posters**

#### **301 Smith, Marra & Reitsma**

Dominance behavior as a determinant of Northern Waterthrush space use during the non-breeding season. JOSEPH SMITH, PETER P. MARRA, *Smithsonian Migratory Bird Center, Washington, DC*, and LEONARD R. REITSMA, *Dept. Nat. Sci., Plymouth State University, Plymouth, NH*.

Space use by Northern Waterthrushes during the non-breeding season was studied in 4 habitat types at Roosevelt Roads Naval Station, Puerto Rico from Jan -Apr 2002 - 2004. We used radio telemetry to quantify sex-specific spacing behavior, habitat use, and food availability on home ranges. Intra-specific aggression was quantified with playback trials and we used distance sampling to estimate density and home range overlap. Overwinter site persistence varied among habitats. Birds using white and red mangrove habitats used a single contiguous territory during the study period while 40% of birds in scrub and 48% of birds in black mangrove made unidirectional dispersal movements an average of 418 m away to new locations. . Regardless of sex, territories of aggressive birds were more exclusive

than non-aggressive birds. Males, relative to females, were more aggressive and more likely to be sedentary from Jan to Apr. Male territories were also more exclusive, and composed smaller areas with higher food availability when compared to females. Of the 4 habitats studied, white mangrove had the highest waterthrush density, smallest home ranges, highest food availability and a male-biased sex ratio (63% male). All other habitats were female-biased (62% female). Our results provide evidence for territoriality in a mangrove habitat mosaic and indicate that variation in habitat quality may result in sex-based competition for high quality wintering sites. If fitness consequences vary with social behavior and space use, then events during the non-breeding season may have important demographic consequences for populations of this species.

### **302 Hubbard & Swaddle**

Male mate choice based on sexually selected traits in female Eastern Bluebirds. JOANNA K HUBBARD and JOHN P SWADDLE, *Biol. Dept., Coll William & Mary, Williamsburg, VA.*

Sexual selection is usually described in terms of two principle mechanisms, female mate choice and male-male competition. However, many species of birds have biparental care and among-individual variation in the quality of both sexes. In such species it seems intuitive that both sexes will be choosy and competitive as they are both significantly investing in their offspring; yet few studies have explored if mutual mate choice occurs. We are assessing whether male eastern bluebirds prefer bright females over dull females; additionally, we are examining whether sexual selection is acting on female traits, specifically plumage coloration. To determine this we are analyzing plumage samples and comparing color to various metrics of quality and reproductive success. Results from these studies show whether male mate choice is occurring in eastern bluebirds and provide a test case for whether male mate choice should be expected in species with biparental care and among-individual variation. Furthermore, these results provide strong evidence for whether or not female plumage coloration is under sexual selection. Combined, these results can show whether male mate choice is driving sexual selection on female plumage coloration.

### **303 Jehl, Henry & St. Leger**

Eared Grebe mortality on hypersaline lakes: encrustation or salt toxicity? JOSEPH R. JEHL, Jr., *U.S. Natl. Mus. Nat. Hist., Washington, DC*, ANNETTE E. HENRY, *Natl. Marine Fish. Serv., La Jolla, CA*, and JUDY St. LEGER, *SeaWorld, San Diego, CA.*

In clinical studies high levels of mortality in Eared Grebes and other waterbirds that visit highly concentrated industrial ponds in the w. U.S. have often been attributed to salt toxicosis. However, behavioral observations of Eared Grebe on trona ponds in sw. Wyoming, knowledge of the birds' physiology, and a critical review of the literature, indicate that salt toxicosis is rarely involved. Grebe do not forage on these sterile ponds, nor do they drink. Mortality results when salts precipitate on the plumage. This increases conductance and leads to death from thermal stress and, in summer, dehydration. 'Toxic' levels of brain sodium do occur, but these are evidently derived secondarily, as heavily encrusted birds ingest water while struggling to avoid drowning, or post mortem. Our findings reinforce the importance of incorporating behavior in diagnostic studies.

### **304 Burger & Gochfeld**

Radionuclides and metals in five species of maritime birds from the Aleutians, Alaska. JOANNA BURGER and MICHAEL GOCHFELD, *Environ. & Occ. Health Sci. Inst., Rutgers Univ., and Consortium for Risk Evaluation with Stakeholder Participation, Piscataway, NJ.*

We examined levels of radionuclides in muscle, and metals in feathers, of 5 species of marine birds nesting on Amchitka and Kiska Islands in the Aleutian Chain of Alaska to determine whether higher trophic levels birds had higher levels, and whether radionuclide levels were higher in birds nesting on Amchitka (which had 3 underground nuclear tests 1965 - 1971) compared to Kiska (reference site). Species examined included Common Eider, Pigeon Guillemot, Tufted Puffin, Glaucous-winged Gull and Bald Eagle. Levels of radionuclides were mainly below detection levels suggesting no cause for concern for either the birds themselves, or for their predators (including subsistence hunters). Metal levels were generally lowest for Common Eider. Bald Eagles had highest arsenic (mean 0.54 ppm), cadmium (0.25 ppm), chromium (2.2 ppm), and manganese (34 ppm). Guillemots had highest lead and mercury (means 1.28 ppm, 7.11 ppm). Puffins had highest selenium (6.6 ppm). Levels of metals in eggs of Common

Eiders and Glaucous-winged Gulls were below the known effects levels for the birds or for their predators. However, gull and eider eggs are a preferred subsistence food of Aleuts, and levels were sufficiently high to suggest that pregnant women should avoid several meals of bird eggs in a short period of time. Supported by the U.S. Department of Energy.

### **305 Horn, Lattin & Ritchison**

Eastern Phoebe use different strategies to provision young. R. IAN HORN, C. LATTIN and G. K. RITCHISON, *Dept. Biol., Eastern Kentucky Univ., RICHMOND, KY.*

How sex, brood size, brood age, and individual quality contribute to variations in parental provisioning behavior remain unclear and require additional studies. Our objective was to compare the provisioning rates of male and female Eastern Phoebes and determine the possible effects of brood size and age on provisioning. Eastern Phoebes are double-brooded species that readily nest in human-made structures. We monitored ( $n = 16$ ) and video-taped nests ( $n = 16$ ) for 2 - 4 hr almost daily. For each visit, we noted the sex of the visiting adult, prey type, prey size, and number of young fed. Using repeated measures ANOVA, we found no significant difference between ( $P = 0.22$ ) mean number of feeding visits for males ( $1.4 \pm 0.4$ ) and females ( $3.3 \pm 0.1$ ) in the mean number of visits per nestling per hour. Provisioning rates did not differ with either nestling age ( $P = 0.9$ ) or brood size ( $P = 0.74$ ). In contrast, mean prey size was significantly larger for larger broods ( $P = 0.04$ ), and interactions between pair and sex were significant ( $P < 0.001$ ), indicating that within pairs males and females provisioning rates differ. Our results are not consistent with other phoebe provisioning behavior studies in that we found no significant difference in the provisioning rates of males and females and feeding rates did not vary with nestling age. However, phoebes do provision at different rates in different pairs, suggesting different strategies of provisioning behavior. Other studies have indicated that factors such as extra-pair copulations and individual quality influence provisioning. Further studies are necessary to determine what influences these different strategies of provisioning behavior.

### **306 Larson, Hobson & Wassenaar**

Deuterium base map for Mexico created using House Sparrow feathers. KEITH W. LARSON, *Klamath Bird Observ., Ashland, OR*, KEITH A. HOBSON and LEONARD I. WASSENAAR, *Environ. Canada, Saskatoon, SK.*

Recent studies in North America have focused on the use of stable-hydrogen isotopes (deuterium), especially in feathers, to identify the natal, breeding, molting, and wintering origins of birds. Ratios of deuterium in precipitation have predictable patterns across North America. Several deuterium based maps for North America have been created using the long-term Global Network for Isotopes in Precipitation (GNIP) database. Of the 39 stations used to develop these maps, only two of the stations exist in Mexico, limiting the usefulness of this portion of the map. We created a more detailed deuterium map for Mexico by collecting feathers from House Sparrows, a widely distributed resident species. These birds are abundant across the country from sea-level to over 3,000 m, except on the Yucatan Peninsula. In addition, we also collected well-water samples. We attempted to sample feathers every 200 km and ground water every 50 km on a transect grid that covered over 18,000 km of roads across Mexico, excluding the Baja Peninsula. The resulting deuterium map was created from 461 feather samples collected at 45 sites. This map has broad applications for studying dispersal and migratory movements of both resident and migrant species.

### **307 Gouse & Jones**

Nests, predators and videotape: using miniature cameras on grassland bird nests. PAULA J. GOUSE, *U.S. Fish & Wildl. Ser., Bowdoin NWR, Malta, MT*, and STEPHANIE L. JONES, *U.S. Fish & Wildl. Ser., Denver, CO.*

From 2002 to 2006 we used miniature video cameras on 18 grassland songbird nests in n.-central Montana. The cameras recorded activity at Sprague's Pipit ( $n = 10$ ), Chestnut-collared Longspur ( $n = 5$ ), Grasshopper ( $n = 2$ ) and Baird's Sparrows ( $n = 1$ ) nests. The cameras were deployed at nests midway through incubation and continuously recorded activity 24 hours a day until the nests failed or fledged young. Of the 18 nests, 8 were successful, 7 were depredated, 2 Chestnut-collared Longspur nests were abandoned and 1 outcome was unknown due to equipment failure. All predation

events took place during the nestling stage and included a mouse (probably *Peromyscus*), 2 Northern Harriers, 2 Western Meadowlarks, a Short-eared Owl and an unidentified mammal. Two additional predators (an unidentified mouse and a plains garter snake) were observed at nests, resulting in forced fledging, where at least one nestling successfully escaped. We investigated whether the proximity of 2-track roads affected predation rates in the camera nests. Adult behavior captured on camera includes timing and duration of incubation and feeding, nest defense, and documentation of male Sprague's Pipits assisting at the nest. Miniature cameras provide direct documentation of predation and details of behaviors that we are rarely able to observe directly.

### **308 Stodola, Cooper & Linder**

Compensatory parental care in a multi-brooded songbird species. KIRK W. STODOLA, ROBERT J. COOPER, *Warnell School For. & Nat. Res., Univ. Georgia, Athens, GA*, and ERIC T. LINDER, *Dept. Biol. Sci., Mississippi State Univ., Mississippi State, MS*.

Energy spent in parental care should act to maximize reproductive output, which may manifest itself in terms of quantity or quality of offspring. Theoretical models of parental care and the allocation of energy expenditure have often focused on the conflict of interest between mated pairs, where each parent prefers the other to expend the most energy. However, this conflict may not exist for socially monogamous multi-brooded species where future matings may depend on current energy expenditure. Our research with the Black-throated Blue Warbler, a socially monogamous multi-brooded songbird species, suggests that male provisioning increases when female provisioning decreases, and that male provisioning is a strong determinant of offspring weight. Furthermore, compensatory care by males is most prevalent in first broods, potentially freeing females from an energetically costly activity and allowing reallocation of energy towards second broods. Here we examine 4 yr of data from 3 sites to investigate the conditions under which this compensation occurs. We provide evidence that male compensatory provisioning is most prominent at sites and in years with lowered food availability.

### **309 Bollinger & Bollinger**

Patterns of natal philopatry in Eastern Bluebirds. PATRICIA B. BOLLINGER and ERIC K. BOLLINGER, *Dept. Biol. Sc., Eastern Illinois Univ., Charleston, IL*.

We studied patterns of natal philopatry in Eastern Bluebirds in east-central Illinois. Between 2001 and 2005, nest boxes were monitored and 521 fledglings were color-banded. Of these, 33 (6.3%) returned to breed in 2002 - 2006 in our boxes. Surprisingly, we found higher return rates among nestlings fledging in the later half of the breeding season. Males and females appeared equally likely to return and within each sex, hatching weights and weights at fledging were virtually identical between those birds that returned and those that did not. Returning nestlings were also not significantly more likely to have hatched or fledged before their nestmates. Over 60% of nests hatched and fledged within 24 hours. These patterns, therefore, may reflect the fairly synchronous hatching and fledging in this species.

### **310 Stone & Cavitt**

Incubation rhythm and behavior of Long-billed Curlew at Great Salt Lake. KYLE STONE and JOHN F. CAVITT, *Dept. Zool., Weber State Univ., Ogden, UT*.

The Long-billed Curlew is the largest of all North American shorebirds and is known to breed throughout the Great Plains and Great Basin. Unfortunately, little information is known about the incubation rhythm, duration of attentive periods and changeover activities of this species. We examined incubation behavior by placing miniature video cameras connected to recorders that allow for continuous recording 24 hr/d. The results of these observations suggest that eggs are rarely left unattended and typically just during changeover periods. The male incubated continuously at night and the female throughout the day. During the day, the incubation bout length was variable but averaged 10 hr in duration.

### **311 Steenhof & Peterson**

Site fidelity, mate fidelity, and breeding dispersal in American Kestrels. KAREN STEENHOF and BRIT PETERSON, *U.S. Geol. Surv., For. & Range. Ecosys. Sci. Center, Snake River Field Station, Boise, ID*.

Most birds return to nest in the same areas year after year, and many pair with the same mate in multiple years. Sometimes, however, the advantages of staying on the same territory or with the same mate may be outweighed by the advantages of moving to a better territory or a better mate. From 1986 to 2006 we monitored marked American Kestrels nesting in artificial boxes in sw. Idaho. Preliminary analyses indicate that turnover was high. In cases where nest box occupants were identified in consecutive years, 77% of boxes had new males ( $n = 299$ ) and 87% of boxes had new females ( $n = 462$ ). High turnover rates were due to a combination of mortality, emigration, and box-switching. Approximately 50% of males and 60% of females that nested within the study area in consecutive years switched boxes. Breeding dispersal distances for birds that switched boxes averaged 1.8 km for males (maximum 22 km) and 2.8 for females (maximum 32 km). Approximately 70% of birds that nested in consecutive years had a different mate in the second year. Mate switches occurred approximately 30% of the time when the previous mate was known to be alive and nesting in the area. We evaluate factors that influence breeding dispersal and mate-switching, and assess the reproductive consequences of switching mates and territories.

### **312 Sly, Townsend, Rimmer & Lovette**

Species limits and phylogeography of Hispaniolan palm-tanagers (*Phaenicophilus*). NICHOLAS D. SLY, *Lab. Ornithol., Cornell Univ., Ithaca, NY*, ANDREA K. TOWNSEND, *Dept. Ecol. & Evol. Biol., Cornell Univ.*, CHRISTOPHER C. RIMMER, *Vermont Inst. Nat. Sci., Woodstock, VT*, and IRBY J. LOVETTE, *Dept. Ecol. & Evol. Biol., Cornell Univ.*

Avian speciation within medium-sized islands is unusual, yet Hispaniola supports several species pairs, including the palm-tanagers, *Phaenicophilus palmarum* and *P. poliocephalus*. These sister species have ranges that meet along a former sea channel in southwestern Haiti. Their respective species status has been questioned after the discovery of a hybrid zone in this region, but the only previous molecular work on this system relied on isozymes. We use sequence data to explore the level of differentiation between the 2 forms, to assess if the timing of their divergence dates to the ancient sea channel, and to examine potential cryptic divergence within the genus. Analysis of an mtDNA-based haplotype network indicates a deep split (mean 5.51%; range: 5.27% - 5.86% uncorrected divergence) between *P. palmarum* and *P. poliocephalus*. The mtDNA networks apparently have no further phylogeographic structure within either species, indicating recent gene flow between many conspecific populations. These data support species status for both palm-tanagers, point toward within-island speciation that corresponds to the timing of the sea channel, as well as confirm *P. poliocephalus* as Haiti's only endemic bird.

### **313 Tsai, Yuan & Chou**

Past reproductive success explains variation in site fidelity of migratory Blue-tailed Bee-eaters on Kinmen Island, Taiwan. PEI-YU TSAI, *Inst. Ecol. & Evol. Biol., Natl. Taiwan Univ, Taipei, Taiwan*, HSIAO-WEI YUAN and LIEN-SIANG CHOU, *School For. & Res. Conserv., Natl. Taiwan Univ.*

Most Blue-tailed bee-eaters (*Merops philippinus*) are colonial breeders. They excavated nest burrows on sandy banks or cliffs. We monitored a migratory bee-eater breeding population on Kinmen Island, 5 km west of Taiwan, from 2003 - 2006. We found that certain bee-eaters bred at the same colony in consecutive years, and thus show site fidelity. In other bird species, variation in site fidelity has been explained by past Reproductive Success (RS). Because RS is the result of a combination of physical environment and biological factors, RS can be used as the cue for assessing the quality of breeding habitat. For colonial species, RS can be further divided into Individual Reproductive Success (IRS -- the relative reproductive success of the individual) and Local Reproductive Success (LRS -- the relative reproductive success of the colony). We investigated whether previous IRS or LRS affected the likelihood that individual bee-eaters would return in future years to breed at the same colony. Using Logistic regression, we found that IRS significantly influenced site fidelity while LRS did not. Moreover, IRS in second year was significantly greater than the mean RS in the prior year. Our data suggest that Individual reproductive success might represent a reliable cue to assess the habitat quality but that local reproductive success appears not to influence future breeding site selection.

### **314 Clifford & Boeckel**

Is the incubation period energetically costly for the Eastern Bluebird? LESLIE D. CLIFFORD and LAUREN BOECKEL, *Dept. Biol., Mansfield Univ., Mansfield, PA.*

Much attention has been focused on the energetic costs that the avian chick rearing period imposes on parents. Significantly less attention has been devoted to the incubation period, which for many years was assumed to be a period of energetic savings for incubating birds. A few experiments have indicated that for some species, the incubation period is energetically costly, but additional data are needed to gain a full understanding of the costs of incubation across taxonomic groups. We tested the hypothesis that the incubation period is energetically costly for the Eastern Bluebird by providing supplemental food to incubating females and their mates during the incubation period only. We found no difference in hatching success or chick growth between supplemented and control groups, but we found that supplemented pairs had higher fledging success than control pairs. This indicates that the incubation period is energetically costly for the Eastern Bluebird. In addition, these results suggest that feeding incubating Eastern Bluebirds may help increase Eastern Bluebird populations.

### **315 Shaw, Ring & Sharbaugh**

Breeding ecology and habitat associations of the Arctic Warbler in interior, Alaska. DAVID W. SHAW, RICHARD RING and SUSAN SHARBAUGH, *Alaska Bird Observ., Fairbanks, AK.*

The North American subspecies of the Arctic Warbler (*Phylloscopus borealis kennecotti*) is a paleotropical-nearctic migrant songbird that breeds in Alaska and winters in Southeast Asia. Due to the paucity of data on the ecology and habitat associations of the species, the Arctic Warbler has been named a species of concern by the Alaska Department of Fish and Game. During the summers of 2004 - 2006, the Alaska Bird Observatory conducted a study of the breeding ecology and habitat associations of Arctic Warblers breeding in the Alaska Range. During this period, on 4 study plots, we monitored 101 Arctic Warbler nests. 92% of nests successfully fledged young. We found the highest densities of Arctic Warblers on higher elevation plots (>1150 m), which were dominated by a mosaic of medium willow (*Salix* sp.) and open areas of tussock grasses and forbs. However, the species appears plastic in its habitat requirements and was found in diverse habitats within the sub-alpine shrub. In the summer of 2006, our study area was struck by an atypical, heavy snowfall, which occurred as Arctic Warblers were laying eggs in late Jun. This storm caused complete abandonment of all nests under observation. Re-nesting attempts showed a 26% reduction in clutch size when compared to previous years but equivalent success.

### **316 Mercadante, Stanback, DiLuzio & Olbert**

Nest size variation in Eastern Bluebirds. AUSTIN MERCADANTE, MARK STANBACK, NICK DILUZIO and JEAN OLBERT. *Dept. Biol., Davidson Coll., Davidson, NC.*

The thermal conditions within a cavity nest can be influenced by the type and amount of nest material. We assessed variation in Eastern Bluebird nest height in 300 nest boxes. We first compared nest height in boxes in spring vs. summer. To control for seasonal effects, we also compared nest height in dark (hot) vs. light (cool) boxes in the same season (both spring and summer). Finally, we compared nest size in light-colored summer boxes in which the floor of the box was raised by 5 cm (50 boxes) vs. control boxes (n = 50 boxes).

### **317 Rivers, Jensen, Kosciuch & Rothstein**

Community-level patterns of host use by a generalist brood parasite. JAMES W. RIVERS, *Dept. Ecol., Evol. & Marine Biol., Univ. California, Santa Barbara, CA*, WILLIAM E. JENSEN, *Dept. Biol. Sci., Emporia State Univ., Emporia, KS*, KARL L. KOSCIUCH, *Tetra Tech EC, Inc., Portland, OR*, and STEPHEN I. ROTHSTEIN, *Dept. Ecol., Evol. & Marine Biol., Univ. California, Santa Barbara.*

Estimates of host use by generalist brood parasites are often difficult to obtain because brood parasites may use many host species within a community. Nevertheless, empirical data on host use is important for conservation measures because brood parasites can negatively impact hosts with small populations. During the 2002 - 2006 breeding seasons, we quantified host use by the Brown-headed Cowbird at Konza Prairie Biological Station in ne. Kansas, a site of high cowbird breeding density. Over all years, 45% of nests (n = 1436) of 15 non-rejecting songbird hosts were parasitized, and parasitized nests contained an average of 2.0 cowbird offspring (range 1 - 7). The vast majority (93%) of parasitized nests comprised 4 core species which harbored 88% of the total cowbird offspring found on the study

site. The parasitism rate of Dickcissel nests, 68% (n = 504 nests), was 3.4x higher than the parasitism rate on Red-winged Blackbird nests, 19.9%, (n = 543 nests) perhaps due to the differences in host quality. The mean proportion of Dickcissel nests parasitized (68%) and the mean number of cowbird offspring per parasitized Dickcissel nest (2.1 offspring) was lower during our study than during a study conducted >25 yr ago at the same site (85% and 2.9 offspring, respectively). Our results suggest that cowbirds differentially parasitize hosts under high breeding densities, the majority of cowbird offspring raised at our study site come from a small number of hosts, and the Dickcissel may be a preferred cowbird host.

### **318 Kosciuch, Rivers & Sandercock**

Stable isotopes identify the natal origins of a generalist brood parasite. KARL L. KOSCIUCH, *Tetra Tech EC, Portland, OR*, JAMES W. RIVERS, *Dept. Ecol., Evol. & Marine Biol., Univ. California, Santa Barbara, CA*, and BRETT K. SANDERCOCK, *Div. Biol., Kansas State Univ., Manhattan, KS*.

Determining the natal origin of brood parasites is difficult because generalist species use different hosts that may breed in diverse habitats. Community-wide patterns of host use are challenging to obtain because nest searching is labor intensive and researchers may fail to locate nests of secretive hosts. Stable isotope ratios obtained from independent young provide an alternative method for identifying natal origins because feathers retain the isotopic composition of the nestling diet. We measured carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) isotope compositions of feathers from nestling Brown-headed Cowbirds raised by different hosts in 2 different habitats to explore whether stable isotopes could be used to determine natal origins. We were unable to assign juvenile cowbirds to host species, but found that feathers sampled from nestlings raised in grassland plots contained significantly more  $^{13}\text{C}$  and less  $^{15}\text{N}$  than nestlings raised in shrub plots. Independent juvenile cowbirds had isotopic signatures that were most similar to cowbird nestlings raised on shrub plots. Thus, stable isotope analysis of feathers represents an effective method for determining the natal origin of parasitic young if nestlings have distinct isotopic profiles.

### **319 Juliusson, Cruz, Walsh, Chace, Swanson & Prather**

Cowbird parasitism, nest predation, and nest success along an urban/wildland boundary, Boulder Co., Colorado. LARA M. JULIUSSON, ALEXANDER CRUZ, JOHN J. WALSH, *Dept. Ecol. & Evol. Biol., Univ. Colorado, Boulder, CO*, JAMESON F. CHACE, *Dept. Biol., Salve Regina Univ., Newport, RI*, HEATHER M. SWANSON, *City of Boulder Open Space & Mountain Parks, Boulder, CO*, and JOHN W. PRATHER, *deceased (20 Feb 2006)*.

A striking urban/wildland boundary exists where the western limit of Boulder, CO is juxtaposed to over 3000 ha ponderosa pine (*Pinus ponderosa*) foothill Open Space. Previous work has shown that Brown-headed Cowbird parasitism of Plumbeous Vireo nests decreases with distance from the urban boundary (Chace et al. 2003, **Landscape & Urban Planning** 64: 179-190). We ask whether this same pattern exists for other host species, and if nest predation is also influenced by the urban boundary. In 1999 - 2001, 256 nests were found and monitored. Parasitism rates, nest predation and nest success were compared with nest distance from the urban boundary, as well as the nearest trail and road. For combined 5 potential host species, cowbird parasitism was significantly higher within 1 km of the urban boundary (29%, n = 112) than nests farther away (15%, n = 43). Among a combined nine species, nest predation and nest success was not influenced by distance from the boundary. Western Wood-pewee nests were more likely to be preyed upon and fail near roads and the urban boundary. Chipping Sparrow nest success was lower closer to roads, and Mourning Dove nest predation was higher closer to trails. These results suggest that the spatial-temporal distribution of cowbirds and subsequent failure of vireo nests (Chace et al. 2003) cannot be applied to all other host species in Open Space. Generalizations of road, trail and urban effects may miss important species-specific responses.

### **320 Boylan, Graham & Bocanegra**

Interior Least Tern nest placement on rooftops. JEANETTE T. BOYLAN, ROBIN GRAHAM, *Dallas Zoo, Dallas, TX*, and OMAR BOCANEGRA, *U.S. Fish & Wildl. Serv., Arlington, TX*.

Since 2001, interior least terns have been nesting on warehouse rooftops in n.-central Texas. The rooftops are highly variable in size but all are covered in pea gravel and contain skylights and air-conditioners. To determine whether there is a pattern to nest placement relative to major roof

features, we measured distance of the nests from the roof edges, roof midline, skylights, air-conditioners, exhaust fans, and access points. Additionally, on one roof that contained an abundance of roof "litter" (bones, concrete bits, construction trash, rocks, and globs of tar), we looked at nest placement relative to this small scale "litter." The terns placed their nests in a non-random fashion by avoiding certain areas of the roofs near major roof features. Conversely, terns preferentially placed their nests close to roof "litter."

### **321 Pereyra & Morton**

Nest-site selection in Dusky Flycatchers: effects of predation and weather. MARIA E. PEREYRA and MARTIN L. MORTON, *Biol. Dept., Univ. Tulsa, Tulsa, OK.*

Selection of nesting sites was compared in 2 widely separated populations of Dusky Flycatcher, one located at Tioga Pass (27° N) in the e. Sierra Nevada, CA, and one near Altin (59° N), BC. Both populations utilized subalpine habitats of similar vertical structure and plant composition (willow, aspen and lodgepole pine). There were seasonal changes in nest-site selection that reflected concurrent changes in environmental conditions such as snow depth and local canopy characteristics. In both populations, aspects of nest location such as height, substrate and surrounding vegetation were largely reflective of plant species abundance and vegetative phenology -- with one notable exception. Lodgepole pines were frequently used for nesting in the Sierran population but never in the Altin population. We evaluate the importance of predation and weather as selective factors influencing behavioral characteristics at the population level and speculate on the importance of these mortality factors in shaping behavioral plasticity in nesting substrate preferences.

### **322 Dauphine, Tsamajain-Yagkuag, Tsamajain-Shiwig, Brooks & Cooper**

New findings in bird breeding biology from the Peruvian Andes: first nest description for the Brown Nunlet and first nest records for other regional breeding birds. NICO DAUPHINE, *Warnell School For. & Nat. Res., Univ. Georgia, Athens, GA*, AGUSTIN TSAMAJAIN-YAGKUAG, OSCAR TSAMAJAIN-SHIWIG, *Comm. Wawas-Anexo Wichim*, DANIEL M. BROOKS, *Houston Mus. Nat. Sci., Houston, TX*, and ROBERT J. COOPER, *Univ. Georgia, Athens, GA.*

We present the first description of the nest, nestling, and egg of the Brown Nunlet. Little is known about the life history or behavioral ecology of this species, which is 1 of 6 in a genus of small, inconspicuous puffbirds (Bucconidae), a Neotropical family of mainly insectivorous birds endemic to humid lowland forest. Its remarkably cryptic nest was found after an adult flushed from a leaf litter burrow hidden underneath the spiked prop roots of a small palm in undisturbed lowland tropical rain forest in the eastern Andean foothills in n. Peru. In addition, we present records of active nests for several other regional species whose breeding ecology is poorly known, including the Buff-rumped Warbler, Buff-throated Saltator, and White-plumed Antbird. We also present photographic records of an unidentified nightjar egg and hummingbird nest from the same region, and welcome input from conference participants as to their possible identities.

### **323 Mendenhall, Sekercioglu, Oviedo-Brenes, Daily & Ehrlich**

Using interpubic distance for sexing manakin species in the field. CHASE D. MENDENHALL, C. H. SEKERCIOGLU, F. OVIEDO-BRENES, G. C. DAILY and P. R. EHRLICH, *Center Conserv. Biol., Dept. Biol. Sci., Stanford Univ., Stanford, CA.*

We evaluated the use of a morphometric measurement to determine the sex of 3 manakin species in Costa Rica. We analyzed the distance between pubic bones of 3 genera – White-ruffed Manakin (*Corapipo altera*; n = 209), Orange-collared Manakin (*Manacus aurantiacus*; n = 95), and Blue-crowned Manakin (*Lepidothrix coronata*; n = 47) – during the 2006 and 2007 field season. We compared interpubic distance to plumage characteristics of multiple age classes to evaluate reliability as a sexing tool. We found that all species were accurately sexed (96.5% - 100%) with little to no overlap between sexes. Preliminary data from Long-tailed Manakin (*Chiroxiphia lanceolata*), Red-capped Manakin (*Pipra mentalis*), and White-collared Manakin (*Manacus candei*) support interpubic distance as a reliable tool to accurately sex manakin species of all ages and plumages. We suggest further research to determine if other avian taxa, including sexually monomorphic species, can be reliably sexed in the field using pubic bone spacing.

### 324 Ervin & Swanson

Nesting and foraging habitat use by American Three-toed Woodpeckers in the Black Hills, South Dakota. AMANDA M. ERVIN and DAVID L. SWANSON, *Dept. Biol., Univ. South Dakota, Vermillion, SD.*

The American Three-toed Woodpecker is a quiet, sedentary and elusive species that prefers spruce habitat in old-growth forests. A permanent population occurs in white spruce (*Picea alba*) forests in the Black Hills of South Dakota is listed as a USDA sensitive species and is of conservation concern due to its rarity and isolation from other populations in the Rocky Mountains. We studied tree substrate use for nesting and foraging for this population of three-toed woodpeckers and compared this with random vegetation samples in white spruce forest habitats. Preliminary data suggest that nest sites are characterized by significantly lower densities of small and large spruce, marginally higher densities of aspen snags, but equal numbers of spruce snags and living and dead ponderosa pine, despite the lower densities of trees overall, which suggests that woodpeckers prefer relatively open forests with relatively high snag densities for nesting. Three-toed woodpeckers spent 72% of their total foraging bouts on spruce trees, with 45% on dead spruce and 27% on living spruce, 20% on living and dead ponderosa pine, and 8% on aspen. Spruce snags were used for foraging in higher proportion than their abundance, while living spruce were used in lower proportion to their abundance. These data suggest that spruce snags are favored foraging substrates for three-toed woodpeckers. Collectively, these data suggest that open spruce forests with substantial numbers of spruce snags are important habitat characteristics for American Three-toed Woodpeckers in the Black Hills of South Dakota.

### 325 Nooker & Sandercock

Breeding ecology and apparent survival of female Greater Prairie-Chickens in unfragmented grasslands. JACQUELINE K. NOOKER and BRETT K. SANDERCOCK, *Div. Biology, Kansas State Univ., Manhattan, KS.*

Greater Prairie-Chicken populations have been declining for the past 30 yr due to the destruction and fragmentation of their tallgrass prairie habitat. Some populations on the fringes of the prairie-chicken's range experience low nesting success and egg hatchability. In this study, I examined nesting success and female movements to provide baseline information for a population in an unfragmented prairie. 4 leks were monitored for 4 yr (2003 - 2006) in ne. Kansas (39° 05' N, 96° 34' W). We fitted 43 females with radio-transmitters to monitor movements and to locate nests. Apparent survival was estimated using Cormack-Jolly-Seber models for live encounter data in Program Mark. Females ranged to  $3.7 \pm 1.9$  km from the lek of capture ( $n = 8$  females) and had large home ranges  $575 \pm 145$  ha in size (95% kernel estimate;  $n = 5$  females). First nests were initiated on 6 May  $\pm 13.4$  d and were located  $1.5 \pm 1.0$  km from the nearest lek ( $n = 27$  nests). Nest survival was low (20.6% of nests hatched;  $n = 34$ ), but egg hatchability was high ( $88.6 \pm 13.3$  % of eggs hatched;  $n = 7$  nests). Following failure of the first nesting attempt, 22.2% of females laid a second nest ( $n = 27$  females). Annual apparent female survival was  $0.33 \pm 0.08$  for all females, but  $0.43 \pm 0.22$  for females that returned at least once. Our data suggests that fragmentation of native prairie could affect female prairie-chickens up to 3.7 km from the disturbance. Nest survival was low in Greater Prairie-Chickens and may be the primary demographic factor limiting population viability.

### 326 Kirkpatrick, Conway & Ali

Complete sanitation of dead nestlings by parent birds may bias nest depredation rates. CHRIS KIRKPATRICK, *Dept. Biol., Univ. Arizona, Tucson, AZ*, COURTNEY J. CONWAY, *USGS Arizona Coop. Fish & Wildl. Res. Unit, Tucson, AZ*, and MOEZ H. ALI, *Univ. Arizona.*

Estimates of avian nesting success typically assume that nests missing all eggs and nestlings (i.e., empty nests) prior to fledging are likely to have been depredated. We provide evidence that an empty nest may not always indicate a depredated nest, but instead may result from complete sanitation of dead nestlings by parent birds. In 2006, we used time-lapse video cameras to monitor ground nests of Red-faced Warblers and Yellow-eyed Juncos in high-elevation, mixed-conifer forests of the Santa Catalina Mountains, AZ. Following rain and hail storms on 4 and 5 Jul, video footage revealed that one pair of Yellow-eyed Juncos and one pair of Red-faced Warblers removed all nestlings from their nests (the nestlings apparently died during the storms). The field personnel who subsequently checked the nests assumed that both nests had been depredated. Complete sanitation of dead nestlings by parent birds may be relatively common behavior in some species (especially ground-nesting birds whose nests may be prone to flooding during intense storms) suggesting that researchers use caution when assigning

fates to empty nests during future nest-monitoring studies.

### **327 Brown & Sherry**

Impacts of Hurricane Katrina on a bottomland hardwood bird community. DAVID R. BROWN, *Dept. Biol. Sci., Louisiana State Univ., Baton Rouge, LA*, and THOMAS W. SHERRY, *Dept. Ecol. & Evol. Biol., Tulane Univ., New Orleans, LA*.

Hurricane Katrina passed directly over the Pearl River basin, the most pristine large bottomland hardwood forest in the region. We compared habitat and avian communities in the Pearl River before and after the storm. We assessed changes in habitat characteristics using vegetation plots and LANDSAT imagery. We used point counts and distance sampling to survey the avian community at the same sites both before and after the storm. The storm caused extensive and severe damage to the forest. A large proportion of trees were felled by wind, many others were stripped of leaves and branches, and the canopy opened considerably. Blackberry thickets sprouted and expanded to cover almost all of what was previously a patchily open forest understory. Because of dramatic vegetation changes, we expected: (1) increased density of avian species that prefer dense understory habitat, and (2) declines in avian species that prefer open understory, closed canopy forest. In the first breeding season following the storm, Yellow-breasted Chats, which prefer open canopy and dense understory habitat, appeared for the first time, and at high density. However, the patterns for most other species were ambiguous. We suspect that avian demographic processes are simply not yet visible, considering our methods. We plan to continue sampling abundances, which will allow us to test our hypotheses further.

### **328 Colon & Ha**

Natal dispersal in Mariana Crows. MELANIE R. COLON and JAMES C. HA, *Psychol. Dept. Univ. Washington, Seattle, WA*.

In species with gender-biased dispersal, the dispersing sex tends to be re-sighted less frequently. We examined natal dispersal in the endangered Mariana Crow, *Corvus kubaryi*, using band re-sight data collected from 1995 to 2007. Though preliminary analyses indicate that males are re-sighted less frequently, we found no significant differences between males and females in either distance dispersed or time of dispersal. Gender-biased dispersal does not seem to account for the disparity in re-sight frequency suggesting a higher mortality in male crows. This may have important implications for the conservation and management of this species.

### **329 Smith, Blancher, Francis & Fahrig**

Change in human population density does not predict change in avian species richness in Ontario. ADAM C. SMITH, *Carleton Univ., Ottawa, ON*, PETER BLANCHER, CHARLES FRANCIS, *Environ. Canada, Natl. Wildl. Res. Centre, Ottawa, ON*, and LENORE FAHRIG, *Carleton Univ.*

We used data from the first and second Ontario Breeding Bird Atlases (1981 - 1985, and 2001 - 2005) and the Population Censuses of Canada conducted in 1986 and 2001. We used the change in human population density between 1986 and 2001 to predict the change in avian species richness in 10x10km atlas squares over a similar time period. After accounting for differences in survey effort between the 2 breeding bird atlases, the change in human population density could account for no more than 2% of the variation in the change in species richness. Population density was not a good predictor of species richness among atlas squares during either the first or second atlas, contrary to patterns observed in studies conducted at broader spatial scales (larger grain of analysis). In addition, there was no peak in species richness at intermediate levels of human density. Currently, we are exploring the scale dependencies of these relationships.

### **330 Post van der Burg, Tyre & Bly**

Modeling abundance, detection and spatial distribution of threatened birds in western Nebraska. MAX POST VAN DER BURG, ANDREW J. TYRE, *School Nat. Res., Univ. Nebraska-Lincoln, Lincoln, NE*, and BART BLY, *Rocky Mtn. Bird Observ., Scottsbluff, NE*.

Accurate abundance and distribution data can help refine our knowledge about the population trends of threatened birds and show us where we need to focus conservation efforts. Unfortunately predicting abundances and distributions of rare and threatened species is particularly difficult, in part

because survey methods cannot detect every individual. We will present the preliminary results of a project designed to analyze the abundance and distribution of 2 birds of concern found in the short grass prairie ecoregion of Nebraska, the Mountain Plover and the Burrowing Owl. Using count data from 2006, we fit N-mixture models, using a hierarchical Bayes approach, which allowed us to simultaneously model both relative abundance and detectability with covariates. We also modeled distribution of both species using a spectral parameterization of a spatial random effect that was included as a covariate with abundance. Thus far, our results suggest that Mountain Plovers had low site relative abundance (0.27, BCI: 0.18 - 0.39) and detection rates (0.30, BCI: 0.14 - 0.52), whereas Burrowing Owls were more abundant (3.38, BCI: 3.14 - 3.65) and easier to detect (0.60, BCI: 0.55 - 0.66). Model selection results from our Mountain Plover analysis suggested that land use and patch characteristics are good predictors of abundance, and that detection rates vary between observers and with time of day. Counts for both species also show some spatial structure, which allowed us to produce abundance maps that can aid in conservation planning.

### **331 Beckmann & Shine**

Australian birds and the invasive cane toad: who is at risk? CHRISTA BECKMANN and RICK SHINE, *School Biol. Sci., Univ. Sydney, Sydney, Australia.*

The invasive and highly toxic cane toad (*Chaunus marinus*) has spread across much of tropical Australia since its introduction in 1935. The cane toad now occupies more than 1,000,000 km<sup>2</sup> of Australia, and is predicted to double its current range. Although interest is growing, little work had been conducted to document the effects of this toxic invader on native fauna. The cane toad has been shown to have adversely affected populations of native Australian predators such as snakes, lizards and quolls, all of which die after consuming toads. We have compiled a list of bird species whose distribution overlaps with the current range of the cane toad, and with predicted expanded range of the toads given likely global warming scenarios. All bird species that eat native frogs (adults, tadpoles or eggs) are potentially at risk of mistakenly consuming toxic cane toads (due to its similar body shape), and are included in an effort to identify bird species potentially at risk. We compared the distribution and phylogenetic history (i.e., "relatedness") of these species in order to determine if evolutionary history affects tolerance to toad toxins. We further broke down this species list to identify birds with endemic or cosmopolitan ranges in order to determine if species with wider ranges show a tolerance to the toad toxin as anecdotal reports suggest.

### **332 Sarver, Ferrell, Mettler, Spellman & Anderson**

Conservation genetics of the American Dipper: the status of a population in severe decline in the Black Hills of Wyoming and South Dakota. SHANE K. SARVER, CAROLYN FERRELL, RAEANN METTLER, GARTH M. SPELLMAN and CYNTHIA ANDERSON, *Center Conserv. Biol. Res., Black Hills State Univ., Spearfish, SD.*

The American Dipper is an aquatic songbird that inhabits mountainous regions of western North America. Dippers are non-migratory and live year-round near fast moving, rocky streams feeding on benthic invertebrates. Degradation of these streams can lead to a decline in the availability of this major food source. For this reason, dippers are considered water quality indicator species. American Dippers were once known to occur in streams throughout the Black Hills, but now number about 50 individuals and reside in a single stream. The recent decline of the American Dipper in the Black Hills of South Dakota is recent and is thought to be due to stream degradation. Here we present the results of a genetic assessment of the Black Hills population of *C. mexicanus*. Samples (either blood or feathers) were collected from dippers in the Black Hills of South Dakota; the Bighorn Mountains of Wyoming and 4 watersheds in Idaho and Montana. Patterns of genetic variation, population differentiation and structure were assessed using 13 microsatellite loci for all sampled populations included in the study.

### **333 Johnson**

Temporal population genetic stability of Peregrine Falcons migrating through Padre Island, Texas. JEFF A. JOHNSON, *The Peregrine Fund & Mus. Zool., Bird Div., Univ. Michigan, Ann Arbor, MI.*

Temporal samples were collected from Peregrine Falcons during both fall and spring migration at Padre Island, TX. Three temporal periods (1985 - 1986, 1988 - 1989, and 2006 - 2007) were analyzed using 11 microsatellite loci. No significant differences in genetic diversity (number of alleles and

heterozygosity) were observed within a migration period or between years, and no significant differences in allele frequencies were identified across temporal periods. Estimates of variance effective population size ( $N_e$ ) were also quite high. Assuming panmixia across breeding territories in North America for migrant Peregrine Falcons, these genetic results indicate that the population is doing well due to extensive efforts to prevent extinction following their precipitous decline in the mid-20th Century.

### **334 Welch, James & Fleischer**

Temporal and spatial variation in the genetic diversity of the endangered Hawaiian Petrel. ANDREANNA J. WELCH, *Smithsonian Inst., Washington, DC, and Behav., Ecol., Evol. & Syst. Prog., Univ. Maryland, College Park, MD*, HELEN F. JAMES and ROBERT C. FLEISCHER, *Smithsonian Inst., Washington, DC*.

The Hawaiian Petrel (*Pterodroma sandwichensis*) is an endemic species that was once extremely abundant in the main Hawaiian Islands. After colonization of the islands by humans approximately 1200 yr ago, and the subsequent introduction of alien mammalian predators, this species declined in population size, and in 1967 it was listed as an endangered species. The exact timing and severity of the decline, however, remain unclear. A genetic analysis was conducted using nuclear and mitochondrial loci from modern, archaeological, and paleontological samples. Genetic diversity was significantly higher in ancient than in modern samples, indicating that the decline in population size has reduced the genetic variability of this species. Additionally, genetic structure was weak, with haplotypes shared among individuals from the adjacent islands of Maui and Hawaii. An understanding of the temporal and spatial dynamics of the genetic diversity of the Hawaiian Petrel will aid in the preservation of this ecologically important endangered species.

### **335 Marvel, Rodriguez & White**

A study of biotic and abiotic factors of Northern Goshawk nest sites in Southern Utah: variables associated with occupancy and nesting. KEELI S. MARVEL, *Dept. Plant & Wildl. Sci., Brigham Young Univ., Provo, UT*, RONALD L. RODRIGUEZ, *U.S. Dept. Agri., Dixie Natl. Forest, Cedar City, UT*, and CLAYTON M. WHITE, *Dept. Plant & Wildl. Sci., Brigham Young Univ.*

The Northern Goshawk has been a species of concern since its decline in the early 1990s, which has been attributed in part to loss of critical breeding and wintering habitat. The goshawk was listed in 1991 as a sensitive species for the Forest Service Intermountain Region, which includes all Utah National Forests. It also holds the status of a Management Indicator Species (MIS) on 4 of the 6 Utah forests. This status requires annual monitoring efforts to track goshawk population trends and to address any activities on the forests that may affect nest site activity. Nest site selection of goshawks has been correlated with forest species composition, forest stand size, diameter of nest tree, percent cover, tree height, site slope, and aspect. Findings show that some territories have been active more overall, and have produced more fledglings than others. Our question is whether specific habitat attributes affect this success, and whether this can be observed over all 3 s. Utah forests in our data set. This information will help forest managers to sustain goshawk populations by identifying sites with characteristics that are correlated with increased goshawk activity, and manage for the enhancement of those characteristics.

### **336 Askins, Folsom & Gentz**

Powerline corridors as habitat for early successional birds. ROBERT A. ASKINS, CORRINE M. FOLSOM and MARGARET C. GENTZ, *Dept. Biol., Connecticut Coll., New London, CT*.

Because of the loss of farmland and the suppression of natural disturbances such as fire and beaver activity, many species of early successional birds have declined in New England. In Connecticut, maintenance of powerline corridors provides habitat for species that require low, woody vegetation. Corridors are maintained by selective removal of trees to create a stable shrub layer below the electrical lines. Fixed-radius point counts of birds along powerlines in se. Connecticut showed that many early successional birds are common on these corridors: Prairie Warblers, Eastern Towhees, Field Sparrows, and Blue-winged Warblers were among the most abundant species. We also found small numbers of Brown Thrashers and Yellow-breasted Chats, both of which are listed as species of conservation concern in Connecticut. We monitored nests of Prairie Warblers on a 1 km stretch of powerline to determine

whether they were reproducing successfully. None of the nests were successful in 2003, and the nest success was 17% (based on the Mayfield method) in 2006. The conditions in both years may have been anomalous, however, with extremely high densities of eastern chipmunks (a nest predator) in 2003 and unusually cool, wet conditions in the early breeding season in 2006. In 2007 we will continue to monitor Prairie Warbler nests, employ active infrared cameras to detect predators at nests, and expand the study to include Field Sparrow nests.

### **337 Reed, Elphick, Zuur & Ieno**

Protection under the U.S. Endangered Species Act increased population sizes of endangered Hawaiian waterbirds. J. MICHAEL REED, *Tufts Univ., Medford, MA*, CHRIS S. ELPHICK, *Univ. Connecticut, Storrs, CT*, A. F. ZUUR and E. N. IENO, *Highlands Statistics, Newburgh, UK*.

Few species protected under the U.S. Endangered Species Act have been delisted because of population recovery, leading to concerns that listing does not necessarily lead to recovery. Population increases, however, should be detectable long before a population achieves full recovery. Here we analyze long-term winter survey data (1956 - 2003) for 3 endangered waterbirds endemic to the Hawaiian Islands, the Hawaiian Moorhen (*Gallinula chloropus sandvicensis*), Hawaiian Coot (*Fulica alai*), and Hawaiian Stilt (*Himantopus mexicanus knudseni*), which were listed as endangered in 1967 - 1970. Time series were initially analyzed by species-island combinations using additive mixed models, with alternative models compared using AIC. Data exhibited simple auto-regressive correlation, and the best model included 2 rainfall smoothers (one for stilts on Oahu and one for both stilts and coots on Maui) and 2 time smoothers (one for stilts on Oahu and Maui, and for moorhen on Oahu and Kauai, and a second for coots on Oahu). No rainfall or temporal trends were apparent for the other species-island time series. Prior to 1970, coots on Oahu exhibited a strong decline; after listing this trend reversed and showed a strong increase until the late 1980s, when the rate of population growth began to slow. Hawaiian Stilts and Hawaiian Moorhens showed strong linear population increases throughout the entire survey period. We suggest that to achieve delisting population size goals more habitat needs to be protected, as well as increased activity restoring protected areas to suitable habitat for these endangered species.

### **338 Prebyl, Gregory, McNew, Wisely & Sandercock**

Greater Prairie-Chicken genetic diversity and structure in a contiguous grassland landscape. T. J. PREBYL, A. J. GREGORY, L. B. McNEW, S. M. WISELY and B. K. SANDERCOCK, *Div. Biol. Kansas State Univ., Manhattan, KS*.

More than 90% of tall grass prairie habitat has been lost. The Flint Hills of Kansas is the last contiguous tract of habitat for such species as the Greater Prairie Chicken (GPC's), which are a grassland indicator species. Understanding population dynamics of GPC's in the Flint Hills will provide important insight into sustainability in an increasingly modified landscape. To examine the genetic health and population structure of Flint Hills GPC's we collected 76 blood samples from 2 populations in the central and southern portions of the Flint Hills of Kansas. We extracted DNA, amplified it with PCR, and genotyped individuals at ten microsatellite loci. We compared genetic diversity and structure of Kansas GPC's to GPC's in fragmented landscapes of Wisconsin and bottlenecked populations in Illinois. The Kansas populations had higher levels of observed ( $H_o$ ) and expected ( $H_e$ ) heterozygosities ( $0.71 \pm 0.06$ ,  $0.67 \pm 0.04$ ) than those of Wisconsin ( $H_e = 0.64$ ) and Illinois ( $H_o = 0.57$ ). Genetic differentiation among populations in Kansas ( $F_{ST} = 0.012 - 0.015$ ) was less than in Wisconsin (0.17 - 0.47) even though populations were closer together in Wisconsin. We found no evidence of a population bottleneck in the recent past, as inferred from a Wilcoxon test for excess heterozygosity in our 2 populations ( $P = 0.50$ ,  $P = 0.57$ ). Our results suggest that the Flint Hills region of Kansas has harbored a genetically healthy and stable population of Greater Prairie Chickens. Demographic studies are ongoing to determine if current populations remain stable. Future population genetic research will investigate genetic structure within a contemporary time frame and at a more localized geographic scale.

### **339 Lansing & Tomback**

Estimating population sizes of the Gray Jay using geographic information systems (GIS) and habitat preferences. JENNIFER M. LANSING and DIANA F. TOMBACK, *Dept. Biol., Univ. Colorado at Denver and Health Sci. Center, Denver, CO*.

We have devised a Geographic Information Systems (GIS) method to estimate wildlife

population sizes. When the species' geographic range, habitat preference, territory size, and social group number per territory are known, a reasonable estimate of population size is possible. We developed and tested this method using a population of Gray Jays within the Fraser Experimental Forest (FEF), Colorado, studied by Tom Nicholls from 1982 - 2005. Using color-banded Gray Jays, we conducted field observations and ground-truthing in the FEF to determine habitat preference and territory size. We learned that Gray Jay habitat use extends beyond spruce-fir forest and into lodgepole pine (*Pinus contorta*) communities. We also quantified the loss of lodgepole pine within territories caused by the recent outbreak of pine beetles. Using this information, we developed a GIS based population estimate and obtained results close to the actual population sizes based on banding data. These results suggest that GIS-based estimates can be potentially useful for monitoring species of concern for which we have adequate information on social systems and habitat use.

#### **340 Aldredge, Miller & Noss**

Breeding territory size and structure in native and partially restored habitats of the Endangered Florida Grasshopper Sparrow. JILL N. ALDREDGE, *Dept. Biol., Univ. Central Florida, Orlando, FL*, PAUL J. MILLER, *Kissimmee Prairie Preserve State Park, Okeechobee, FL*, and REED F. NOSS, *Dept. Biol., Univ. Central Florida*.

The economic defensibility of a territory is expected to balance the energy costs of defending a territory with the benefits of more exclusive access to the resources available. Territories in high quality habitat containing both abundant prey and secure sites for raising young are expected to be smaller than territories lacking sufficient resources. The defense of a breeding territory with adequate resources becomes more critical as the amount of available optimal habitat is reduced. Grassland ecosystems continue to decline rapidly throughout much of North America resulting in the decline of many grassland dependent species. Previous literature states that optimal habitat for the Endangered Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*; FGSP) is composed predominantly of dry prairie. However, FGSP have also been known to defend breeding territories in improved pasture sites. We collected location information for male FGSP defending territories in both dry prairie and improved pasture habitats during the 2003 and 2004 breeding seasons. Territory sizes in improved pasture were found to be slightly larger than those in dry prairie. Habitat structure and dominant plant species also varied considerably between the 2 habitats. These results may provide some guidelines for dry prairie restoration and possible reintroduction and recovery of this imperiled species.

#### **341 Chace & Faccio**

Canada Warbler age structure, site fidelity, territory characteristics, and pairing success in northeastern Vermont. JAMESON F. CHACE, *Dept. Biol., Salve Regina Univ., Newport, RI*, and STEVEN D. FACCIO, *Conserv. Biol. Dept., Vermont Inst. Nat. Sci., Quechee, VT*.

Canada Warbler populations have been in a 30-yr decline and yet little is known about its population ecology. From 2002 - 2006 we studied a population of warblers in the Nulhegan Basin of the Silvio O. Conte Fish and Wildlife Refuge in ne. Vermont. Age structure ranged from 5.6:1 to 1.5:1 (ASY:SY) adults to first year breeding males, and 15 - 30% of territorial males returned to the population each year. We measured the breeding habitat characteristics of 31 territories (21 paired and 10 unpaired with females) and 20 nonuse points near those territories in the same habitat type at 3 locations (2003 - 2004). Canada Warbler male territories had a greater density of large (diameter > 2.5 cm) shrub and sapling stems and a greater percent ground cover of moss than the unoccupied "nonuse" points. During focal periods of observations (n = 737), males sang significantly higher in vegetation than when they exclusively foraged. Density of understory stems was found highly correlated with prey abundance. Pairing success, however, was not related to any of the 25 vegetative characteristics measured on male territories. Females probably choose males on these sites by subtle habitat cues combined with behavioral and morphological characteristics of the males themselves. Indications from pairing success (50%) and return rates (25%) in ne. Vermont are more consistent with population declines stemming from issues on nonbreeding grounds or during migration, rather than on breeding sites. Clearly, more Canada Warbler breeding sites need to be studied.

#### **342 Giovanni, Powell & Schacht**

Gone with the wind: effects of wind speed on bird species detectability. MATTHEW D. GIOVANNI,

LARKIN A. POWELL, *School Nat. Res., Univ. Nebraska-Lincoln, Lincoln, NE*, and WALTER H. SCHACHT, *Dept. Agron. & Hort., Univ. Nebraska-Lincoln*.

Incomplete species detectability in wildlife surveys affects all stages of research, management, and conservation decision making. Detectability is a species-specific metric, but some environmental variables can affect the detectability of multiple species simultaneously. We used information-theoretic methods in program DISTANCE to compare species-specific detectability models for grassland birds in the Nebraska Sandhills. We compared models with observer and environmental covariates, including observation type (visual or auditory), observer, wind speed, topography, and plant community type. Wind speed best explained variability in detection functions for all species analyzed. For example, Western Meadowlark detection probabilities declined from  $p = 0.46$ , with an effective detectability radius of 135 m, at lowest wind speeds (0 - 7 km/hr), to  $p = 0.36$ , with an effective radius of 119 m, at higher wind speeds (8 - 13 km/hr). 65% (1669/2572) of our bird detections were auditory, and high wind speeds created an auditory obstruction for observers. Ornithologists should account for variations in detectability from wind and other auditory impediments such as industrial, biological, or water-related noise.

### **343 Atterberry-Jones, Peer & Jones**

Cooperative breeding in Red-headed Woodpeckers. MEGAN R. ATTERBERRY-JONES, BRIAN D. PEER, *Dept. Biol. Sci., Western Illinois Univ., Macomb, IL*, and JASON D. JONES, *Dept. RPTA, Western Illinois Univ.*

Although Red-headed Woodpeckers are one of the most easily recognizable species of birds, little is known about their social system and breeding behavior due to their monochromatic coloration. In general, Red-headed Woodpeckers are thought to be monogamous breeders and solitary during the non-breeding season. However, several anecdotal observations have noted family groups remain together for lengthy periods of time and several other members of *Melanerpes* are cooperative breeders. We studied the breeding behavior of an extremely dense population of Red-headed Woodpeckers in w. Illinois. Preliminary data collected at this site found that there were many more woodpeckers than nesting territories, which suggests a substantial floater population or that they may be cooperatively breeding. In 2007, we found that Red-headed Woodpeckers do occasionally breed cooperatively and they also have a small floater population. What is so unique about this area that allows it to support such a high density of woodpeckers? The most obvious feature that distinguishes our study site was the large number of telephone poles. Future studies will investigate whether the increased availability of nesting structures in the form of telephone poles is the key feature making this habitat so attractive to woodpeckers.

### **344 Johnson & McDonald**

Insect and bird species diversity in habitat undergoing restoration to tallgrass prairie and an unrestored site. KENDRA D. JOHNSON, *Dept. Environ. Engr., Massachusetts Inst. Tech., Cambridge MA*, and MARA A. McDONALD, *Lab. Genetics, Univ. Wisconsin, Madison, WI*.

We compared the breeding bird and insect species diversities of a site undergoing tallgrass prairie restoration to those of a minimally disturbed control site to evaluate the early stage effects of prairie restoration on species diversity in Madison, WI. Bird Species Diversity, as assessed by Point Census Counts, was significantly greater in the prairie site than control ( $p < 0.05$ ), as was the number of birds per 100 net hours ( $p < 0.001$ ). However, insect species diversities for species larger than 2 mm were comparable for the 2 sites. We hypothesize that although breeding birds depend on insects as a source of nutrition for their nestlings, some other aspect of the restored prairie might influence the numbers and diversity of the birds found there in the early stages of restoration. We have expanded the restored prairie site and will report on our preliminary analyses of the ongoing research.

### **345 Renaud, Desrochers & Cadman**

Area-sensitivity by forest songbirds: what scale to use? CHRISTINE RENAUD, ANDRÉ DESROCHERS, *Centre d'étude de la forêt, Faculté de Foresterie & Géomatique, Université Laval, Québec, QC*, and MIKE CADMAN, *Canadian Wildl. Ser., and Univ. Guelph, Guelph, ON*.

Songbird presence is often associated with surrounding area of habitat. The spatial extent for which this association is maximized may provide critical information on species' "perceptual ranges" and

scales at which they select habitats. We tested the response of forest songbirds to species-specific habitat area measured at 4 scales: local (100, 200 m radius), neighborhood (400, 800 m), landscape (1.6, 3.2, 6.4 km) and regional (12 - 24 km). Land cover was obtained from Landsat-TM images. Songbird occurrence was obtained from the Ontario Forest Bird Monitoring program, i.e., 1147 point counts, each visited over several years between 1987 - 2005. 26 of the 30 species studied were area-sensitive at one or more scales, and each scale yielded significant area-sensitivity for >17 species. In most species, area-sensitivity varied depending on scale, with apparent prevalence of local, neighborhood, landscape and regional factors in 4, 2, 3, and 11 species respectively. Thus, interspecific comparisons of area-sensitivity were strongly dependent on the choice of scale. We conclude that the concept of area-sensitivity applies to a broader set of scales than generally assumed, that local species occurrences are determined primarily by regional habitat availability, and that a broad set of scales should be analyzed before taking conservation decisions based on avian area-sensitivity.

#### **346 Stanback, Mercadante, Jameson, Burke, Ray & Grunwald**

Nest site competition between cavity-nesting birds and wasps. MARK STANBACK, AUSTIN MERCADANTE, REBECCA JAMESON, HOWELL BURKE, GRAHAM RAY and DOUG GRUNWALD, *Dept. Biol., Davidson Coll., Davidson, NC.*

Nest boxes provide sheltered nesting sites for both passerines and paper wasps. Although neither wasps nor birds appear to evict the other once one is fully established, it is unclear which is the dominant competitor at the onset of the breeding season. Using wire mesh, we excluded birds (but not *Polistes* wasps) from every other box along a transect in 2006 and 2007. If wasps dominate Carolina Chickadees and Eastern Bluebirds during the early spring (all have similar nest initiation dates), we would expect wasps to settle in both box types at equal frequencies. However, if birds dominate wasps, we would expect wasp nests to be concentrated in bird-proof boxes. We found wasps in bird-proof boxes significantly more often than expected. Additionally, we found that during the period of nest initiation, birds usurp wasps significantly more often than vice versa.

#### **347 Doster, Kremetz & James**

Winter habitat affinities of two grassland bird species in the lower Mississippi River alluvial valley: Sedge Wren and Le Conte's Sparrow. ROBERT H. DOSTER, DAVID G. KREMENTZ, *Arkansas Coop. Fish & Wildl. Res. Unit, Dept. Biol. Sci., Univ. Arkansas, Fayetteville, AR,* and DOUGLAS A. JAMES, *Dept. Biol. Sci., Univ. Arkansas, Fayetteville, AR.*

Forest restoration activities in the lower Mississippi River alluvial valley (LMAV) have resulted in increasing amounts of early-successional habitats available to wintering grassland birds. Two species of conservation concern occur in these habitats in winter -- Sedge Wren and Le Conte's Sparrow. In Jan and Feb 2002, measures of habitat structure were collected for these species where encountered and compared to randomly-selected habitat samples. We concluded that Sedge Wrens over-wintering in the LMAV preferred uniformity in vegetation height; selected for a balance between plant litter depth and vertical vegetation diversity; and favored a corresponding increase in composition of plant litter and coverage of forbs as ground covers. Sedge Wrens were also likely to occur in areas with grass cover as a significant proportion of the available substrate. Le Conte's Sparrows favored a corresponding increase in grass and plant litter as ground covers; occurred when a parallel increase between forbs and grass were present; and were present when mean vegetation height increased along with an increase in plant litter and forbs. Le Conte's Sparrows were also predicted to occur in sites where vegetation was shorter than the available habitat along with low amounts of bare ground. Our research identifies specific habitat requirements for land managers targeting the needs of wintering Sedge Wrens and Le Conte's Sparrows in the LMAV and elsewhere.

#### **348 McClung & Smith**

The response of avian populations to oak decline in the Ozark Mountains of Arkansas. MAUREEN R. McCLUNG and KIMBERLY G. SMITH, *Dept. Biol. Sci., Univ. Arkansas, Fayetteville, AR.*

In oak-hickory forests of the Arkansas Ozark Mountains, the breeding habitat of Neotropical migratory birds is changing due to oak decline (i.e., the gradual deterioration and death of oak trees). In 1999 and 2001, an outbreak of the red oak borer (*Enaphalodes rufulus* Haldeman) devastated stands of red oak (*Quercus Sect. Lobatae*). Since birds use vegetational structure in habitat selection, changes in

vegetation due to oak decline might have serious implications for diminishing populations of Neotropical migrants. Preliminary results will be presented from point counts conducted in May and Jun 2007, and will be compared with data collected from 1993 through 1999, prior to the outbreak of red oak borers. Canopy-nesting birds are expected to decline and early successional species are expected to increase in diversity and abundance due to the loss of canopy and development of a shrub layer. Understanding the response of bird populations to oak decline is essential for managing breeding habitat for Neotropical migrants in the Ozark Mountains.

**349     vacant**

**350     Rockwell, Marra, Studds, Bocetti, Doran, Ewert & Wunderle**

The effect of winter habitat type and diet on spring arrival times in an endangered species, the Kirtland's Warbler. SARAH M. ROCKWELL, *Univ. Maryland, College Park, MD*, PETER P. MARRA, *Natl. Zool. Park, Washington, DC*, COLIN E. STUDDS, *Univ. Maryland*, CAROL BOCETTI, *Environ. Sci., California Univ. of Pennsylvania, California, PA*, PAT DORAN, DAVE EWERT, *The Nature Conservancy, E. Lansing, MI*, and JOE WUNDERLE, *USDA Forest Service, Palmer, PR*.

Factors that limit populations of migratory birds remain poorly understood. While there is evidence that both summer and winter limitation are important, events within one season may also influence fecundity and/or survival in subsequent seasons. We tested the seasonal interaction hypothesis for an endangered migratory bird, the Kirtland's Warbler. We obtained arrival dates and tissue samples (feathers, claw and blood) for isotope analysis for 100 adult males on their Michigan breeding grounds. Animals assimilate habitat- and diet-specific isotope signatures of moisture (carbon), proportion of insects consumed (nitrogen), and latitude (hydrogen) into their tissues through food webs. Adult males from wet winter habitats arrived earlier on temperate breeding grounds than those from dry habitats. Those with a greater proportion of insects in their late winter diet arrived sooner than those that consumed more fruit. Finally, males wintering at more southerly latitudes tended to arrive earlier, suggesting a leapfrog migration pattern. Our results provide evidence that events on wintering areas are tightly linked with events on breeding areas for the Kirtland's Warbler. Continued research on the wintering ecology of this species, and how winter events affect reproductive success in summer, will be essential for developing management plans.

**351     Sorensen, Hipfner & Norris**

Consequences of pre-breeding diet quality in a dominant marine predator the Rhinoceros Auklet. MARJORIE C. SORENSEN, *Dept. Integrative Biol., Univ. Guelph, ON*, J. MARK HIPFNER, *Centre for Wildl. Ecol., Dept. Biol. Sci., Simon Fraser Univ., Burnaby, BC*, and D. RYAN NORRIS, *Dept. Integrative Biol., Univ. Guelph*.

Our study will examine how winter diet quality carries over to influence the reproductive success of a dominant marine predator, the Rhinoceros Auklet. As with most other Pacific seabirds, Rhinoceros Auklets exhibit extreme variation in reproductive success but virtually nothing is known about diet quality during the pre-breeding period and how this may influence success during breeding. We predicted that the diet quality of adults during the pre-breeding period (as estimated from stable-nitrogen and-carbon isotopes in breast feathers) would be positively related to body condition, length of incubation, and hatching success, and negatively related to nesting date. Rhinoceros Auklet reproduction was monitored between May and mid-Jun on Triangle Island, BC. Results from this study provided a rare opportunity to examine the winter diet of a marine seabird and to test unique predictions regarding carry-over effects using a novel technique. Our findings have significant implications for seabird conservation and management throughout the annual cycle.

**352     Haskell**

A test of Darwin's "manufactory" hypothesis. DAVID G. HASKELL, *Dept. Biol., Univ. of the South, Sewanee, TN*.

Darwin hypothesised that evolutionary trees would show autocorrelation in richness across levels of taxonomic hierarchy. For example, he predicted that speciose genera would contain species that were divided into many sub-species. I tested Darwin's prediction across all bird families. His prediction was supported, particularly within the non-passerines. This finding may indicate vertical continuity of rates of

cladogenesis within lineages through time.

### 353 Pugesek

Fledging mass of offspring of known-aged California Gulls. BRUCE H. PUGESEK, *U.S Geol. Surv., Northern Rocky Mountain Sci. Center, Bozeman, MT.*

California Gulls nesting at Bamforth Lake, WY, are known to live upwards of 30 yr. In this population, fledging success is known to increase and survival decrease with the age of parents. Here I present data on the mass of chicks measured on the 40th day post-hatching of the first egg of 1- and 2-egg nests. The offspring of young parents, 4 - 10 yr old, were significantly lighter than those of old parents, 17 and older, in both clutch size categories. The size of many of the offspring of younger parents did not appear to be sufficient for them to survive emancipation from their parents. Results indicate that simple measures of fledging success, i.e., whether or not offspring survive to the fledging stage, are likely to underestimate differences in age-specific reproductive rate.

### 354 Landeen & Badyaev

Developmental evolution of sexual displays: model and a test of feather growth and pigmentation. ELIZABETH A. LANDEEN and ALEXANDER V. BADYAEV, *Dept. Ecol. Evol. Biol., Univ. Arizona, Tucson, AZ.*

A tremendous diversity of avian color displays has stimulated numerous studies of natural and sexual selection. Yet, the developmental mechanisms that produce such diversification, and thus the proximate targets of selection pressures, are poorly understood. In particular, because feathers are colored during growth, feather growth dynamics play a deterministic role in ornament variation. However, no study to date has addressed the contribution of feather growth to the expression of carotenoid-based ornamentation. Here we examine the developmental basis of variation in ornamental feather shapes in male house finches – a species in which overall carotenoid displays are under strong natural and sexual selection. First, we use geometric morphometrics to partition the observed variation in fully grown feathers among populations, ages, degrees of elaboration, ornamental body parts, and individuals. Second, we use biologically informed mathematical model of feather growth to predict variation in ornamental feather shape due to simulated growth rate, angle of helical growth of feather barbs, initial barb ridge number, new barb addition rate, barb diameter, and ramus expansion angle. We find a close association of feather growth dynamics and overall ornamentation and identify the proximate targets of selection for elaboration of sexual displays. Further, the close developmental association of feather growth and pigmentation not only can reinforce condition-dependence in color displays, but can also enable phenotypic and genetic accommodation of novel pigments into the evolutionary diversification of color displays.

### 355 Moser, Klicka & Spellman

Phylogeography of the Bushtit. JESS MOSER, *Biol. Dept., Black Hills State Univ., Spearfish, SD*, JOHN KLICKA, *Barrick Mus., Univ. Nevada, Las Vegas, NV*, and GARTH M. SPELLMAN, *Biol. Dept., Black Hills State Univ.*

The Bushtit (Aegithalidae: *Psaltriparus minimus*) is a year round resident of mixed deciduous and coniferous montane chaparral habitats in western North America. They range as far north as Vancouver to as far south as Mexico and Guatemala. Historically, the Bushtit has been classified into 3 distinct subspecies groups: the *minimus* group, residing in the Pacific coastal regions, the *plumbeus* group, residing in the Great Basin and southern Rocky Mountains, and the *melanotis* group, residing south of the Mexico-American border and into Guatemala. Although these groups are geographically isolated throughout most their range, there exist zones of secondary contact between contiguous populations in California, Texas and n. Mexico. It is because of these contact zones that the 3 distinct subspecies groups have been maintained as a single morphologically diverse species. Using a multi-locus phylogeographic approach, we are reconstructing the evolutionary history of the Bushtit to explore the evidence for genetic distinction among the 3 subspecies groups. Preliminary results from mitochondrial DNA sequences show evidence of the *minimus* group forming a monophyletic clade while the *plumbeus* and *melanotis* groups are paraphyletic with respect to each other. This is contrary to traditional taxonomy which states that the *minimus* and *plumbeus* groups are more closely related.

### 356 Sturge, Jacobsen, Rosensteel, Neale & Omland

Completing the oriole phylogeny with the Orange-crowned Oriole (*Icterus auricapillus*): colonization of South America from Caribbean Islands. RACHEL J. STURGE, FRODE JACOBSEN, BRYAN B. ROSENSTEEL, RICHIE J. NEALE and KEVIN E. OMLAND, *Dept. Biol. Sci., Univ. Maryland-Baltimore Co., Baltimore MD.*

There are roughly 29 species recognized in the New World Oriole genus (*Icterus*). The phylogeny proposed by Omland et al. (*Mol. Phyl. Evol.* 1999 12: 224-239) was constructed using 2 mitochondrial genes, cytochrome b and ND2, and shows that 43 of the recognized species and subspecies are divided into 3 clades, A, B and C, with strong support for each clade. However, one species, *I. auricapillus*, was missing from the 1999 phylogeny due to a lack of fresh tissue, and only one of the 2 genes had been sequenced for another well-differentiated subspecies, *I. dominicensis dominicensis*. To complete the phylogeny, we sequenced both cyt b and ND2 for both of the above orioles. We imported these results into PAUP and GARLI and ran parsimony and maximum likelihood analyses. We found strong agreement between the PAUP equally-weighted parsimony search (method used in 1999) and the GARLI maximum likelihood search (a more complex model-based method). We found that both these orioles fit into Clade A. This placement has important implications for biogeography as it gives evidence that Clade A orioles colonized mainland South America from the Caribbean. Most models of biogeography assume the opposite, with mainland species colonizing islands, followed by speciation.

### 357 Mettler & Spellman

Molecular analysis of Black-headed Grosbeak and Rose-breasted Grosbeak hybridization in the Great Plains. RAEANN D. METTLER and GARTH M. SPELLMAN, *Biol. Dept., Black Hills State Univ., Spearfish, SD.*

Black-headed Grosbeaks (*Pheucticus melanocephalus*) and Rose-breasted Grosbeaks (*P. leudovicianus*) are passerine birds known to hybridize in the Great Plains - Rocky Mountain suture zone of North America. Past work on avian hybrid zones within this suture zone credits exogenous factors for the generation and maintenance of hybrid zones, but little is known about the endogenous factors acting within these zones. The objective of this study is to genetically characterize the zone of hybridization using modern genomic techniques to determine if postzygotic reproductive isolating mechanisms are acting within the grosbeak hybrid zone. Grosbeak specimens collected from across the Great Plains hybrid zone will be genotyped using 10 polymorphic microsatellite loci and a diagnostic mitochondrial DNA marker. The impact of postzygotic isolation will be tested by exploring and contrasting patterns of genetic differentiation and gene flow across the Grosbeak hybrid zone. Haldane's Rule, which predicts avian female hybrids to have lower fitness compared to male hybrids, will be tested by contrasting patterns of gene flow between maternally inherited mtDNA and bi-parentally inherited microsatellite loci. Nuclear DNA will also be used to assess linkage across the hybrid zone. Linkage disequilibrium in hybrids is predicted to decay with increased backcrossed generations, and elevated levels of linkage disequilibrium in the hybrid zone may indicate a preponderance of F1 hybrids.

### 358 Kwong, Lee & Choe

The effects of wind on the orientation and morphological characteristics of the nests of Korean Black-billed Magpies. EUNBI KWON, SANG-IM LEE and JAE CHUN CHOE, *Dept. Ecoscience, Ewha Women's Univ., Seoul, Korea.*

In species like magpies who build their nests in tall trees, strong wind can decrease the temperature inside of the nest and can also topple nests from trees. Birds may adopt 2 different strategies in order to reduce the influence of strong wind. Nest can be woven tightly so wind does not pass through the nest wall, or the nest can be shaped and streamlined to reduce the risk of falling, although a solution to one problem may exacerbate the other. We measured morphological characteristics from 58 nests in Daejeon (n = 31) and Seoul (n = 27), where wind directions and velocities differ. In Daejeon where the wind is stronger on average, more nests were streamlined to the direction of the strongest wind and the nest walls were thicker than the nests in Seoul. However, the ratio between longest and shortest axes did not significantly differ between sites, and was not related with nest height. Brood size was positively related with the nest volume in Daejeon. Our results imply

that magpies concern more of maintaining the temperature in the nest, by adjusting the thickness of the nest walls, than structural stability.

### **359 Kiere, Cronin, Omland, Hofmann & Price**

Reconstructing evolution of cacique carotenoid color. LYNNA M. KIERS, THOMAS W. CRONIN, KEVIN E. OMLAND, *Dept. Biol. Sci., Univ. Maryland-Baltimore Co., Baltimore, MD*, CHRISTOPHER M. HOFMANN, *Dept. Biol., Univ. Maryland, College Park, MD*, and J. JORDAN PRICE, *Dept. Biol., St. Mary's Coll. of Maryland, St. Mary's City, MD*.

The caciques (*Cacicus*, *Psarocolius*, and *Ocyalus*), a clade of Central and South American blackbirds, are a useful group in which to study carotenoid color evolution. Nearly all caciques have black body feathers with distinct carotenoid plumage patches. These carotenoid patches appear to divide caciques into 2 distinct types -- those with yellow plumage and those with red. Interestingly, there are no orange intermediates. Quantitative color data from reflectance spectrometry support this observation, with the spectral location of "red" and "yellow" taxa separated by over 5 standard errors. The lack of intermediate colors and the gap in spectral location between the "red" and "yellow" groups suggest that carotenoid color has evolved discretely in caciques rather than as a continuous character. Ancestral state reconstructions using a molecular phylogeny suggest a yellow ancestor, with 2 independent changes to red and one loss of carotenoid coloration (similar results were obtained using parsimony and maximum likelihood methods). This discrete pattern in caciques differs from carotenoid evolution in the closely related New World orioles (*Icterus*), which vary continuously from yellow, through multiple orange intermediates, to scarlet. This contrast suggests possible differences in the mechanisms of carotenoid plumage color in each group and emphasizes the importance of considering discrete or continuous evolution in ancestral state reconstruction.

### **360 Arnaiz-Villena, Zamora, Moscoso, Serrano-Vela & Ruiz del Valle**

*Rhodopechys obsoleta* (desert finch): a pale ancestor of greenfinches according to molecular phylogeny. ANTONIO ARNAIZ-VILLENA, JORGE ZAMORA, JUAN MOSCOSO, JUAN IGNACIO SERRANO-VELA and VALENTIN RUIZ DEL VALLE, *Dept. Immun. Med., and Madrid Regional Blood Center, Universidad Complutense, Madrid, Spain*.

The evolutionary history of 3 out of 4 birds traditionally classified into the genus *Rhodopechys* has been studied by comparing their mitochondrial cytochrome b DNA sequence with that of greenfinches and other genus *Carduelinae* finches. The desert finch (*Rhodopechys obsoleta*) or a sister extinct species seems to have existed about 6 million years ago in Asian and perhaps African desert-like areas. This bird has no molecular relationship with other *Rhodopechys* birds and seems to have given rise to the greenfinches radiation (*Carduelis chloris*, *ambigua*, *sinica*, *spinoides*), probably by allopatry of marginal or isolated groups; the latter would have evolved to green plumage colours and more simple song modulations (i.e., greenfinches). The possible role of assortative mating and the newly postulated acquired phenotypic characters in greenfinches speciation are discussed.

### **361 Marks**

Comparative phylogeography of three Afrotropical passerines. BEN D. MARKS, *Mus. Nat. Sci., Louisiana State Univ., Baton Rouge, LA*.

Much of the recent literature focused on diversification in the tropics has identified montane or ecotonal habitats as the primary areas for diversification. The idea that the majority of recent diversification has taken place outside of lowland forests (i.e., mountains, ecotonal areas) has gained much support, however detailed analyses of genetic diversity in widespread lowland taxa are still few and far between. This is an important information gap because many lowland taxa are morphologically homogeneous across their ranges. This morphological homogeneity, acting as a proxy for intraspecific diversity, has obscured the recognition of existing genetic diversity. At least one Afrotropical lowland forest bird species investigated to date, *Bleda syndactyla*, shows high levels of genetic diversity in the absence of discreet morphological breaks. Here I compare patterns of molecular and morphological differentiation in 3 widespread and co-distributed African rainforest birds; *Bleda syndactyla*, *Hylia prasina*, and *Andropadus latirostris*. Coalescent, population genetic, phylogeographic, and supertree analyses are used to compare phylogeographic patterns in these 3 taxa.

### **362 DenUyl, Lombardo & Thorpe**

Sperm production in birds: a re-evaluation of avian semen quality indices. JODI L. DenUYL, MICHAEL P. LOMBARDO and PATRICK A. THORPE, *Dept. Biol., Grand Valley State Univ., Allendale, MI.*

Across a wide variety of bird species, larger testes and high sperm production are associated with increased levels of sperm competition. As a result, avian testes size and ejaculate quality data sets are frequently used as reliable indices of sperm competition intensity. However, accurate measures of avian testes size and ejaculate quality are difficult to obtain and imprecise measurements have been used in comparative studies. We reexamined the assumption that relatively large testes size correlates with increased sperm production using an updated data set that met more stringent standards for inclusion. Our preliminary results suggest that ejaculate volume and number of sperm per ejaculate do not correlate with testes size. Additionally, sperm concentration appears to be negatively correlated with residual testes mass. These results are not consistent with previous findings and suggest that testes size may not be a reliable measure of sperm production in birds.

### **363 Billerman & Huber**

Gene flow between North American and South American breeding populations of Barn Swallows. SHAWN M. BILLERMAN, *Lab. Ornithol., Cornell, Univ., Ithaca, NY,* and GERNOT H. HUBER, *Dept. Ecol. & Evol. Biol., Cornell Univ.*

In 1980, 6 pairs of Barn Swallows were discovered breeding in Argentina within the species' historic wintering range. Since that time, the breeding population has increased dramatically, and today thousands of pairs breed annually in Argentina. This Southern Hemisphere breeding location represents a drastic change in breeding range from the historical Northern Hemisphere breeding distribution. This study set out to determine the genetic context in which this colonization event has taken place. 8 microsatellite markers are being examined to look for evidence of a founder effect in the Argentine breeding population. To provide a genetic context for the establishment and divergence of this population, we also analyze North American breeding populations and Argentine wintering birds. The Argentine breeders appear to have reduced their migratory distance and have undergone some morphological changes and possibly changes in molt timing. Our molecular analysis will provide the genetic context in which these changes are occurring, providing information on the plasticity of breeding, migratory, and molt behavior in Barn Swallows.

### **364 McKay**

Yellow-throated Warbler phylogeography. BAILEY D. MCKAY, *Dept. Biol. Sci., Auburn Univ., Auburn, AL.*

I examined the phylogeography of the Yellow-throated Warbler to determine whether its 3 continental subspecies are the product of Pleistocene (or earlier) diversification or whether the morphological, ecological, and migration differences between subspecies evolved earlier. Of particular interest was if and how this species fit into a comparative phylogeographical pattern that is emerging in the se. U.S. To this end, I analyzed control region sequences of 118 Yellow-throated Warblers from 10 populations from across its range. Considerable variation was uncovered, but most of this variation was found within rather than between populations or subspecies. A shallow phylogenetic tree, star-like haplotype network, and unimodal mismatch distribution all suggested a recent expansion. Coalescent modeling indicated this expansion was from a single common ancestral population indicating that the current morphological, ecological, and migration differences between subspecies are the result of rapid evolution. These results are useful for advancing our knowledge of comparative phylogeography in the se. U.S. and for defining taxonomic groups for conservation in the Yellow-throated Warbler.

### **365 Chase, Holmes, Gardali, Ballard, Geupel, Nur & Porzig**

Two decades of change in a coastal scrub community: songbird responses to plant succession. MARY K. CHASE, AARON L HOLMES, THOMAS GARDALI, GRANT BALLARD, GEOFFREY R. GEUPEL, NADAV NUR and ELIZABETH L PORZIG, *Point Reyes Bird Observ. Conserv. Sci., Petaluma, CA.*

Bird responses to plant succession in n. California coastal scrub were studied intensively for 22 yr at the Palomarin Field Station of PRBO Conservation Science, coastal Marin Co., California. Our objectives were to (1) describe plant succession in coastal scrub over 22 yr, (2) evaluate changes in bird species richness and community assemblage, and (3) evaluate evidence for population responses to

plant succession in 3 coastal scrub resident birds (Wrentit, Song Sparrow, White-crowned Sparrow). We report significant increases in overall shrub diversity as well as increases in both height and percent cover of Douglas-Fir (*Psuedotsuga menziesii*). Changes in the avian community include declines of some early successional-associated bird species and the increase of some forest-associated species. We also report significant increases in Wrentit territory density and decreases in White-crowned Sparrow density. Territory density of Song Sparrows did not change significantly with habitat succession, but is positively correlated with annual rainfall in the previous year.

### **366 Budd & Kremenz**

Habitat selection by Least Bitterns in the Delta Region of Arkansas. MICHAEL J. BUDD and DAVID G. KREMENTZ, *USGS, Arkansas Coop. Fish & Wildl. Res. Unit, Univ. Arkansas, Fayetteville, AR.*

We conducted Least Bittern surveys in the Lower Mississippi Alluvial Valley of Arkansas during Apr - Jun 2006 to determine habitat selection. We surveyed 76 sites 9 times following the National Marsh Bird Monitoring Protocol. Surveys were repeated to assess detection probability allowing for a more accurate assessment of habitat selection. Using AIC model selection we found that Least Bitterns select for areas with emergent vegetation and low forest area adjacent to the wetland. The next model, which was not separated by more than 2 AIC units, included the rank amount of woody vegetation. Using summed model weights, the amount of emergent vegetation and amount of forest adjacent to the wetland showed strong support with respect to influencing site occupancy. Based on our results we encourage managing wetlands for increasing amounts of emergent vegetation, such as cattails (*Typha* spp.) and rushes (*Juncus* spp.). Wetlands managed for Least Bitterns should also have less than 50% forest coverage within 400 m.

### **367 Malone & Emerick**

Using bird indices of biological integrity to assess habitat quality in southern Rocky Mountain riparian ecosystems. DELIA G. MALONE, *Roaring Fork Stream Health Initiative, Redstone, CO*, and JOHN C. EMERICK, *Div. Environ. Sci. & Engineer., Colorado School of Mines, Golden, CO.*

Breeding bird surveys were conducted as part of a stream and riparian habitat assessment in the Roaring Fork Watershed on the Western Slope of the Southern Rocky Mountains in Central Colorado. Assessments were conducted on the Roaring Fork River from the headwaters to the confluence with the Colorado River and on at-risk tributaries. Assessment measures included quantifying in-stream physical and riparian habitat quality using established protocols and collecting information on community assemblages of biological indicators including birds. Results indicate that changes in stream and riparian habitat quality are correlated with changes in the assemblage of breeding birds. During recent years there has been interest in using birds as indicators of habitat condition particularly in riparian areas. Recent studies have developed Bird Indices of Biotic Integrity to assess human impacts on the quality of riparian habitat. We wanted to look broadly at the condition of riparian-stream ecosystems in the watershed and also wanted to assess the value of bird Indices of Biotic Integrity (IBI) to provide information with regard to habitat quality in the Southern Rocky Mountains. Gradient analysis methods were used to assess bird community composition and its relationship to riparian habitat quality and human disturbance related factors. We found bird community assemblage to be a valuable tool in assessing riparian quality. However, our results also indicate that to be reliable, a bird IBI should be tailored to regional differences in bird community responses to disturbance and habitat use.

### **368 Emerson & Cavitt**

The effects of succession on American Avocet and Black-necked Stilt nest site selection at Great Salt Lake, Utah. RICHARD EMERSON, *Utah Geological Survey, Salt Lake City, UT*, and JOHN F. CAVITT, *Dept. Zool., Weber St. Univ., Ogden, UT.*

The Great Salt Lake (GSL) ecosystem is one of the most important inland shorebird sites in North America. This system contains the largest breeding assemblage in the western U.S. of American Avocets and Black-necked Stilts. Because of the shallow gradient in the lake bottom, relatively small changes in lake level can either inundate or expose large areas of shoreline. This dynamic nature results in multiple successions and can affect shorebird utilization. We examined the change in nesting patterns and nest-site selection of American Avocets and Black-necked Stilts following a GSL flooding event which set back succession in a freshwater wetland. Our results indicate that nest sites followed the

successional changes in vegetation and moved an average of 200 m from 2003 to 2006. In addition, nearest neighbor distance declined from an average of 17 m to 13m over the study as colony breeding density increased over the 3-yr study.

### **369 Howie & Cristol**

The infiltration of aquatic mercury into the terrestrial ecosystem. MIKAELA G. HOWIE and DANIEL A. CRISTOL, *Dept. Biol., Coll. William & Mary, Williamsburg, VA.*

Most mercury contamination studies and health advisories have been focused on the cycling of mercury through the aquatic ecosystem and specifically the consumption of contaminated fish. Few studies have focused on the transport of mercury through the terrestrial ecosystem. The main objective of this study is to predict the variation in exposure risk for terrestrial songbirds in the context of the following parameters: 1) foraging distance from the river (contamination source), 2) size of prey, and 3) the specific carbon and nitrogen stable isotope signature of the prey. Anticipated results for this project are that mercury exposure does remain a threat throughout the floodplain and may be transported outside the floodplain to higher order vertebrates. The analysis of collected prey items will provide insight as to what types of prey accumulate higher loads of mercury in relation to their size and specific isotopic signature. Furthermore, future work will determine whether spider prey feed on aquatic or terrestrial prey by examining their isotopic signatures. This project will be one of the first studies to predict how far the risk of mercury exposure extends into the riparian ecosystem of a contaminated river. The results of this project can be used in performing risk assessments for aquatic mercury contaminated sites worldwide.

### **370 Smith & Hatch**

Habitat use by spring migrating landbirds in northeastern Pennsylvania. ROBERT SMITH, *Dept. Biol., Univ. Scranton, Scranton, PA,* and MARGRET HATCH, *Penn State Worthington Scranton, Dunmore, PA.*

Long-term data sets reveal population declines in many populations of landbird migrants, with declines especially evident in shrub-nesting species. Moreover, transitional shrub/scrub habitats are becoming scarce, reducing breeding habitat for these species. Because migrants often occupy habitats en route that are similar to the breeding season, the persistence of shrub-scrub habitats may be critical for these species during passage. We know little about migrant-habitat relations, especially with respect to habitat use at inland, non-forested stopover sites. The purpose of this study was to assess the importance of forested and upland shrub/scrub habitat to spring migrating landbirds by understanding 1) spatial (forested vs. shrub/scrub) and temporal variation in resource abundance and 2) migrant use of forested vs. shrub/scrub habitat during stopover. We collected data on bird-habitat relations (via mist netting and transect census) and invertebrate abundance simultaneously from both habitats at 2 sites in or nearby Lackawanna State Park, Lackawanna Co., Pennsylvania. We captured and counted more short-distance and long-distance migrants in shrub/scrub than forested habitat, and trapped more flying arthropods in shrub/scrub also. Our sampling indicated no difference between habitats for resident birds or nonflying arthropods. Shrub/scrub habitats appear to be important to spring migrating landbirds.

### **371 Carey & Smith**

Effect of spring temperature on the arrival timing of a short distance migrant, the Field Sparrow, at breeding grounds in northeastern Pennsylvania. MICHAEL CAREY and ROBERT SMITH, *Dept. Biol., Univ. Scranton, Scranton, PA.*

Given global warming, the effect of temperature on the arrival of spring migrants at their breeding grounds is an area of growing interest. Most studies have focused on the arrival of long distance migrants, finding earlier arrival dates corresponding with increasing temperature. Field Sparrows are short distance migrants, spending both winter and summer in eastern North America. In ne. Pennsylvania, from 1987 - 2006, mean male arrival date was 24 Apr (mean earliest male arrival = 9 Apr); mean female arrival was 7 May (mean earliest female 23 Apr). There was no significant trend toward earlier arrival through the interval, nor was there a trend toward increasing mean local Apr temperature. Annual variation in Field Sparrow arrival timing was unrelated to annual variation in Apr mean, maximum or minimum temperatures, nor did arrival relate to mean temperatures in the 1-wk or 2-wk intervals preceding mean arrival date. Apparently some factor other than temperature is the primary factor governing the timing of spring migration in this short distance migrant.

### 372 Buchanan & Rodewald

Habitat selection, movements, and stopover duration of migratory landbirds in the western Lake Erie Basin of northern Ohio. ASHLEY A. BUCHANAN and PAUL G. RODEWALD, *School Environ. & Nat. Res., Ohio State Univ., Columbus, OH.*

Migration is likely a critical period for many Nearctic-Neotropical landbird migrants. Nonetheless, few studies have investigated migrant ecology during stopover and especially movement behavior and habitat selection. Our research uses radio telemetry to quantify migrant movements within and among habitat patches and stopover duration. Our study was conducted in the Western Lake Erie Basin in nw. Ohio, an agriculturally dominated landscape with high concentrations of spring migrants. From 20 Apr to 1 Jun in 2006, we continuously tracked 18 Red-eyed Vireos and 20 Yellow-rumped Warblers; similar numbers were sampled in 2007. We measured local (within patch) and landscape level habitat characteristics to determine how these are associated with stopover behavior. Individuals of both species exhibited diverse patterns of stopover behavior. Many migrants moved widely among forest patches during stopover (e.g., one Yellow-rumped Warbler moved >7 km over an 11-hr period). Mean stopover duration for Yellow-rumped Warblers was 7 d, with 2 birds staying at least 13 d. In contrast, mean stopover duration for Red-eyed Vireos was 1.5 d, with one bird remaining at least 4 d. Our results should be valuable for the restoration and management of stopover habitats in the Great Lakes and other regions where geographical barriers to migration result in high concentrations of landbird migrants.

### 373 Ludwick, Fedynich, Perrigo & Schwertner

Urban breeding and nest site selection of the Inca Dove in south Texas. TIMOTHY J. LUDWICK, ALAN M. FEDYNICH, *Caesar Kleberg Wildl. Res. Inst., Texas A&M Univ.-Kingsville, Kingsville, TX*, GLENN H. PERRIGO, *Dept. Biol., Texas A&M Univ.-Kingsville*, and T. WAYNE SCHWERTNER, *Texas Parks & Wildl. Dept., Mason, TX.*

Inca Doves are a common resident throughout most of Texas. Originally a species of arid areas, the Inca Dove appears to be adapting well to the urban environment. As part of a larger multi-species study, we examined the nesting ecology of the Inca Dove in s. Texas. Breeding activity as evidenced by courtship displays was first noted in mid-Mar. The first nest was located on 13 Apr. The peak in nesting activity occurred from late May through mid-Jun. Inca Dove nests were found in 14 species of trees, but occurred most frequently in hackberry (*Celtis occidentalis*) and honey mesquite (*Prosopis glandulosa*) trees, neither of which were used in a significantly different proportion than their availability. We monitored 63 nests during the field season and 34 were successful (54%). The doves averaged 1.05 fledglings per pair over the entire study area. Inca Doves nest in small trees low to the ground, however, they use the larger branches in the tree. Our data seem to indicate that Inca Doves in s. Texas are breeding in patterns similar to those observed elsewhere.

### 374 Wright & Steadman

Flight muscle sizes of columbids and rails. NATALIE A. WRIGHT, *Dept. Zool., Univ. Florida, Gainesville, FL*, and DAVID W. STEADMAN, *Florida Mus. Nat. Hist., Gainesville, FL.*

Trends in the sizes of major flight muscles relative to body size (the ratio of the mass of pectoralis major and supracoracoideus to total body mass) were examined for both insular and continental species of Rallidae and Columbidae. Rails were shown to have significantly smaller flight muscles relative to body mass than pigeons and doves, supporting earlier work showing the flight muscles of columbids to be relatively twice as large as in volant rails (Hartman 1961, **Smithsonian Misc. Coll.** 143: 1-91). Within both families, island species have significantly smaller pectoralis major and supracoracoideus muscles than their continental relatives. Among columbids, intraspecific differences in relative flight muscle size are evident between populations on different islands, with populations from smaller or more remote islands having relatively smaller flight muscles. Unexpectedly, the flight muscle to body mass ratio is not correlated with wing length in either family.

### 375 Schroeder, Tuhela & Burt

Quantifying the concentration of oligopeptides released from feathers during in vitro degradation by *Bacillus licheniformis*. MAX. R. SCHROEDER, LAURA TUHELA, *Dept. Bot. & Microbiol., Ohio Wesleyan Univ., Delaware, OH*, and EDWARD. H. BURTT, Jr., *Dept. Zool., Ohio Wesleyan Univ.*

Keratinase produced by feather-degrading bacilli breaks the b-keratin of feathers into

oligopeptides. As the bacteria degrade the feathers more completely, oligopeptides accumulate in the medium. To quantitatively assess the feather-degrading ability of a microbe, the concentration of accumulated oligopeptides can be measured. Previously, oligopeptide concentrations were measured by obtaining the absorbance at 230 nm (Goldstein et al. 2004, **Auk** 121: 656-659). While effective, the 230 nm method of protein determination requires taking a single measurement for each sample. In this work, we used a commercially available bicinchoninic acid (BCA) protein assay kit that colorimetrically detects proteins to determine if the BCA method was comparable to the 230 nm method. The BCA method allows up to 96 samples to be analyzed at once using a microtiter plate. Both methods were used to analyze oligopeptide concentrations in uninoculated control flasks of feather medium and flasks of feather medium inoculated with *B. licheniformis* that were incubated for five days at 37°C. The two methods produced comparable results; on day 5 the BCA and 230 nm methods were used to determine that the average protein concentration of the inoculated samples that resulted in  $125 \pm 20 \mu\text{g/mL}$  and  $122 \pm 18 \mu\text{g/mL}$ , respectively. This suggests that in vitro feather-degradation can be quantitatively assessed by either method.

### **376 Dubina & Peer**

Egg destruction behavior in Brown-headed Cowbirds. KERIANN M. DUBINA and BRIAN D. PEER, *Dept. Biol. Sci., Western Illinois Univ., Macomb, IL.*

Obligate brood parasites may destroy the contents of host nests if they locate the nests too late to successfully parasitize them. This "farming" behavior forces the hosts to re-nest, giving the brood parasites another opportunity at parasitism. While the function of the behavior is clear, there is controversy as to how frequently parasites such as the Brown-headed Cowbird practice this behavior. It is also unknown whether males engage in this behavior. In this experiment, we tested whether female and male cowbirds regularly destroy nest contents by placing cowbirds in experimental cages that contained nests and plaster eggs. We discuss the results and their implications for brood parasite-host coevolution.

### **377 Sullivan**

Women in ornithology: who is leading the flock? KIMBERLY A. SULLIVAN, *Dept. Biology, Utah State Univ., Logan, UT.*

Since the 1970s the number of women receiving advanced degrees in the life sciences has dramatically increased. Women currently represent 50% of the student members of the AOU, COS and WOS. Across the life sciences women have been less successful than men in transitioning into permanent professional positions, receiving tenure and promotion to full professor and assuming academic leadership positions. I examined annual reports of the AOU, COS and WOS from 1974 to 2006 to identify female recipients of student research awards, student presentation awards, service awards and lifetime achievement awards, female elective members and fellows of the AOU, female members of boards and councils and female officers and editors. I then compared the frequency of women in each category to their frequency as student or regular members and examined trends over time. Preliminary analyses indicate women are well represented among recipients of student awards and as members of boards and councils. Women are less likely to receive lifetime achievement awards or become journal editor or society president than expected based on their frequency of membership or representation among the elective members and fellows of the AOU. Patterns over time across these 3 ornithological societies will be discussed.

### **378 Peele, Burt & Greenberg**

The effect of salt concentrations on microorganisms in the plumage of Coastal Plains Swamp Sparrow, Seaside Sparrow, and Saltmarsh Sharp-tailed Sparrows. ASHLEY M. PEELE, EDWARD H. BURTT, Jr., *Dept. Zool., Ohio Wesleyan Univ., Delaware, OH,* and RUSSELL GREENBERG, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC.*

Swamp Sparrows, *Melospiza g. georgiana*, that breed in freshwater marshes and bogs have lighter plumage than the Coastal Plain Swamp Sparrow *Melospiza g. nigrescens* that breeds in coastal salt marshes (Greenberg & Droege 1990, **Condor** 92:393-404). The feather-degrading bacterium, *Bacillus licheniformis*, shows much higher occurrence and abundance in the Coastal Plain Swamp

Sparrow (Peele et. al 2007, ###). Burt & Ichida (2004, *Auk* 121:652-655) found higher levels of feather-degrading bacilli in the plumage of *M. melodia morphna*, a dark subspecies of western Song Sparrow, than the pale subspecies, *M. m. fallax*. In the case of Song Sparrows, the relationship was consistent with Gloger's rule. The subspecies in warm, humid climates exhibited darker plumage and higher bacterial abundance, than those in cooler, arid climates. The coastal marsh habitat of *M. g. nigrescens* has similar humidity levels to the inland peat bog habitat of *M. g. georgiana*, thus salinity represents the major difference between the 2 habitats. *B. licheniformis* is a highly salt tolerant bacterium, which may account for its high occurrence and abundance in the darker Swamp Sparrow's plumage. We tested this hypothesis by sampling the darker, Coastal Plains Swamp Sparrow where a freshwater stream flows into coastal saltmarsh, creating a gradient of salinity concentration. Seaside (*Ammodramus maritimus*) and Saltmarsh Sharp-tailed Sparrows (*A. caudacutus*) were included in our sampling, due to their habitat overlap with Coastal Plains Swamp Sparrows. We report on the correlation found between varying concentrations of salinity and the occurrence of feather-degrading bacteria in these saltmarsh nesting species.

### **379 Williams, Owen, Moore & Garvin**

Changes in immunocompetence of the Gray Catbird during an experimental West Nile virus infection. AMANDA JO WILLIAMS, JENNIFER C. OWEN, FRANK R. MOORE, *Dept. Biol. Sci., Univ. Southern Mississippi, Hattiesburg, MS*, and MARY GARVIN, *Dept. Biol., Oberlin College, Oberlin, OH*.

Bacterial and fungal infections are attacked primarily by the innate immune system, while the energetically more expensive acquired immune system is principally responsible for responding to viruses. The up-regulation of the acquired immune system of birds infected with a viral pathogen may cause an energetic trade-off resulting in a reduction in innate immune function. We experimentally infected 11 hatching-year male Gray Catbirds with West Nile virus and measured the activity of their immune systems before, during, and after infection. 8 uninfected conspecifics were used as controls for seasonal and steroid hormone-related variation in immunocompetence. Innate immunity was quantified using a microbicidal assay, which correlates immunocompetence with the ability of a bird's blood to kill a panel of microbes (*Staphylococcus aureus*, *Candida albicans*, and 2 strains of *Escherichia coli*). Acquired immunity was measured as the virus clearance rate for each bird. We predict that a shift in resources away from innate immunity in the West Nile-challenged birds will result in infected birds having lower bacterial and fungal-killing rates compared to uninfected conspecifics. Similarly, within the infected birds, those with higher virus clearance rates are predicted to have lower bacterial and fungal-killing abilities. These results will be discussed in the context of understanding the potential impact of secondary infections on birds infected with West Nile virus.

### **380 Sheppard, VandenBerge, Able & McCleery**

Live O.W.L. demo -- Ornithological Worldwide Literature. JAY M. SHEPPARD, *Laurel, MD*, JAMES C. VANDEN BERGE, *Naperville, IL*, KENNETH P. ABLE, *McArthur, CA*, and ROBIN MCCLEERY, *Edward Grey Inst. Field Ornithol., Oxford, UK*.

Stop at poster display and do a live, on-line search of the FREE Ornithological Worldwide Literature (OWL) database! The capabilities and important features of this indexed, bibliographic service will be demonstrated with actual live searches of the database tailored to those then in attendance at the poster session. OWL is an indexed bibliography of >75,000 citations that pertain to ornithology and come from the periodic, worldwide scientific literature over the past 25 yr ([www.birdlit.org/owl](http://www.birdlit.org/owl)). In the 21st Century, published scientific information that cannot be readily found at a later date by others becomes lost information. OWL is a project operated by a cadre of volunteer abstractors and editors around the globe and supported by the AOU, BOU, and Bird Australia.

### **381 Swiston & Mennill**

A comparison of manual and automated methods for identifying target sounds within audio recordings. KYLE A. SWISTON and DANIEL J. MENNILL, *Dept. Biol., Univ. Windsor, Windsor, ON*.

While automated recording units (ARUs) are vital pieces of equipment in many acoustic behavior studies, locating sounds of interest within the large recording datasets that these units generate can be both costly and time consuming. Here we compare the effectiveness of two sound scanning methods in identifying target sounds within 24-hr audio recordings: 1) a manual method in which the

recording is scanned by a person with the help of computer software that provides a visual representation of the recording as a sound spectrogram, and 2) an automated method using sound analysis software that has been programmed to identify specific sounds. Both methods were used to identify the vocal and mechanical sounds of the Pileated Woodpecker (*Dryocopus pileatus*) and the Pale-billed Woodpecker (*Campephilus guatemalensis*), as well putative sounds of the Ivory-billed Woodpecker (*Campephilus principalis*), from recordings collected by ARUs in nw. Florida and Guanacaste, Costa Rica, during 2006 and 2007. As of this writing, preliminary results indicate that manual sound scanning efforts miss fewer target sounds and return less false-positive identifications than the automated process. Total person hours needed to scan and process a 24-hr audio recording was dependent on a number of variables including target sound complexity, and the number of target sounds within the recording. We will discuss the advantages and disadvantages of both sound scanning methods in relation to accuracy, speed, and cost.

### **382 Hatch & Smith**

Arrival timing and blood parameters in Gray Catbirds. MARGRET I. HATCH, *Penn State Worthington Scranton, Dunmore, PA*, and ROBERT J. SMITH, *Univ. Scranton, Scranton, PA*.

A growing area of interest in ornithology is the assessment of blood parameters such as hematocrit and differential white blood cell counts as indicators of physiological condition. Only recently have workers begun to examine these parameters during migration, one of the more physiologically stressful periods in the annual cycle. We made differential white blood cell counts from blood smears collected from Gray Catbirds arriving at a breeding site in ne. Pennsylvania in 2006. We were interested in whether leukocytes and hematocrit (ratio of plasma to packed red blood cells) were related to condition and arrival date. Total white blood cell count increased with date while hematocrit decreased. Eosinophil and lymphocyte counts increased with date while heterophils and monocytes did not. The heterophil to lymphocyte ratio (H/L), an indicator of stress, declined with arrival date. Mass was unrelated to total white blood cell count and H/L ratio, but was negatively related to hematocrit. Fat score and mite score also were unrelated to total white blood cell count and H/L ratio. Our results indicate a shift towards increased lymphocytes with advancing date, but that total number of white blood cells is unrelated to other measures of condition (mass and fat score). We are presently examining a second species to determine if these patterns are general or are specific to catbirds at our site.

### **383 vacant**

### **384 Cooper**

Daily and seasonal variation in body mass and fat in Mountain Chickadees and Juniper Titmice. SHELDON J. COOPER, *Dept. Biol., Univ. Wisconsin Oshkosh, Oshkosh, WI*.

Diurnal variations in body mass and visible fat scores were measured for seasonally acclimatized Mountain Chickadees and Juniper Titmice to examine if they undergo winter fattening. Body mass varied with time of day and was highest in evening for both species in summer and winter. Body mass expressed as percent mass increase from morning to evening was 7.3% for summer chickadees, 7.6% for summer titmice, 9.1% for winter chickadees and 6.1% for winter titmice. Body mass was not significantly higher in winter-acclimatized birds compared to summer-acclimatized birds. Visible fat scores were significantly elevated in winter-acclimatized Mountain Chickadees relative to summer. Mountain Chickadees and Juniper Titmice appear to have seasonally constant body mass rather than undergoing winter fattening. These data are similar to other North American species in the family Paridae but contrast with data on European parids.

### **385 Eo, Nairn & Carroll**

Subspecies and management units of the Northern Bobwhite in the United States. SOO HYUNG EO, C. JOSEPH NAIRN and JOHN P. CARROLL, *Warnell School For. & Nat. Res., Univ. Georgia, Athens, GA*.

The Northern Bobwhite (*Colinus virginianus*) is a widespread resident in the U.S. and Mexico, experiencing population decline throughout most of its native geographic range, due in large part to habitat loss and fragmentation during past 50 yr. We assessed the mitochondrial DNA control region sequences among nine local populations covering 4 purported subspecies of the Northern Bobwhite (*C. v. marilandicus*, *C. v. virginianus*, *C. v. floridanus*, and *C. v. taylori*) in the U.S. The sampled subspecies

did not show monophyly or complete mtDNA haplotypes sorting as evolutionary significant units. However, our AMOVA results, significant pairwise  $\Phi_{ST}$ -values, and estimated gene flow among subspecies and populations showed that *C. v. floridanus* and *C. v. taylori* exhibited different genetic structures. Based on current populations that reflect historical genetic structure, our results suggest that *C. v. floridanus* and *C. v. taylori* should be considered distinct management units, whereas, the other 2 subspecies (*C. v. marilandicus* and *C. v. virginianus*) should be managed as a single genetic entity.

### **386 Lucier & Smith**

Presence/absence surveys for monitoring and estimating habitat use of wintering Rusty Blackbirds. JASON D. LUSCIER and KIMBERLY G. SMITH, *Dept. Biol. Sci., Univ. Arkansas, Fayetteville, AR.*

Rusty Blackbirds have sharply declined across their entire range over recent decades. Therefore, it is important for managers to monitor populations and to target important Rusty Blackbird habitat in land management. To estimate occupancy with Program PRESENCE as a means for monitoring populations and evaluating habitat use, we surveyed presence/absence of Rusty Blackbirds 8 times at 79 sites and 10 times at 115 sites during the winters of 2006 and 2007, respectively, in the Lower Mississippi Alluvial Valley of Arkansas, Mississippi, and Louisiana. This survey technique is easy to implement and analyses are not data hungry, thus it is suitable for monitoring rare species such as Rusty Blackbirds. Naïve occupancy during 2006 was 0.709, but accounting for imperfect detection probability of 0.181 (0.022 SE), estimated occupancy was 0.881 (0.078 SE). During 2007, naïve occupancy was 0.452, but with a detection probability of 0.099 (0.037 SE), estimated occupancy was 0.610 (0.074 SE). We recommend using occupancy estimation as a logistically feasible survey technique for monitoring populations and habitat use of future populations of Rusty Blackbirds.

### **387 Jones**

The conservation status of West African raptors. LANDON R. JONES, *Dept. Plant & Wildl. Sci., Brigham Young Univ., Provo UT.*

Birds of prey, as top predators on the food chain, are some of the best indicator species of quality habitat and intact ecosystems. West Africa is home to 49 species of breeding Falconiformes. As a region, it contains all the habitat zones of Africa in significant portions, but has been sparsely surveyed compared to the rest of Africa. Additionally, the human population in West Africa has tripled since the 1970s, exacerbating the habitat problem in this region. I surveyed the literature for raptor studies in West Africa and scored each of 49 breeding species of Falconiformes in the 22 countries in the region. I scored studies conducted on raptors in each country and gathered statistics on each to identify conservation priorities. I found 113 total articles on Falconiformes in West Africa, 33 (without anecdotes) pre-1980 and 80 (including anecdotes) post-1980. These studies or notes represented 9% of the continental African raptor literature up to 1980 and 5% post-1980. I found 5 total regional studies, 28 country studies, and that approximately 75% of the post-1980 articles were anecdotal accounts. Study priorities include the Central African Republic, which has the most raptor species of any country in the whole region, yet has only 1 published note on its raptors. Smaller countries like Guinea, Togo and Benin, which each contain over 40 species of breeding raptors and with few or no conducted studies, must also become study and conservation priorities.

### **388 Cooper, Murphy, Redmond & Dolan**

Does the early bird really get the worm? NATHAN W. COOPER, MICHAEL T. MURPHY, LUCAS J. REDMOND and AMY C. DOLAN, *Dept. Biol., Portland State Univ., Portland, OR.*

The timing of spring arrival by migrant birds may have substantial reproductive consequences. Early arriving birds may produce larger, heavier clutches, have greater seasonal reproductive success, and experience higher offspring recruitment. These advantages may arise from earlier breeding dates or preferential access to high quality territories and mates. Here we describe relationships between arrival timing, territory quality, breeding date, clutch size, and the number of young fledged for a population of Eastern Kingbirds from Malheur National Wildlife Refuge in se. Oregon that we studied over 4 seasons (2004 - 2007). We found that early arriving males settled on higher quality territories than later arrivers. This trend was not significant for after second-year (ASY) birds, possibly because of the high site fidelity exhibited by male kingbirds. Both male and female kingbirds that arrived early bred earlier than later arrivers. In addition, females that bred early produced larger clutches and successfully fledged more

young. Our data suggest that both male and female kingbirds benefited from early arrival on the breeding grounds. Preliminary data also suggest that recruitment rate is highest among early fledged young. Hence, selection for early arrival appears to be strong, but it is still unclear whether the positive effects can be attributed to date itself or the quality of the individual.

### **389 Rush & Irwin**

Phylogeography of the “Western Flycatcher” species complex. ANDREW RUSH and DARREN IRWIN, *Dept. Zool., Univ. British Columbia, Vancouver, BC.*

Regional differences in the innate vocalizations of suboscine passerines are thought to correlate with genetic differences. *Empidonax* flycatchers exhibit great morphological similarity, but are divergent in vocalizations, and provide an opportunity to investigate this relationship. The former “Western Flycatcher” was split into the Pacific-slope (*Empidonax difficilis*) and Cordilleran Flycatcher (*Empidonax occidentalis*) based on analysis of vocal and genetic characters by Johnson in ne. California (Johnson & Marten 1988. *Auk* 105:177-191). Populations in the Pacific Northwest, however, exhibit songs and calls intermediate between the 2 forms, indicating a high level of gene flow. In order to clarify the taxonomic relationships in the “Western Flycatcher” species complex and to test whether vocalization distance is highly predictive of genetic distance in suboscine birds, we recorded and took blood samples from “Western Flycatchers” from sw. Canada. Preliminary analysis of vocalizations indicates a high level of intermediacy. Initial analysis of the mitochondrial gene ND2 indicates that “Western Flycatchers” in sw. Canada are more closely related to Pacific-slope Flycatchers. Analysis of nuclear markers (AFLPs) however, indicates that the sw. Canadian birds are intermediate between the 2 forms. A systematic study of “Western Flycatchers” utilizing modern analysis of vocal and genetic characters will help to clarify the taxonomy of this group and examine the relationship between song divergence and genetic divergence in suboscines.

### **390 Fuchs, Ericson, Cruaud & Pasquet**

Geographic structure of the genetic variation within an Indo-Malayan lineage, the *Alophoixus* bulbuls. JÉRÔME FUCHS, *Muséum national d'Histoire naturelle, Paris, France*, PER G.P. ERICSON, *Naturhistoriska riksmuseet, Stockholm, Sweden*, CORINNE CRUAUD, *Genoscope, Evry, France*, and ERIC PASQUET, *Muséum national d'Histoire naturelle.*

Heavy exploitation of natural resources for wood or pet trade render the Indo-Malayan region among the most threatened on Earth (Sodhi 2006 *Auk*, 123: 275-277). The severe threats have sparked intensive work to protect the fauna and flora including planning of conservation programs all over the region. Among many other things, such work requires a thorough understanding of the patterns of genetic diversity among and within species. Here, we focus on the genetic diversity found within 3 species of *Alophoixus* bulbuls (*A. flaveolus*, *A. pallidus* and *A. ochraceus*) that have a parapatric range. We investigate the phylogeographic structure of these taxa using sequences from 5 loci (2 mitochondrial, 2 autosomal and 1 Z-linked) obtained from over one hundred individuals that represent most of the described subspecies. Our results strongly support the polyphyly of one species and the presence of strong genetic breaks between parapatric taxa. The use of nuclear sequence data allowed us to formerly describe the presence of a hybridization zone between 2 of the studied taxa. From a conservation point of view, the present work not only tell us which populations are strongly differentiated from each other but also indicates areas where natural processes such as hybridization occur.

### **391 Benz & Robbins**

Molecular phylogenetics, song attributes, and species limits in *Celeus* woodpeckers. BRETT W. BENZ and MARK B. ROBBINS, *Nat. Hist. Mus. and Biodiversity Res. Center, Univ. Kansas, Lawrence, KS.*

We analyzed nucleotide sequence variation in ~3.1 kb (ND2, ATP6-8, COIII, and Control Region) of mitochondrial sequence data from 34 individuals of *Celeus* woodpeckers, to investigate the phylogenetic relationships within this broadly distributed neotropical genus. Complete ND2 sequence was obtained from an additional 12 individuals via ancient DNA extraction from toepads of museum specimens, for complete species-level representation of the genus, including several distinctive and geographically isolated subspecies. Model-based phylogenetic analyses yielded a well-supported but exceptionally shallow topology across the *Celeus* radiation. Monophyly of the widely distributed *Celeus*

*elegans* complex is examined in detail, integrating song attributes, and plumage traits sampled across its distribution and from closely related sister species, *Celeus flavescens* and *Celeus lugubris*, to advance our understanding of species limits within these recently diverged lineages.

### **392 Lokugalappatti, Fjeldså, van Vuuren & Bowie**

Unraveling the origin of a “leapfrog” distribution pattern in the Yellow-streaked Greenbul. L. G. S. LOKUGALAPPATTI, *DST-NRF Centre of Excellence, FitzPatrick Inst., Dept. Bot. & Zoo., Univ. Stellenbosch, Matieland, South Africa* and Mus. Vert. Zool. and Dept. Integrative Biol., Univ. California, Berkeley, CA, JON FJELDSÅ, *Zool. Mus., Univ. Copenhagen, Copenhagen, Denmark*, BETTINE J. VAN VUUREN, *Evol. Genomics Group, Dept. Bot. & Zool., Univ. Stellenbosch*, and RAURI C. K. BOWIE, *Mus. Vert. Zool. and Dept. Integrative Biol., Univ. California, Berkeley, CA*.

The Yellow-streaked Greenbul (*Phyllastrephus flavostriatus*) is a common polytypic songbird with a highly disjunct distribution pattern in southern and east African forests. The distributional range of disjunct taxa has an interesting “leapfrog” pattern where the grey-headed forms in coastal (South Africa to Tanzania) and montane (Albertine Rift and Eastern Arc) parts of the range are separated from each other by a brown-headed intervening population/taxon (subspecies *P. f. alfredi*) found in sw. Tanzania and n. Malawi. We use analyses of multi-gene DNA sequences (2302 bp) of different populations representing all taxa to elucidate the evolutionary history of this unusual and complex geographical differentiation. The results support a ‘leapfrog’ pattern in morphology. They further indicate that many of the montane highland populations are deeply divergent from each other. In contrast, coastal populations extending from Tanzania to South Africa appear to be more closely linked sharing both mtDNA haplotypes and nDNA alleles.

### **393 Welsh**

Tracheophone systematics: gnateaters, tapaculos, and ground antbirds. CHARLES J. WELSH, *Biol. Dept., Allegheny Coll., Meadville, PA*.

Plumage and skeletal material of gnateaters (Conopophagidae), tapaculos (Rhinocryptidae), and ground antbirds (Formicariidae) were examined for characters useful in a phylogenetic analysis. Phylogenetic analysis suggested the monophyly of all 3 families combined. Data from woodcreepers (Dendrocolaptinae), ovenbirds (Furnariinae), and the typical antbirds (Thamnophilidae) were used for outgroup comparisons. The analysis also suggested the monophyly of the gnateaters and tapaculos exclusive of the ground antbirds. This is part of bigger project aimed at elucidating the relationships within the entire tracheophone assemblage. The results are consistent with DNA hybridization studies.

### **394 Ruiz-del-Valle, Zamora, Moscoso, Serrano-Vela, Reguera & Arnaiz-Villena**

Citril Finch belongs to genus *Carduelis* by conjoint molecular canaries and goldfinches phylogenies. VALENTIN RUIZ-DEL-VALLE, JORGE ZAMORA, JUAN MOSCOSO, JUAN IGNACIO SERRANO-VELA, RAQUEL REGUERA and ANTONIO ARNAIZ-VILLENA. *Dept Immunology, Medicine and The Madrid Regional Transfusion Blood Center, Madrid, Spain*.

Conjoint mitochondrial phylogenetic trees for canaries *Serinus* spp. and goldfinches *Carduelis* spp. show several specific polytomies. Canaries and goldfinches seem to form a phylogenetic group separated from other Carduelini tribe radiations. The present study conjointly analyses for the first time the phylogenetic relationships among canaries (genus *Serinus*) and goldfinches (genus *Carduelis*), and others, and the particular case of citril finch (*Serinus citrinella*) which has been included by different authors either in the canaries or in the goldfinches group. Also, 2 new species: *Serinus totta* and *Serinus syriacus* have been newly DNA sequenced and studied. Eurasian, African and American canary and siskin-goldfinches species living range was surveyed. Also, island (Corsica and Sardinia) and continental (Madrid, Alps and Pyrenees) citril finch individuals were analysed. Mitochondrial cytochrome b (mt cyt b) DNA gene was sequenced. Parsimony and genetic distance based methodologies were used for dendrograms construction. Enforced constraints were used to test the inclusion of Citril Finch within either *Serinus* or *Carduelis* groups. Canaries and goldfinches may or may not be different genetic radiations with different evolutionary pathways. However it is confirmed that canaries are the closest Fringillidae family relatives to goldfinches. Also, each of these groups shows monophyletic and non-monophyletic supported subgroups as indicated by bootstrap values. Citril finch is definitively included within the genus *Carduelis*. This is supported by cladistic, and distance-based phylogenetic

molecular analyses; it was also postulated by Bernis (1954, *Ardeola* 1:11-85) based on phenetics. Citril finch island individuals seem to be more ancient than those extant in the continent. Genus *Loxia* (crossbills) is included within genus *Carduelis*. *Serinus totta* seems to cluster with the small African canaries clade and *Serinus syriacus* is included within the *Serinus pusillus* / *Serinus alario* subgroup.

### 395 Spellman & Klicka

Speciation in North American Certhiid(s): is the Brown Creeper a single morphologically diverse species? GARTH M. SPELLMAN, *Biol. Dept., Black Hills State Univ., Spearfish, SD*, and JOHN KLICKA, *Barrick Mus. Nat. Hist., Univ. Nevada, Las Vegas, NV*.

Cryptic plumage coloration due to adaptation to their microhabitat has confounded the study of species limits in the family Certhiidae. In fact, the sole North American representative of the family, the Brown Creeper (*Certhia americana*) was only recently elevated to species status based on vocalization differences between it and its closest Old World relatives, *C. familiaris* and *C. brachydactyla* (Thielcke 1962, *J. Orn.* 103:266-271; Baptista & Johnson 1982, *J. Orn.* 123:131-144.). These same studies remarked that although there exists evidence of considerable vocal variation within North America, geographic sampling across subspecies boundaries was inadequate to address taxonomic questions within the species. Recently, it has been demonstrated that molecular phylogenies closely track vocal variation and species limits in Old World Certhiids (Tietze et al. 2006, *Ibis* 148:477-488). In this study, we apply a multi-locus phylogeographic analysis of genetic variation within the Brown Creeper to infer its evolutionary history and address questions of species limits in North America. Phylogenetic analyses identify 4 reciprocally monophyletic clades that correspond geographically with the regional North American coniferous forests. The observed deep phylogenetic structure indicates the existence of more than one species of Brown Creeper in North America. This hypothesis could be tested through a thorough study of vocal variation within and between populations in the divergent clades.

### 396 Jacobsen, Kenny & Omland

Multi-locus Z phylogeny of New World orioles (genus *Icterus*): a novel way to test a female-biased mtDNA phylogeny. FRODE JACOBSEN, DOROTHY A. KENNY and KEVIN E. OMLAND, *Dept. Biol. Sci., Univ. Maryland-Baltimore Co., Baltimore, MD*.

Any phylogeny based on a single gene tree (e.g., mtDNA) ideally needs to be corroborated by data from other independent loci such as non-coding nuclear introns. We tested a well-resolved mtDNA phylogeny of New World orioles (*Icterus*) using multiple Z-linked introns. Due to their much slower sorting rate relative to mtDNA, nuclear introns are more affected by the stochastic process of lineage sorting and retention of ancestral alleles. A substantial number of nuclear gene trees therefore need to be resolved in order to achieve the same level of confidence as from a single mitochondrial gene tree. Having only 3/4  $N_e$  that of autosomal loci, Z-linked introns are expected to sort slightly faster and perhaps work better at reconstructing lower-taxonomic levels. Furthermore, a Z phylogeny offer a novel way to test a female-biased mtDNA phylogeny as the Z phylogeny should be 2/3 due to the male history of the species. Combined analysis of 3 Z-linked introns seems to resolve all 3 major clades within *Icterus* as well as many sub-clades also supported by mtDNA. However, for species that split in the last 1-2 million years, additional loci or other approaches are likely needed.

### 397 Wolfe, Ryder & Pyle

Using molt cycles to inform age-categorization in tropical birds: a new integrative system. JARED D. WOLFE, *Dept. Wildl., Humboldt State Univ., Arcata, CA*, T. BRANDT RYDER, *Dept. Biol. and Whitney Harris World Ecol. Center, Univ. Missouri-St. Louis, St. Louis, MO* and PETER PYLE, *Inst. Bird Pop., Point Reyes Station, CA*.

Methods to accurately differentiate age-classes are essential for the long-term monitoring of resident tropical bird species. Molt and plumage criteria have long been used to accurately age temperate birds and recent studies have shown that similar criteria can be used to place tropical individuals into age-classes. Application of temperate models to the neotropics has been hindered because temperate models do not always match the annual life cycle events of tropical taxa. Ultimately, the value of applying temperate aging tools to tropical taxa is contingent upon our limited knowledge-base of plumages and molts in the New World tropics. Here, we review plumage and molt cycles of commonly captured families of tropical passerines and assign probable molt strategies to those

families using Howell et al.'s (2003, *Condor* 105:635-653) modified H-P terminology. We develop a categorical age-class system for tropical birds using molt-cycles and examine implications of the system using case studies. The molt-cycle based aging system provides a framework for investigating questions that address the dynamics of populations which could ultimately influence management decisions.

**398 vacant**

**399 Hallinger, Kazmer, Zabransky & Cristol**

Does mercury contamination affect birdsong? KELLY K. HALLINGER, KATHERINE A. KAZMER, DANIEL J. ZABRANSKY and DANIEL A. CRISTOL, *Dept. Biol., Coll. William & Mary, Williamsburg VA.*

Mercury is a toxic heavy metal that can cause severe behavioral abnormalities and death in animals. While several studies have demonstrated the serious physiological and reproductive problems associated with mercury poisoning, little is known about the more subtle behavioral effects of mercury, such as effects on song. The purpose of this study was to determine whether birds inhabiting a site of known mercury contamination along the Shenandoah River in Virginia exhibited detectable differences in song compared to birds from reference sites. Song Sparrows, Carolina Wrens, and House Wrens were recorded and their songs analyzed using the Raven bioacoustics program. We measured parameters that might have been the product of poor current condition of the contaminated birds, as well as those that might indicate developmental stress and interference with song learning. Such parameters included total amount of singing, strophe length, emphasized frequencies, and song rate. We detected differences in frequency between contaminated and reference birds for both the Carolina Wren and the House Wren with reference birds singing higher frequency songs than contaminated birds. In addition, several other parameters, while not producing significant differences, suggest that there may be numerous differences in song attributable to mercury. These differences in song may have important implications for the population dynamics of songbirds in polluted areas and demonstrate the importance and usefulness of behavioral biomarkers in ecotoxicological studies.

**400 Weng, Yuan & Mays**

Differential response of the male and female Steere's Liocichlas to stereo duet playback. YI-SHAN WENG, HSIAO-WEI YUAN, *School Fors. & Res. Conserv., Natl. Taiwan Univ., Taipei, Taiwan*, and HERMAN L. MAYS, *Dept. Biol., Georgia Southern Univ., Statesboro, GA.*

Duetting where members of a pair coordinate their song with some temporal precision may function as a form of cooperative joint territory defense. However, duetting could also be a consequence of sexual conflict where the duet song advertises the mated status of a partner to other potential mates and thus serves as a form of acoustic mate guarding. We conducted a stereo duet playback experiment to test hypotheses concerning the function of duetting in a Taiwanese endemic passerine, Steere's Liocichla (*Liocichla steerii*). Treatments included female solo playback, male solo playback, duet playback of strangers and duet playback of neighbors. During playbacks, males initiated nearly all vocalizations (98.79%). Male song initiation rate and latency to sing were not significantly different among treatments. Females answered their partner's song more frequently and sang with a shorter latency in response to female solo and stranger duet playbacks compared to male solo and neighbor duet playback. These data suggest that lone females and unfamiliar pairs are perceived as a bigger threat to females. In most cases (9/12), members of a pair approached speakers together and moved to the opposite speaker after channel switching. These findings suggest that in addition to joint territory defense, duetting in Steere's Liocichla serves the mate guarding function concerning with conflict of interests.

**401 Crowell, Peer, Thomas & Therrien**

The effects of urban noise on the vocalizations of the Red-winged Blackbird. SARA E. CROWELL, BRIAN D. PEER, JEANETTE A. THOMAS, *Dept. Biol. Sci., Western Illinois Univ., Macomb, IL*, and RONALD E. THERRIEN, *EcoSmart Res. Inst., Bradenton Beach, FL.*

Birds must contend with many sources of noise in their environment that can potentially mask their signals and reduce the efficiency of communication. Urbanization has presented birds with a new challenge that they have responded to by modifying the frequencies, amplitudes, and durations of the signals they transmit. In this study, the responses of Red-winged Blackbirds to high levels of

anthropogenic noise were investigated. Red-winged Blackbird vocalizations and background noise were recorded in several locations from urban Chicago to rural western Illinois. Song parameters such as low frequency, high frequency, and duration were measured for a random sample of songs recorded. Background noise in the noisiest areas of Chicago was over 8 times as loud as in more rural Illinois. Results indicated that Red-winged Blackbirds in noisier areas were shifting the frequencies of their songs up, and possibly sacrificing elaborate detail of their songs in exchange for emphasis of fundamental notes. Red-winged Blackbirds are therefore modifying their songs in several ways in noisy urban areas, which could possibly affect their ultimate fitness.

#### **402 Henry, Jehl & Rankin**

Vocalizations of migrating Eared Grebes: what we might be missing. ANNETTE E. HENRY, J. R. JEHL, Jr., and S. RANKIN, *Southwest Fish. Sci. Center., La Jolla, CA.*

We describe 2 vocalization given by Eared Grebes in fall migration that are distinct from calls known from the breeding grounds. On many evenings we heard the type "A" call moments before the grebes took flight on a nocturnal migration. We suspect it functions primarily to signal an intent to depart. The type "B" call, though more frequent, was barely perceivable, even in laboratory conditions; its role remains to be determined. Grebes often migrate in large flocks, whose cohesion is maintained in the dark over long distances; but how. Are these, or other calls, used to sustain flock structure? New techniques for studying sounds of nocturnal migrants coupled with information on the timing and locations of departure events from staging areas may make it feasible to study this question.

#### **403 Mumme**

Breeding biology of a Neotropical warbler: the Slate-throated Redstart in Monteverde, Costa Rica. RONALD L. MUMME, *Dept. Biol., Allegheny Coll., Meadville, PA.*

The Slate-throated Redstart (*Myioborus miniatus*), 1 of 12 species of *Myioborus* redstarts, inhabits montane forest from northern Mexico to Bolivia. As part of a 5-yr study of plumage evolution and foraging behavior in this species, I investigated the reproductive biology of a color-banded population of Slate-throated Redstarts in Monteverde, Costa Rica, 2000 - 2004. Slate-throated Redstarts in Monteverde are socially monogamous and territorial during the Mar - Jun nesting season. Females construct domed nests in banks along roads and trails or in niches on open steep slopes. Mean clutch size in Monteverde is 2.9 (range 1 - 4: n = 82 nests), and 88% of clutches contain 3 eggs. The incubation period averages 14.2 d (range 14 - 15 d: n = 19 nests) and fledging occurs when nestlings are 10 - 12 d old (mean 11.3 d; n = 18 nests). Females perform all incubation and brooding, but both sexes feed nestlings and fledglings. Fledglings remain with and are fed by their parents for at least 4 wk after fledging. Nesting success is generally low (35.3%: n = 51 nests found before clutch completion), with most nest failures attributable to nest predation. Double brooding is very rare. Although the breeding biology of this Neotropical warbler is similar to that of temperate-zone Parulids, the Slate-throated Redstart has a smaller clutch size, longer incubation period, longer nestling period, and perhaps a longer period of post-fledging dependence than its northern relatives.

#### **404 Dolbey, Lipowicz, Lindberg & Sheckels**

Song performance and parental care. ANDREW S. DOLBEY, H. T. LIPOWICZ, K. L. LINDBERG and K. M. SHECKELS, *Dept. Biol. Sci., Univ. Mary Washington, Fredericksburg, VA.*

According to current theory, female choice should favor male courtship signals, such as song, that serve as honest indicators of male mate quality. A possible mechanism has been proposed to explain how the honesty of song performance as an indicator of quality is maintained, but evidence that song predicts males' ability to provide parental care remains limited. We tested the hypothesis that song performance honestly indicates paternal quality in the Gray Catbird. Males produce complex song during courtship and contribute at least 50% of total chick feedings. Specifically, we predicted that hourly chick feeding rates by males would correlate positively with song-phrase duration, maximum power frequency (MPF), and MPF variation. While chick feeding rates were not correlated with either song-phrase duration or the MPF coefficient of variation, they were significantly positively correlated with MPF (n = 20). Therefore, MPF may indicate male parental quality in Gray Catbirds. Previous research on other species has found that MPF can be reduced by dietary deficiency and stress during the nestling phase,

and furthermore, MPF has been associated with increased extrapair mating success. Thus, even among species that produce complex song featuring large repertoire sizes, song performance parameters such as MPF may be biologically significant indicator signals for females during mate choice.

#### **405 Barker, Burns, Klicka, Lanyon & Lovette**

Assembling, and using, the nine-primaried oscine *Tree of Life*: the poster. F. K. BARKER, *Bell Mus. Nat. Hist., Univ. Minnesota, Minneapolis, MN*, K. J. BURNS, *Dept. Biol., San Diego State Univ., San Diego, CA*, J. KLICKA, *Marjorie Barrick Mus., Univ Nevada, Las Vegas, NV*, S. M. LANYON, *Bell Mus.*, and I. J. LOVETTE, *Lab. Ornithol., Cornell Univ., Ithaca, NY*.

The nine-primaried oscines (currently classified in the families Thraupidae, Cardinalidae, Emberizidae, Icteridae and Parulidae) are one of the most diverse groups in the New World avifauna, and the focus of a massive volume of research in diverse fields of biology. However, this diversity has hampered understanding of phylogenetic relationships in the group, limiting their usefulness in comparative biology. Using molecular data from multiple loci and nearly all the genera within these families, we demonstrate that they form a monophyletic group within passerines. Furthermore, our data support 5 major groupings, roughly corresponding to the traditionally-recognized families, as well as a number of lineages more distantly related to various of these family groups. This poster is in support of Symposium A - *Assembling, and using, the nine-primaried oscine Tree of Life*.

#### **406 Powell, Barker & Lanyon**

A complete phylogeny of the grackles, including the extinct Slender-billed Grackle (*Quiscalus palustris*), inferred from mitochondrial DNA. A. F. L. A. POWELL, F. K. BARKER and S. M. LANYON, *Dept. Ecol., Evol. & Behav., and Bell Museum Nat. Hist., Univ. Minnesota, St. Paul, MN*.

The grackles (*Quiscalus*), together with their sister genus *Euphagus*, comprise a clade within the New World blackbirds (Icteridae). We used 2 protein-coding mitochondrial genes, cytochrome b and NADH dehydrogenase subunit 2 (ND2), to reconstruct relationships within the group. A primary concern was determining the phylogenetic position and genetic distinctiveness of the only extinct blackbird, the Slender-billed Grackle (*Q. palustris*), a poorly known endemic of the once marshy valleys of central Mexico, last collected and recorded in 1910. Our analysis differs from previous efforts by inclusion of all recognized species, including Slender-billed and Nicaraguan (*Q. nicaraguensis*) grackles, intraspecific sampling of Greater Antillean (*Q. niger*) and Great-tailed (*Q. mexicanus*) grackles, inclusion of additional sequence data, and use of likelihood and Bayesian methods. The recovered phylogeny reveals a complicated pattern of relationships. Notably, the Slender-billed Grackle is most closely related to one of the 2 major haplotype groups of the Great-tailed Grackle, the other being sister to Boat-tailed Grackle (*Q. major*). We discuss implications of these and other relationships in the genus for species limits and biogeography.

#### **407 Swanson, Cruz & Prather**

Recreational development and ponderosa pine forest birds. HEATHER M. SWANSON, *Boulder Open Space and Mountain Parks, Boulder, CO*, ALEXANDER CRUZ, *Ecol. and Evol. Biology, Univ. Colorado, Boulder, CO*, and JOHN W. PRATHER, *deceased (20 Feb 2006)*.

Recreational development along Colorado's Front Range is increasing as population increases and open space systems expand. However, the impact on wildlife of increased recreational use is poorly understood. We monitored the ponderosa pine forest bird community on Heil Ranch, Boulder Co., CO, during the summers of 1999 - 2004. During that time, the area progressed from being closed to the public to installation of a parking lot, picnic facilities, a hiking trail and mountain biking loop. To track the response of the bird community to these changes, we conducted point counts and monitored nests throughout development. We found that most species did not show changes in relative abundance in response to trail installation or use. However, some species specific responses to trails were observed. Some common species showed a large drop in relative abundance during a severe drought year, in both trail and non-trail areas. This suggests that local climatic conditions may have a larger influence on abundance of some species than disturbance from human recreation. To the contrary, we found a significant decline in nesting success for multiple species following recreational development of the

property. This suggests that although the abundance of some breeding birds may be unaffected by recreation, reproductive success may be compromised, leading to unsustainable local populations for some species.

#### **408 Houde, Fain & Cooper**

Gondwana origin of Eurypygae falsified. P. HOUDE, M. G. FAIN, *Dept. Biol., New Mexico State Univ., Las Cruces NM*, and ALAN COOPER, *Univ. Adelaide, Adelaide, Australia*.

Members of the so-called "order Gruiformes" often have been proposed to have diversified in Gondwana before its break-up because many are southern endemics and are believed to be monophyletic. Among these, the Eurypygae are said to include the Neotropical Sunbittern (*Eurypyga helias*), the near-flightless New Caledonian Kagu (*Rhynochetos jubatus*), and the extinct flightless adzebills of New Zealand (*Aptornis* spp.) Analyses of 12S ribosomal RNA and alcohol dehydrogenase-1 intron 5 unambiguously indicate that adzebills are misplaced in the Eurypygae, and instead were primitive flightless rails (Rallidae). And while Sunbittern and Kagu are certainly sister taxa, relaxed Bayesian clock dating of a dozen nuclear loci further indicates that they most likely diverged 20 - 25 million years subsequent to the Cretaceous/Tertiary boundary and long after the break-up of Gondwana.

#### **409 Schahl & Peer**

A test of the Sensory Bias hypothesis for sexual selection in the Common Grackle. JENNIFER R. SCHAHL and BRIAN D. PEER, *Dept. Biol., Western Illinois Univ., Macomb, IL*.

The Sensory Bias Model for sexual selection states that females prefer a male with a novel trait because it is appealing to their sensory system. Evidence in support of this model is mixed. We tested the Sensory Bias Model in the Common Grackle by adding a feather crest to a male grackle's head. Neither Common Grackles nor any of their close extant relatives typically have crests, thus we created a novel trait. We found no evidence that female grackles preferred males with crests indicating that there is no pre-existing bias toward this novel trait. Interestingly, however, females also showed no distinct preference for males without crests. These results suggest that female Common Grackles do not have a sensory bias for males with crests.

#### **410 Keeley, Germaine & Wanner**

Brown-headed Cowbird abundance in thinned and unthinned ponderosa pine stands in Colorado's Front Range. WILLIAM H. KEELEY, STEPHEN S. GERMAINE and CHRISTOPHER E. WANNER, *City of Boulder Open Space & Mountain Parks Dept., Boulder, CO*.

Fire suppression in Colorado front-range coniferous forests has resulted in increased within-stand tree densities, canopy closure, ladder fuels, and flammable organic litter, while understory vegetative diversity and composition have declined. As these conditions have become more pronounced, many species of wildlife are believed to have decreased use of fire suppressed stands. To improve conifer forest stand conditions, managers have begun using thinning prescriptions to restore a natural mosaic of age and size classes. However, wildlife response to forest restoration efforts is little understood. We examined cowbird distributions in thinned and unthinned ponderosa pine stands to explore potential effects of forest restoration procedures on nest parasitism. Cowbirds are aggressive nest parasites, whose abundance has increased as sedentary domestic cattle have replaced wide-ranging buffalo herds. We are currently investigating our first full season of data collection following a brief pilot season. We detected cowbirds during 30% and 16% of visits to thinned and unthinned stands, respectively. A contingency analysis using our preliminary data shows cowbird detection rates in thinned and un-thinned forest stands approaches significance ( $p = 0.08$ ). We will present full analysis and discussion of our 2007 field season.

#### **411 Fletcher, Battin & Chalfoun**

The role of habitat area and edge in fragmented landscapes: definitively distinct or inevitably intertwined? ROBERT J. FLETCHER, Jr., L. RIES, J. BATTIN and A. D. CHALFOUN, *Div. Biol. Sci., Univ. Montana, Missoula, MT*.

Over the past few decades, much research has focused on the effects of patch area and habitat edges in fragmented landscapes. We review and synthesize the literature on area and edge effects to identify whether the ecological processes influenced by patch size and edge are distinct, to summarize

evidence for the relative effect of each, and to discuss how estimating the independent effects of each may be accomplished in field studies. Area and edge directly influence ecological processes in distinct ways, yet indirect effects can be similar, making it difficult to isolate the effects of area and edge in nature. Many studies investigating both area and edge have been confounded in their design and/or analysis (i.e., studies did not control for one potential effect while testing for the other). Non-confounded studies have more frequently found support for edge effects, and comparisons between non-confounded and confounded studies suggest that some observed area effects could be explained by edge effects. We argue that by focusing on the fundamental processes directly influenced by area and edge, and by developing more rigorous study designs and analyses that isolate their relative influence, greater insight can be gained in future investigations on habitat loss and fragmentation.

#### **412 Cilimburg & Fletcher**

Surveying for Flammulated Owls in Montana via citizen monitoring. AMY B CILIMBURG, *Avian Science Center, Dept. Biol. Sciences, Univ. Montana, Missoula, MT*, and ROBERT J. FLETCHER Jr., *Dept. Wildl. Ecol. Cons., Univ. Florida, FL*.

Flammulated Owl populations in the Intermountain West may be declining due to habitat alterations, yet their secretive nature and scattered distribution have made monitoring difficult. In 2005, the Avian Science Center and the Northern Region of the U.S. Forest Service (USFS) initiated the first-ever Region-wide survey for Flammulated Owls in Montana and n. Idaho. Sampling methods using GIS modeling proved effective, and we now have a much clearer understanding of Flammulated Owl distributions. However, a long term monitoring program using an established protocol is needed to understand population trends. A Citizen-Science approach has the potential to provide a cost-effective means of collecting population data across a large area over time, and Flammulated Owl surveys may be particularly appropriate for citizen monitoring because identification is straight forward, equipment is easy to use and inexpensive, and the public has expressed a keen interest in both hearing owls and contributing to valuable science. In 2007, we initiated a pilot project using volunteers from local Audubon groups to survey "adopted" routes selected using the GIS-based sampling methods we developed with the USFS. Surveys conducted by volunteers have the potential to provide long-term monitoring information across wide areas.

#### **413 Harris, Juiña & Carpio**

Territory size, foraging behavior, and vocalizations of the Jocotoco Antpitta in southeastern Ecuador. J. BERTON C. HARRIS, MERY JUIÑA and ROLANDO CARPIO, *Fundación de Conservación Jocotoco, Quito, Ecuador*.

The Jocotoco Antpitta (*Grallaria ridgelyi*) was discovered in 1997 in lower temperate forest on the east slope of the Andes in se. Ecuador. This rare and secretive species remains little known. Basic aspects of its biology such as territory size, foraging, reproductive, and vocal behavior are essentially unknown with most data coming from potentially unusual observations after tape playback. From Jan - Jul 2007, we radio-tagged and tracked 3 Jocotoco Antpittas in the Fundación Jocotoco's Tapichalaca Biological Reserve in Zamora-Chinchipec province, Ecuador. During this period we also observed natural foraging and vocal behaviors. From minimum convex polygon analysis, we estimate territory size at 21 ha. We also present new information on vocal communication between the sexes, provide the first description of foraging in nature, and describe new dietary items. The Jocotoco Antpitta's territory size is much larger than any other described for *Grallaria*. This large territory size suggests that reserves must contain relatively large areas of land in the appropriate elevational range for conservation of the species. Further investigation of territory size, habitat requirements, and natural history of this species will enable more effective conservation action in the future.

#### **414 Stenger & Burt**

Pattern of damage among tail feathers of sparrows. JACK M. STENGER and EDWARD H. BURTT, Jr., *Dept. Zool., Ohio Wesleyan Univ., Delaware, OH*.

Typically, songbird tail feathers are dark or the central tail feathers are dark and the lateral tail

feathers have small to large amounts of white on the medial surface of the vane. We hypothesize that the light colors in the tail occur where damage is minimal, because melanin in dark feathers strengthens them. The tail feathers are subjected to 3 types of damage: abrasion by airborne particles, bacterial degradation, and collision with objects. The relative importance of these 3 factors in damaging the tail feathers is uncertain. We quantified the damage in the tails of museum specimens and wild birds caught in mist nets. We also compared damage to the tail of related species of sparrows in different habitats. Understanding the pattern of wear among tail feathers may help us identify the source of the damage and better understand the potential cost of different color patterns in the tails of songbirds.

#### 415 Whitehorne

Does wintering behaviour mediate the tradeoff between reproduction and survival in migratory and sedentary American Dippers? IVY WHITEHORNE, *Dept. Biol. Sci., Simon Fraser Univ., Burnaby, BC.*

American Dipper populations in British Columbia are composed of both sedentary and migratory individuals. Sedentary individuals (residents) initiate breeding earlier and have greater reproductive success than migratory individuals (migrants), but have lower annual survival. This trade off between reproduction and survival may result from the costs of maintaining a territory year round. During winter, residents maintain their territory, which may limit their ability to exploit areas of high food abundance, while migrants (without territories), may retain greater flexibility to respond to changing conditions. Resident and migrant birds were observed on their common wintering ground to determine if foraging behavior, energetic intake, body condition (size corrected mass), and site fidelity varies between residents and migrants. Preliminary analysis suggests that migrants are able to spend more time foraging, use more complex feeding methods, have greater body condition, and exhibit less site fidelity than residents. I argue that tradeoffs between reproduction and survival in the American Dipper are mediated by wintering behaviour. The constraint of maintaining a territory reduces the ability of the residents to respond to changing conditions and prevents resident individuals from exploiting food resources as effectively as migrants, thus elevating resident winter mortality.

#### Index of Authors

		Arnaiz-Villena, A	394	Beckmann, C	331
		Askins, R A	336	Bednarz, J C	183
		Atamian, M T	164	Bednarz, J C	208
		Atterberry-Jones, M R	343	Bednarz, J C	237
-A-				Bednarz, J C	44
Able, K P	380			Bednarz, J C	214
Aldredge, J R	340	-B-		Bednarz, J C	239
Aldredge, R A	119	Badyaev, A V	354	Beissinger, S R	10
Alfaro M	206	Badyaev, A V	153	Belinsky, K L	74
Alfaro, M	78	Baker, A J	p1	Benham, P M	179
Ali, M H	326	Bakermans, M H	123	Benkman, C	s16
Alisauskas, R T	1	Balakrishnan, C N	s07	Benkman, C W	197
Allen, J H	120	Balakrishnan, C N	76	Benkman, C W	198
Anciaes, M	s25	Balakrishnan, C N	203	Benson, M D	77
Anderson, B L	166	Ballard, G	2	Benson, T J	183
Anderson, C	332	Ballard, G	365	Benson, T J	237
Anderson, E M	73	Barker, F K	405	Benson, T J	239
Anderson, M	77	Barker, F K	406	Benz, B W	391
Anderson, T W	51	Barker, F K	s01	Bermingham, E B	113
Anfinson, J O	44	Barnum, D A	51	Bierregaard, R O, Jr	127
Angelier, F	156	Barr, I R	40	Billerman, S M	363
Anich, N M	237	Barrow, W C, Jr	94	Blacklock, G W	20
Apa, A D	133	Barrowclough, G F	115	Blackwell, B	77
Applegate, R D	103	Barton, D C	26	Blake, J G	157
Arce Chavez, V J	124	Battin, J	411	Blake, J G	s29
Arcese, P	228	Battley, P	205	Blakesley, J A	224
Arcese, P	116	Bech, C	156	Blanc, L A	181
Ardia, D R	146	Beck, M L	37		
Arnaiz-Villena, A	360				

Blancher P	329	Burns, K J	s01	Conroy, M J	215
Block, W M	s18	Burns, K J	s02	Conway, C J	326
Blums, P	102	Burns, K J	193	Conway, C J	s19
Bly, B	330	Burttt, E H, Jr	34	Conway, C J	65
Bocanegra, O	320	Burttt, E H, Jr	375	Conway, C J	255
Bocetti, C	350	Burttt, E H, Jr	378	Cook, M I	25
Bock, C E	243	Burttt, E H, Jr	414	Cook, M I	68
Bock, J H	243	Bush, S E	s12	Cooper, A	408
Boeckel, L	314			Cooper N W	388
Bollinger, E K	309	-C-		Cooper, R J	52
Bollinger, P B	309	Cade, B S	94	Cooper, R J	71
Bonaccorso, E	202	Cadman, M	345	Cooper, R J	88
Bostwick, K	s24	Call, E C	25	Cooper, R J	89
Boughton, R K	119	Callo, P A	9	Cooper, R J	215
Boughton, R K	143	Camfield, A F	55	Cooper, R J	308
Boughton, R K	147	Carey, M	371	Cooper, R J	322
Bouzat, J L	108	Cariveau, A B	220	Cooper, S J	384
Bowden, R M	27	Carling, M D	138	Cornish, T E	42
Bowen R	6	Carlson, J	8	Corwin, K	223
Bowie, R C K	111	Carpio, R	413	Couloux, A	192
Bowie, R C K	192	Carroll, J P	385	Cox, J A	s21
Bowie, R C K	151	Caruana, R	17	Cristol, D A	80
Bowie, R C K	392	Casey, A E	158	Cristol, D A	369
Bowlin, M S	22	Cavitt, J F	310	Cristol, D A	399
Bowman, R	119	Cavitt, J F	368	Cristol, D A	85
Bowman, R	147	Chavez-Ramirez, F	221	Cronin, T W	33
Boyd, W S	73	Chace, J F	165	Cronin, T W	359
Boylan, J T	320	Chace, J F	319	Crowell, S E	401
Boyle, W A	125	Chace, J F	341	Cruaud, C	390
Brawn, J D	217	Chades, I	228	Cruz, A	165
Breedden, J	172	Chalfoun, A D	14	Cruz, A	319
Brelsford, A	s11	Chalfoun, A D	411	Cruz, A	407
Brelsford, A T	137	Champagne, J	242	Curry, R L	128
Breniser, H	106	Chandler, C C	124	Curry, R L	135
Bridge, E S	119	Chandler, R C	124	Cuthbert, F J	170
Bridge, E S	143	Charif, R	67		
Brightsmith, D J	194	Chase, M K	365	-D-	
Briskie, J V	24	Chastel, O	156	DaCosta, J M	s07
Brooks, D M	322	Chesser, R T	114	Daily, G C	323
Brown, D R	327	Cheviron, Z A	130	Danz, N P	66
Brown, J W	186	Chipman, K G	199	Dauphine, N	15
Brubaker, J L	30	Choe, J C	358	Dauphine, N	322
Brumfield, R T	130	Chou, L-S	313	Davis, S K	236
Brumfield, R T	138	Cibois, A	110	Day, L	s23
Brumfield, R T	76	Cicero, C	112	Debruyne, C A	24
Buchanan, A A	372	Ciecka, A L	126	DenUyl, J L	362
Budd, M J	366	Cilimburg, A B	412	Derrig, J L	218
Buitron, D	120	Clement-Chastel, C	156	Desrochers, A	345
Burger, J	304	Clark, L	8	Dhondt, A A	105
Burger, L W	244	Clayton, D H	s12	Diggs, N E	71
Burke, D	91	Clifford, L D	314	DiLuzio, N	54
Burke, H	144	Clotfelter, E D	146	DiLuzio, N	144
Burke, H	240	Coe, S J	122	DiLuzio, N	316
Burke, H	346	Collins, J	82	Dingle, C	95
Burns, K J	190	Colon, M R	328	Dinsmore, S J	117
Burns, K J	405	Condon, A M	85	Doherty, K E	42

Doherty, K E	43	Feierabend, D S	100	Ghalambor, C K	58
Doherty, P F	149	Felch, J M	32	Ghalambor, C K	104
Doherty, P J	118	Ferrell, C	332	Gibson, R	s28
Dolan A C	388	Feswick, A	147	Gibson, R M	133
Dolby, A S	404	Fiedler, C E	200	Gill, R E G	205
Doll, L	s18	Filardi, C E	48	Giovanni, M D	342
Dooley, J L	149	Filardi, C E	s08	Gochfeld, M	304
Dor, R	195	Fink, D	17	Gonzalez Rojas, J I	159
Doran, P	350	Fink, D	83	Gordon, C E	245
Doster, R H	347	Fisk, A T	52	Goulet, P	178
Doucet, S	s26	Fisk, A T	52	Gouse, P J	307
Dreitz, V J	29	Fjeldsa, J	192	Graham, J M	43
Driskell, A	187	Fjeldsa, J	392	Graham, R	320
Dubina, K M	376	Fjeldsa, J	111	Grant, B R	s06
Dufty, A M, Jr	72	Flather, C	p2	Grant, T A	218
Dugas, M B	38	Flather, C H	19	Gratto-Trevor, C L	171
Dunn, P O	154	Fleischer, R C	334	Greenberg, R	32
Dunning, J B	229	Fleischer, R C	187	Greenberg, R	107
Duraes, R	s29	Fletcher, R J, Jr	75	Greenberg, R	378
Durst, S L	45	Fletcher, R J, Jr	411	Gregory, A J	s31
DuVal, E	s33	Fletcher, R J, Jr	412	Gregory, A J	338
-E-		Flint, P	102	Greig, E I	64
Eadie, J	s13	Folsom, C M	336	Grenier, J L	82
Ebbert, S E	101	Forsyth, M H	35	Griffith, S C	40
Edman, M	178	Frame, A M	35	Grippo, R S	208
Edwards, S	76	Francis, C	329	Groth, J G	115
Edwards, S V	203	Francis, C D	176	Grunwald, D	144
Ehrlich, P R	323	Franzreb, K E	211	Grunwald, D	240
Ellison, K	222	Frick, J W	77	Grunwald, D	346
Elphick, C S	337	Friedman, N R	59	Gunderson, A R	35
Emerick, J C	367	Fuchs, J	41	Gutzwiller, K J	94
Emerson, R	368	Fuchs, J	192	-H-	
Eng, M	91	Fuchs, J	390	Ha, J C	328
Eo, S H	385	Fusani, L	s23	Hach,, S	13
Ericson, P G P	390	-G-		Hagerthey, S E	68
Eriksson, A-M	178	Gallagher, S W	160	Hahn, D C	7
Ervin, A M	324	Garcelon, D K	92	Haig, S M	129
Eshedagho, T	77	Garcelon, D K	162	Halfwerk, W	95
Esler, D	73	Garcia, V	225	Hall, J S	8
Estey, M E	69	Gardali, T	365	Hallinger, K K	399
Etterson, M A	66	Garvin, J C	106	Hallworth, M	175
Evers, D C	79	Garvin, M C	379	Hallworth, M	179
Ewert, D	350	Garvin, M C	5	Hames, R S	83
-F-		Gasner, M R	126	Hames, R S	230
Faccio, S D	341	Gavin, T A	105	Hamrick, R	244
Fahrig L	329	Gawlik, D E	49	Hanni, D	224
Fain, M G	408	Gawlik, D E	50	Hanni, D	17
Fain, M G	204	Gebhardt, K J	194	Hannon, S J	16
Farmer, A	206	Gehring, J L	209	Hansen, A J	p2
Farnsworth, A	230	Gentz, M C	336	Hansen, J	176
Fasina, F O	46	Germaine, S S	410	Harper R G	77
Fedy, B C	134	Geupel, G	2	Harris, J B C	413
Fedynich, A M	140	Geupel, G R	365	Hartman, C A	163
Fedynich, A M	373	Ghalambor, C K	56	Hartman, S A	23
		Ghalambor, C K	57	Haskell, D G	352

Hatch, M	370	Jacobsen, F	396	Kirkpatrick, C	326
Hatch, M I	382	James, D A	347	Kirkpatrick, C	s19
Haukos, D A	235	James, F C	189	Klaus, N	88
Heath, J A	118	James, H F	187	Klavitter, J	172
Heath, J S	164	James, H F	334	Klicka, J	113
Henry, A E	303	James, H F	p3	Klicka, J	355
Henry, A E	402	Jameson, R	144	Klicka, J	405
Heredia, F J	221	Jameson, R	240	Klicka, J	s01
Herring G	49	Jameson, R	346	Klicka, J	s03
Herring, H K	25	Jankowski, J E	126	Klicka, J	112
Hicks, T L	212	Jansen van Vuuren, B	392	Klicka, J	191
Hill, G E	97	Jehl, J R, Jr	303	Klicka, J	395
Hill, G E	212	Jehl, J R, Jr	402	Knopf, F L	219
Hill, G E	213	Jehl, J R, Jr	233	Kobza, R M	25
Hill, J R, III	212	Jensen, W E	93	Kobza, R M	68
Hindsley, C	144	Jensen, W E	317	Komar N	6
Hipfner, J M	351	Jensen, W J	103	Koopman, M E	19
Hobson, K A	107	Johnson K A	78	Koper, N	242
Hobson, K A	306	Johnson, B G P	30	Kosciuch, K L	10
Hochachka, W M	17	Johnson, J A	333	Kosciuch, K L	317
Hochachka, W M	67	Johnson, K D	344	Kosciuch, K L	318
Hofmann, C M	33	Johnson, K P	s12	Krakauer, A	s30
Hofmann, C M	359	Johnson, L A	220	Kremetz, D G	234
Holmes, A L	365	Johnson, L S	30	Kremetz, D G	366
Hooper M J	78	Johnson-Randall, L	94	Kremetz, D G	347
Horn, R I	305	Jones, C A	s21	Kress, J	s14
Houde, P	185	Jones, J D	343	Krosby, M B	136
Houde, P	408	Jones, K L	158	Kuehn, M J	121
Houde, P	204	Jones, L R	387	Kwon,E B	358
Howie, M G	369	Jones, S L	307	Kyle, K O	126
Howie, M H	369	Jones, Z F	243		
Hubbard, J K	302	Joyce, L A	19	-L-	
Huber, G H	99	Juiña, M	413	Lambert, J D	179
Huber, G H	363	Juliusson, L M	319	Lanctot R B	78
Huber, S K	4			Landeen, E A	354
Huizinga, M	58	-K-		Laniawe, L	172
Humphries, E M	188	Kaiser, S A	92	Lank, D	s32
Hunt, J H	82	Kaler, R S A	101	Lansing, J M	339
Hunter, M D	89	Karubian, J	39	Lantz, S M	50
Hurteau, S R	s18	Kazmer, K A	399	Lanyon, S M	405
Huss, M J	183	Keeley, W H	410	Lanyon, S M	s01
Hutto, R L	s17	Keenan, P C	198	Lanyon, S M	s05
Hutton K	224	Keith, R	s02	Lanyon, S M	406
Hylton, R A	84	Kelling, S	17	Larson, K W	306
		Kempema, S L F	241	Lattin, C	305
-I-		Kendall, W L	227	Lee K B	36
Ieno, E N	337	Kennedy, L	243	Lee, S I	358
Irestedt, M	192	Kenny, D A	396	Lehnen, S E	177
Irwin, D	389	Kerns, C K	218	Lelevier, M J	113
Irwin, D	s11	Kershner, E L	92	Lewin A	36
Irwin, D E	137	Kesler, D C	96	Lifjeld, J T	154
Isler, M L	114	Kiere, L M	359	Ligon, R	212
		Kim, D H	166	Ligon, R	213
-J-		Kim, D H	145	Lindberg, K L	404
Jablonski, B	115	King, A W	93	Lindberg M	102
Jacobsen, F	356	King, D I	124	Linder, E T	308

Link, W A	11	McCusker, C E	217	-N-	
Linkhart, B D	100	McDonald, D	s27	Nacci, D E	83
Lipowicz, H T	404	McDonald, M A	344	Nadeau, C P	65
Liu, I A	32	McDonald, M V	180	Nairn, C J	385
Liu, M	10	McFarland, KP	81	Naka, L N	127
Liu, M	97	McGowan, K J	223	Naugle, D E	42
Liu, P	76	McGraw, K J	36	Naugle, D E	43
Loesch, C R	69	McGraw, K J	34	Neale, R J	356
Loiselle, B A	157	McKay, B D	364	Neiman, M	109
Loiselle, B A	s29	McKinney, S T	200	Nemeth, N	6
Lokugalappatti, L G S	392	McKinney, S T	199	Newlon, K	s20
Lombardo, M P	53	McLaughlin, J	1	Newman, S	68
Lombardo, M P	362	McLean, R G	8	Nicodemus, A	135
Loos, E R	10	McNew, L B	338	Niemi, G J	66
Lotem A	195	Mendenhall, C D	323	Niemuth, N D	69
Lovett, I	s04	Mennill, D J	212	Niven, D K	11
Lovette, I J	s01	Mennill, D J	62	Noel, B L	214
Lovette, I J	312	Mennill, D J	213	Nooker, J	s31
Lovette, I J	405	Mennill, D J	381	Nooker, J K	325
Lovvorn, J R	73	Mercadante, A	54	Norris, D R	228
Lovvorn, J R	21	Mercadante, A	144	Norris, D R	351
Ludwick, T J	140	Mercadante, A	168	Norris-Caneda, K	109
Ludwick, T J	373	Mercadante, A	240	Noss, R F	340
Lukacs, P M	224	Mercadante, A	316	Nuechterlein, G L	120
Luscier, J D	386	Mercadante, A	346	Nur, N	365
Lyon, B	s13	Mercer, D M	129	Nuttle, T	90
Lyon, B E	142	Mettke-Hofmann, C	107		
		Mettler, R	332	-O-	
-M-		Mettler, R M	357	O'Brien,C	2
Macchi, L	206	Meyer, K M	109	Odom, K	212
Macchia, E T	208	Mezquida, E T	197	Oesterle, P T	8
Maddox, J D	27	Miles, A K	51	Oh, K P	153
Maley, J M	196	Miller, M J	113	Olbert, J	144
Malone, D G	367	Miller, P M	340	Olbert, J	54
Marks, B D	41	Mindel, D P	186	Olbert, J	240
Marks, B D	361	Moe, B	156	Olbert, J	316
Marra, P P	301	Mohamed, A E I	15	Olsen, B J	32
Marra, P P	350	Mooers, N	8	Olson S L	187
Marra, P P	228	Moore, C T	215	Omland, K E	33
Marra, P P	71	Moore, F R	379	Omland, K E	59
Martin, K	134	Moore, F R	5	Omland, K E	356
Martin, K	18	Moore, L	91	Omland, K E	359
Martin, K	55	Mordecai, R S	215	Omland, K E	396
Martin, T E	14	Morgan, G M	150	Oring, L W	163
Martin, T E	26	Moroni, M	182	Ortega, C P	176
Martin, T M	228	Mortensen, J L	128	Outlaw, D C	131
Marvel, K S	335	Morton, M L	321	Oviedo-Brenes, F	323
Marzot, V G	72	Moscoso, J	360	Owen, J C	5
Mattsson, B J	215	Moscoso, J	394	Owen, J C	379
Mauck, W M	s02	Moser, J M	355		
Mauck, W M, III	193	Moser, T J	227	-P-	
Mays, L H	400	Moyle, R G	41	Perot, A	13
McCleery, R	380	Mumme, R L	403	Packett, D L	229
McClung, M M	348	Munson, A	17	Panjabi, A O	159
McCracken K	102	Murphy, M T	388	Parchman, T L	197
McCready, R	159	Murphy, R K	218	Parker, P	157

Parker, P G	s29	Ralph, C J	397	Rose, A R	167
Parker, T H	40	Rankin, S	402	Rosenberg, K V	230
Parrish, J K	152	Rappole, J H	20	Rosensteel, R R	356
Pasquet, E	41	Rappole, J H	238	Ross, J D	108
Pasquet, E	110	Raudales, R	124	Rotella, J	s20
Pasquet, E	192	Ray, G	144	Rotenberry, J T	28
Pasquet, E	390	Ray, G	240	Rothstein, S I	317
Paxton, E H	45	Ray, G	346	Rowe, M	155
Payne, R B	s07	Redmond L J	388	Rubin, C S	218
Pearce, J	102	Reed J L	114	Ruiz-del-Valle, V	394
Pearson, S F	55	Reed, J M	337	Ruiz-del-Valle, V	360
Peele, A M	378	Reguera, R	394	Ruiz-Gutierrez, V	105
Peer, B D	77	Reichard, D G	63	Rush, A	389
Peer, B D	401	Reitsma, L R	179	Rush, S	91
Peer, B D	409	Reitsma, L R	175	Rush, S A	52
Peer, B D	343	Reitsma, L R	301	Rush, S A	52
Peer, B D	376	Remington, T E	133	Rush, S A	88
Peluc, S I	104	Renaud, C	345	Ruth, J M	245
Pereyra, M E	321	Rengifo, C	123	Ruvalcaba Ortega, I	159
Perez J H	146	Renner, S C	238	Ryba, A J	218
Perrigo, G H	140	Renner, S C	20	Ryder, T B	s29
Perrigo, G H	373	Rensel, M A	98		
Peterson A T	46	Reynolds, M H	172	-S-	
Peterson, B	132	Reynolds, R E	69	Saab, V	s20
Peterson, B	311	Ribic, C A	222	Sample, D W	222
Peterson, J T	215	Ricca, M A	51	Sandercock, B K	s31
Phillips, L	p2	Richman, S E	21	Sandercock, B K	78
Piper, W H	161	Ricklefs, R E	131	Sandercock, B K	101
Porzig, E L	365	Riedewald, M	17	Sandercock, B K	103
Possingham, H	228	Riegner, M F	31	Sandercock, B K	158
Post van der Burg, M	330	Ries, L	411	Sandercock, B K	206
Poulin, J-F	178	Riffell, S	244	Sandercock, B K	318
Pourtless, J A, IV	189	Rigby, E A	235	Sandercock, B K	325
Powell, A F L A	406	Rimmer, C C	81	Sanders, T A	149
Powell, G	194	Rimmer, C C	312	Santisteban, L	198
Powell, L A	241	Ring R	315	Sarver, S K	332
Powell, L A	342	Ripper, D L	160	Sauer, J R	11
Powers, M E	230	Ritchison, G K	305	Schacht, W H	241
Prather, J W	319	Ritland, C	134	Schacht, W H	342
Prather, J W	407	Rivers, J W	77	Schahl, J R	409
Prebyl, T J	338	Rivers, J W	317	Schlinger, B A	s23
Price, J J	59	Rivers, J W	318	Schnell, G D	12
Price, J J	359	Robbins, M B	391	Schoech, S J	98
Price, J J	63	Roche, E A	170	Schoech, S J	119
Price, T	s09	Rodewald, A D	87	Schoech, S J	143
Prito, R	76	Rodewald, A D	123	Schoech, S J	150
Pruett-Jones, S	64	Rodewald, A D	148	Schroeder, M R	375
Pruett-Jones, S	155	Rodewald, A D	177	Schroeder, M R	34
Puckett, H	244	Rodewald, A D	210	Schwabl, H	37
Pugesek, B H	353	Rodewald, P G	231	Schwabl, H	141
		Rodewald, P G	372	Schwertner, T W	140
-R-		Rodriguez, R L	335	Schwertner, T W	373
Raabe, J	77	Rohwer, F C	10	Scott-Morales, L	221
Rabenold, K N	126	Rohwer, S A	136	Seavy, N	172
Racicot, R A	190	Rolek, B R	212	Sedano, R	s02
Ralph, C J	207	Rolek, B W	213	Seddon, N	s10

Seddon, N	61	Sorokina, D	17	Thomas, J A	401
Sedinger, J S	164	Spellman, G M	112	Thorpe, P A	53
Sefc, K M	s07	Spellman, G M	332	Thorpe, P A	362
Segal, M T	121	Spellman, G M	395	Tibbitts, L	205
Seifert, M L	141	Spellman, G M	355	Titman R	102
Sekercioglu, C H	323	Spellman, G M	357	Tobias, J A	61
Serrano-Vela, J I	360	Spring, S E	51	Tobias, J A	s10
Serrano-Vela, J I	394	Sroka, J E	34	Toews, D P L	s11
Shaby, B A	17	St Leger, J	303	Tomback, D F	199
Shaffer, T L	218	Stanback, M	54	Tomback, D F	200
Shannon, C J	28	Stanback, M	144	Tomback, D F	339
Sharbaugh, S	315	Stanback, M	240	Tori, W	s29
Sharpe, P	162	Stanback, M	316	Tori, W P	157
Shaw, D W	315	Stanback, M	346	Torres-Dowdall, J	78
Shawkey, M D	10	Stanback, M	168	Torres-Dowdall, J	206
Sheckels, K M	404	Stanley, T R	70	Torres-Dowdall, J	58
Sheppard, J M	380	Stanley, T R	245	Townsend, A K	312
Sherry, T W	327	Steadman, D W	374	Trocki, C L	83
Shine, R	331	Steenhof, K	132	Trubey, R	124
Shizuka, D	142	Steenhof, K	311	Tsai, P-Y	313
Shull, H C	s07	Stein, A C	s08	Tsamajain-Shiwig, O	322
Shultz, A J	151	Stenger, J M	414	Tsamajain-Yagkuag, A	322
Shustack, D P	210	Stiver, J R	133	Tucker, J A	s21
Shutler, D	1	Stodola, K W	89	Tuff, T	165
Siegfried, D G	12	Stodola, K W	308	Tuhela, L	375
Siepelski, A	s15	Stolen, E D	226	Tyre, RA	330
Sillett, T S	104	Stoleson, S H	90		
Sillett, T S	56	Stone, K	310	-U-	
Sillett, T S	57	Stouffer, P C	127	Uy, J A C	s08
Silverman, M N	100	Strand, A E	109		
Simons, T A	84	Strong, C	127	-V-	
Skagen, S K	70	Strum, K	206	Van Riper, C, III	2
Skipper, B R	145	Strum, K M	78	Vanden Berge, J C	380
Skradep, P D B	117	Studds, C	350	VanderWerf, E A	106
Slabbekoorn, H	95	Sturge, R J	356	Varian, C W	39
Slagsvold, T	169	Stutchbury, B J M	91	Varland, D E	183
Sly, N D	312	Sullivan, K A	377	Vekasy, M S	172
Smith, A C	329	Super, P	2	Vercauteren, T	160
Smith, B T	191	Swaddle, J P	302	Vetter, J	106
Smith, C	182	Swaddle, J P	35	Villard, M-A	13
Smith, C N W	9	Swanson, D L	324	Villard, M-A	178
Smith, J	301	Swanson, H M	319	Vitz, AC	87
Smith, J L	152	Swanson, H M	407		
Smith, K G	348	Swift, T L	16	-W-	
Smith, K G	386	Swinnerton, K J	106	Waits, L P	194
Smith, L A	34	Swiston, K A	212	Walker, B L	42
Smith, M	244	Swiston, K A	381	Walker, B L	43
Smith, R J	370			Walker, D	242
Smith, R J	371	-T-		Wall, B	77
Smith, R J	382	Taft, B N	60	Walsh, J J	165
Smith-Castro, J R	148	Taylor, D R	109	Walsh, J J	319
Sofaer, H R	57	Taylor, R J	81	Walters, J R	s22
Sofaer, H R	58	Temeles, E J	s14	Walters, J R	32
Sogge, M K	45	Tewksbury, J J	121	Walters, J R	181
Sorensen, M C	351	Therrien, R E	401	Walters, J R	96
Sorenson, M D	s07	Thibault, J-C	110	Wang, J M	10

Wanner, C E	410
Ward, M P	217
Warkentin, I	182
Warnock, N	205
Washburn, A	109
Wassenaar, L I	306
Wear, E	77
Weatherhead, P J	27
Webster, M	37
Webster, M S	39
Webster, M S	141
Welch, A J	334
Welsh, C J	393
Weng, Y- S	400
White, C L	171
White, C L	236
White, C M	335
White, J D	94
White, M L J	15
Whitehorne, I	415
Whittingham, L A	154
Wiebe, K L	169
Wilcoxon, T E	143
Wilken, T A	40
Williams, R A J	46
Williams, A J	5
Williams, A J	379
Williams, C K	103
Wilson, A G	116
Wilson, S	18
Winger, B	s04
Winker, K	112
Winker, K	113
Winker, K	188
Winker, K	196
Winter, M	67
Wisely, S	s31
Wisely, S M	158
Wisely, S M	338
With, K A	93
Wolfe, J D	397
Wolfe, J D	207
Woodrey, M S	52
Woodrey, M S	52
Woolfenden, G E	147
Wright, N A	374
Wunder, M B	219
Wunder, M B	233
Wunder, M B	232
Wunderle, J	350

-Y-

Yoon, J	56
Yoon, J	57
Yoon, J	58
Yoon, J	104

Yuan, H-W	313
Yuan, H-W	400
-Z-	
Zabransky, D J	399
Zaccagnini, M E	78
Zalat, S	15
Zamora, J	360
Zamora, J	394
Zehnder C B	89
Zimmerman, G S	227
Zuur, A F	337
Zygo, L M	94