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Abstracts

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PLENARY TALKS

Plenary 1. Bock

Ernst Mayr at 100: a reflection on a life inside and outside of ornithology. **WALTER BOCK**, *Biol. Sci., Columbia Univ., New York, NY*.

With his birth in 1904, Ernst Mayr is truly a biologist of the 20th century, having published his first paper in ornithology 80 yr ago. Several recent ornithologists have reached their 100th birthday, but to my knowledge none before Mayr will have a book published on this milestone. His career in biology is marked by a series of most fortunate chance-based events starting with his 1923 observation of pair of Red-crested Pochards in Germany, and his ability and hard work to make the most of each one of these chances. This series of chances led him to graduate work with Professor Erwin Stresemann in Berlin, an expedition to New Guinea and the Solomon Islands, a position at the American Museum of Natural History, and finally to one of the principle architects of the Evolutionary Synthesis, all within 20 yr. He went from a successful career in systematic ornithology to an equally successful one as an evolutionary theorist, then to one as a historian of biology and finally to one as a philosopher of science. Of special interest is the assessment and comparison Mayr's work inside of ornithology with that outside of ornithology and a consideration of their mutual influence. During his long career since receiving his Ph.D. in 1926, Ernst Mayr has influenced the careers of many ornithologists and it is fair to say that if he had not observed that pair of ducks in 1923, many of us would not be here discussing his contributions to science.

Plenary 2. Hobson

From birds to butterflies: making connections with stable isotopes. **KEITH A. HOBSON**, *Prairie & Northern Res. Centre, Canadian Wildl. Serv., Saskatoon, SK*.

The last decade has seen an exponential growth in the application of stable isotope measurements to avian and other wildlife investigations. Three areas of particular significance involve applications to dietary reconstructions, linking breeding, wintering, and migratory stopover locations, and the quantification of endogenous vs. exogenous nutritional inputs to reproduction. In this plenary, I will review these applications with particular emphasis on the use of isotopic measurements of the light elements (C, N, O, H and S) and will cover recent studies conducted on several continents and involving a diverse array of taxa. Dietary applications involve the delineation of source of feeding and trophic interactions among individuals and species (using primarily ^{13}C , ^{15}N , ^{34}S) including the tracing of frugivory in resident and migratory populations. The investigation of connectivity between breeding and wintering populations relies primarily on the use of deuterium isotope measurements of feathers in North America and on the use of $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ measurements of tissues in trans-Saharan migrants from Europe. Together with genetic and trace element analyses, this approach promises to relieve some of the disadvantages of traditional mark-recapture approaches to tracking migratory wildlife and has been applied to organisms as small as monarch butterflies. The quantification of the allocation of nutrient reserves to eggs by laying females using stable isotope measurements (primarily ^{13}C , ^{15}N , ^{34}S) of endogenous and exogenous reserves promises to shed new light on the evolution of life history traits involving the capital vs income continuum. While all of these recent advances herald an exciting future for isotopic applications to avian studies, as with all new techniques it will be important to establish cautions and caveats to guide our research.

Plenary 3. Parker

Behavioral ecology and infectious disease in island endemics. **PATRICIA G. PARKER**, *Dept. Biol., Univ. Missouri - St. Louis and St. Louis Zoo, St. Louis, MO*.

Studies of Galápagos birds reveal marked variation in mating system and social organization among island populations for some species, and among individuals within populations for others. These studies have produced information on variation in rate of physical interactions among individuals, and rates of gene flow among island populations for several endemic species. Such population data have provided a strong background against which to interpret new data on the distribution, prevalence, and transmission of infectious disease organisms and parasites on the islands; data on the disease organisms, in turn, inform the original inquiry into mating systems and mate choice with meaningful indices of individual quality. Significant relationships exist among habitat

quality and social group size (negative), group size and parasite load (positive), parasite load and host body condition (negative), group size and condition (negative), and population size and genetic diversity (positive); strikingly, the strongest predictor of parasite load is genetic diversity (negative). Conservation implications of this work are large; to date, our studies of native and introduced dove species do not implicate exotics as sources of pathogens, although much work remains. Recent focus on avian pox likewise reveals that the domestic chickens on inhabited islands have a very different poxvirus than that in the endemic passerines on the same islands. Modern genetic and phylogeographic approaches allow unprecedented resolution in understanding the history of interactions among hosts and pathogens, and their dependence on population structure, behavior, and ecology.

Plenary 4. Piersma

Migration: negotiating variable ecological paths through space and time. **THEUNIS PIERSMA**, *Animal Ecol. Group, Centre for Ecol. & Evol. Studies, Univ. Groningen, and Dept. Marine Ecol. & Evol., Royal Netherlands Inst. Sea Research (NIOZ), Texel, The Netherlands.*

Seasonal migration, the phenomenon that birds commute between parts of the world where they do not reproduce to areas where they do, is a massive phenomenon that has attracted enormous ornithological attention. In this presentation I aim to focus on the details of the ecological conditions encountered by shorebirds, champion long-distance migrants, in the course of their seasonal migrations. A further focus will concern the 6 subspecies – and flyways – of Red Knots *Calidris canutus*, whose migrations provide a model system for studies on how habitat quality shapes avian itineraries. Red Knots are a suitable model species because of their stark diet and habitat specialization, which restricts their occurrence outside the breeding season in the High Arctic to open coastal intertidal wetland habitats, and their diet to hard-shelled molluscs and crustaceans. Red Knots are amenable to studies in captivity and this has enabled us to quantify the relationships between environmental conditions, time budgets, levels of energy expenditure, prey quality and quantity and relevant features of the digestive tracts. I hope to show how food quality determines fueling rates and how this is reflected in the use, and the timing of this use, of staging sites en route between southern nonbreeding and breeding areas in the far north.

SYMPOSIUM PAPERS

s01 Lein

Ernst Mayr as a life-long naturalist. M. ROSS LEIN, *Dept. Biol. Sci., Univ. Calgary, Calgary, AB.*

Ernst Mayr last attended a meeting of the American Ornithologists' Union in 1983, and several generations of ornithologists know him only through his publications. Student (and younger non-students) probably associate his name primarily with the "Biological Species Concept" that he has championed for >60 yr, or identify him as an architect of the "New Synthesis" that revolutionized thinking about evolution in the 1940s. Those with a theoretical or historical bent will be familiar with his contributions to the history and philosophy of biology exemplified by **The growth of biological thought** (1982), **Toward a new philosophy of biology** (1988) and **One long argument** (1991), all published after Mayr's "retirement". Older members will remember his early contributions to avian systematics and biogeography (something that has come full circle with the recent publication of **The birds of northern Melanesia** (2001) by Mayr and Jared Diamond). Many of Mayr's writings express his deep admiration of Charles Darwin, and argue that Darwin's contributions resulted, in no small measure, from the fact that he was a naturalist who was fascinated with, and stimulated by, the immense diversity of life in the world around him. I argue that, in addition to his well-deserved recognition as ornithologist, systematist, evolutionist, historian, and philosopher, Ernst Mayr is a naturalist in the Darwinian tradition. To support this thesis I present evidence including accounts of his early activities and his interactions with "amateur" ornithologists (especially youthful ones), a content analysis of one of his seminal works, and on the careers and personal experiences of the graduate students that he supervised. I conclude that he meets Futuyma's definition of a naturalist as "a person who is inexhaustibly fascinated by biological diversity, and who does not view organisms merely as models, or vehicles of theory but, rather, as the [thing] . . . that excites our admiration and our desire for knowledge, understanding, and preservation".

s02 Vuilleumier

Ernst Mayr's first and last interests – biogeography of birds. FRANÇOIS VUILLEUMIER, *Am. Mus. Nat. Hist., New York, NY.*

For 75 yr, from his 1926 Ph.D. thesis on the range expansion of the Serin *Serinus serinus* in Europe to the book he co-authored in 2001 with Jared Diamond, **The birds of northern Melanesia**, Ernst Mayr has been interested in biogeography in general, and of birds in particular. Evolutionary biologists probably think that Mayr's most substantial contributions to 20th Century biology are his views on species and speciation and historians of science are likely to consider **The growth of biological thought** as his masterpiece. Ornithologists must make it clear that another of Mayr's contributions to biological thought consists of his numerous publications on biogeography, which together form an impressive body of work. Unfortunately, however, Mayr did not publish a book-length synthesis on biogeography that is comparable in its sweeping vision to those he wrote on speciation and the history of biology. Hence his biogeographical ideas remain scattered in the journals in which they were originally published, with the notable exception of the recent book he co-authored with Diamond. From the very beginning of his ornithological career as a student in Berlin to beyond his retirement, Mayr wrote prolifically about this field. His ideas, and their historical and chronological development, are reviewed, to put his fascination with geographical distribution and its causes in a proper perspective. Although Mayr started thinking about biogeography from a continental point of view (the Serin in Europe), his focus shifted rather quickly to islands and archipelagos. It seems clear that his lifelong preoccupation with the geographical origins of the biota of islands was inspired, first by the writings of authors like Darwin and next by the direct influence of scientists like Erwin Stresemann and Bernhard Rensch. His own fieldwork in New Guinea and the Solomon Islands brought about the direct confirmation that islands are natural laboratories of evolution, and that the key to unraveling biogeographical histories should be sought in insular distribution patterns. Mayr thus examined the distribution of birds in Polynesia, Indonesian islands like Timor and Sumba, and the archipelagos of Melanesia. As Mayr did not return to the field after his own work in the sw. Pacific in the 1920s, his empirical research was based on the study of the collections at AMNH. Mayr's interests in biogeographical concepts encompassed the entire range of topics that are still current today, including range expansion, colonization, dispersal, faunal turnover, faunal elements, faunal buildup, ecological displacement due to competition, continental drift and plate tectonics, and extinction.

s03 LeCroy

Ernst Mayr as the Whitney-Rothschild Curator at the American Museum of Natural History MARY LeCROY, *Am. Mus. Nat. Hist., New York, NY.*

Sagacious planning by Leonard C. Sanford and a number of lucky coincidences that occurred in the 1920s and 1930s at the American Museum of Natural History led to Ernst Mayr's arrival in New York in 1931 as a Research Associate, his appointment in 1932 as Associate Curator of Birds, and in 1935 as Curator of the Whitney-Rothschild Collections in the Department of Ornithology. Mayr's publication in 1942 of **Systematics and the origin of species** was a synthesis of his years of study of the Whitney South Sea Expedition collections, the Rothschild Collection, and other collections from the southwest Pacific. I will present some of the historical background relating to this period at the American Museum. Special attention will be given to the central role of Leonard C. Sanford for the development of the Bird Department, American Museum of Natural History, during the first half of the 20th Century and for Ernst Mayr's work in the American Museum.

s04 Schodde

Ernst Mayr and southwest Pacific birds: inspiration for ideas on speciation. RICHARD SCHODDE, *Australian Biol. Res. Study, Environment Australia, Canberra, Australia.*

When circumstance landed Ernst Mayr at the American Museum of Natural History in 1931, it was to work on the systematics of sw. Pacific birds. That region, which stretches from east Indonesia through Melanesia to s. Micronesia, Polynesia and Australia - New Zealand, holds a bird fauna of some 2000 species, with more endemic families (ca. 30) than any other region on earth. Moreover, its archipelagic nature has fostered such vast and complex allopatric speciation that Ernst Hartert could say to Mayr in 1925: "there is no other place in the world more favorable for the study of speciation in birds." The collections at Mayr's disposal were unrivalled for such research. The huge Whitney collections, gathered systematically from archipelagic Melanesia, Micronesia and Polynesia through the 1920s into the 1930s, came from islands hardly touched before by ornithological exploration; and the Rothschild collection from Tring, of 280,000 skins sold and sent to the American Museum in 1932,

was then the most representative collection of birds in the world. It filled major gaps for New Guinea, the Indonesian archipelagos and Australia. This fortuitous coincidence, of superlative, barely researched collections from one of the most bird diverse regions on earth, offered unsurpassed potential for not just base-line faunal revision and inventory but also for developing and testing ideas about species evolution, species concepts and biogeographic principles. It was a challenge tailor-made for Mayr's intellect and energy. His early empirical work on the collections, producing nearly 200 revisionary papers, 26 new species and over 400 subspecies, provided the platform for imposing theoretical contributions later to speciation theory, evolutionary processes and zoogeographical interpretation, ushering in modern thinking about them. It was through Mayr, more than anyone else, that the biological species became established as a focal concept in biology, with broad application in population genetics and ecology as well as taxonomy. And this theoretical phase in turn provided the base for Mayr's historico-philosophical phase that followed. Because of the avifauna in which he worked, the collections available to him, and his own intuitive perception and extraordinary capacity for synthesizing information into unified ideas, Mayr was the right man in the right place at the right time.

s05 Buehler, Confer & Canterbury

Update on the U.S. Fish and Wildlife Service Status Assessment for the Golden-winged Warbler. DAVID A. BUEHLER, *Dept. For. Wildl. & Fish., Univ. Tennessee, Knoxville TN*, JOHN L. CONFER, *Dept. Biol., Ithaca Coll., Ithaca, NY*, and RON A. CANTERBURY, *Dept. Biol., Concord Coll., Athens, WV*.

We have conducted a status assessment of Golden-winged Warbler populations rangewide in an effort to identify the key threats to population viability for this species. Based on this review, in the southern Appalachians in the se. U.S., habitat loss is the primary concern because of a limited supply of early successional habitat. In the ne. U.S., habitat loss and hybridization with Blue-winged Warblers appear to be primary threats. Populations in Minnesota, Wisconsin, Michigan, and Ontario are more abundant, although recent population trend data suggest these populations may be declining as well. Declining populations in the ne. U.S. and in the se. U.S. may ultimately lead to isolated populations, cut off from the major breeding center in the Great Lake States. This isolation may have serious consequences for population viability of this species.

s06 Roth

Golden-winged Warbler habitat associations in Wisconsin. AMBER ROTH, *Wisconsin Dept. Nat. Res., Rhinelander, WI*.

Golden-winged warblers are declining in Wisconsin by 2.2%/yr and across the U.S. by 3.6%/yr according to Breeding Bird Survey data from 1966 - 2002. Concerns over their decline have led to the need to better identify their habitat associations for local and regional management planning. The Wisconsin Breeding Bird Atlas and the Golden-winged Warbler Atlas Project provide statewide datasets on habitat use by Golden-winged Warblers in Wisconsin. These programs used different habitat classification systems and data reporting methodologies that result in limitations in data interpretation. Results from both datasets generally concurred on Golden-winged warbler habitat preferences in Wisconsin. Problems of applying these conclusions on a regional scale and the associated management challenges will be discussed.

s07 Bulluck & Buehler

The distribution and demographics of Golden-winged Warblers in the Cumberland Mountains of Tennessee. LESLEY P. BULLUCK and DAVID BUEHLER, *Dept. For. Wildl. & Fish., Univ. Tennessee, Knoxville TN*.

Early successional habitats are becoming scarce due to suppression of disturbances. As a result, disturbance-dependent species such as the Golden-winged Warbler are experiencing significant population declines. Extensive coal mining in the Cumberland Mountains of Tennessee has created an abundance of suitable breeding habitat for this species. The patches of early-successional habitat are located within a matrix of contiguous forest, a configuration that mimics natural disturbance at the landscape scale. Furthermore, Blue-winged Warblers and Brown-headed Cowbird parasitism are nearly absent in the Cumberland Mountains of Tennessee. The main objectives of my research are to (1) document the spatial distribution of this species in the region and (2) measure several demographic parameters such as breeding productivity (via nest success), return rates, pairing success, and feeding rates. During the breeding season of 2003 I located 100 territories of singing males, 3 of which were Brewster's Warblers. 59 of these individuals were located on reclaimed

surface mines: 17 were reclaimed before 1988 and 29 were reclaimed before 1998. 11 individuals were found on reclaimed deep mine sites, 13 on coal haul-roads, 3 in utility rights-of-ways and 5 on timber harvest sites. Nesting success was 50% during this same year ($n = 12$). These results indicate that Golden-winged Warblers are associated with reclaimed mine sites in this region and particularly mine sites that were reclaimed between 6 - 20 yr ago. Succession occurs slowly following mining activity due to the poor soils, and current reclamation procedures involve the planting of non-native species that delay the colonization of native forbs and shrubs. With proper management, the current distribution and abundance of reclaimed mine sites in this region may maintain a viable breeding population of essentially pure Golden-winged Warblers in one of the most southerly extremes of its range.

s08 Canterbury

A long-term (17-year) analysis of Golden-winged Warbler populations in the southern West Virginia coalfields. RON CANTERBURY, *Dept. Biol., Concord Coll., Athena, WV.*

The Golden-winged Warbler is a rapidly vanishing songbird throughout much of its range, including the Appalachians. The causal agents of decline have been studied with some linkage to expanding Blue-winged Warblers. In this study, I examined changes in Golden-winged Warbler populations at the time of initial contact with expanding Blue-winged Warblers, and assessed populations during advancing age of secondary contact. I compared territoriality, habitat preference, and reproductive success of Golden-winged Warblers in allopatry and sympatry with Blue-winged Warblers in the coalfields of s. West Virginia. Data and analyses from 17 yr of research disclosed an average annual return rate of 16% for adult male Golden-winged Warblers, but relatively high reproductive success (long-term average of 61%). Comparative analyses of populations in different ages of secondary contact showed rapidly vanishing Golden-winged Warbler populations and virtual replacement by Blue-winged Warblers within 5 yr in lowland sites. On the other hand, a stable coexistence with relatively long-term contact ($n = 13$ yr) was evident in upland populations. Logistic regression analysis and modeling documented that elevation and slope were significant predictors of Golden-winged Warbler density and nesting success, while proximity of unmated, male Blue-winged Warblers negatively affected reproductive success in upland Golden-winged Warblers. Mechanisms of species displacement were noted and GIS was used to assess habitat features of source populations.

s09 Confer & Serrell

Sink and source habitat for Golden-winged Warblers. JOHN L. CONFER and REBECCA SERRELL, *Dept. Biol., Ithaca Coll., Ithaca, NY.*

This decline of the Golden-winged Warbler (GWWA) in the ne. U.S. is largely due to a loss of habitat as shrubland fields become forests. However, extirpation has occurred in many regions where suitable habitat remains following range intrusion by the Blue-winged Warbler (BWWA). Southern New York and especially Sterling Forest State Park (SFSP) is the only region where GWWA and BWWA have coexisted for over 50 yr with documentation by peer-reviewed literature and here they have co-existed for over 100 yr. At SFSP, GWWA and BWWA nest in close proximity in upland sites with old field succession and in managed shrubland sites under utility rights-of-way. These habitats are like extensive areas in the northeast where the presence of BWWA is associated with GWWA extirpation. At SFSP, GWWA also nest in swamp forest, which is rarely utilized by BWWA. Our studies test if the presence or absence of BWWA, and the subsequent hybridization and competition, determine if a habitat supports sink or source populations of GWWA.

s10 Kubel & Yahner

Breeding ecology of the Golden-winged Warbler in central Pennsylvania, with special reference to habitat management and forest cover type. JACOB E. KUBEL and RICHARD H. YAHNER, *School Forest Res., Pennsylvania State Univ., University Park, PA.*

Suppression of natural disturbances may cause the Golden-winged Warbler, a declining species dependent on early successional habitats, to rely on anthropogenic disturbances for breeding habitat. We assessed habitat quality (via warbler density and reproductive success) among 3 anthropogenic habitats (1-ha clearcuts, a wide powerline right-of-way, and a narrow powerline right-of-way) and between 2 cover types (aspen and oak) at State Game Lands 176 in central Pennsylvania. We observed 38 and 41 warbler territories in 2002 and 2003, respectively. Density did not differ between the clearcuts and wide right-of-way. However, distribution was restricted to aspen cover, where open patches of goldenrod commonly occurred within dense shrub thickets (oak cover lacked

such patches). No warblers were detected on the narrow right-of-way, despite presence of goldenrod patches. Due to differences in nest depredation rates, nest success (60% vs. 21%) and productivity (2.41 vs. 0.94) were greater in the clearcuts than in the wide right-of-way. Our results suggest that clearcutting may provide better habitat for golden-winged warblers than maintenance of powerline rights-of-way, but success of habitat manipulation can depend on forest cover type and predator abundance.

s11 Fraser, Friesen & Robertson

Mixed-paternity broods indicate we may be underestimating levels of hybridization between Golden-winged and Blue-winged Warblers. RACHEL FRASER, VICKI L. FRIESEN and RALEIGH J. ROBERTSON, *Dept. Biol., Queen's Univ., Kingston, ON.*

Extra-pair paternity was assessed in a population of Golden-winged Warblers (*Vermivora chrysoptera*) using microsatellite DNA. Mixed-paternity broods indicate that female *chrysoptera* engage in both within- and extra-pair copulations. The occurrence of extra-pair paternity in a population of *chrysoptera* could have implications for the ongoing hybridization with Blue-winged Warblers (*V. pinus*) if heterospecifics are chosen by females. Such mate recognition errors are not unexpected between closely related species that share behaviours associated with mate choice, or when costs associated with producing hybrid offspring are low. Morphometrics, parasite load, age of males and proximity to females were examined to determine their effect on mate-choice decisions. Matings between *chrysoptera* and *pinus* occur in all areas of sympatry suggesting they sometimes see each other as conspecifics. Our assessment of hybridization based on pairbonds may therefore underestimate the level of introgressive hybridization in a given area.

s12 Rosenberg & Barker

Present-day hybrid zone and rangewide population status of Golden-winged Warbler. KENNETH ROSENBERG and SARA BARKER, *Lab. Ornithology, Cornell Univ., Ithaca, NY.*

With an estimated breeding population of 105,000 - 270,000 pairs, the Golden-winged Warbler (GWWA) is among the most vulnerable and steeply declining of North American passerines. Using a tape-playback protocol, birders and biologists in 16 U.S. states and 3 Canadian provinces surveyed for GWWA, Blue-winged Warblers (BWWA), and their hybrids in 2000 - 2004, as part of the Golden-winged Warbler Atlas Project (GOWAP). Hybrids occur in a zone at roughly 44° N latitude across Minnesota, Wisconsin, Michigan, s. Ontario and n. New York, as well as in and around a now-disjunct band of populations in the Appalachians from s. New York to n. Georgia. Pure GWWA populations occur north of this hybrid zone, but recently expanding populations in Ontario may have reached their northern limit, and the future of these northern populations (where 80% of the species occurs at present) is highly uncertain because of continued BWWA expansion. GWWA exploits a wide range of ephemeral habitats, including abandoned farmland, aspen clearcuts, beaver-mediated shrub wetlands, abandoned strip-mines, and utility rights-of-way, all of which will require focused management to sustain populations into the future. Important concentrations persist in the Cumberland Mountains region of West Virginia and Tennessee. Roughly 250 pairs in w. North Carolina may be the only Appalachian population to escape contact with BWWA; other Appalachian populations are rapidly declining. Conservation of GWWA may rely on protection or management of "safe haven" sites where GWWA persist in sympatry with BWWA with limited or no hybridization.

s13 Patton, Maehr & Larkin

Habitat of the Golden-winged Warbler and Blue-winged Warbler on reclaimed surface mines in eastern Kentucky. LAURA L. PATTON, DAVID S. MAEHR and JEFFERY L. LARKIN, *Dept. Forestry, Univ. Kentucky, Lexington, KY.*

The Golden-winged Warbler in Kentucky was considered rare and restricted to the higher elevations (>1220 m) of Black Mountain. In recent years, several territorial males have been observed during the breeding season on reclaimed surface mines at lower elevations (393 - 783 m) in se. Kentucky. Our research focuses on use of reclaimed surface mines by the Golden-winged Warbler and Blue-winged Warbler. We examine habitat use at 2 scales: the individual territory and the area of group use. Habitat variables are compared between areas used by Golden-winged and Blue-winged Warblers to identify the conditions that promote Golden-winged Warbler occupancy while discouraging use by the Blue-winged Warbler and potential competition and hybridization. Surface mining has created approximately 219,000 ha of reclaimed, early successional habitat in Kentucky since 1984. Suitably reclaimed mine lands may become a valuable habitat for the Golden-winged Warbler and

facilitate colonization by a species that has experienced declines throughout most of its historical range.

s14 Will, Paulios & Thogmartin

Setting population and habitat objectives for Golden-winged Warbler conservation in the upper Midwest. TOM C. WILL, *U.S. Fish & Wildl. Serv., Fort Snelling, MN*, ANDY T. PAULIOS, *Wisconsin Dept. Nat. Res., Madison, WI*, and WAYNE E. THOGMARTIN, *USGS Upper Midwest Environ. Sci. Center, La Crosse, WI*.

The 2004 Partners in Flight *North American Landbird Conservation Plan* estimates the global population of Golden-winged Warblers at only 212,000 breeding adults. The Plan places the species with 20 others on its Watch List with multiple causes for concern across their entire range, recommends immediate action, and sets an objective of doubling the continental population of GWWA over the next 30 yr. Since Minnesota harbors an estimated 42% of the global population, it has a substantial stewardship potential for meeting the Plan objective. However, extrapolating from local point counts in 3 national forests, researchers at the Natural Resources Research Institute in Duluth estimate the Minnesota population alone at about 450,000 and stable. Given that the species is perceived as common and not declining in the state, planners are reluctant to commit to doubling the population at the expense of interior forest species. In addition, management for early succession aspen habitat has been proposed as a strategy for increasing the GWWA population, but a northern forest systems management plan based on historical range of natural variation and endorsed by many partners recommends reductions in this habitat type. We review and evaluate population and habitat association models for the species including data from an a priori hierarchical statistical landscape model, the Cornell Golden-winged Warbler Atlas Project, and local site-based studies in an attempt to provide a comprehensive framework for recommending specific conservation actions for the species in Minnesota and Wisconsin within the context of competing forest management alternatives.

s15 Neville, Fraser & Robertson

Sex ratios in Golden-winged Warbler nestlings: is there evidence of a cost to hybridization? KATE NEVILLE, RACHEL FRASER and RALEIGH J. ROBERTSON, *Dept. Biol, Queen's Univ., Kingston, ON*.

The primary sex ratio of a population of Golden-winged Warblers in e. Ontario was examined for potential bias. Although Fisher proposed that frequency-dependent selection should maintain a 50:50 ratio of males to females, recent studies indicate that sex ratio skews often occur. Haldane suggested that if one sex of a hybrid is inviable or infertile, it will be the heterogametic sex. Thus, in birds, if hybrid offspring suffer reduced viability, we would expect the heterogametic females to have lower survival and the sex ratio would be male-biased. As Golden-winged Warblers interbreed with Blue-winged Warblers, Haldane's Rule may apply. Conversely, if hybrid females perceive themselves to be of low quality, we would expect a female-biased sex ratio, based on the Trivers-Willard hypothesis that females in poor condition will produce more females (which have less variance in reproductive success). However, sex ratio skews could be attributed to other factors, including environmental factors and breeding systems, thus could illuminate selective pressures. The offspring sex ratio of the study population exhibited no deviation from unity, thus indicating that male and female young are equally viable. Moreover, there was no deviation from expected proportions of male and female offspring within nests based on the phenotype of mothers, social fathers, or genetic fathers (hybrid/introgressed vs. pure Golden-winged Warblers). This study corroborates the power of Fisher's Principle, as an example of a population where the sex ratio is maintained at parity.

s16 McEachen, Wilson, Aubry & Seutin

A molecular genetic assessment of the genus *Catharus*. TARA McEACHEN, PAUL WILSON, *Nat. Res. DNA Profiling Centre, Biol. Dept., Univ. Trent, Peterborough, ON*, YVES AUBRY, *Canadian Wildl. Serv., Sainte-Foy, QC* and GILLES SEUTIN, *Biodiversity Div., Parks Canada, Gatineau, QC*.

North American *Catharus* thrushes are very similar morphologically. One of the species, Bicknell's Thrush (*Catharus bicknelli*), was treated as a sub-species of the Gray-cheeked Thrush (*Catharus minimus*) until 1995 when the American Ornithological Union granted it full species status based on a taxonomic report by Henri Ouellet that analyzed morphological, biochemical, and vocal traits. The objective of our study was to evaluate phylogenetic relationships within North American *Catharus*, in particular to determine whether *C. bicknelli* and *C. minimus* were distinct species using mitochondrial DNA. Our sample included: Bicknell's Thrush, Gray-cheeked Thrush, Veery (*C. fuscescens*), Swainson's Thrush (*C. ustulatus*) and Hermit Thrush (*C. guttatus*), as well as an

outgroup Wood Thrush (*Hylocichla mustelina*). Bicknell's Thrush, Gray-cheeked Thrush and the Veery formed a tight phylogenetic cluster and, although the former 2 are confirmed as distinct species, they are not each others closest relatives.

s17 Wilson, McEachen, Aubry, Seutin, Busby, Rimmer & McFarland

Conservation genetics of Bicknell's and Gray-cheeked Thrushes. PAUL WILSON, TARA McEACHEN, *Nat. Res. DNA Profiling Centre, Biol. Dept., Univ. Trent, Peterborough, ON*, YVES AUBRY, *Canadian Wildl. Serv., Sainte-Foy, QC*, GILLES SEUTIN, *Biodiversity Div., Parks Canada, Gatineau, QC*, DANIEL BUSBY, *Canadian Wildl. Serv., Sackville, NB*, CHRISTOPHER C. RIMMER and KENT P. McFARLAND, *Vermont Inst. Nat. Sci., Woodstock, VT*.

We undertook DNA-based assessments of phylogeographic structure, levels of gene flow and genetic diversity at different geographic scales in Bicknell's and Gray-cheeked Thrushes. Blood samples were collected primarily from Québec, with additional samples from Nova Scotia, Newfoundland, New England and wintering areas in Cuba. Genetic connectivity and levels of genetic variation were assessed using mitochondrial DNA and microsatellite loci. Additional objectives included identifying the number of distinct subpopulations and to identify specific migration events among the different subgroups. Whereas gene flow provides an indirect measure of historic levels of gene flow, individual-based genetic assignment tests provide an estimate of current movements and identify directional movements among groups. Results on the metapopulation structure of these species with an emphasis on Bicknell's Thrush will be presented. A genetic assessment of the Bicknell's Thrush is particularly important in view of its status as a species of special concern in Canada.

s18 Rimmer, McFarland, Evers, Aubry, Busby & Taylor

Mercury levels in Bicknell's Thrush and other insectivorous passerines in montane forests of the northeastern United States and Canada. CHRISTOPHER C. RIMMER, KENT P. McFARLAND, *Vermont Inst. Nat. Sci., Woodstock, VT*, DAVID C. EVERS, *Biodiversity Res. Inst., Gorham, ME*, YVES AUBRY, *Canadian Wildl. Serv., Sainte-Foy, QC*, DANIEL BUSBY, *Canadian Wildl. Serv., Sackville, NB*, and ROBERT J. TAYLOR, *Texas A&M Univ., College Station, TX*.

Despite well-documented negative impacts of elevated methylmercury (MeHg) toxicity on wildlife populations, few data exist on mercury (Hg) burdens in terrestrial, migratory passerine birds. We examined Hg blood and feather levels in 4 terrestrial passerines of montane forests in the ne. U.S. and adjacent Canada, focusing on Bicknell's Thrush. All 4 species had MeHg:total Hg ratios of nearly 1:1, indicating a high withdrawal of MeHg in blood from the total Hg consumed. At the 2 most intensively sampled sites, Stratton Mt. and Mt. Mansfield in Vermont, Hg blood levels of Bicknell's Thrush were significantly higher at the southern site (Stratton), reflecting higher modeled atmospheric Hg deposition patterns at this site. Among all sampling sites, Hg blood and feather concentrations were highest at the southernmost site (Stratton) and lowest at the northernmost site on Québec's Gaspé Peninsula. Blood Hg levels of Bicknell's Thrush on the species' Greater Antillean wintering grounds were significantly higher than levels in North America, suggesting the existence of a pulse in Hg deposition during winter. Among breeding sites, male Bicknell's Thrushes had significantly higher mean blood Hg levels (0.111 ppm \pm 0.05 SD) than females (0.094 ppm \pm 0.04 SD). Feather Hg data were significantly higher in birds >2 yr old than in yearlings, suggesting chronic accumulation with age. However, in 20 known-identity individuals sampled in 2 - 4 successive years, feather Hg data showed no clear trend, decreasing overall in 13 males and increasing in 7 females. Of 13 Bicknell's Thrushes sampled at 3 - 4 wk intervals during a single breeding season, every bird showed a decrease in Hg blood level between its first and subsequent capture. These data, while preliminary, suggest that Bicknell's Thrush may be an appropriate bioindicator of Hg pathways in montane forests, and that additional research is needed.

s19 Chisholm & Leonard

Pre-commercial thinning and the abundance and distribution of Bicknell's Thrush in industrial forests of New Brunswick. SARAH E. CHISHOLM and MARTHA L. LEONARD, *Dept. Biol., Dalhousie Univ., Halifax, NS*.

Traditional Bicknell's Thrush nesting habitat is described as dense stands of naturally stunted conifers located at high altitudes. However, Bicknell's Thrushes have been found in regenerating stands of industrial forests. There is concern that the practice of pre-commercial thinning, which takes place at least 10 yr after clear-cutting and which dramatically reduces the density of trees, may be

eliminating suitable breeding habitat for this species. We are interested in determining the distribution of Bicknell's Thrushes throughout the progression of an industrial forest, and specifically we want to examine the impact of pre-commercial thinning upon Bicknell's Thrush abundance. In Jun 2003 we conducted auditory point counts in 26 stands of regenerating forest that represented a continuum of ages from 6 to 25 yr following clear-cutting, 15 of which had been previously pre-commercially thinned. To evaluate the immediate impact of pre-commercial thinning, we conducted surveys in 5 stands that were thinned following fieldwork in 2003 to obtain a baseline to compare to controls and abundance data to be collected from these thinned stands in 2004. Preliminary results suggest that the highest numbers of Bicknell's Thrushes are found in stands that are of sufficient density to be thinned, and that forests that are reduced in density by thinning continue to support lower numbers of Bicknell's Thrushes for several years, after which abundance declines further. An objective for 2004 is to examine breeding activity in thinned stands in order to understand why some birds remain in seemingly sub-quality habitat.

s20 Whittam

The High Elevation Landbird Program: Monitoring Bicknell's Thrush in Maritime Canada. BECKY WHITTAM, *Bird Studies Canada - Atlantic Reg. Sackville, NB.*

In 2002 I initiated the High Elevation Landbird Program (HELP) to monitor trends in the population and distribution of Bicknell's Thrush and other high elevation landbirds (Swainson's Thrush, Fox Sparrow, Blackpoll Warbler, Winter Wren and White-throated Sparrow) in "natural" and industrial forest habitat in New Brunswick and Nova Scotia. Methods are comparable to those used by the Mountain BirdWatch program in the U.S. Volunteers and staff use 10-min point counts to survey 5-stop routes at pre-dawn and post-dusk in Jun. Playback of Bicknell's Thrush songs and calls is used if no Bicknell's Thrush is detected during the point-count protocol. Results of 2003 surveys indicate that 26 of 39 routes in NB (67%), and 11 of 24 routes in NS (46%), had Bicknell's Thrush. All but 6 detections occurred during the silent point counts. An average of 1.6 and 1.2 Bicknell's Thrush were detected per route in NB and NS, respectively. Routes located in natural habitat were more likely to have Bicknell's Thrush, and to have greater numbers of Bicknell's Thrush, than routes in industrial forest habitat, although there is very little natural habitat in New Brunswick. I will present data from the third year of monitoring (2004) and discuss the feasibility of the survey as a population monitoring tool for this sensitive species.

s21 McFarland, Rimmer, Renfrew, Frey & Sillett

Do ski areas affect Bicknell's Thrush demographics? KENT P. MCFARLAND, CHRISTOPHER C. RIMMER, R. B. RENFREW, SARAH FREY, *Vermont Inst. Nat. Sci., Woodstock, VT*, and SCOTT SILLETT, *Smithsonian Natl. Zool. Park, Migratory Bird Ctr., Washington, DC.*

Among Neotropical migrant birds in the ne. U.S., Bicknell's Thrush is ranked as the species of highest conservation priority in the region. We collected breeding season demographic data on 2 mountains in Vermont in natural forests and areas developed for skiing from 1994 - 2003. Overall, we found few significant differences between developed and natural areas on each mountain. We captured and released 61 males and 40 females on natural forest plots and 71 males and 39 females on ski areas. Mark-recapture analysis showed no strong evidence for a habitat effect on survivorship of adults. We located (most via radio telemetry) and monitored over 130 thrush nests. We found no evidence that nest predation rates or productivity differed between ski area and natural forest plots. Despite higher nest densities near ski trail edges, it appears that edge effects do not exert an important influence on rates of nest predation for Bicknell's Thrush, and that the 'ecological trap' hypothesis does not apply to this species in existing ski areas.

s22 Lambert & McFarland

Projecting effects of climate change on Bicknell's Thrush habitat in the northeastern United States. J. DANIEL LAMBERT and KENT P. MCFARLAND, *Vermont Inst. Nat. Sci., Woodstock, VT.*

Bicknell's Thrush is a rare habitat specialist that breeds in montane fir-spruce forests of the ne. U.S. and adjacent Canada. A warming climate may reduce availability of this forest type by allowing upslope encroachment of mixed and hardwood forests. We used 2 GIS modeling approaches to assess how elevated temperatures could affect Bicknell's Thrush habitat in the U.S. Both methods rely on known relationships between forest type, temperature, and elevation. We measured the possible effects of 1 - 8 °C temperature increases on habitat area, number of habitat patches, and mean patch size. Results indicate that a 3°C increase in mean Jul temperature could result in an 88%

to 98% loss of U.S. habitat and extirpations of Bicknell's Thrush from the Catskill Mountains, the s. Adirondacks, the Green Mountains, and the mountains of w. Maine. The same increase could eliminate breeding habitat from up to 144 mountains in New Hampshire. The Adirondack High Peaks, the Presidential Range, and Mount Katahdin are most likely to maintain forest characteristics suitable for Bicknell's Thrush. The recent disappearance of Bicknell's Thrush from coastal locations in Canada and from small mountains in the U.S. may signal early effects of climate change. The actual pace and pattern of habitat loss will depend on the rate of temperature change, the influence of site factors (slope, aspect, substrate), and the effect of climate on reproductive rates, resource competition, and natural disturbance.

s23 Aubry, McFarland, Rimmer & Goetz

Contribution of video monitoring to the Bicknell's Thrush breeding ecology. YVES AUBRY, *Canadian Wildl. Serv., Sainte-Foy, QC*, KENT P. MCFARLAND, CHRISTOPHER C. RIMMER, *Vermont Inst. Nat. Sci., Woodstock, VT*, and JAMES E. GOETZ, *Macaulay Lib., Lab. Ornithol., Cornell Univ., Ithaca, NY*.

Video monitoring of Bicknell's Thrush parental activities at the nest has been instrumental in documenting this species' unusual breeding ecology, in which 80% of broods are fed by the brood female and 2 or more males. Video monitoring of color-banded adult thrushes provided estimates of their relative feeding effort, and revealed that some males fed broods of multiple females concurrently or consecutively in the same breeding season. A comparison of feeding and paternity data revealed that not all males fed broods in which they sired young, and not all feeders of a brood sired young. Nest predator identification was also a valuable contribution of the video monitoring. This presentation will feature a number of video sequences, including chick-feeding and depredation.

s24 Schmiegelow & Cumming

Applying landscape-scale research to the design of a boreal-wide monitoring program. FIONA K. A. SCHMIEGELOW, *Dept. Ren. Res., Univ. Alberta, Edmonton, AB*, and STEVE G. CUMMING, *Boreal Ecosystems Research Ltd, Edmonton, AB*.

A comprehensive bird monitoring program is urgently needed in Canadian boreal forests, but the large spatial extent and inherent variation of the system pose unique challenges. Any program will involve substantial costs, and it is imperative that effort is invested efficiently and effectively. We outline important design considerations for a broad-scale boreal bird monitoring program, emphasizing use of existing data to direct site selection and within-site sampling efforts. We distinguish between approaches designed for explanation of existing patterns of bird distribution and abundance relative to landscape attributes, versus prediction of future relationships given anticipated landscape trajectories. Methods that incorporate the statistical properties of both the response variables (bird populations) and landscape covariates are discussed, and examples from recent research efforts presented. We highlight the need for a heuristic approach to monitoring that is hypothesis-driven, and employs robust experimental design principles within an adaptive management framework.

s25 Hobson & van Wilgenburg

Bioacoustic techniques for forest bird monitoring. KEITH A. HOBSON and STEVE L. VAN WILGENBURG, *Canadian Wildl. Serv., Saskatoon, SK*.

The recent development of high-quality omnidirectional recording equipment for bird songs that allow the estimation of relative abundance of individuals over known distances provides an alternate approach to conventional point counts using a trained observer in the field. The permanent archive of acoustic records allows for complete standardization of bird identification through time and removes the limitation of not having enough "excellent" recorders in the field during the relatively short summer recording period. In addition, recordings permit sophisticated post-recording analyses using computer software and can provide the opportunity for multiple sampling to obtain estimates of detectability of individual species in various stand types. We illustrate these advantages using several years of data from bird surveys in the boreal forest of Saskatchewan and outline some future directions for product development.

s26 Rempel & Kushneriuk

Spatially-explicit, multiple-scale analyses to associate patterns of forest structure with songbird density. ROBERT S. REMPEL and ROBERT S. KUSHNERIUK, *Centre for Northern Forest Ecosys. Res., Ont. Min. Nat. Resour., Lakehead Univ., Thunder Bay, ON*.

If maintaining endemic levels and variation of biodiversity is identified as one of the goals for

sustainable forest management, then it is important to develop a monitoring approach that will provide meaningful data to determine the effectiveness of the biodiversity strategy. We believe that this involves selecting an array of focal species that respond to the extremes of forest management actions, and that can be monitored at spatial scales relevant to forest management. In this study we apply a spatially explicit, multiple scale analysis to study the relationships between forest structure and relative density of breeding forest songbirds in boreal region sites located in Ontario and in Manitoba. The study has 6 major methodological components: (1) create continuous response surfaces (maps) of songbird density and forest structure; (2) characterize wildlife response and forest structure across a range of spatial scales; (3) ordinate and classify songbirds into functional response groups; (4) develop and select the best biometric model to describe the relationship between forest structure and bird density and diversity; (5) calculate species' response curves to environmental parameters, and (6) apply and test the biometric models in a different geographic area to estimate their robustness (validity). We used the validated models to estimate the response of songbirds (by functional response groups) to address the management question, "How do songbirds respond to increasing levels of forest harvest and forest edge, across spatial-scales?" Understanding the response (and dose thresholds) of wildlife to increasing levels of harvest can help resource managers specify landscape-level harvest designs for creating the desired future forest conditions necessary for conserving songbird biodiversity.

s27 Zimmerling & Francis

Integrating the goals of research and monitoring: Ontario's Boreal Forest Bird Program. RYAN ZIMMERLING, *Bird Studies Canada, Port Rowan, ON*, and CHARLES FRANCIS, *Canadian Wildl. Serv., Ottawa, ON*.

Integrating the goals of monitoring and research in ecology is not a new concept but, in practice, has rarely been implemented. In Ontario, efforts have been made to integrate the monitoring of boreal songbirds with research. Long-term monitoring of boreal birds in Ontario (e.g., Ontario Breeding Bird Atlas) has provided information on the distribution and population trends of breeding songbirds. Recently, research has sought to assist in achieving monitoring goals while also understanding the impacts of forest management on bird communities throughout boreal Ontario. To meet this objective, biologists conducted 2 yr of fieldwork using unlimited-radius point counts and omnidirectional microphones. Breeding birds were surveyed in 3 landscape types: harvested landscapes, landscapes where timber harvesting was planned, but had not taken place, and protected landscapes where no timber harvesting is planned. By the end of the second field season, 9,174 points were sampled in 365 landscapes (10- x 10-km squares) across boreal Ontario, resulting in one of the largest landscape-level studies of forest management in the country. The results of this research suggest that, in most parts of Ontario, although bird communities clearly differ among habitats, at a landscape level, bird communities are similar regardless of treatment. Hence, with careful planning, integrating the goals of monitoring and research can improve the effectiveness of monitoring and the interpretation of monitoring results.

s28 Butterworth

Waterfowl monitoring in Canada's western boreal forest. ERIC BUTTERWORTH, *Ducks Unlimited Canada, Edmonton, AB*.

The Western Boreal Forest located west of the Manitoba/Ontario border is second only to the Prairie Pothole Region in terms of continental waterfowl breeding effort and has been ranked in the top 5 priority waterfowl habitat areas in North America by Ducks Unlimited. Industrial activity including oil and gas, forestry, mining and hydro electricity generation as well as agriculture has greatly expanded in the Western Boreal Forest. The influence of these activities and the potential consequences of climate change, on boreal wetland ecosystems remain largely unknown. In 1997 Ducks Unlimited Canada established the Western Boreal Forest Program to help answer questions about boreal wetlands and the influence of associated land-use activities. Landscape level planning and evaluation have been underway since 1997. Between 1997 and 2003, using TM satellite imagery we have mapped, in partnership with the Western Regional Office of Ducks Unlimited, the water and vegetation habitat on over 40,000,000 ha, in 9 project areas across in the western boreal forest. This landscape level habitat inventory is ongoing and accompanied with waterfowl inventory sampling in each project area. Waterfowl inventories have been completed on 6 of the 9 project areas. Waterfowl inventories include the spatial distribution of waterfowl during breeding, brood rearing, molting, and fall migration periods. Identification of the value of various wetland/riparian habitat types are inventoried with rotary-wing aerial surveys during spring/summer (breeding and brood surveys) and fixed-wing aerial surveys

in late summer and fall (migration/molting/staging surveys). We are currently modelling the relationship between the habitat and waterfowl distributions.

s29 Darveau, Reed, Bordage, Ross & Bateman

Multiple uses of waterfowl aerial surveys in the eastern boreal forest. MARCEL DARVEAU, *Ducks Unlimited Canada, Québec, QC*, ERIC REED, *Canadian Wildl. Serv., Gatineau, QC*, DANIEL BORDAGE, *Service canadien de la faune, Sainte-Foy, QC*, KEN ROSS, *Canadian Wildl. Serv., Nepean, ON*, and MYRTLE BATEMAN, *Canadian Wildl. Serv., Sackville, NB*.

Following the decline observed in American Black Duck wintering populations from 1955 to 1982, different measures were established by the Black Duck Joint Venture of the North American Waterfowl Management Plan. These included an aerial survey program aimed at estimating breeding populations of black ducks in the boreal forest. From 1990 - 1995, the Canadian Wildlife Service conducted helicopter surveys of 10- x 10-km quadrates systematically distributed across the boreal regions of Ontario, Québec, and Atlantic provinces. In 1996, the quadrate size was reduced to 5- x 5-km and the number of quadrates was increased (314 in total). Even though the primary purpose of the survey is to get an estimate of breeding populations of American Black Duck, all waterfowl species and large aquatic birds such as the Common Loon and the Sandhill Crane are located on 1:50,000 topographic maps during the survey and entered into georeferenced databases. Over time, this database has been used for several purposes that fall in 3 broad categories: population estimation, distribution maps, and bird-habitat relationships. Examples for each category include: population estimates for geese and loons; distribution maps for threatened species such as the eastern population of Barrow's Goldeneye in the north shore of the St-Lawrence River in Québec; wetland classification for boreal forest waterfowl in the Ontario claybelt. As the database grows, we see fascinating new opportunities to exploit the data and increase our knowledge of boreal aquatic birds.

s30 Leclerc, Gauthier & Lamothe

The use of shoreline habitats by landbirds along reservoirs and lakes of the northern boreal forest. JACQUES LECLERC, *Service canadien de la faune, Sainte-Foy, QC*, JEAN GAUTHIER, *Service canadien de la faune, Sainte-Foy, QC*, and PIERRE LAMOTHE, *Hydro-Québec, Montréal, QC*.

Large hydroelectric reservoirs in the boreal forest of n. Québec, were created 15 - 25 yr ago and since then are submitted to water-level fluctuations controlled by regional precipitation budgets and hydro-energy demands. These large water fluctuations (several meters) created a disturbed shore vegetation contrasting with many natural lake shores near these reservoirs where a well-defined shore vegetation is developed as the water fluctuates naturally. In this study, we compared land bird communities breeding in the shore zone of 4 large hydroelectric reservoirs with communities of adjacent control lakes. We counted land birds along 400-m transects randomly chosen from a larger set of transects accessible by service roads. Each transect was replicated by 2 observers. Habitats were photo-interpreted using very-high-resolution airborne images (50 cm pixel resolution) and classified into 9 classes: closed black spruce, open black spruce, jack pine, alder, regenerating immature stands, Ericaceae-dominated shrubs, lichen-dominated low vegetation, herbaceous/organic soils, and burned patches. Generalized estimating equations were used to model the relationships between dependent variables (like richness or occurrence for the more frequent species) and independent variables (region, reservoir/lake, habitat and observer). We found more birds and more species in the western part of the study area where climate is milder than in the eastern part. We detected more birds and more species along reservoirs than along adjacent lakes. Several significant habitat effects were found. Our results are discussed in terms of climate, reservoir productivity upsurge after flooding, disturbance regimes and habitat.

s31 Cyr & Larivée

Use of volunteer checklist programs to monitor boreal forest birds. ANDRÉ CYR, *Département de biologie, Université de Sherbrooke, Sherbrooke, QC*, and JACQUES LARIVÉE, *Cégep de Rimouski, Rimouski, QC*.

We used the ÉPOQ (Études des Populations d'Oiseaux du Québec) program to analyze the trends of 50 species of boreal birds breeding in Québec or migrating through this area. The data are checklists gathered by volunteer, but qualified bird watchers. The coverage extends from 1970 to 2003. Between 2,000 and 18,000 checklists are collected each year, and above 8,000 since 1982. Previous results showed significant correlations between ÉPOQ data and Breeding Bird Survey (BBS) data, both for summer and fall data from Québec. Since sample size had little qualitative effect for

data from 1969 to 1989, extending the analysis over >30 yr, up to 2003 should show the same quality in the analysis. Some trend changes are analyzed to reflect the current status of the species. Some boreal populations show trends that are not always the same as those further south.

s32 Handel & Matsuoka

The Alaska Landbird Monitoring Survey: ALMS for populations on the edge. COLLEEN M. HANDEL, *U.S. Geol. Surv. Alaska Sci. Center, Anchorage, AK*, and STEVE MATSUOKA, *U.S. Fish & Wildl. Serv., Anchorage, AK*.

Alaska's boreal forests provide breeding habitat for 90 species of landbirds and 55 species of waterbirds; half of these species breed predominantly north of the U.S.-Canada border. The road-based North American Breeding Bird Survey (BBS) provides some data on population trends in Alaska but most northern species are inadequately monitored because of limited geographic coverage. Boreal Partners in Flight has developed the Alaska Landbird Monitoring Survey (ALMS) to monitor breeding populations in roadless areas. The primary objectives are to (1) monitor long-term population trends; (2) determine abundance by habitat; and (3) model distribution across Alaska. A 10- x 10-km sampling grid has been overlaid across Alaska. The initial sampling frame has been defined as federal resource lands, excluding glaciers, ice-fields, and large lakes; these natural areas encompass about 678,000 km², or 45% of the state's land mass. An initial effort has been proposed to survey a grid of 25 points within each of 200 randomly selected sample units stratified by ecoregion and land management area. Each grid will be surveyed using 10-min point-transects once per summer on a biennial basis; habitat data will also be collected. Trend data will be analyzed jointly with BBS data to test for differences between roadless and roadside areas and to increase power to detect statewide trends. Additional grids will be surveyed as resources become available. Long-term monitoring will enable analysis of change in bird populations in relation to fire, disease and insect damage, resource development, climate-related change, and other landscape-level disturbances in these threatened forests.

s33 Schieck

A cost-effective, broad-scale, monitoring program for birds (plus many other taxa) and habitats. JIM SCHIECK, *Integrated Resource Manage., Alberta Research Council, Vegreville, AB*.

To minimize risks of biodiversity loss, and to meet provincial, national, and international commitments about biodiversity, the government, industries, and academia in Alberta worked jointly during the last 6 yr to develop the Alberta Biodiversity Monitoring Program (ABMP). Monitoring birds during the breeding and winter seasons are integral parts of this program. The ABMP is based on a systematic grid of approximately 1650 sites spaced 20 km apart throughout Alberta. The ABMP is capable of detecting broad regional changes in biodiversity over time and relating these changes to changes in human land use. Field sampling of terrestrial biota (vascular plants, mosses, lichens, fungi, arthropods, birds, and mammals), terrestrial habitats (trees, snags, logs, litter, spatial heterogeneity) have been developed and peer reviewed (<http://www.abmp.arc.ab.ca>). Sampling of aquatic biota (benthic invertebrates, zooplankton, amphibians, and fish), aquatic habitats (basin characteristics, water chemistry and nutrients), and remote sensing of vegetation polygons, landscape patterns, and human disturbances are presently being developed. Data from the prototype will be used to estimate statistical power for selected species, species groups, and habitats, and to evaluate whether the ABMP can detect a 3% annual change in biodiversity after a 10-yr period. Preliminary results indicate the program exceeds expectations. Data from the prototype will be used to develop products and services that are needed by managers to make land-use decisions. In addition, a web-based system to store, manage, manipulate, and disseminate the data will be developed. The complete ABMP will be implemented in 2007.

s34 Rivers

Brown-headed Cowbird begging intensity is adjusted relative to nestmate size. JAMES W. RIVERS, *Dept. Ecol., Evol. & Marine Biol., Univ. California, Santa Barbara, CA*.

Begging behaviors in brood parasites are not constrained by kinship, and are often more exaggerated than those of species that raise their own young. Generalist brood parasites use a range of hosts that typically vary in size, yet it is unclear how young brood parasites respond to nestmates of different competitive abilities. In response to varying competitive environments, brood parasites may adopt a begging strategy that is the single best strategy averaged across hosts, or they may vary their begging among hosts in a way that minimizes costs. I experimentally tested the begging strategies of

the Brown-headed Cowbird when competing against hosts that differ in size and while controlling for short-term need. Cowbird chicks responded as fast as or faster than host nestmates on the majority of feeding visits and begged more intensively than their host nestmate for a given level of need in hosts of 3 sizes. In small and similar-sized hosts cowbird begging intensity tracked that of their hosts, but begging intensity was consistently high across treatments when competing against large hosts. The amount of food cowbird chicks received was negatively correlated with host nestmate size, suggesting that cowbird increased begging intensity in large host nests was due to short-term need. That cowbird begging varied among different hosts indicates that cowbirds have a flexible begging strategy that is used in a way that minimizes costs incurred by begging behaviors.

s35 Budden & Beissinger

Sex biased patterns of resource allocation vary with brood size in an asynchronous parrot. AMBER BUDDEN and STEVEN R. BEISSINGER, *ESPM Ecosystems Sci. Div., Univ. California, Berkeley, CA.*

Within the context of solicitation and provisioning behaviours, parrots differ from most passerine species in that they demonstrate strict parental control of resource allocation and selective feeding of younger offspring. Previous research on Green-rumped Parrotlets has uncovered higher mortality of later-hatched young in asynchronous broods and reduced mortality when synchrony was manipulated and nestlings were of similar size. These findings suggested a strong role of sibling competition in resource acquisition and implied that the selective feeding strategy observed in other parrots may not be adaptive in this large-brooded species. Through experimental manipulation of brood size and nestling hunger we documented sibling competition and parental feeding in a system where nestmate competition appears to shape brood survival. Older nestlings received significantly more food than their younger siblings in both experimentally large and small brood sizes, and hunger manipulations further influenced the distribution of resources among nestlings. There was no difference in brood provisioning rates attributable to brood size or hunger manipulations. Furthermore, male and female parents did not differ in brood provisioning rates. Resource distribution among different aged young was similar between parents provisioning small broods however, there was significant variation between the sexes when provisioning large broods; females demonstrated increased feeding of later-hatched young whereas male feeding was biased towards older offspring. We tested the importance of nestling solicitation on parental provisioning behaviours and interpret these findings within the context of life history strategy, questioning the adaptive nature of brood reduction in this system.

s36 Roulin

The importance of sibling negotiation in within-brood food allocation in birds. ALEXANDRE ROULIN, *Dept. Ecol. & Evol., Univ. Lausanne, Switzerland.*

When siblings differ markedly in need for food, they may benefit from signaling to each other their willingness to contest the next indivisible food item delivered by the parents. This sib-sib communication system, referred to as 'sibling negotiation', may allow them to adjust optimally investment in begging. Using Barn Owl broods, I assessed the relevance of the sibling negotiation hypothesis and investigated the factors that influence sib-sib negotiation including body condition, need for food of nestmates, sex, hatching asynchrony. I also examined the intricate interaction between sibling negotiation and begging in the within-brood allocation of food. In this presentation, I will also introduce results from a game-theoretical model demonstrating the factors that can promote the evolution of sibling negotiation in birds. My aim is therefore to point out the importance of considering this type of sib-sib interaction in the resolution of family conflicts in a large number of species.

s37 Biran, Erev & Lotem

Alternative begging strategies and learning rules in virtual nests: a computer simulation study. INBAR BIRAN, *Dept. Zool., Tel-Aviv Univ., Israel*, IDO EREV, *Dept. Indust. Engineering & Management, Israel Inst. Tech., Israel*, and ARNON LOTEM, *Dept. Zool., Tel-Aviv Univ.*

We used computer simulations to study the relative success of alternative begging strategies and learning rules in virtual nests in which nestling success is affected by dynamic sibling competition, digestive constraints, and parent-offspring communication. We first verified that under a wide range of conditions, nestlings that beg honestly (in relation to their need) do better than dishonest nestlings. We then explored the effect of parental responsiveness and nestling rank on begging intensity, digestive efficiency and mass gain, illustrating some non-trivial relationships. Finally, we tested a set

of learning algorithms by which nestlings can adjust their begging reaction norm in relation to begging effectiveness. The results illustrate that while some learning rules may be adaptive in general, they can also produce locally maladaptive behaviors. The simulation could also be used for testing alternative behavioral models in relation to real data.

s38 Skypala

Offspring reactions to playback of begging. A. C. SKYPALA, *Univ. North Carolina, Chapel Hill, NC.*

Begging vocalizations have been examined primarily as signals between parents and individual offspring, but siblings might be recipients of signals as well. The only documented cost of begging is attraction of predators to the nest. In this case, begging by any 1 individual would put all in the nest in jeopardy. Siblings might thus do well to silence siblings when they themselves are not in need of food. Conversely, if begging has any individual energetic cost, a nestling might do well to save its energy and to allow a sibling to beg to incite parents to continue feeding. Begging thus has possibilities for both shared benefits and shared costs that could influence individuals to change their own levels of begging in relation to that of siblings. I tested the hypothesis that nestling birds adjust their begging in response to begging by their nestmates by observing individual chicks in nests of Northern Mockingbirds by video camera while simultaneously playing back tape-recorded begging vocalizations. I saw no change in the numbers of begs in response to playback, but I did find that 1 or a few chicks in a nest made the majority of the begging vocalizations in short periods of time. These data indicate no support that chicks are begging competitively, but do not rule out the possibilities that chicks parasitize the begs of others or cooperate with siblings.

s39 Dor, Kedar, Winkler & Lotem

Begging in the absence of parents in House Sparrow nestlings. ROI DOR, HILLA KEDAR, *Dept. Zool., Tel-Aviv Univ., Israel*, DAVID W. WINKLER, *Dept. Ecol. & Evol. Biol., Cornell Univ., Ithaca, NY*, and ARNON LOTEM, *Dept. Zool., Tel-Aviv Univ.*

Nestling begging in the absence of parents may reflect "false alarms" due to cognitive constraints or signaling activity towards nest mates (sibling negotiation). In our study of house sparrows, nestling begging in the absence of parents composed up to 50% of the begging events at the nest. It was more frequent at an early age and among low-ranked nestlings. Data analysis suggests that the effect of nestling age is genuine, but the effect of rank is a result of hunger: low-ranked nestlings were more likely to be fed second during a parental visit and thus to receive a smaller meal. The probability of begging during real parental visits was slightly affected by hunger, but not by age or rank. The effect of hunger on begging in the absence of parents can be explained by both the false alarms and the sibling negotiation hypotheses. However, the reduction in the frequency of such begging events with age, in the absence of a similar reduction in begging during real parental visits, favors the false alarm explanation.

s40 Glassey & Forbes

Brood size and behavioral thermoregulation in nestling blackbirds. BARB GLASSEY, *Dept. Behav. & Life Sci., Univ. College Cape Breton, Sydney, NS*, and SCOTT FORBES, *Dept. Biol., Univ. Winnipeg, Winnipeg, MB.*

Red-winged Blackbird females hatch their broods asynchronously, creating size hierarchies. Although partial brood losses are high, doomed nestlings frequently survive until midway through the nestling period. We present the "thermal facilitation hypothesis" which suggests that the last-hatched nestling facilitates the survival of nestmates by maintaining a critical brood size at the inertial stage of brood development. We measured the thermal contribution of last-hatched offspring by: (1) temporarily removing nestlings from broods while monitoring the body and brood temperatures of the remaining nestlings; and (2) by adding a nestling to endothermic broods. Our results identify 3 nestlings as the minimum number needed to maintain brood temperature in the absence of the parent. Adding a nestling to older broods did not significantly affect temperature, although may impact behavioral thermoregulation.

s41 Leonard & Horn

Efficacy and the design of begging calls. MARTY L. LEONARD and ANDREW G. HORN, *Dept. Biol., Dalhousie Univ., Halifax, NS.*

Much recent work on begging has attributed the conspicuousness of the display to selection for costly, and hence reliable, signalling. We suggest, however, that some of this conspicuousness is

needed for effective signal transmission. We discuss how begging calls, in particular, might be designed to overcome transmission problems presented by nest acoustics, environmental noise and interference from nestmates.

s42 Fleischer, Beadell, Ishtiaq, Gering, Peirce, Fonseca, Bensch, Atkinson & Jarvi

Worldwide phylogeography of the Hawaiian type of avian malaria. R. FLEISCHER, J. BEADELL, F. ISHTIAQ, E. GERING, M. PEIRCE, D. FONSECA, *Dept. Zool. Natl. Mus. Nat. Hist., Smithsonian Inst., Washington, DC*, S. BENSCH, *Dept. Ecol., Lund Univ., Lund, Sweden*, and C. ATKINSON, *USGS, Hawaii Natl. Park, HI*, and S. JARVI, *Univ. Hawaii, Hilo, HI*.

Avian malaria (*Plasmodium relictum*) was introduced to the Hawaiian Islands sometime after its primary mosquito vector (*Culex quinquefasciatus*) in 1826. It has become a major problem for native birds in the Hawaiian Islands, causing excess mortality and limiting the distributions of many native bird species to higher elevations where mosquitoes normally do not occur. The vector was thought to have been introduced from Mexican populations; however, recent genetic data indicate that most *Culex* in the islands are derived from Australian or other Pacific populations. We have been using mitochondrial DNA and a single-locus nuclear gene (DHFR) to document the genotypes found in Hawaiian populations of *P. relictum* and the phylogeographic structure worldwide. In Hawaii, we have thus far found only a single haplotype of mtDNA and a single DHFR genotype. We have intensively sampled particular localities around the world, although coverage is not even in all regions. We found that all infected samples from Bermuda had the same Hawaiian mtDNA haplotype and DHFR genotype. The haplotype is extremely rare in North, Central and South America (including the Caribbean, based on the results of Fallon and Ricklefs), Southern Asia, Gabon, and Australia and New Guinea. The Hawaiian haplotype, and closely related ones, are found more commonly in birds in southern and eastern Africa, the India Ocean Islands, and in adult European birds that mostly migrate to Africa. Thus, it appears that the type of *P. relictum* currently found in Hawaii, likely originated from Africa. It is also interesting that it is the only parasite haplotype thus far found in 2 sets of oceanic islands, Hawaii and Bermuda, but with vastly different consequences for the resident avifaunas. Preliminary data, based on museum specimens of Hawaiian birds, suggest that avian malaria was not present or common in Hawaii until after the 1930s or 1940s.

s43 Fallon, Ricklefs, Bermingham, Graves & Fleischer

Geographic patterns of avian malaria parasite lineages in eastern North America and the Caribbean region. SYLVIA M. FALLON, *Genetics Prog., Smithsonian Inst., Washington, DC*, R. E. RICKLEFS, *Univ. Missouri St. Louis, St. Louis, MO*, E. B. BERMINGHAM, G. GRAVES and R. FLEISCHER, *Smithsonian Inst., Washington, DC*.

The geographic distribution of organisms can often provide insights into the ecological and evolutionary forces that determine those distributions. For parasites, geographic patterns are particularly important to our understanding of how these disease organisms are able to move between discrete and continuous landscapes as they infect susceptible individuals. Here we explore the geographic distributions of genetically distinct avian malaria parasite lineages in an island and mainland system. Patterns in the Lesser Antillean archipelago reveal geographic structure suggesting limited dispersal, local extinction events and the presence of endemic parasite lineages. Despite evidence of localization, nearly 80% of Lesser Antillean parasite lineages were recovered from 1 of 3 other geographic regions: the Greater Antilles, South America or North America, demonstrating the ability of parasites to move great distances, perhaps due to migrating host species. Within a continental location (eastern North America), intensive sampling of one target migratory species, the Black-throated Blue Warbler, reveals little geographic structure of parasite lineages indicating greater homogenization across comparable distances to the island system. Together our results suggest that disease dynamics in avian malaria function differently on isolated islands than on continuous landscapes, which may lead to variable selection pressures, for example, in terms of host specialization. Additionally, avian malaria parasite lineages are unlikely to serve as precise geographic markers for migratory birds as has been previously suggested.

s44 Gager

Temporal changes in mixed species *Plasmodium* infection in *Turdus grayi*. ANDREA GAGER, *Ecol. & Evol. Biol., Princeton Univ., Princeton, NJ*.

Attention to disease in wild avian populations has increased in the last decade particularly because of the devastation caused by the spread of *Plasmodium relictum* in the native Hawaiian avifauna. However, we know very little about how these parasitic organisms behave in endemic avian

hosts and in the presence of other parasites. In this study, I looked at the life history traits of 2 *Plasmodium* parasites in a wild, banded population of the tropical thrush, *Turdus grayi*, in Panama over the course of 3 yr. Using both molecular methods and traditional blood smear analysis to identify parasites I tracked changes in infection at the individual and population level to describe seasonality, duration of infection and peak parasitemia of these 2 co-occurring *Plasmodium* species. Infection in this tropical bird host was highly dynamic and the parasite composition in individual birds changed dramatically between recaptures. The data from this study suggest that co-infecting parasites can vary greatly in life history traits and therefore in expected fitness effects on host organisms. Also, longitudinal studies of parasitism, in addition to traditional measures of infection, such as parasitemia and prevalence, are necessary to capture the dynamism of this host-parasite community.

s45 Barraclough, Robert, Ravaoarimalala & Goodman

Blood parasite prevalence across fragmented highland forest in Madagascar. R. K. BARRACLOUGH, *Field Mus., Chicago, IL*, V. ROBERT, *Institut de Recherche pour le Developpment, Institut Pasteur, Antananarivo, Madagascar*, A. RAVAOARIMALALA, *Institut Pasteur, Antananarivo, Madagascar*, and S. M. GOODMAN, *Field Mus and WWF, Antananarivo, Madagascar*.

Fragmentation and loss of forest has been widespread in Central Highland Madagascar. Such fragmentation, with the associated increased edge effects, habitat modification, and population isolation, has manifold well-studied impacts on ecosystem functioning. Therefore, it is reasonable to assume that fragmentation will also be affecting avian host and blood-parasite dynamics and thereby the prevalence of blood parasites in Malagasy birds that are entirely or partially forest dependent. We explored this possibility by asking whether the prevalence of blood parasites differed between the largest remaining forest remnant (1250 ha) within the Ambohitantely Special Reserve and 2 smaller forest fragments situated just outside the reserve boundary. 98 birds were surveyed from the large forest remnant and 95 were surveyed from the smaller forest fragments over a 2-mon period in the middle of the rainy season. Additional birds from species dedicated to open habitats were not included in the prevalence statistics. Slides were inspected for the presence of *Plasmodium*, *Haemoproteus*, *Leucocytozoon*, *Trypanosoma* and microfilariae. 24 avian species from 15 families were represented in the sample. We found 57% of sampled birds to be positive for at least 1 type of haematozoan. Overall prevalence was similar across the study sites (55% in the large forest remnant and 57% in the smaller fragments collectively). These prevalence statistics greatly exceed those from other reported Malagasy prevalence studies to-date (e.g., 36% and 22%). As expected, the different parasite groups preferentially infected certain avian host species. Small sample sizes limited some within-host species comparisons across sites, however differences between the large forest remnant and smaller fragments were evident. For instance, disparities in prevalence and parasitemia for *Leucocytozoon* spp. within 2 avian host species and infected birds from the smaller forest fragments were more likely to have double or treble infections. We will report on these and other outcomes, and the direction of our on-going research.

s46 Dhondt

Mycoplasma gallisepticum in House Finches: the dynamics of an emerging pathogen in an introduced host. ANDRÉ DHONDT, *Lab. Ornithol., Cornell Univ, Ithaca, NY*.

In early 1994 a novel strain of the poultry pathogen *Mycoplasma gallisepticum* appeared around Washington, DC, causing severe conjunctivitis in House Finches. The new disease spread rapidly in the eastern (introduced) part of the finch's range, but has now also reached the western (native) range. *Mycoplasma gallisepticum* also causes disease in several other finch species, but these seem to be spill-over infections. The study system is interesting in that the House-Finch strain of *Mycoplasma gallisepticum* is most likely a novel strain (it causes only mild clinical signs in poultry) that emerged recently and invaded a new host that itself was introduced in 1940 in eastern North America. House Finches increased by about 6 orders of magnitude in 60 yr. They are a mobile, patchily distributed, seasonally breeding social species. As the bacterium cannot survive outside a host for more than a few days it is assumed that transmission occurs primarily through direct contact and/or through fomites, less through vertical transmission. Disease prevalence shows strong seasonal fluctuations, whose amplitude and cycle, though, varies geographically. To understand and model the dynamics of *Mycoplasma gallisepticum* in House Finches we combine data from 3 lines of investigation: volunteers to describe disease prevalence at large geographic scales; intense capture-mark-recapture studies in local populations to determine the effects of disease on survival and behavior; and controlled experimental infections in captivity to understand factors influencing the course of the disease in individuals in controlled conditions. I will present recent advances in our

understanding of the disease dynamics using results from all three lines of investigation. The project is funded by NSF (DEB) and carried out in collaboration with colleagues at Cornell Univ., Princeton Univ., Univ. Wisconsin-Madison and Emory Univ.

s47 Hawley

How social factors mediate immunity and disease susceptibility in House Finches. DANA M. HAWLEY, *Dept. Ecol. & Evol. Biol., Cornell Univ., Ithaca, NY.*

Parasites and pathogens are receiving renewed recognition as important ecological and evolutionary forces for their hosts, sparking considerable interest in the relationship between host behavior and susceptibility. Social organisms suffer higher rates of parasitism due to the ease of transmission and the impact of social stress on immunity. However, susceptibility to parasites and pathogens may not be equal across group members. I examined how social status influences immune responses to a novel antigen in captive flocks of wintering House Finches. An individual's dominance status was a strong predictor of antibody response, with dominant individuals mounting significantly higher responses. Furthermore, experimental manipulations of dominance caused proportional changes in antibody response within the same individual. Finally, I discuss how individual dominance status impacts susceptibility to a natural bacterial pathogen, *Mycoplasma gallisepticum*, that infects House Finches during periods of flocking. Overall, my results underscore the importance of the social environment for individual immunity and the value of integrating behavioral ecology into studies of host-pathogen interactions.

s48 McLean, Dusek, Ubico, Kramer & Guptill

Prevalence of West Nile virus in migratory birds during spring and fall migration. ROBERT G. McLEAN, *Natl. Wildl. Res. Center, Fort Collins, CO*, ROBERT J. DUSEK, SONYA R. UBICO, *USGS Natl. Wildl. Health Center, Madison, WI*, LAURA KRAMER, *New York Dept. Health, Slingerlands, NY*, and STEPHEN C. GUPTILL, *USGS, Eastern Region Geog., Reston, VA.*

Since the invasion of West Nile virus (WNV) into New York in 1999, this disease has spread across the North American continent to 46 of the lower 48 states, into 7 Canadian provinces, and south to the Caribbean, Mexico and El Salvador. Migrating birds are thought to be the major contributor to the rapid dissemination of this mosquito-borne virus. To investigate their potential role in dissemination, we measured the prevalence of WNV and antibodies to WNV in birds during the spring and fall migrations at 8 - 10 sites in the Atlantic flyway during 2001 - 2003, and 5 sites on the Mississippi flyway during 2002 and 2003. We obtained blood samples from 13,402 birds captured in mist-nets, representing 135 species. The WNV antibody prevalence each season was generally low (<5%) at each site, but was as high as 18.4% at some sites. In the Atlantic flyway, Gray Catbirds and Northern Cardinals were most commonly found with antibody to WNV and were the first and third most commonly sampled species. In the Mississippi flyway, antibody to WNV was most commonly detected in Northern Cardinals, the most commonly sampled species. Preliminary results from samples collected in 2003 indicate the WNV epizootic among birds continued to escalate throughout our study areas. The number of WNV antibody positive birds captured in 2003 more than doubled the combined total for 2001 and 2002. Additionally, at least 17 birds had WNV viremias compared with 2 in 2002 and 0 in 2001. Our results indicate that the WNV epizootic that began in eastern North America almost 5 years ago is still growing in that geographic region. These results add to the body of evidence that migratory birds are the principal agent involved in the spread of WNV in North America.

s49 Dupuis, Kramer & Marra

West Nile virus antibody seroprevalence in birds, Caribbean, 2001 - 2004. A. P. DUPUIS II, L. D. KRAMER, *Arbovirus Labs., Wadsworth Center, New York State Dept. Health, Slingerlands, NY*, and P. P. MARRA, *Smithsonian Environ. Res. Center, Edgewater, MD.*

West Nile virus (WNV) has spread rapidly since its initial emergence in New York City in 1999. It is suspected that birds, both migratory and resident, play a key role in this dispersal. In response to the potential threat of expansion of WNV to the tropics, we began an intensive sampling campaign on the overwintering grounds of Neotropical migratory songbirds. Between 2001 - 2004, over 6000 blood samples were collected from resident and migratory birds in Jamaica, Puerto Rico, Cuba, and the Yucatan Peninsula of Mexico. In 2002, neutralizing antibodies to WNV were detected in 18 samples collected from resident birds in Jamaica. 26 resident birds from Jamaica and 7 residents from Campeche and Yucatan, Mexico were positive in 2003. Results from 2004 Cuba and Puerto Rico collections are pending. To date, evidence of WNV transmission has been detected throughout most

of the continental U.S., Canada, and Mexico, as well as the Caribbean and Central America!

s50 McGowan, Clark, Robinson, Serrell & Patrican

Patterns of mortality from West Nile virus in a marked population of American Crows in Ithaca, New York, 2002 - 2003. KEVIN J. MCGOWAN, *Lab. Ornithol., Cornell Univ., Ithaca, NY*, ANNE B. CLARK, DOUGLAS A. ROBINSON, Jr., REBECCA SERRELL, *Biol. Sci., Binghamton Univ., Binghamton, NY*, and LISA A. PATRICAN, *Arthropod-Borne Disease Program, NYSDOH, Ithaca, NY*.

Mortality rates from West Nile virus (WNV) in populations of American Crows apparently exceed those of most other bird species, but are hard to estimate on the basis of winter counts. In a unique, marked population studied for 15 yr in Ithaca, NY, the impact of WNV has been local but dramatic over 2 yr (2002 - 2003). In both years, 35 - 40% of well-known families died or disappeared during Jul-early Oct, the WNV season. Most were found dead and tested positive for WNV. Mortality was unbiased by age or sex class. Both those roosting with family members on territory and those roosting communally off-territory died. Birds often moved while in initial stages of illness such that they could have spread the disease to new areas. Deaths also continued after the peaks of mosquito activity; additional routes of transmission could be involved. The sustained high mortality over two years suggests that few crows are surviving infection. Continued monitoring of social and population impacts are needed, together with studies of transmission routes.

s51 Marshall, Grubb, Zuwerink, Neubig, Kimball, Kuenzli, Doherty & Restifo

Responses of Ohio birds to West Nile virus. JAMES S. MARSHALL, THOMAS C. GRUBB, Jr., D. ANDREW ZUWERINK, JEFFREY P. NEUBIG, SCOTT A. KIMBALL, JOHN J. KUENZLI, *Dept. Evol., Ecol. & Organ. Biol., Ohio State Univ., Columbus, OH*, PAUL F. DOHERTY, Jr., *Colorado State Univ., Ft. Collins, CO*, and ROBERT A. RESTIFO, *Ohio Dept. Health, Columbus, OH*.

West Nile virus (WNV) arrived in Ohio in 2001. We present seroprevalence and persistence of WNV antibodies since 2002 for species captured during our routine winter banding at 54 sites within forest fragments in an agricultural landscape in n.-central Ohio. We compare annual survival rates of several species of bark-foraging birds and of Eastern Screech-Owls before and after the arrival of the virus. Finally, we present preliminary data on distribution of WNV-positive mosquitoes within our study landscape, and on survival and reproductive success of WNV-positive Northern Cardinals.

s52 Clark, Hall, Oesterle & McLean

Detection of West Nile virus from oral swabs of nestling Cliff Swallows: potential use as an early surveillance method. LARRY CLARK, JEFFREY HALL, PAUL OESTERLE and ROBERT McLEAN, *USDA, Animal & Plant Insp. Serv., Wildl. Serv., Natl. Wildl. Res. Center, Fort Collins, CO*.

We report early seasonal activity of West Nile virus (WNV) virus infection in Cliff Swallow nestlings from the Fort Collins, CO, area. Using TaqMan reverse transcription-PCR we were able to detect WNV virus in oral swab samples taken from nestling Cliff Swallows. The timing of virus activity in the nestling population predates the general human activity of WNV in the Fort Collins area by 5 wk. WNV virus activity in nestlings corresponded spatially to case reports of viral infection in humans. This surveillance method may prove useful in designing a sensitive, spatially explicit, early detection system that can predict risk to human populations and thus help guide mosquito control efforts.

GENERAL PAPER SESSIONS

1 Sullivan

Natal dispersal in Yellow-eyed Juncos. KIMBERLY A. SULLIVAN, *Dept. Biol., Utah State Univ., Logan, UT.*

Dispersal patterns can affect genetic variability, effective population size, genetic drift and the opportunity for group selection, kin selection and local adaptation. I studied natal dispersal in a population of Yellow-eyed Juncos in se. Arizona over 8 breeding seasons. 50 individuals that were banded as nestlings were located on their first breeding territory as adults. Unlike many avian species, Yellow-eyed Junco females did not disperse farther than males. Most males and females bred within 800 m of their natal nest site. Birds hatched during drought years roamed farther as independent juveniles and dispersed farther than birds hatched in wetter years. Yellow-eyed Juncos tended to establish territories in areas they spent time in as independent juveniles. Siblings often shared territory boundaries. Pairs consisting of 2 first-year breeders were generally captured together or observed foraging together as independent juveniles

2 Peluc

* Plasticity in nest site selection in response to an avian nest predator: a manipulative experiment in Orange-crowned Warblers. SUSANA I. PELUC. *Dept. Biol., Univ. California-Riverside. Riverside, CA.*

Nest predation is the major cause of reproductive failure for most open-cup nesting passerines. Selection should thus favor individuals who select safe nest sites and minimize their risk of nest predation. Ground nests usually face the lowest risk of predation, and species with flexible nest site choices should select the safest nesting stratum (e.g., ground instead of shrubs). I examined the importance of nest predation in shaping nest site selection in an open-cup nesting species, the Orange-crowned Warbler (OCWA hereafter). In contrast to almost all other *Vermivora* breeding on mainland North America which are exclusively ground-nesters, OCWAs endemic to the California Channel Islands nest at variable heights (0 - 5 m), and breed in areas with few avian predators. I tested if the potential risk of nest predation influences nest site selection in OCWA breeding on Santa Catalina Island. I used vocalizations and mounts of the Western Scrub-Jay, a key nest predator on the mainland but absent from the Island, to experimentally increase the apparent presence of an avian nest predator in 12 OCWA territories (predator treatment). I exposed 12 OCWA pairs to vocalizations and models of a non-predator (House Finch), and 12 pairs to no decoy (control). I conducted the experiment on days when females were prospecting for nest-sites, but before they started nest building. OCWA exposed to the predator cues were expected to nest on the ground (safer stratum) relative to the non-predator or control birds, if nest site selection was influenced by predator presence. Nest heights differed significantly among treatments (Kruskal-Wallis $X^2 = 11.389$, $df = 2$, $P = 0.003$). All females exposed to jays built nests on the ground. Nest heights of females exposed to finch presentations did not significantly differ from control females. The shift in nest site selection observed in OCWAs constitutes a potentially adaptive response to predator presence and provides convincing evidence that birds can recognize not only potential risks but also change their nesting behavior in a short time.

3 Marshall-Rosenberger & Smith

* Behavior and chip note vocalizations of female Hooded Warblers during nest defense. L. C. MARSHALL-ROSENBERGER and K. G. SMITH, *Dept. Biol., Univ. Arkansas, Fayetteville, AR.*

This study was undertaken to determine if, when threatened with predation, the chip note and behavior of female Hooded Warblers differ with respect to experience of females (ASY vs. SY), the type of predator (snake vs. squirrel), and timing of the nesting cycle. The objective was to use chip rate and physical properties of the signal as quantitative measures of intensity. The study allows comparison of chip notes given during different events. Predators were placed either 5 or 10 m from a nest. Behavioral and vocal responses were recorded for a period of 1 h. Statistically significant differences were seen in behavior. In the presence of a predator ASY females more often moved onto the nest silently, while SY females more often moved onto the nest chipping. The behavior did not vary with type of predator or nest cycle. A simple comparison of means suggests that the rate of chipping becomes more rapid in the presence of a snake compared to a squirrel and with progression of the nesting cycle. Physical properties may differ as well. Results indicate a female in her first nesting season learns the behavior of a female in her second or later nesting season. Physical structure and rate with which the chip is given in different circumstances indicate different intensities of

responses to different predators according to their stimulus-value. Because vocalizations are likely a component of nest defense, changes in intensity with the nesting cycle may be attributed to parental investment.

4 Kesler & Haig

* Prospecting, forays, and dispersal in cooperative Micronesian Kingfishers. DYLAN C. KESLER, *Dept. Fish & Wildl., Oregon State Univ, Corvallis, OR*, and SUSAN M. HAIG, *USGS Forest & Rangeland Ecosyst. Sci. Center, Oregon State Univ.*

In many cooperatively breeding species, some young disperse from natal territories while others delay dispersal and assist with future reproduction as helpers. The ecological constraints hypothesis suggests that individuals determine whether to disperse or remain as helpers based on the availability of reproductive opportunities in surrounding and natal territories. The hypothesis rests on the assumption that potential dispersers have knowledge of resource availability, but few studies attempt to evaluate how potential dispersers might gain that information. We analyzed 110 prospecting forays made by 14 radio-marked juvenile and helper Micronesian Kingfishers (*Todirhamphus cinnamomina*). Juveniles forayed farther from natal home ranges than helpers, and birds were more likely to prospect during months when kingfishers were initiating nests. Most forays lasted from 2 - 4 h, and all prospecting birds returned to natal areas prior to sunset. Three individuals eventually dispersed to areas that were the focus of repeated daily forays, and 1 bird remained on a natal area as a helper for >1 yr after 13 prospecting forays. Results suggest that prospecting behavior in Micronesian Kingfishers is influenced by breeder phenology, social rank, and the availability of unoccupied territories. Further, results suggest that juveniles and helpers actively gather knowledge about extraterritorial resources and territory occupancy prior to choosing whether to delay dispersal.

5 LeClair, Bowman & Schoech

* Comparison of hatching failure in a wildland and suburban population of the Florida Scrub-Jay. S. C. LeCLAIR, *Dept. Biol., Univ. South Florida, Tampa, FL*, R. BOWMAN, *Archbold Biol. Sta., Lake Placid, FL*, and S. J. SCHOECH, *Dept. Biol., Univ. Memphis, Memphis, TN*.

Rates of hatching failure are significantly higher in suburban Florida Scrub-Jays than those living in wildland habitat. Egg hatchability has been correlated with a variety of factors, including predation risk. Human disturbance may be analogous to perceived predation risk, and this may lead birds to change their behavioral patterns during incubation. These changes may affect the microclimate of the nest, and thus the hatchability of the eggs. Thermocouples and cameras were placed at nests to gauge both nest microclimate and behavior in each treatment. We expected that male visits to the nest would be less frequent, female off-bouts would be longer and less frequent and nest microclimate would be more variable in suburban habitat and where human disturbance is higher. Mean nest temperatures were significantly higher in suburban habitat vs. wildland habitat, and ambient temperatures were higher in suburban habitat even when controlling for date. Control suburban females took shorter, more frequent off-bouts, but spent a greater proportion of time off their nests than either wildland or increased visitation suburban nests. Wildland males had the lowest rates of incubation feedings. Our results suggest that the perception of predation risk is lower in suburban scrub-jays, and thus normal human activity may not affect their incubation behavior. However, if suburban scrub-jays tend to spend a greater proportion of time off of their nests, and temperatures in this habitat are warmer than those in wildlands, this combination may lead to higher rates of hatching failure in this population.

6 Garcia & Conway

* Ultimate factors affecting natal dispersal age in Burrowing Owls. VICTORIA GARCIA and COURTNEY J. CONWAY, *Arizona Coop. Fish & Wildl. Res. Unit, School Nat. Res., Univ. Arizona, Tucson, AZ*.

A juvenile's decision of when to initiate natal dispersal may influence subsequent survival probability and may impact its ability to find a suitable breeding territory the following year. Burrowing Owls are a good species in which to examine the factors influencing intraspecific variation in age of natal dispersal because individuals vary widely in dispersal age. We determined the age at which juvenile Burrowing Owls initiated natal dispersal by placing a radio transmitter on 1 juvenile in each of 137 broods. We experimentally tested the effects of food abundance on dispersal age of juvenile burrowing owls by randomly assigning 67 nests to a treatment (food-supplemented) group and 70 nests to a control (non-supplemented) group. We also examined the relationship between dispersal age and relative abundance of prey in the natal area by trapping small mammals and invertebrates.

To determine whether a heavy load of ectoparasites affects dispersal age, we randomly assigned 77 nests to a treatment group and 60 nests to a control group. At each treatment nest, we added diatomaceous earth powder to reduce ectoparasites. Of the 137 radio-marked juveniles, 72 definitely dispersed. Results from the first year of fieldwork suggested that juveniles from food-supplemented burrows dispersed later and those from burrows treated with diatomaceous earth dispersed earlier. Results from year 2 will be included. I will also discuss the relationship between local relative food abundance and dispersal age. I will compare the results I obtained from the experimental and correlative approaches to examining the effects of food on dispersal age.

7 Long & Stouffer

* Territorial behavior in wintering Hermit Thrushes: attributes of winners and costs to losers. JENNIFER A. LONG, *Dept. Biol., Univ. Maine, Orono, ME*, and PHILIP C. STOUFFER, *School Renew. Nat. Res., Louisiana State Univ., Baton Rouge, LA*.

Much research has been done on the endocrine basis of breeding territory defense, however, little is known about the endocrine response to intraspecific competition for territories outside of the context of breeding. Wintering Hermit Thrushes in se. Louisiana aggressively defend territories with agonistic displays that are similar to those used to defend breeding territories. We investigated the relationship between age and physiological condition and intensity of territorial behavior in pairs of Hermit Thrushes kept in a large outdoor aviary just after their arrival on the wintering grounds. We measured baseline corticosterone before and immediately after territorial encounters, as well as the adrenocortical response, to determine if corticosterone secretion differed between "winners" and "losers" of territorial interactions (defined by the number of aggressive displays). We found that neither age nor physiological condition alone was a good predictor of the outcome of territorial battles, however, birds that were older and in better condition tended to be more aggressive (significant interaction term). We also found that while baseline corticosterone was low in both groups initially, "losers" had significantly elevated baseline corticosterone compared to "winners" of territorial encounters. The adrenocortical response to stress, however, was highly variable and not significantly different between "winners" and "losers". We believe that the elevated baseline levels of corticosterone in "losers" may direct movement away from the disputed territory. This pattern of corticosterone secretion suggests that young birds or birds in poor condition that are unable to secure a territory may incur the costs associated with chronically elevated corticosterone.

8 Lewis, Esler & Boyd

* Surf Scoter and White-winged Scoter foraging behavior in response to variation in bivalve prey. TYLER LEWIS, DAN ESLER, *Centre for Wildl. Ecol., Simon Fraser Univ., Burnaby, BC*, and SEAN BOYD, *Canadian Wildl. Serv., Delta, BC*.

Waterfowl, like other birds, have been shown to adjust their foraging behavior in response to variation in food abundance or quality. These changes in foraging behavior, once understood, can be used to assess or predict changes in habitat quality. Relationships between variation in food and foraging behavior are largely unknown for sea ducks. We are conducting a study in Baynes Sound, on the east coast of Vancouver Island, BC, to describe foraging behaviors of wintering Surf and White-winged Scoters in response to variation in their primary prey (clams). Intertidal clam sampling indicates that clam densities vary geographically within our study site, as well as temporally through winter depletion from scoter predation. Significant winter density decreases were observed for both manila clams (*Venerupis philippinarum*) and varnish clams (*Nuttallia obscurata*), the main bivalve prey species of scoters in Baynes Sound. We monitored foraging behaviors of radio-marked scoters and non-marked flocks at clam sampling sites. In areas of temporally declining clam densities, proportion of time spent feeding and number of dives/h increased throughout the winter while foraging success rates (number of clams captured/dive) decreased. Our findings suggest that scoters respond to variation in prey abundance by altering their overall foraging effort, highlighting the importance of an abundant and dependable winter food supply.

9 Brito

* The influence of glacial refugia on Tawny Owl genetic diversity: phylogeography in Western Europe. PATRICIA H. BRITO, *Am. Mus. Nat. Hist., New York, NY*.

The glacial refugia hypothesis states that during the height of the Pleistocene glaciations temperate species that are today widespread in Western Europe must have survived in small, and climatically favorable areas called glacial refugia. Thus, northern Europe was subsequently

recolonized by one or a by a combination of more than one refugia, which ought to have left genetic signatures in the populations. In this study, I used control region mtDNA sequences from 186 individuals distributed among 14 populations to test whether current genetic diversity in the Tawny Owl populations could be explained by this glacial refugia hypothesis. Several population genetic statistics were estimated to describe the patterns of genetic diversity within and among populations, and the genealogy of haplotype relationships was used to infer phylogeographic patterns. Phylogenetic tree topology recovers 3 main clades. These clades reflect haplotype distributions that correspond to recognized refugial populations. There is an Iberian clade, a mainly Italian and French clade, and a clade that contains individuals from Greece as well as individuals from all northern European populations. The results suggest that (1) the hypothesis of glacial refugia is supported by the phylogeographic history of the Tawny Owl in Western Europe; (2) most of northern Europe was repopulated by owls from the Balkans; and (3) expansion out of Iberia and Italian refugia had only a regional effect that is best represented by the genetic diversity of the French populations.

10 Brown, Birt, van Coeverden de Groot, Seutin, Boag & Friesen

Population genetics of Canadian Peregrine Falcons. JOSEPH W. BROWN, TIM P. BIRT, PETER J. VAN COEVERTEN DE GROOT, *Dept. Biol., Queens Univ., Kingston, ON*, GILLES SEUTIN, *Parks Canada, Hull, QC*, PETER T. BOAG and VICKI L. FRIESEN, *Dept. Biol., Queens Univ.*

The Peregrine Falcon, *Falco peregrinus*, is among the most recognized, empathized, and emphasized higher vertebrate species at risk in North America. After being essentially extirpated east of the Great Plains, extensive reintroduction programs, in conjunction with curtailing organochlorine contaminants, have seen a dramatic increase in census population sizes. Despite the wide interest in the fate of this species, very little is known about the genetics of post-reintroduction populations. Here we utilize data from the mitochondrial control region and 11 polymorphic microsatellite loci to examine the distribution of genetic variation in nearly 200 unrelated Canadian birds, with a particular emphasis on delimitation of subspecies (*F. p. anatum*, *F. p. tundrius*, and *F. p. pealei*). Mitochondrial diversity was extremely low range-wide, with only 4 haplotypes found, 1 of which was found in all *pealei* and West Coast *anatum* individuals. Microsatellite variation was much higher, with between 2 and 13 alleles per locus (mean of 6.1), and an average heterozygosity of 0.54. Overall, *pealei* appears to be the most distinct genetically. Pairwise F_{st} measures range from 0.02 between *anatum* and *tundrius* to 0.08 between *tundrius* and *pealei*. Molecular assignment tests delegated birds to recognized subspecies with reasonable success 85%, 72%, and 64% for *pealei*, *tundrius*, and *anatum* birds, respectively. These results demonstrate that the markers used are potentially highly useful in population monitoring and management.

11 Sorenson, McCracken, James, Heath & Johnson

Congruent and conflicting evidence in waterfowl systematics. MICHAEL D. SORENSON, *Dept. Biol., Boston Univ. Boston, MA*, KEVIN G. MCCRACKEN, *Dept. Biol. & Wildl., Univ. Alaska, Fairbanks, AK*, HELEN F. JAMES, *Natl. Mus. Nat. Hist., Smithsonian Inst., Washington, DC*, TRACY A. HEATH, *Integr. Biol., Univ. Texas, Austin, TX*, and KEVIN P. JOHNSON, *Illinois Nat. Hist. Surv, Urbana, IL*.

We test previous molecular and morphological hypotheses with an expanded DNA sequence data set comprising several mitochondrial and nuclear loci (both coding and non-coding) for representatives of all extant waterfowl genera (family Anatidae). Analyses based on independent genetic loci and both mitochondrial and nuclear data sets are broadly congruent with respect to the genus-level relationships of waterfowl but are at odds with a morphological phylogeny of the waterfowl in several important respects. Notable results that were found consistently across the various molecular data sets include: 1) a clade comprising pygmy geese (*Nettapus*) and "stifftails" (*Oxyura*, *Nomonyx*, *Heteronetta*, and *Stictonetta*); 2) substantial genetic divergence of Pink-eared Duck (*Malacorhynchus*) and Musk Duck (*Biziura*), respectively, from all other waterfowl; 3) a sister relationship between Coscoroba Swan and Cape Barren Goose; and 4) several novel results for the remaining duck genera (subfamily Anatinae).

12 Barker, Burns, Klicka, Lanyon & Lovette

Multiple nuclear genes support major clades of New World nine-primaried oscines (Emberizinae). F. K. BARKER, *Bell Mus., St. Paul, MN*, K. J. BURNS, *San Diego State Univ., San Diego, CA*, J. KLICKA, *Barrick Mus., Las Vegas, NV*, S. M. LANYON, *Bell Mus.*, and I. J. LOVETTE, *Cornell Univ., Ithaca, NY*.

The subfamily Emberizinae (*sensu* Sibley & Ahlquist 1990, **Phylogeny and classification**) is

one the most diverse passerine groups in morphology, ecology, and species richness, and rigorous analysis of this diversity should be informed by a robust phylogeny of the group. While studies of mitochondrial DNA sequences have proven informative for many relationships (e.g., within tribes), basal relationships of these groups, and the affinities of many enigmatic taxa (e.g., *Spindalis*, *Zeledonia*, *Icteria*) remain controversial. We have focused instead on sampling loci from the relatively slowly-evolving nuclear genome, including both protein-coding and non-coding sequences. We sequenced 7461 bases from a total of 6 nuclear introns and the protein-coding gene RAG1, from a total of 11 species including representatives of all 5 tribes of Emberizinae. These data strongly support monophyly of 2 major groups: 1) a tanager/cardinal clade, which includes the so-called "tanager-finches," and 2) a clade containing New World sparrows, true warblers, and blackbirds (Icterini). Outside of both these groups are the Old World or holarctic "emberizi" taxa *Emberiza* and *Calcarius*, though the relative branching relationships among these lineages remains unresolved. Our collaboration is expanding its nuclear sequence sampling to include many more taxa, and will eventually incorporate mitochondrial data for all species in the subfamily.

13 Beresford, Barker, Ryan & Crowe

New answers to old questions: resolving enigmatic African songbirds with nuclear loci. P. BERESFORD, *FitzPatrick Inst., Univ. Cape Town, South Africa*, F. K. BARKER, *Bell Mus., Univ. Minnesota, St. Paul, MN*, P. G. RYAN and T. M. CROWE, *FitzPatrick Inst.*

Since recent molecular work has shown that 2 enigmatic, endemic Africa species (rockjumpers, *Chaetops* spp. and rockfowl, *Picathartes* spp.) share a most recent common ancestor with Australo-Papuan robins (Petroicidae) and Passerida (~3500 species), the possibility that other African taxonomically isolated or enigmatic songbirds might be older than assumed was explored. 10 such enigmatic African oscines were added to a large (44 families) nuclear (RAG-1 and RAG-2) genetic dataset of Passeri (see Abstract 12). The results resolve many long-standing questions about the phylogenetic affinities of the enigmatic birds, many not predicted by traditional approaches. Several higher taxa have basal nodes subtending endemic African taxa, for example, Promeropidae in a monophyletic assemblage of Passeroidea and the Sphenoeacus group in one of Sylvioidea. Relationships between several African and Malagasy taxa are also shown. When the molecular data are calibrated, both the spatial and temporal patterns reveal a previously unsuspected role for Africa in the Tertiary cladogenesis of Passerida, and the consequent implications for future phylogenetic projects are discussed.

14 Barrowclough, Groth & Mertz

Phylogenetic relationships among parrots. GEORGE F. BARROWCLOUGH, JEFF G. GROTH and LISA A. MERTZ, *Dept. Ornithology, Am. Mus. Nat. Hist., New York, NY.*

We investigated the phylogenetic relationships among extant genera of parrots using the nuclear RAG-1 exon. Approximately 95% of the generally recognized generic-level taxa were sampled. The results indicate that the large New Zealand parrots are sister to all other taxa. The traditional Cacatuidae, including *Nymphicus*, form the next, monophyletic clade and are sister to the remaining taxa. The New World parrots are monophyletic, but are nested within the Old World taxa; long-tailed and short-tailed genera of Neotropical parrots do not form monophyletic clades. Within the Old World, African parrots are not monophyletic. The traditional Loriidae are not basal; they form a terminal radiation within Australian taxa.

15 Cicero, Wieczorek & Peterson

The ORNIS network: data and tools for the ornithological community. CARLA CICERO, JOHN R. WIECZOREK, *Mus. Vert. Zool., Univ. Calif., Berkeley, CA*, and A. TOWNSEND PETERSON, *Nat. Hist. Museum and Biodiv. Res. Center, Univ. Kansas, Lawrence, KS.*

North American museum collections house approximately 5 million ornithological specimens, yet it is currently impossible to access, retrieve, and integrate data efficiently across these collections for biodiversity research. For example, tracking and anticipating the emerging disease West Nile virus has been impeded by lack of efficient access to avian biocollections regarding bird species' seasonal distributions and migratory movements. Although distributed database technology was originally developed for ornithological collections (The Species Analyst), this community has lagged behind other vertebrate groups (e.g., FishNET, MaNIS, HerpNET) in broadscale development and implementation. The ORNIS network, now funded by NSF, is designed to unite the ornithological collections community via a distributed database that will encompass over 4 million specimens

(including sound recordings and eggs) from 30+ institutions in the U.S., Canada, and Mexico. Specifically, this project will couple support for database networking with development of novel web-based software tools for error-checking and data improvement. While reduced NSF funding placed primary emphasis on software development, the community network created by ORNIS will enable georeferencing of all North American (and hopefully more) specimen-based locality data in ORNIS institutions. In addition, ORNIS will make spatial applications (e.g., mapping) possible via these georeferenced data, and will lead to improved data quality by developing new tools for cleaning up taxonomy, locality, and date inconsistencies. The enriched data from the ORNIS network will serve as a testbed for the software tools, and will be served to the broader community to enable many exciting research applications in ornithology.

16 Voelker, Bowie & Rohwer

Systematics and biogeography of the genus *Turdus*. GARY VOELKER, *Dept. Biol., Univ. Memphis, Memphis, TN*, RAURI BOWIE, *Univ. Stellenbosch, South Africa*, and SIEVERT ROHWER, *Univ. Washington, Seattle, WA*.

Using 2368 bp from the mitochondrial cytochrome b, ND2 and ND3 genes, we have begun to analyze the molecular systematics of the genus *Turdus*. Preliminary bayesian phylogenetic analysis of this dataset, which is complete for 54 of 65 extant *Turdus* species (following Sibley and Monroe), suggests: 1) that *viscivorous* + *philomelos* (Eurasia) are the oldest extant *Turdus* species, 2) that *kessleri* (Asia) and *rufopalliatu*s (Central America) are sister to the remaining species, and 3) that these remaining *Turdus* species fall into 3 groups. The first of these is a clade consisting of 24 species (23 Neotropical + 1 African (basal)). The second is a clade of 12 Eurasian species. The third clade consists of 14 species from the Caribbean, Africa, Asia, and North America. The second and third clade are sisters relative to clade one. The genera *Nesocichla* (Tristan da Cunha), *Platycichla* (South America), and *Cichlherminia* (West Indies) are all firmly placed within *Turdus*; the former two fall within the largely Neotropical clade (group one), while *Cichlherminia* falls within clade three.

17 Calvert & Gauthier

Exceptional conservation measures: how have they impacted survival and hunting mortality in Greater Snow Geese? ANNA M. CALVERT and GILLES GAUTHIER, *Dept. Biol., Univ. Laval, Québec, QC*.

In response to rapid population growth in recent years, unusual conservation measures were implemented for Greater Snow Geese (*Chen caerulescens atlantica*) in 1999, with the intention of reducing adult survival and stabilising abundance. The effects of the resulting new spring hunting season and liberalised autumn and winter regulations were analysed using a comprehensive dataset of hunter-recovered banded birds from 1990 - 2002 (4,800 recoveries of 45,000 geese banded). We built models in program MARK to estimate annual survival and recovery probabilities, and developed a flexible model structure in program SURVIV to determine the specific impacts of the changes made to each of the 3 hunting seasons (autumn and spring in Québec, winter in the U.S.). Finally, annual and seasonal recovery rates were transformed into kill rates using band-reporting rates. Adult recovery and kill rates increased strongly since 1999, mainly because of the addition of the spring hunt and the liberalised winter regulations; juvenile recovery and kill rates also showed a slight increase but were highly variable across years. A decline in mean annual adult survival rate was observed since the regulation changes, from 83.0% to 72.5%. Adult survival was negatively related to annual harvest rate, but not in juveniles where the relationship was complicated by the high and variable autumn migration mortality. Overall, our results suggest that adult survival and hunting mortality rates were affected by the special conservation measures as expected under the hypothesis of additive hunting mortality, and that regular season regulations could be manipulated for future population control once the spring hunt is discontinued.

18 Vilella

Distribution and abundance of the Red-tailed Hawk in Puerto Rican Parrot occupied habitat. FRANCISCO J. VILELLA, *USGS-BRD Coop. Res. Unit, Mississippi State, MS*.

The Red-tailed Hawk (RTHA) is a top predator of upland ecosystems in the West Indies. The endangered Puerto Rican Parrot (PRPA) is confined to the rainforest regions of the Luquillo Mountains. RTHA are known PRPA predators and may represent a limiting factor for recovery. From 2000 - 2002, 34 captive-reared PRPA were released in the Caribbean National Forest (CNF). This reserve includes 11,330-ha of montane rainforest located in ne. Puerto Rico. Predation by RTHA accounted for most mortalities of captive-reared PRPA, despite pre-release acclimation, including

predator aversion training. We conducted fixed radius point counts and roadside surveys for RTHA in CNF and adjacent lands during 2001 - 2002. We defined the observation period as the median peak observation time \pm 0.5 SD. We used distance sampling to estimate RTHA density. RTHAs estimates were similar for roadside surveys and point counts. Estimates (D) from roadside surveys were 0.0115 hawks/ha (95% CI = 0.00870 - 0.01515), and 0.0129 hawks/ha (95% CI = 0.00888 - 0.01858) from point counts. The estimated total number of RTHA using CNF and adjacent lands were 130.1 (98.57 - 171.65) for roadside surveys, and 146.6 (100.61 - 210.51) for point counts. Number of RTHAs did not differ by watershed ($P = 0.429$) nor between surveys ($P = 0.640$). Ongoing habitat conversion surrounding CNF may be related to the high number of RTHAs observed.

19 Schmiegelow & Cumming

Boreal birds and landscape change: a retrospective study of the ecological consequences of industrial development in western Canada. FIONA K. A. SCHMIEGELOW, *Dept. Ren. Res., Univ. Alberta, Edmonton, AB*, and STEVEN G. CUMMING, *Boreal Ecosys. Research, Edmonton, AB*.

Industrial development in the Canadian boreal will result in loss and fragmentation of old forest. The expanding network of roads and other linear features may compound direct harvesting effects. We describe a multi-year study to quantify the effects of industrial development on boreal forest songbirds and generate predictive statistical relationships for use in spatial dynamic models, exploration of ecological thresholds, and the design of adaptive management experiments. Sampling units were ~ 100 km² in n. Alberta. The design variables were the abundance of old mixed-wood forest (focal habitat), a spatial configuration metric and indices of industrial development. Within landscapes, we sampled forest birds along 9 km belt transects that traversed representative habitats, and by point count surveys in large patches of focal habitat. From 2001 - 2003, we sampled 116 landscapes within a 150,000 km² region extending ~ 300 km N-S and ~ 600 km E-W. The data were modeled by multiple Poisson regression. Geographic location and sampling date explained 50% of the deviance in total detections of neotropical migrants, and were also significant for most individual species. Patch-scale relative abundances of many species were negatively correlated with landscape-scale indices of fragmentation and industrial development. The predicted abundances of sensitive species (e.g., the Black-throated Green Warbler and several congeners) varied by factors of 4 - 5 over the ranges of these covariates. For such species, significant regional declines may already have occurred. The 2004 field season will test this by sampling relatively pristine landscapes accessible only by air- or watercraft.

20 Sherry, Hannon, Holmes, Marra, Norris & Smith

Geographic variation in the breeding behavior of American Redstarts? THOMAS W. SHERRY, *Dept. Ecol. & Evol. Biol., Tulane Univ., New Orleans, LA*, SUSAN HANNON, *Dept. Biol. Sci., Univ. Alberta, Edmonton, AB*, RICHARD T. HOLMES, *Dept. Biol. Sci., Dartmouth Coll., Hanover, NH*, PETER P. MARRA, *Smithsonian Environ Res. Center., Edgewater, MD*, D. RYAN NORRIS, *Dept. Biol., Queen's Univ., Kingston, ON*, and ROB J. SMITH, *Dept. Biol., Univ. Scranton, Scranton, PA*.

American Redstarts breed from se. Alaska and Newfoundland south to s. Louisiana, which spans a range of environments that should select for geographic variation in nesting behavior. We compared clutch size, nest structure, and nest location traits among geographically distant sites. Nest tree species, nest materials, and use of vines for concealment varied considerably among sites, as expected for opportunistic responses. Nests also differed in size and nest micro-habitat based on Discriminant Function Analysis. Louisiana, Ontario, and Alberta nests were readily distinguishable from each other. Louisiana nests were the smallest in all dimensions, had significantly smaller clutch size, were placed at different nest heights (means 17.2, 6.5 and 3.8 m, respectively), were typically placed on relatively horizontal branches several meters from the tree trunk, and were situated within more leafy cover. The almost complete absence in Louisiana of low nests close to a main trunk, so characteristic of redstarts' northern nests, is difficult to explain as just an opportunistic response to bottomland hardwoods environments in Louisiana. These and additional nesting data support nest predation and climate as important selection pressures that appear to maintain geographic variation in redstart nesting behavior.

21 Campbell, Hunter & Witham

A twenty-year study of spatial responses of birds to a group selection timber harvest in an oak-pine forest in Maine. STEVEN P. CAMPBELL, MALCOLM L. HUNTER, Jr., *Dept. Wild. Ecol., Univ. Maine, Orono, ME*, and JACK W. WITHAM, *Holt Research Forest, Arrowsic, ME*.

Many studies have investigated the effects of forest management on bird populations, but comparatively few have been long-term, have included experimental manipulations that allow for pre- and post-treatment comparisons, or have reported data more detailed than changes in relative abundance. Here we present preliminary findings from a 20-yr data set (5 yr pre-harvest and 15 yr post-harvest) of local distributional changes of birds in response to a group selection timber harvest in an oak-pine forest at the Holt Research Forest in Arrowsic, Maine. The location data of all bird species in the 40-ha study area were collected by 16 rounds of territory mapping in each breeding season. We analyzed shifts in bird locations caused by the creation of gaps using 3 metrics: 1) the change in the proportional use of gap, buffer (< 25 m from gaps), and interior forest (>25 m from gaps) areas, 2) the distance from bird locations to the nearest harvest-created gap, and 3) the proportion of gap area occurring in a species' range within the forest. 7 species showed changes that were significant and consistent across the 3 metrics. Ovenbirds and Black-throated Green Warblers avoided harvested areas, while White-throated Sparrows, Common Yellowthroats, and Eastern Wood-Pewees moved into these areas. Winter Wrens were previously absent from the forest and appeared in harvested areas immediately following the harvest. Black-and-white Warblers moved into harvested areas 5 yr after the harvest. All of these species except the Black-and-white Warbler returned to near pre-harvest distributions 15 yr after the harvest occurred.

22 Robert, Jobin, Shaffer, Robillard & Gagnon

Yellow Rail distribution and numbers in southern James Bay, Québec. MICHEL ROBERT, BENOIT JOBIN, FRANÇOIS SHAFFER, LUC ROBILLARD, *Canadian Wildl. Serv., Sainte-Foy, QC*, and BENOIT GAGNON, *Hydro-Québec, Montréal, QC*.

We surveyed Yellow Rails in 3 marshes located in se. James Bay, in order to help document the status and distribution of this species at risk. Night-surveys of calling males were made along 75 km of line transect on 21 - 25 Jul 2002, and 186 individual Yellow Rails were recorded 80 in Cabbage Willows Bay, 77 in Boatswain Bay, and 29 in Hall Cove. Day-time surveys yielded 19 additional calling males, for a total of 205 rails. Transects were distributed in plant communities dominated by slimstem reedgrass (*Calamagrostis stricta stricta*), chaffy sedge (*Carex paleacea*), buckbean (*Menyanthes trifoliata*), or by red fescue (*Festuca rubra*). We detected an overall density of 0.05 calling rail/ha with maximum densities in Boatswain Bay (0.08 male/ha) and Hall Cove (0.06 male/ha). Densities calculated for specific plant communities permitted to estimate that 397 male Yellow Rails may inhabit the marshes 216 in Boatswain Bay, 132 in Cabbage Willows Bay, and 49 in Hall Cove. The highest densities were calculated for chaffy sedge stands, slimstem reedgrass stands, and fens dominated by buckbean. This study indicates that the Yellow Rail is a common bird in coastal high-marshes of the se. James Bay, and revealed the highest densities ever reported for the species. The extensive estuarine tidal marshes found in s. James Bay may be home of a thousand or more adult male Yellow Rails and thus represents a key area for this species. In addition to the Yellow Rail, the high-marshes we surveyed hosted other high-concern bird species in Québec such as the Nelson Sharp-tailed Sparrow, Short-eared Owl, and Marbled Godwit. Habitats currently not protected, such as Hall Cove, should therefore be considered as potential conservation areas.

23 Strong, Perlut, Shustack & Puryear

Land use patterns as an ecological trap for Bobolinks in the Champlain Valley. ALLAN M. STRONG, NOAH G. PERLUT, DANIEL P. SHUSTACK, *Rubenstein School Environ. & Nat. Res., Univ. Vermont, Burlington, VT*, and KRISTEN A. PURYEAR, *Botany Dept., Univ. Vermont*.

Typical hayfield management (fields cut in late-May/early-Jun) likely produces ecological traps for Bobolinks, as nest success after cutting is 0% and re-nesting is sufficiently delayed such that second nests are often destroyed by additional cuts. However, the severity of this ecological trap may be magnified by land use patterns. Using vegetation, field, and landscape characteristics of agricultural fields in the Champlain Valley (NY, VT), the degree of landscape openness within 2500 m was the most parsimonious model explaining male Bobolink abundance. Consequently if the intensity of hay cutting varies with the degree of landscape openness, then landscape patterns may further exasperate the degree to which hayfields function as ecological traps. Within a heavily agricultural sub-sample of the Champlain Valley, 53.7% of the hayfield area was mowed by 26 Jun, and 83.3% by

11 Jul. In contrast, when examining cutting patterns across the Champlain Valley as a whole, approximately 41% of hayfield area was cut by 26 Jun and 55% by 11 Jul. If birds are preferentially selecting fields in open landscapes, they will be more likely to experience nest failure as these landscapes are more intensively managed. Significant from a management perspective is that forage quality decreases significantly after 26 Jun, but 14 - 30% of hayfields are cut after this date. If landowners that cut fields during this time are not actively producing livestock forage, then extension and education programs may allow more bird-friendly management practices for Bobolinks on a substantial acreage of grasslands

24 Phillips, Powell & Taylor

Molt migration and ecology of King Eiders. LAURA PHILLIPS, ABBY N. POWELL, *Alaska Coop. Fish & Wildl. Res. Unit, Univ. Alaska, Fairbanks, AK*, and ERIC J. TAYLOR, *U.S. Fish & Wildl. Serv., Migratory Bird Manage., Anchorage, AK*.

We studied the molting ecology of 33 King Eiders (14 females and 19 males) that bred on the North Slope of Alaska in 2002 and 2003 using satellite telemetry. Males dispersed from the study area and arrived at molting areas significantly earlier than females. Duration of molt migration (mean = 41 d \pm 11 SD), distance to molting areas (mean = 1952.4 km \pm 865.3 SD), number of days at molting sites (mean = 61 d \pm 18 SD), and distribution of molt locations did not differ among sexes or years. Most King Eiders migrated to molting sites along the Russian and Alaskan coasts of the Bering Sea. Molt sites included areas along the Chukotka, Kamchatka, and Alaska Peninsulas, St. Lawrence Island and the Alaskan Beaufort Sea coast. Molt locations for subsequent years (n = 10) suggest molt site fidelity.

25 Mills

New World latitudinal patterns of seasonal range size: breeding rarefaction and winter compaction. ALEXANDER M. MILLS, *Dept. Zool., Univ. Toronto, Toronto, ON*.

Where there is seasonal disparity among constraints, the season in which constraints are greatest is the period most likely to limit populations. Among migrant birds, any of breeding, migratory or winter conditions could exclusively constitute such population-limiting factors. In the Americas, most temperate breeding passerines spend the winter further south, commonly in the tropics where landmass is substantially less. I considered patterns of breeding range size, winter range size and winter distribution using a sample of 43 migrant wood warbler and sparrow species that breed in eastern North America and that primarily winter north of South America. Analysis of such patterns leads to the following observations: (a) breeding range sizes and winter range sizes diminish the further south a species winters, (b) birds with large breeding ranges and those with large winter ranges are not restricted to the tropics in winter, (c) winter range size is usually substantially smaller than breeding range size within species (averaging 40% for wood warblers and 64% for sparrows), and (d) winter range size as a proportion of breeding range size diminishes the further south a species winters. These patterns collectively suggest that the southward reduction in landmass is a limiting factor for migrant bird populations, adding to other research concluding that winter conditions can prevail over breeding conditions in the limitation of populations. Hectare for hectare, habitat destruction in the tropics is likely to have the greater impact on the welfare of passerine populations breeding in North America.

26 Holberton, Horton, Johnston, Long, Perkins, Wilder & Wright

Across- and within-season adjustments in hematocrit, corticosterone secretion, and energy reserves in North American migratory songbirds. REBECCA HOLBERTON, BRENT HORTON, JASON JOHNSTON, JENNIFER LONG, DEBORAH PERKINS, SARAH WILDER and WESLEY WRIGHT, *Dept. Biol. Sci., Univ. Maine, Orono, ME*.

Migratory birds experience a wide variety of environmental conditions across diverse habitats throughout the annual cycle. Behavioral and physiological plasticity (e.g., seasonal shifts in diet, digestive processes, energy reserves, and thermoregulatory capabilities) enables migrants to meet large and small scale changes in energy demand. To better understand these adjustments, we investigated across- and within-season patterns of variables related to metabolic activity and energy regulation. From a database comprising over 600 migrant songbirds sampled in North America during the two stationary periods as well as spring and fall migration, we found significant across-season changes in energy reserves, hematocrit (HCT), and baseline corticosterone (CORT0). HCT and fat score were highest during winter and lowest during summer; spring and fall values were similar to

each other and intermediate to the two stationary periods. While CORT0 was greatest during fall and spring and lowest during winter, it was unexpectedly higher during summer compared to winter in spite of the fact that elevated CORT0 is believed to compromise breeding success. During winter, greater fat reserves and higher HCT may help birds meet greater metabolic demands. While CORT0 plays a major role in regulating within and across-seasonal shifts in energy reserves, it does not appear to regulate changes in HCT. The factors affecting HCT across and within-seasons are not directly linked to energy reserves and are little understood.

27 Bêty, Giroux & Gauthier

Individual variation in timing of migration: causes and reproductive consequences in Greater Snow Geese. JOËL BÊTY, *Dépt. Biologie, Univ. Québec à Rimouski, Rimouski, QC*, JEAN-FRANÇOIS GIROUX, *Dépt. Sciences Biologiques, Univ. Québec à Montréal, Montréal, QC*, and GILLES GAUTHIER, *Dépt. Biologie, Univ. Laval, Québec, QC*.

Decisions made by birds during migration to breeding grounds can strongly affect their fitness. We investigated possible causes and reproductive consequences of interindividual variation in the migratory behavior of an arctic-nesting species, the Greater Snow Goose, by radio-tracking females at their main staging area and on their breeding ground. Females showed relatively high repeatability in the duration of migration and arrival date on the breeding ground suggesting that these traits are characteristics of individuals. Conversely, no individual consistency in departure date from the staging area was detected. Females paired with dominant males departed slightly earlier from the staging area than females accompanied by subordinate males. However, neither social status (i.e., paired vs. unpaired) nor dominance scores were associated with arrival time of individuals. Finally, the probability of breeding was positively related to arrival date suggesting a reproductive cost of arriving too early. Our results indicate possible genetically based differences among individuals in migration duration and arrival date. If this is confirmed, adaptive evolution of migration and reproduction to climate changes would be expected as the breeding date is strongly related to arrival time in these birds.

28 Rodewald

Migrant landbirds in upland and riparian forest stopover habitats across an urban to rural gradient. PAUL G. RODEWALD, *School Nat. Res., Ohio State Univ., Columbus, OH*.

Stopover habitat relationships of landbirds are not well known and this represents a shortcoming in conservation plans for migratory birds. In 2001 - 2003, I studied migrant use of upland and riparian forests during spring in central Ohio. I surveyed migrants along 250-m transects, and quantified foraging behavior, local- and landscape-level habitat characteristics, and percent cover by forest, urbanization, and agriculture. Percent urbanization within 1-km of riparian (19.9%) and upland sites (22.2%) did not differ. There was a trend toward higher forest cover in landscapes surrounding riparian sites (42.0%) than in upland sites (30.5%); forest cover was similar between rural (39.3%) and urban (35.1%) landscapes. Habitat structure was statistically similar between upland and riparian areas, but riparian areas tended to have less understory vegetation. Species richness and abundance of transient Neotropical migrants did not differ by landscape type (urban vs. rural), and were much higher in upland forests in both landscapes. Of 23 transient species, 14 species differed in their use of riparian and upland forests, and 13 of these were most abundant in upland forest [e.g., Nashville, Magnolia, Black-throated Green, Bay-breasted warblers]. Conservationists value riparian forests in midwestern states because they provide wildlife habitat and protect water quality, however, these data suggest that upland forest woodlots are potentially important for migrating songbirds.

29 Bisson, Stutchbury & Lougheed

The evolutionary history of migration in the Cassin's Kingbird. ISABELLE-ANNE BISSON, BRIDGET J. M. STUTCHBURY, *Dept. Biol. York Univ., Toronto, ON*, and STEPHEN C. LOUGHEED, *Dept. Biol., Queen's Univ., Kingston, ON*.

The evolution of migration remains one of the quintessential questions in ornithology despite a century of proposed hypotheses. Recent theories suggest that migration evolves out of the tropics from sedentary populations as population's breeding ranges expand out of the tropics and into the temperate zone. Intraspecific phylogeographic studies using species that have retained sedentary, short-distance and long-distance migrant populations can provide important insights on the evolutionary history of migration in avian species. However, such systems are rare. We investigate the evolutionary history of migration within a phylogeographic and population genetic framework in the

Cassin's Kingbird. Extant Cassin's Kingbird populations differ in migratory behavior at 3 levels: populations in s. Mexico are sedentary, populations in n. Mexico are short-distance migrants, and populations in the sw. U.S. are long-distance migrants. We use 759 base pairs of the mitochondrial cytochrome b gene to infer phylogenetic relationships among individuals that were caught and bled throughout the species range (U.S. and Mexico) and that represented the 3 groups of populations that differed in migratory behaviour. A maximum likelihood phylogenetic analysis and haplotype network show very little structure in terms migratory behavior and geography. Sedentary, short-distance migrants, and long-distance migrants are not each other's closest relatives. Furthermore, and interestingly, we found high haplotypic diversity among the 87 individuals assayed (71 unique haplotypes, 82%) and deep genetic divergences (4.97%, Kimura 2-parameter) that do not coincide with geographic, morphological or vocalization structure. Further population genetic analyses suggest an ancient range expansion but further analyses are pending.

30 Buler, Moore & Woltmann

Landscape-scale habitat use by landbirds during migration along the northern Gulf Coast: patch size matters. JEFFREY J. BULER, FRANK R. MOORE, *Univ. Southern Mississippi, Hattiesburg, MS*, and STEFAN WOLTMANN, *Tulane Univ., New Orleans, LA*.

We tested if patch size affects migrant landbird use of hardwood forests and determined how migrants distribute themselves across the landscape along the Mississippi Gulf Coast during migration. We surveyed bird abundance every 2 - 3 d and arthropod abundance weekly among 24 transects during 2 fall and 2 spring migration seasons (2002 - 2004). Half of the transects were within large bottomland-hardwood forests (>30,000 ha) of 2 major river systems, and half were located within small (< 100 ha) patches of hardwood forest along lower-order tributaries. Transects were also split within 2 distance bands; between 15 and 25 km (near) of the coastline or between 35 and 60 km (far) of the coastline. In general, resident and migrant bird abundances were greater within the large forests sites compared to small forest sites during spring and fall migration. Similarly, arthropod abundances were greater within large forest sites. Uniquely, Wood Thrushes were more abundant in small forest sites only during fall migration. This may be due to greater abundance of fruiting trees in small forest sites. Sites nearer the coast tended to have greater bird abundance during both seasons. The ratio of bird abundance in large sites to small sites was inversely related to bird abundance at large sites, consistent with the phenomenon of density dependent habitat use. Due to fewer food resources and birds, as well as density dependent use, small forest patches appear to be less suitable as stopover habitat for migrating landbirds than large forests.

31 Diehl, Bates & Willard

Hazards of migration over Lake Michigan: a case study. ROBERT H. DIEHL, *Univ. Southern Mississippi, Hattiesburg, MS*, JOHN M. BATES and DAVID E. WILLARD, *Field Mus. Nat. Hist., Chicago, IL*.

Recent research supports the long held view that the highest proportion of annual mortality among migratory birds is incurred during the migratory phase of the life cycle. Yet the sources of this mortality remain largely speculative, because the specific conditions or circumstances leading to bird deaths seldom occur where they can be monitored or observed. In May 1996, nearly 3,000 dead landbirds comprising 114 species appeared along the southwestern shores of Lake Michigan. Archived meteorological data from radar and other sources offered the rare opportunity to explore weather as the potential cause for the appearance of this large migratory bird kill. In 3 instances during that month, radar echoes attributed to migrating birds and storm activity appeared in close proximity over open water. In 1 storm, precipitation either took the form of hail or extremely high rain rates (>150 mm/h). Onshore winds followed these bird-storm encounters which in turn led to migrants appearing along shorelines. Recent history showed May 1996 to be unique among Mays of the 1990s, exhibiting exceptionally high amounts of precipitation and the highest proportion of onshore winds. While birds probably regularly encounter precipitation over water, the sequence of events which led these encounters to be documented was unusual. Documenting bird kills provides an opportunity to measure the species composition of migratory flights and further understand the behavioral responses to migratory barriers.

32 Fitzgerald & Taylor

Juvenile Yellow-rumped Warblers can correct migratory orientations mid-course. TRINA M. FITZGERALD and PHILIP D. TAYLOR, *Biol. Dept., Acadia Univ., Wolfville, NS.*

Juvenile neotropical passerine migrants from the eastern boreal forest of Canada traverse a coastal route through eastern North America during their first fall migration. Some of these individuals are displaced from this normal migratory pathway due to prevailing northwesterly winds and end up east of their intended routes. These individuals are naïve migrants so strategies should exist to enable them to correct such displacements. We hypothesized 3 strategies: 1) continued orientation in the innately preferred direction, 2) orientation from the new location to the intended direction or 3) a mid-course correction to re-establish the preferred pathway. To test these hypotheses we measured the direction of orientation of juvenile Yellow-rumped Warblers captured at a Nova Scotian coastal island stopover site. We used video-based orientation cages to determine intended direction and related that to an individual's natal latitude measured using the deuterium isotopic signature from collected feathers. We assumed that birds with natal latitudes northwest of the stopover site had been displaced from their normal migratory pathway and were east of their intended routes. Regression analysis revealed, after accounting for possible effects of endogenous variables (fat) and exogenous variables (wind, day), that individuals originating from more north-westerly parts of the breeding range, tended to orient in a westerly direction, whereas migrants originating from more southerly latitudes oriented south-westerly. This supports hypothesis 3. Individuals from northern latitudes likely respond to an easterly displacement by orienting in a westerly direction where they can re-establish their previous migratory route.

33 Mackin

* Differences in diving depths between individual Audubon's Shearwaters. WILLIAM A. MACKIN, *Biol. Dept., Univ. North Carolina-Chapel Hill, Chapel Hill, NC.*

Shearwaters had been thought to capture prey on or near the surface, but recent studies that have attached maximum depth recorders (MDRs) to several species of *Puffinus* shearwaters have shown that the birds reach greater depths (up to 70 m) than indicated by observations at sea. Previous studies of diving have focused on differences between populations. The present study examined depths of diving by Audubon's Shearwaters: 136 MDRs retrieved from 69 birds. The median maximal depth was 7.6 m (0.9 - 29.3 m). There was no relation between maximal depths and morphology, sex, or the growth of chicks. Among 34 individuals that returned MDRs on at least 2 different nights, there were greater differences between individuals than within individuals. Thus, individual shearwaters might use different foraging strategies.

34 Nooker & Sandercock

* Variation of Individual male behavior on Greater Prairie-Chicken leks. JACQUELINE K. NOOKER and BRETT K. SANDERCOCK, *Div. Biol., Kansas State Univ., Manhattan KS.*

Leks are a type of mating system where males aggregate at communal display sites which females visit to obtain copulations. Female mate choice in lek-breeding species may be based upon male morphology, territorial position, or behavior. In previous work in ne. Kansas, we found that mating success of male Greater Prairie-Chickens correlated primarily with behavioral traits. Our primary objective of this study was to determine how male behavior varies within and among individuals and years. 10-min focal observations were conducted on individually marked birds throughout the breeding season. Observations were obtained from 35 males on 3 leks in 2003 and from 49 males on 4 leks in 2004. A principal components analysis yielded an index of display rate (PC1) and aggressive behavior (PC2). The display activity (PC1) of all males on a lek increases with female presence, increases between mid-Mar into Apr, and decreases during the morning. Aggression (PC2) also increased with female presence, but was not related to seasonal or daily timing of observation. Inter-individual differences in behavior are correlated with position of the bird on the lek, with peripheral birds investing more in display and central birds in aggression.

35 Loiselle, Blake, Durães, Ryder & Tori

Environmental correlates of lek placement in six co-occurring manakin species (Aves: Pipridae). BETTE A. LOISELLE, JOHN G. BLAKE, RENATA DURÃES, T. BRANDT RYDER and WENDY TORI, *Dept. Biol., Univ. Missouri-St. Louis, St. Louis, MO.*

At the Tiputini Biodiversity Station, 6 manakin species co-occur and establish lek display sites in the same general habitat. Leks have attracted much attention because of the often huge inequities

in male mating success. Male success at leks is often correlated with the number of females visiting leks (e.g., Hoglund et al. 1993, **Beh. Ecol. Sociob.** 32: 31-39). Consequently, factors that promote female visitation should be strongly selected for and the targets of selection are likely lek placement, size, and spatial structure. The hotspot hypothesis proposes that leks are placed in areas that contain the greatest densities of females. As manakins rely heavily on fruit resources and are expected to overlap widely in diet, then one expects that interspecific aggregations of leks to occur in the environment where fruit resources are abundant and females come to feed. Evidence for interspecific overlap in space of leks has been observed in Costa Rica (Westcott 1997, **Anim. Behav.** 53: 235-247). Here we test whether interspecific aggregation of leks occur in a lowland wet forest of Ecuador where diversity of manakins is >2-fold higher than Central America. We found that at mesoscales (i.e., 100 ha), >6 species of manakins establish leks and co-occur in environmental space. However, leks largely do not overlap spatially at finer scales and species segregate along environmental axes of elevation and topography. The implications of environmental lek site selection for male mating success and spatial structure of leks are discussed.

36 Doucet & Hill

* The signal function of multiple sexual ornaments in Long-tailed Manakins. STÉPHANIE M. DOUCET and GEOFFREY E. HILL, *Dept. Biol. Sci., Auburn Univ., Auburn, AL.*

Long-tailed Manakins, *Chiroxiphia linearis*, display a striking array of elaborate sexual ornaments, including a scarlet crown patch, a sky-blue mantle, bright orange legs, and elongated central rectrices. Because they are produced by different mechanisms, these color displays could potentially reveal different aspects of male quality. These birds also exhibit an unusual pattern of delayed plumage maturation whereby males move through a yearly, stepwise progression of distinct plumage categories before attaining full adult plumage in their fifth year. We investigated the potential signal function of variation in sexual ornamentation within and among age classes of Long-tailed Manakins. First, we captured 136 manakins and quantified variation in morphology, sexual ornamentation, and several indicators of condition among age classes. Second, we examined the association between ornamental traits and indicators of quality within age classes. While the degree of ornamentation increased with male age, body condition actually worsened with age. Males perform behavioral displays with increasing frequency as they age, so this reduction body condition may reflect adaptive changes which facilitate acrobatic displays or may instead result from the physiological stress imposed by increasing display activity. The signal function of various ornaments also appears to change with male age. The size of the carotenoid crown patch was predicted by indicators of condition in young males whereas the structurally-determined blue rump color was predicted by indicators of condition in older males. Thus, the multiple sexual ornaments of Long-tailed Manakins may reveal different aspects of male quality within and among age classes.

37 Uy & Endler

Modification of the visual background increases the conspicuousness of bearded manakin displays. J. ALBERT C. UY, *Biol. Dept., San Francisco State Univ., San Francisco, CA*, and JOHN A. ENDLER, *Univ. California at Santa Barbara, Santa Barbara, CA.*

Effective visual communication requires signals that are easy to detect, transmit, receive and discriminate. Animals can increase the probability that their visual signals would be detected by evolving signals that contrast with their visual background. Animals can further enhance this contrast by behaviorally modifying the existing visual background. Male Golden-collared Manakins (*Manacus vitellinus*) clear leaf litter from the ground to form courts, which are used as display arenas. Using reflectance measures of the signal (male plumage) and the visual background (cleared court and adjacent litter), the irradiance measures of ambient light during display, and published measures of photoreceptor sensitivity of a Passerine, we test the hypothesis that court-clearing augments the contrast between male plumage and the visual background. We find that the chromatic and brightness contrasts of golden patches used during courtship are greater against the cleared court than against adjacent litter. In addition, we find that cleared courts provide a less variable background for these color patches, resulting in displays that consistently contrast the visual background. These results suggest that modification of the visual background may act to increase the conspicuousness of colorful male plumage during display, providing an explanation for why Golden-collared Manakins, and possibly other avian species, build or clear display courts.

38 DuVal

* Adaptive significance of cooperative male courtship in the Lance-tailed Manakin. EMILY DuVAL, *Mus. Vert. Zool., Univ. California Berkeley, Berkeley, CA.*

Cooperative reproduction poses a dilemma for evolutionary biologists because individuals appear to assist the reproductive efforts of others instead of maximizing their own fitness. Male Lance-tailed Manakins (*Chiroxiphia lanceolata*) develop long-term cooperative partnerships with other males to perform courtship displays, but only the alpha male copulates with females that the pair attracts. This study investigates the adaptive advantages of cooperative courtship for the non-mating beta males. I combine behavioral observations of a color-banded population with genetic analyses of paternity and relatedness to test 3 hypotheses explaining the adaptive value of beta cooperation in this previously unstudied species: 1) betas benefit directly through unobserved copulations, 2) betas increase their inclusive fitness by facilitating relatives' courtship displays, and 3) betas receive delayed direct benefits by inheriting the display territory from their alpha partner. Beta males do not sire young ($n = 75$ chicks with paternity assigned under strict confidence limits) and were never observed copulating. Average pairwise relatedness between 35 alpha-beta pairs was -0.02 ± 0.05 SE (95% CI -0.123 to 0.08), and not significantly different from random pairings of males. Beta males did benefit through occasional inheritance of display sites, and seem to be making the best of a bad job until they attain alpha status. Unexpected variability in patterns of beta male territory inheritance suggest that betas assess more than simply immediate territory vacancy when deciding whether to remain on a territory. Multiple types of delayed direct benefits may function in selecting for cooperation in Lance-tailed Manakins.

39 Quinn, St. John & Cotter

Recent insertion of a truncated CR1 element further clarifies the identity of the sister species of *Coscoroba coscoroba*. THOMAS W. QUINN, JUDY St. JOHN, *Dept. Biol. Sci., Univ. Denver, Denver, CO*, and JOHN-PAUL COTTER, *The Queen Elizabeth Hospital, South Australia, Australia.*

Chicken Repeat 1 (CR1) elements are members of the non-long terminal repeat class of retrotransposons and are taxonomically widespread among vertebrates. Here we report the identification of a truncated CR1 element that has recently inserted into an intron within the lactate dehydrogenase B gene of the Coscoroba (*Coscoroba coscoroba*). Because the element is lacking in swan and goose exemplars, and because sequence characteristics match those of "typical" CR1 elements, the insertion appears to be recent in evolutionary time. The insertion is present in the same intron of just one of several species that have been proposed as being sister to coscoroba, and is absent in sampled outgroups.

40 Klicka, Burns & Spellman

Defining a monophyletic Cardinalidae: a molecular perspective. JOHN KLICKA, *Barrick Mus., Univ. Nevada Las Vegas, Las Vegas, NV*, KEVIN J. BURNS, *Dept. Biol., San Diego State Univ., San Diego, CA*, and GARTH M. SPELLMAN, *Barrick Mus.*

Within the nine-primaried oscine assemblage, the family Cardinalidae has not yet received a comprehensive molecular assessment. Recent studies have suggested that the taxonomic affinities of some of its members lie outside the group while others have identified non-cardinaline taxa that should be included. In addition, little is known regarding relationships among constituent cardinalid genera. We address these issues using mtDNA sequence data (complete ND2 and cyt-b genes) and modern analytical methods. All putative genera in Sibley and Monroe's tribe Cardinalini ($n = 13$) were sampled for this study as were 37 of 42 species within this group. Preliminary analyses of these data indicate that the Cardinalidae (~ Cardinalini) as presently understood, is indeed a polyphyletic assemblage. Members of the genus *Saltator* (16 species) are better placed among the Thraupidae as is the species *Parkerthraustes* [*Caryothraustes*] *humeralis*. We identify with certainty, 5 "non-cardinalid" genera that belong in a "modified" cardinalid clade. Earlier work, suggesting that the thraupid genera *Piranga*, *Habia*, and *Chlorothraupis* are in fact cardinaline, is supported. Perhaps more surprising, *Amaurospiza* and *Granatellus* are also shown to be members of this clade. *Amaurospiza* (bamboo seedeaters, putative emberizids) are embedded within the cardinalid genus *Cyanoscompsa*. *Granatellus* (New World chats, putative parulids) are sister to the grosbeaks in the genus *Pheucticus*. These novel taxonomic placements are supported by plumage characters. The redefined cardinalid clade receives relatively strong bootstrap and Bayesian support and appears to be closely linked with the Thraupidae.

41 Harshman, Braun, Braun, Bowie, Hackett, Han, Huddleston, Yuri, Kimball, Marks, Sheldon, Miglia, Moore & Steadman

What, if anything, is a ratite? JOHN HARSHMAN, *Field Mus., Chicago, IL*, EDWARD L. BRAUN, *Univ. Florida, Gainesville, FL*, MICHAEL J. BRAUN, *Smithsonian Inst., Washington, DC*, RAURI C. K. BOWIE, SHANNON J. HACKETT, *Field Mus.*, KIN-LAN HAN, *Univ. Maryland, College Park, MD*, CHRISTOPHER J. HUDDLESTON, TAMAKI YURI, *Smithsonian Inst.*, REBECCA T. KIMBALL, *Univ. Florida, Gainesville, FL*, BEN D. MARKS, FREDERICK H. SHELDON, *Louisiana State Univ., Baton Rouge, LA*, KATHLEEN J. MIGLIA, WILLIAM A. MOORE, *Wayne State Univ., Detroit, MI*, and DAVID STEADMAN, *Florida State Mus., Gainesville, FL*.

Analyses of many unlinked nuclear loci show that though paleognaths are monophyletic, ratites are not, and that tinamous are nested within them. We explore the implications for biogeography and the evolution of flightlessness.

42 Bertelli & Giannini

A phylogeny of penguins (order Sphenisciformes). SARA BERTELLI and NORBERTO P. GIANNINI, *Div. Vert. Zool., Am. Mus., New York, NY*.

A phylogeny of penguins was estimated on the basis of 151 morphological characters that included osteology (63 characters), myology (15), integument (66), and breeding traits (7 characters) scored in 18 extant forms (all currently recognized species plus 1 distinct subspecies). *Gavia* was placed at the root, and 11 species of representative procellariiform groups completed the outgroup. A heuristic parsimony analysis under equal weights was performed. Tree resolution was almost complete, with the 2 trees obtained differing only in 1 grouping within *Spheniscus*. The analysis recovered monophyly of Sphenisciformes and all the traditional polytypic genera. The ingroup topology was ((*Eudyptula* + *Spheniscus*) (*Aptenodytes* (*Pygoscelis* (*Megadyptes* + *Eudyptes*)))). All genera and some suprageneric groups (e.g., *Megadyptes* + *Eudyptes*) were well-supported. Morphological characters performed optimally at the ordinal and generic level, also providing resolution and varying degrees of support at the supra- and intrageneric levels.

43 Jones, Kennedy & Zink

* Evolutionary history of Philippine birds. ANDREW W. JONES, *Bell Mus., Univ. Minnesota, St. Paul, MN*, ROBERT S. KENNEDY, *Maria Mitchell Assoc., Nantucket, MA*, and ROBERT M. ZINK, *Bell Mus., Univ. Minnesota*.

The Philippine archipelago has high species diversity and particularly high endemism for its size. Because it has never been attached to other islands, overwater dispersal must account for all avian taxa, yet ideas on colonization routes have never been tested with a historical approach. To remedy this situation, we are using mitochondrial DNA data to recover evolutionary relationships among populations within species occupying the major Philippine islands. 10 species have been analyzed to search for congruent phylogeographic breaks. In 8 of the species, there are multiple phylogeographic breaks (2 to 4), generally reflecting Pleistocene island groups. These breaks correspond to 2 to 10% sequence divergence, suggesting that speciation events pre-date the late Pleistocene. As predicted, the colonists typically originated from Borneo, but the precise colonization routes are idiosyncratic.

44 vacant

45 Norris & Martin

Birds and beetles: responses of cavity nesters to forest health changes in interior British Columbia. ANDREA R. NORRIS, *Centre for Applied Conserv. Res., Univ. British Columbia, Vancouver, BC*, and KATHY MARTIN, *Centre for Applied Conserv. Res., Univ. British Columbia and Canadian Wildl. Serv., Delta, BC*.

In our 10 yr study (1995 - 2004), we monitored species richness and relative abundance of cavity nesting birds and mammals using point count and nest surveys on 29 forest stands (7 - 38 ha), as well as species and condition of >10,000 individual trees. Since 1997, boring bark beetles have attacked all conifer species, with mountain pine beetle being the most abundant. The timing of the onset and severity of beetles varied, but on most sites there was an increase in the number of dead and dying trees. Cavity nester densities changed over the study as the number of nests and detections/hectare tripled for Mountain Chickadee and doubled for Red-breasted Nuthatch. For both species, nests increased with the proportion of lodgepole pine trees attacked by boring insects on the

study area. Overall numbers of woodpeckers nesting also increased, mainly Northern Flickers and Three-toed Woodpeckers. We examined potential ecological mechanisms driving bird population changes such as food availability, winter weather conditions, and predator presence (improving survival) or competition for nest sites (nest site availability). Increases in numbers of weak excavators may be related to changes in cavity nester community, such as recent decreases in European Starlings and red squirrels. The relationship may be indirect if warm winter weather has improved conditions for both birds and beetles. Studies that examine relationships between cavity nester communities and forest health allow a comprehensive examination of many ecological mechanisms driving avian population change.

46 Rodewald & Vitz

Edge- and area-sensitivity of shrubland birds. AMANDA D. RODEWALD and ANDREW C. VITZ, *School Nat. Res., Ohio State Univ., Columbus, OH.*

We examined the sensitivity of shrubland specialists to mature-forest edges and stand area and evaluated if habitat or food characteristics and productivity were potential underlying causes. In 2002-2003, we used constant-effort mist-netting on 6 small (4 - 8 ha) and 6 large (13 - 16 ha) regenerating clearcuts that were 4 - 6 yr post-harvest in s. Ohio. At each site we placed 3 nets at 20, 50, and 80 m from the mature-forest edge (n = 9 nets/site), and sampled vegetation, fruit, and arthropods at each net. Seven of 8 shrubland specialists avoided mature-forest edges, with twice as many birds caught 80 m from edges compared to 20 m. In particular, Blue-winged Warbler, Prairie Warbler, Yellow-breasted Chat, Indigo Bunting, and Field Sparrow strongly avoided edges. Most species were positively associated with area, though the combined area effect over all species was not statistically significant. Yellow-breasted Chats showed the greatest degree of area-sensitivity and were captured twice as frequently in large than small stands. Neither area nor edge was associated with habitat characteristics, fruit abundance, arthropod biomass, or productivity. Our study shows that shrubland birds avoid habitat edges and, to a lesser extent, may be area-sensitive. Thus, small or narrow cuts may not provide optimal habitat for this suite of declining species, and managers should consider options to minimize edge and provide larger patches of shrubland habitats.

47 Gehring, Kerlinger & Manville

Avian collisions with communication towers: a quantification of some associated tower variables. JOELLE L. GEHRING, *Dept. Biol., Central Michigan Univ., Mount Pleasant, MI*, PAUL KERLINGER, *Curry & Kerlinger, LLC, Cape May Point, NJ*, and ALBERT M. MANVILLE, II, *USFWS, Div. Migratory Bird Manage., Arlington, VA.*

The U.S. Fish and Wildlife Service conservatively estimates that as many as 4 - 5 million birds/yr collide with communication towers; however, some sources suggest the number could be higher. Communication towers continue to be constructed throughout the U.S. at a rate of approximately 5,000/yr. The objectives of this study are to determine the relative risks that different tower support systems (guy wires or self-support), and tower height categories pose to migratory birds. During the 2003 fall songbird migration, 6 Michigan communication towers (146 m above ground level, 3 guyed and 3 unguyed) were systematically searched for bird carcasses. After adjustments for scavenging and observer detection rates, 51 bird carcasses were estimated to be at the 3 guyed towers but none at the unguyed towers. Using a repeated measures analysis of variance design, towers supported by guy wires killed significantly more birds than towers that were self-supported ($P = 0.017$). Additional data will be presented from the 2004 spring songbird migration, during which 23 Michigan communication towers will be simultaneously and systematically searched for bird carcasses. Avian mortality will be compared among different tower height categories, and tower support systems. Next Generation Radar will be used to quantify songbird migration intensity and this variable will be included as a covariate in statistical comparisons of bird mortalities at different tower types. With these data, managers and regulators can make appropriate recommendations and regulations specific to minimizing or eliminating the collision related mortality of neotropical migratory birds.

48 Desholm

Assessing the impact from bird-turbine collisions : a European perspective. MARK DESHOLM, *Natl. Environ. Res. Inst., Dept. Wildl. Ecol. & Biodiv., Ministry Environ., Rønde, Denmark.*

This talk will describe the process of assessing the number of avian collisions, and their impact at the population level, at European offshore wind farms using different models based on field data. The model input data will consist of measured effects of different factors related to either the bird

species involved (flight altitude profile, avoidance response and population dynamics), the physical structure of the turbines (height, wing length and rotation speed) and the weather (wind speed, wind direction and visibility). Especially the wind are expected to affect the number of collisions to a high degree, since it will both alter the spatial and altitudinal migration pattern of the birds and the orientation and speed of the turbine wings. The estimated bird-turbine collision rate obtained from modelling will be validated using the Thermal Animal Detection System (TADS), which will monitor the avian collisions by thermal imaging. Finally, the cumulated impacts of the many relatively small local effects will be assessed in a flyway-based context.

49 Rejt, Rutkowski & Gryczyńska-Sięmiątkowska

Genetic variability of urban Kestrels in Warsaw : preliminary data. Ł. REJT, R. RUTKOWSKI, *Mus. & Inst. Zool., Polish Acad. Sci., Warsaw, Poland*, and A. GRZYCZYŃSKA-SIEMIĄTKOWSKA, *Dept. Biol., Univ. Warsaw, Warsaw, Poland*.

The synurban populations have been known to be either ecological and ethological different in comparison to populations inhabiting natural sites. The differences include factors which could affect the genetic diversity of population : more sedentary style of life, decreasing proportion of breeding specimens, high re-occupation rate, higher longevity or lower natural selection. Additionally synurban population can be isolated from rural ones and thus suffer from genetic drift and inbreeding resulting in low level of genetic variability. This report is based on preliminary results, obtaining from analysis of 3 microsatellite loci in Kestrels inhabiting 2 areas of Warsaw: centre of the city and outskirts. Two hypothesis were tested: (i) genetic variability of birds inhabiting centre of Warsaw is lower than birds from outskirts due to clearer isolation of centre population from wild conspecifics, and (ii) the indicators of genetic variability reached similar values in populations from centre and from outskirts of Warsaw. While mean allelic diversity is slightly higher in outskirts sub-group, the mean heterozygosity reached a higher value in population of Kestrel from centre of Warsaw. The differences in frequency of particular alleles in studying areas were observed and the Fisher exact test show highly significant genetic differentiation between investigated groups of Kestrel for each locus ($P = 0.0004$, $SE = 0.00021$).

50 Stouffer, Bierregaard & Strong

Understory bird abundance in Amazonian forest fragments: 20 years of bird response to a dynamic landscape. PHILIP C. STOUFFER, *School Renew. Nat. Res., Louisiana State Univ., Baton Rouge, LA*, RICHARD O. BIERREGAARD, Jr., *Dept. Biol., Univ. North Carolina, Charlotte, NC*, and CHERYL STRONG, *San Francisco Bay Bird Observ., Alviso, CA*.

A 20-yr history of understory bird captures in 1 - 100 ha Amazonian forest fragments reveals dramatic changes in abundance for most guilds, especially in 1 - 10 ha fragments. For most guilds, abundance declined after isolation and then increased between 10 and 20 yr post-isolation, presumably due to birds moving to the fragments from nearby continuous forest. Arboreal and ground-foraging insectivores and species that always participate in mixed-species flocks showed little recovery except in 100 ha fragments. Most other guilds returned to preisolation abundance in 100 ha fragments and some 1 and 10 ha fragments. We used an information-theoretic approach to evaluate the relative importance of fragment and landscape variables as predictors of bird abundance. Fragment size and age of the second growth immediately surrounding the fragment were consistently the most highly weighted variables, although relative variable importance differed among guilds. In this landscape, developing second growth and proximity to continuous forest partially counterbalance negative effects of area reduction. Even so, some fragments had as little as 20% of their preisolation understory bird abundance, including complete absence of some guilds.

51 Schreiber & Schenk

Survival and determinants of population size in a multi-species seabird colony over 35 years: Johnston Atoll, central Pacific Ocean. E. A. SCHREIBER, *Natl. Mus. Nat. Hist., Smithsonian Inst., Washington, DC*, and G. A. SCHENK, *Alexandria, VA*.

Population sizes of 13 seabird species breeding on Johnston Atoll were monitored from 1964 - 1969 and 1984 - 2003. Extensive banding and recapture was carried out to determine annual survival, movement rates and to study other breeding biology traits. Various military activities, including nuclear missile testing, nerve gas storage and burning, and leaking agent orange containers, all had the potential to effect bird populations. In spite of all this, population sizes of all species grew significantly over 35 yr. Major effects on population size were those of 1 seabird species on another and not due to

man. Other annual factors affecting population size to a small degree were the occurrence of El Niño events and the clearing of vegetation by humans. Adult survival in Red-tailed Tropicbirds between 1984 and 2002 averaged 90% and juvenile survival to breeding averaged 78%. Adult survival rates were significantly higher during non-El Niño years than during El Niño years. This same trend is detected for pre-breeders but is not significant.

52 Sturge, Rockwell & Rising

The effects of habitat degradation on the Savannah Sparrows of La Pérouse Bay, Manitoba. RACHEL J. STURGE, *Dept. Zool., Univ. Toronto, Toronto, ON*, ROBERT F. ROCKWELL, *Am. Mus. Nat. Hist., New York, NY*, and JAMES D. RISING, *Dept. Zool., Univ. Toronto*.

The destructive grazing activities of Snow Geese found in and around the coastal salt-marshes of La Pérouse Bay in n. Manitoba, have led to the fragmentation/degradation of much of the surrounding shrub-grassland habitat. As a result, the Savannah Sparrow population in the area has declined considerably. In order to assess the effect of this habitat destruction on the sparrows, male territories were located and assessed for their quality, in terms of both land area and vegetation content. The mating and breeding success of each male was recorded, and this information was used to determine which features of a male's territory were linked to its reproductive success. Territories were also compared to historical data from 25 yr ago. Preliminary results show that territory sizes have increased while the proportions of shrub and grasses in the territories have decreased (and have been replaced with mud lands dominated by salt tolerant species such as *Salicornia*).

53 Smith, Marra & Reitsma

The influence of winter seasonality on spatial behavior and habitat occupancy of the Northern Waterthrush in Puerto Rico. JOSEPH SMITH, PETER P. MARRA, *Smithsonian Environ. Res. Center, Edgewater, MD*, and LEONARD R. REITSMA, *Dept. Nat. Sci., Plymouth State Coll., Plymouth, NH*.

Wintering Northern Waterthrushes were studied in 4 habitat types at Roosevelt Roads Naval Station, Puerto Rico, from Jan - Apr 2002 - 2004. We monitored seasonal changes in moisture levels and food availability within these habitats and used mist netting, radio telemetry, point counts, and playback trials to quantify habitat-specific sex ratios, spacing behavior and habitat use patterns of individual birds. White mangrove was the most seasonally stable habitat with respect to moisture and food availability. Red mangrove, black mangrove, and dry forest all became significantly drier as the dry season approached. Individuals tracked in white mangrove were more often male, occupied smaller home ranges, and showed more inter-specific aggression. Waterthrushes tracked in seasonally dynamic habitats were more often female, showed less inter-specific aggression, were on larger home ranges, and frequently occupied multiple habitat types. This research emphasizes the importance of understanding temporal and spatial heterogeneity in habitat quality for migratory birds. Such information is essential to the understanding of population dynamics and in the identification of high-quality winter habitats for the conservation of migratory species.

54 White

Post-fledging movement patterns of juvenile Swainson's Thrushes in central coastal California. JENNIFER D. WHITE, *Div. Biol. Sci., Univ. Missouri, Columbia, MO*.

I used radiotelemetry to study post-fledging movement patterns of juvenile Swainson's Thrushes along 2 creeks in central coastal California from 2000 to 2002. I followed 35 juveniles to independence from 30 different broods. Dependent juveniles had "drifting" and "stationary" natal movements similar to those described for the Wood Thrush. After independence, all Swainson's Thrush juveniles settled in at least 1 post-fledging dispersal site, 26 juveniles (76%) dispersed to a second site, and 2 (6%) dispersed to a third site. Median first post-fledging dispersal distance was 155 m (range 28 - 1,040 m, n = 34), median subsequent dispersal distance was 403 m (range 154 - 2,624 m, n = 26). Initial dispersal direction was random at each creek and final dispersal was random for all but 1 plot where juveniles moved in a westerly direction (mean bearing = 275°, Rayleigh test, P = 0.02). I calculated home range estimates using program KERNELHR for 24 juveniles that had at least 25 locations each. Median home range size (95% fixed kernel) was 2.0 ha (range 0.2 - 9.0 ha). I suggest that post-fledging movements were influenced in large part by foraging opportunities.

55 Loiselle & Graham

The impacts of large-scale deforestation on ecological niches of tropical birds. BETTE A. LOISELLE, *Dept. Biol., Univ. Missouri-St. Louis, St. Louis, MO*, and CATHERINE GRAHAM, *Ecol. Evol., Stony Brook Univ., Stony Brook, NY*.

The Atlantic forests of Brazil have undergone large-scale deforestation making it one of the world's most endangered ecosystems. The consequences for forest birds are large reductions in the suitable habitat remaining and likely shifts in the ecological niche occupied. Previously we have examined the reduction in range sizes for the endangered forest cotingids (Cotingidae) of the Atlantic forests of Brazil. We used museum records and environmental layers to model with GIS the presumed historic area of occupancy of these birds. We then reexamined this historic area of occupancy by overlapping it with current distribution of forest cover to estimate the amount of suitable area remaining. The reductions in suitable area were on the order of from 81 to 95%. Here we examine the consequences of forest loss on the environmental space occupied by species in the Pipridae and Cotingidae. We found that the ecological niche space of these birds also is dramatically reduced, but reductions vary in form and degree among species. Understanding how the ecological niche of species has been altered (e.g., shifted, contracted) is important for developing conservation action plans as it may help to prioritize and target populations for recovery efforts. Moreover, reductions in environmental space occupied likely more directly reflect the potential loss of genetic variation and may be more important indicators of threat than is loss of geographic space occupied.

56 Sauter, Bowman, Schoech & Scheigg

Good start, lousy finish? Variation in growth and survival of Florida Scrub-Jay nestlings across an urban gradient. A. SAUTER, *Universität Zürich, Zoologisches Institut, Zürich, Switzerland*, R. BOWMAN, *Archbold Biol. Sta., Lake Placid, FL*, S. SCHOECH, *Univ. Memphis, Memphis TN*, and K. SCHEIGG, *Universität Zürich*.

Natural foods may decrease in urban areas, while human-provided foods increase, altering the distribution of resources. We studied variation in nestling growth and survival by supplementing suburban (n = 28) and wildland (n = 55) Florida Scrub-Jay families with natural foods during the first 10 d after hatching of the young. In each hierarchical size rank, suburban nestlings were heavier than wildland nestlings at d3 post-hatching. However, within-brood size hierarchies were greater in the suburbs. Brood reduction between d3 and d11 was greater in the suburbs. By d11, suburban nestlings were significantly lighter than wildland nestlings of the same size-rank. Food supplementation increased nestling mass and decreased brood reduction in both habitats, but the effects were stronger in the suburbs. Post-fledging survival was lower in the suburbs than in the wildlands. In suburbs, post-fledging survival was most affected by hatching date and d11 mass; in wildlands, d11 mass and food supplementation were important. Access to human-provided food in suburbs may enable jays to invest in egg quality that subsequently influences the quality of recently-hatched nestlings. However, these foods may not be appropriate for subsequent growth, resulting in reduced growth and survival. Food supplementation in suburbs did not appear to increase nestling mass enough to influence post-fledging survival, which also is likely influenced by predator differences between the 2 habitats.

57 Foote & Barber

* High level of song sharing found in an eastern population of Song Sparrows. JENNIFER R. FOOTE, *Dept. Biol. Dalhousie Univ., Halifax, NS*, and COLLEEN A. BARBER, *Saint Mary's Univ., Halifax, NS*.

Previous studies have found that while males in a western subspecies of Song Sparrow share many songs in their repertoire with neighbours, males of an eastern Song Sparrow subspecies rarely do. A high degree of song sharing with neighbours is important in territory defence. We recorded 29 male eastern Song Sparrows in Sackville, NS, from Apr - Jul in 2002 and 2003. Repertoires were considered fully recorded after both 200 songs and 20 song-type switches. All songs were digitized and sonograms were printed for analysis. The level of song sharing between neighbouring and non-neighbouring individuals was determined by visually comparing song types and calculating a sharing index, as per standard protocol. Like western Song Sparrows, males in this eastern population were found to share an average of 24.2% of their repertoire with neighbours. Song sharing levels between neighbours were significantly greater than with non-neighbours in the local population (16.5%). Our results suggest that eastern and western Song Sparrows likely do not differ genetically in the way they learn song types. Different levels of song sharing among eastern populations of Song Sparrows could be due to factors acting at the population level such as the degree of site fidelity.

58 Vondrasek

Individual and sex-specific variation in the acoustic structure of song in Northern Cardinals. JOANNA R. VONDRASEK, *Biol Dept., Univ. North Carolina, Chapel Hill, NC.*

When both sexes of a territorial species produce complex vocal repertoires, the vocalizations are often sex-specific. In some cases, however, males and females produce similar vocalizations, as in the Northern Cardinal, a temperate-zone passerine. The cardinal raises the issue of whether or not sexual identity can be determined by auditory cues alone. A previous study suggested that male and female cardinals from an Arizona population differ in the repeatability and harmonic structure of song (Yamaguchi 1998, *Condor* 100: 504-511). In this study, I recorded the songs of a population of cardinals in North Carolina and categorized the syllables into 18 distinct types. Males' and females' repertoires of syllable-types did not differ in size. I also examined 2 syllable-types sung by most of the population for any sex specific acoustic differences. Repeatability of these 2 syllable-types did not differ between the sexes in this population. Harmonics were not often present in my recordings, and I therefore could not measure sex differences in harmonic structure. Two measures of frequency and timing of these syllable-types differed slightly but consistently between the sexes. These differences were small in relation to the significant variation among individuals, regardless of sex. Thus individual differences in the songs of cardinals were more prominent than sex differences.

59 Searcy, Nowicki & Anderson

Singing behaviors as aggressive signals in Song Sparrows. WILLIAM A. SEARCY, *Dept. Biol., Univ. Miami, Coral Gables, FL*, STEPHEN NOWICKI, *Dept. Biol., Duke Univ., Durham, NC*, and RINDY C. ANDERSON, *Univ. Miami.*

A number of singing behaviors have been suggested to be graded signals of aggression in songbirds. Some signaling models, however, predict that animal signals should never be informative on likelihood of attack. We tested whether singing behaviors predict attack in Song Sparrows. We provoked aggressive singing in territorial males using a brief playback, and recorded each subject's song for 5 min. We then revealed a stuffed mount of a male Song Sparrow coupled with further playback, and gave the subject another 14 min in which to attack. Of 95 males tested, 20 attacked and 75 did not. Some of the singing behaviors most often cited as aggressive signals turned out not to be informative on attack likelihood, including song type matching, song type switching, and song rate. The behavior that was most informative on aggressive intentions was the production of low amplitude "soft songs." Song immediately preceding attack was more reliable at predicting attack than was song during the initial recording period.

60 Charrier & Sturdy

What makes a Black-capped Chickadee *chick-a-dee* call? ISABELLE CHARRIER and CHRISTOPHER B STURDY, *Dept. Psychology, Univ. Alberta, Edmonton, AB.*

Animals use their acoustic signals in a wide range of contexts, but these are usually only directed towards their conspecifics. Species-specific recognition is essential for efficient communication between conspecifics. For this to occur, species information must be unambiguously encoded in the repertoire of each species' vocalisations. Until now, the study of species recognition in songbirds has been focussed mainly on male songs and male territorial behaviour. The Black-capped Chickadee is a small North American songbird species that is unique among songbirds since both its song and its call are learned, and that the acoustic structure of a *chick-a-dee* call is more complex than those of their *fee-bee* song. Moreover, the *chick-a-dee* call is used in a wider range of contexts than song, being produced during social interactions between conspecifics. Here, we present an experimental field study investigating the coding of the species-specific information in the Black-capped Chickadee *chick-a-dee* call. By modifying natural calls in both temporal and frequency domains and by observing the behaviour of Black-capped Chickadees upon the playback of these modified calls, we demonstrated that the species-specific recognition relies on several acoustic features: syntax, frequency modulation, frequency range and to a lesser extent, call rhythmicity.

61 Kosciuch & Sandercock

* Proximate mechanisms account for nest desertion in response to cowbird parasitism by Bell's Vireo. KARL L. KOSCIUCH and BRETT K. SANDERCOCK, *Div. Biol., Kansas State Univ. Manhattan, KS.*

Nest desertion is a response of small-bodied songbirds to interspecific brood parasitism by the Brown-headed Cowbird and can be an effective anti-parasite strategy. However, high variability in the

incidence of desertion is perplexing because of the high cost of accepting a parasitic egg for many small-bodied hosts. Bell's Vireos were studied at Konza Prairie Biological Station near Manhattan, KS, from May to Aug 2003. We visited nests every 3 d to record contents and response to parasitism. 68% of all vireo nests ($n = 119$) and 76% of all pairs ($n = 37$) were parasitized at least once. Seasonal productivity (total fledglings/pair) differed among responses ($F_{3, 33} = 14.98$, $P < 0.0001$) with pairs that desert 1 or more nests fledging more host young (mean = 2.2 ± 0.28) than accepting pairs (mean = 0). Using logistic regression we determined that the number of host eggs remaining in a parasitized nest explained more variation ($X^2 = 12.37$, $P = 0.0004$) in the probability of nest desertion than the number of cowbird eggs received ($X^2 = 0.03$, $P = 0.87$). These results are consistent with the predictions of the clutch reduction hypothesis, which suggests nest desertion is a response to egg loss during the egg laying or incubation stages.

62 Krakauer

* Kin selection and the evolution of cooperation in Wild Turkeys. ALAN H. KRAKAUER, *Mus. Vert. Zool., Univ. California, Berkeley, CA.*

Polygynous animal societies are typically characterized by intense competition among males; male-male cooperation in these systems therefore seems paradoxical in an evolutionary context. Wild Turkeys form coalitions of 2 to 4 males that display cooperatively to females and compete with other males for breeding opportunities. Only the dominant male in each coalition was believed to reproduce directly, raising the question as to how subordinate individuals benefit from group membership. This cooperation has been cited as a classic example of kin selection; here I provide the first data to directly support this hypothesis. Data from 9 microsatellite loci indicate that males in coalitions are indeed highly related. Average r -values for 5 coalitions is 0.47, indicating that coalition members are close relatives. Genetic paternity data suggests that kin selection represents the predominant force keeping subordinate males in coalitions. Subordinate members of coalitions do not appear to achieve direct reproduction. However, their presence increases the reproductive success of their dominant partner over that of solitary males. Moreover, the indirect fitness benefits accrued by subordinates are greater than the reproductive success achieved by the average solitary breeder. Although regarded as a textbook example of kin selection, Wild Turkeys represent a relatively unusual example of avian helping behavior in that the groups do not form from delayed dispersal on a territory, involve offspring helping their parents, or entail alloparental care.

63 Norris, Marra, Kyser & Ratcliffe

* Post-breeding molting latitude and reproductive effort in a long-distance migratory bird. D. RYAN NORRIS, *Dept. Biol., Queen's Univ., Kingston, ON*, PETER P. MARRA, *Smithsonian Environ. Res. Center, Edgewater, MD*, T. KURT KYSER, *Dept. Geol. Sci., Queen's Univ.*, and LAURENE M. RATCLIFFE, *Dept. Biol., Queen's Univ.*

Molt, the periodic replacement of feathers, is one of the most energetically costly but least understood aspects of migratory bird ecology. We analyzed stable-hydrogen isotope values in tail feathers of returning adult male American Redstarts to determine post-breeding molting latitude from the previous breeding season. Stable-hydrogen isotope values in the tip and base of the feather were highly correlated, indicating that feathers were generally molted at 1 location regardless of starting latitude. Surprisingly, 50% of adult males molted tail feathers south of the breeding grounds during fall migration and this was related to reproductive effort. Males that molted tail feathers south of breeding areas were more likely to have invested a large amount of parental care late in the breeding season, whereas all of the males that failed to fledge young or fledged first nests molted on the breeding grounds before migration. Causes of delayed breeding, such as high nest predation rates, could influence the molting locations of migratory birds and may have significant impacts on individuals during the subsequent migration and non-breeding periods. In addition, recent studies that have used δD values in feathers to infer population connectivity and dispersal may be incorrectly assigning breeding latitudes.

64 Huyvaert, Anderson & Parker

* The social and genetic dynamics of promiscuity in Waved Albatrosses (*Phoebastria irrorata*). KATHRYN P. HUYVAERT, *Dept. Biol., Univ. Missouri- St. Louis, St. Louis, MO*, DAVID J. ANDERSON, *Dept. Biol., Wake Forest Univ., Winston-Salem, NC*, and PATRICIA G. PARKER, *Dept. Biol., Univ. Missouri- St. Louis.*

We used behavioral observations and molecular parentage data to examine hypothetical social and genetic correlates of extra-pair copulations (EPCs) and extra-pair fertilizations (EPFs) in the

long-lived, socially monogamous waved albatross. From the female perspective, we demonstrate a mate acquisition benefit of frequent copulations: females acquiring new mates copulate most with the male they later acquire as a social mate. Support for other social benefits is not strong in our study population. We show mixed support for predictions of the good genes hypothesis whereby females engaging in EPCs gain fitness benefits of having chicks sired by males of better quality than their social mates. Female EPCs are not correlated with proximate measures of male quality, although females have EPCs with breeders more often than non-breeders. Support for the good genes idea extends to comparisons of behavior between cuckolded males and those that were never cuckolded, but we show no differences in male body size, bill shape or EPC rate between pairs of cuckolded males and the genetic sires of the chicks they raise. Strong philopatry inherent to this species' single-island endemism could set in motion mate choice that promotes inbreeding avoidance by females or EPF tolerance by cuckolded males when genetic sires are closely related; we show no support for either of these hypotheses. Instead, males might adjust care in response to paternity uncertainty. Waved Albatross males appear to respond variably to uncertainty: within-pair copulations increase with female EPCs but feeding frequency is not different for cuckolded males.

65 DeLuca, Marra & King

Using food abundance, site parameters, and land use at multiple scales to describe Chesapeake Bay waterbird abundance. WILLIAM V. DeLUCA, PETER P. MARRA and RYAN S. KING, *Smithsonian Environ. Res. Center, Edgewater, MD.*

Bird populations are influenced by both natural and anthropogenic factors. This is especially true for estuarine systems that are subjected to dynamic salinity conditions, tide cycles, and fluctuating nutrient levels as well as by anthropogenic stressors such as contaminant and nutrient runoff from watersheds and shoreline habitat alterations. We used classification and regression trees to identify food abundance, local site parameters and land use at local and watershed scales as potential factors that determine the abundance of 5 waterbird groups: gulls, terns, waders, raptors, and cormorants. Local land use is the primary factor explaining variation in abundance for all 5 waterbird taxa. Food abundance and site parameters explain significant variance in the abundance of terns, waders and cormorants. These results are important to the development of reliable indicators for estuarine condition in addition to identifying variables that influence the abundance of species of conservation concern.

66 Stratford & Robinson

Large-scale habitat selection of southeastern migrants in a rapidly urbanizing landscape. JEFF STRATFORD, *Center of Forest Sustainability, Auburn Univ., Auburn, AL* and W. DOUGLAS ROBINSON, *Dept. Fish. & Wildl., Oregon State Univ., Corvallis, OR.*

In 2002 and 2003, we monitored birds in central w. Georgia to understand the effects of urbanization on avian communities where the rate of land use conversion to urban cover is particularly high. Over 650 point count stops were visited twice each year. We quantified land use at 3 scales (100, 200, 1000 m) around each count point. In 2002, the best predictors of migrant species richness were large-scale urban cover and the interaction between mid-scale mixed hardwoods and transitional (early succession) cover. In 2003, the best predictors of migrant species richness were large-scale weighted-edge density and large-scale transitional cover. To understand the relationship between particular species and land use we plotted the habitat associated with each species along these land uses. None of the averages of our study species contained >20% urban cover. Not surprisingly, forest-interior migrants were associated with very low levels of urban cover in the landscape. However, some species associated with disturbance (e.g., Prairie Warbler, Blue Grosbeak) were also associated with the lowest levels of urbanization.

67 Guénette & Villard

Evidence for stand and landscape-scale thresholds in forest bird response to habitat alteration. JEAN-SÉBASTIEN GUÉNETTE and MARC-ANDRÉ VILLARD, *Canada Research Chair in Landscape Conservation, Dép. de biol., Univ. Moncton, Moncton, NB.*

Owing to their intellectual and practical appeal, threshold responses have been sought in a wide variety of scientific contexts. In spite of this, empirical evidence for actual thresholds in ecological responses remains elusive. Using short-term, spatially extensive forest bird surveys in a managed forest landscape, we report evidence for the nonlinear responses of many species to habitat alterations associated with harvesting. For this purpose, we surveyed forest birds at 390 stations sampling wide gradients in habitat alteration. Using logistic regression, ROC analysis and PCA, we

investigated the response of 42 species to these gradients and determined thresholds in stand and landscape characteristics for those responding significantly to either gradient. By combining these threshold values, we found that canopy closure had to reach 70% and the density of large trees (>30 cm dbh) had to exceed 80 stems/ha for all these species to be above their respective occurrence thresholds. Even though thresholds are species-specific, we also found a relatively narrow threshold range in mature forest cover within 1 km. The probability of presence of 9 species increased significantly with forest cover, the most sensitive being the Ovenbird. Thresholds such as these offer valuable insight as a first step in the development of conservation strategies.

68 Nol, Francis & Burke

Using distance from putative source woodlots to predict occurrence of woodland birds in putative sinks. ERICA NOL, *Biol. Dept, Trent Univ., Peterborough, ON*, CHARLES FRANCIS, *Natl. Wild. Res. Centre, Canadian Wildl. Serv., Ottawa, ON.*, and DAWN BURKE, *Ontario Min. Nat. Res., London, ON.*

We used occurrence data and distances between putative sources and sinks for 4 species of area-sensitive forest birds to predict occupancy in small fragments. For Ovenbird, Wood Thrush, Veery and Rose-breasted Grosbeak, distance from large woodlots was a significant predictor of occurrence in small woodlots. Small woodlots 15 km from a large woodlot were unlikely to contain any of these species. Distance from large woodlots did not predict occupancy of Red-eyed Vireo, a species with no apparent difference in productivity in relation to fragment size. Two other candidate models (vegetation structure, area of putative sink) had little to no support in explaining occupancy in small fragments, using AIC criteria. These results suggest that maintenance of large, productive forest fragments benefit regional occurrence of forest-breeding birds by providing individuals to neighboring small woodlots. Limited reproduction in these small woodlots means that they may act as a reservoir for excess individuals in the case of catastrophic events that result in vacancies in source woodlots. Conservation and sound forest management of small forests should be directed particularly toward those closer to large regional forests.

69 Carignan & Drapeau

Are conspecific playbacks more accurate than point counts? VINCENT CARIGNAN and PIERRE DRAPEAU, *Groupe de Recherche en Écologie Forestière and Chaire d'Études sur les Écosystèmes Urbains, Univ. du Québec à Montréal, Montréal, QC.*

We compare 2 frequently used techniques of bird survey (point counts and conspecific playbacks) towards their capacity to detect target species, their ability to estimate bird abundance and their usefulness in detecting reproductive activity. We hypothesized that conspecific playbacks, due to the suite of behaviours they provoke in many bird species, would provide a less labour-intensive alternative to point counts and lead to more accurate results in bird surveys. Our study was conducted during the summers of 2002 and 2003 in the southwestern portion of the province of Québec. We surveyed species (Ovenbird, Black-throated Blue Warbler, Wood Thrush, Scarlet Tanager, White-breasted Nuthatch and Pileated Woodpecker) at 350 stations located in mature maple forests. The comparison of the 2 survey methods indicated that point counts allowed the detection of our target species at an average of 11.8% more sites and an average increase of 28.2% in the detection of individuals. Nevertheless, conspecific playbacks allowed the detection of target species at 25.9% more sites in which they were not detected by point counts; 27.4% more individuals undetected by the alternative method and convincing evidence of reproductive activity in many cases. We conclude that point counts and conspecific playbacks do not constitute, by themselves, a reliable method to estimate the presence or abundance of bird species.

70 Brasso & Emslie

A late Pleistocene avifauna from Sandia Cave, New Mexico. REBECKA BRASSO and STEVEN D. EMSLIE, *Dept. Biol. Sci., Univ. North Carolina at Wilmington, Wilmington, NC.*

The late Pleistocene avifauna from Sandia Cave, New Mexico, contains 311 bones representing over 30 species. This avifauna includes 2 extinct taxa, *Coragyps occidentalis* and *Ectopistes migratorius*, as well as several rare species of owls. This collection provides a more complete understanding of the habitat structure present in this area of New Mexico during the late Pleistocene and is very similar to other cave avifaunas from the Great Basin and Rocky Mountain regions dating to this time period. The species from Sandia Cave suggest a disharmonious or nonanalog community structure during the late Pleistocene with fossils from birds currently found in arctic tundra, boreal, and steppe climates. This collection is important in providing additional evidence

for this steppe-tundra habitat present in western North America during the late Pleistocene.

71 Alldredge, Pollock, Simons & Collazo

Multiple-observer and time of detection methods for estimating abundance of birds from point count surveys. MATHEW W. ALLDREDGE, KENNETH H. POLLOCK, THEODORE R. SIMONS and JAIME COLLAZO, *Coop. Fish & Wildl. Res. Unit, North Carolina State Univ., Raleigh, NC.*

We developed multiple independent-observer and a time of detection methods for estimating abundance from point count surveys. These approaches use the detection histories of individual birds detected to estimate abundance using a capture-recapture framework. The full suite of capture-recapture models was used, including individual heterogeneity models and covariate models. Abundance estimates using these methods were reasonably precise. Models that accounted for individual heterogeneity were always selected as the most parsimonious models. Models that did not account for individual heterogeneity had large negative bias in abundance estimates. Modeling individual heterogeneity in detection probabilities requires 4 observers for the independent-observer approach and 4 time intervals for the time of detection approach. The extra field effort required for these methods is justified to account for bias in count statistics and make spatial or temporal comparisons valid.

72 Alldredge, Pollock & Simons

* Multiple species modeling of point count surveys. MATHEW W. ALLDREDGE, KENNETH H. POLLOCK and THEODORE R. SIMONS, *Coop. Fish & Wildl. Res. Unit, North Carolina State Univ., Raleigh, NC.*

A multiple species modeling approach for estimating abundance of birds from point count surveys was developed for distance sampling, multiple-observer, and time of detection methods. The multiple-species model uses a hierarchical approach to group species by similar characteristics, develop a set of candidate models and test for group effects. Single species models were selected as the “best” models for the distance sampling approach but multiple species models were generally “better” for the multiple-observer and time of detection methods. Multiple species models gave more precise parameter and abundance estimates than single species models. Finite-mixture models of unobservable individual heterogeneity in detection probabilities were always selected as the “best” models for the multiple-observer and time of detection analyses. We suggest that multiple species models will also have application to estimating abundance of rare or elusive species.

73 Knoche, Powell, Wooller & Barboza

* King Eider wing molt Inferences from stable isotope analyses. MICHAEL KNOCHE, ABBY N. POWELL, *Alaska Coop. Fish & Wildl. Res. Unit, Univ. Alaska, Fairbanks, AK*, MATTHEW WOOLLER, *Water Env. Res. Cent., Univ. Alaska*, and PERRY S. BARBOZA, *Inst. Arctic Biol., Univ. Alaska*.

The stable carbon and nitrogen isotope composition ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of primary feathers of North American King Eiders were used to examine the foraging ecology and differential carbon sources available during wing molt of this species. We collected 288 primary feathers and 17 birds during spring and fall migration 2003 on Alaska's North Slope. The $\delta^{13}\text{C}$ values of primary feathers (mean $\delta^{13}\text{C} = -17.96\text{‰} \pm 1.69 \text{ SE}$, range $114.67\text{‰} - -25.55\text{‰}$) appeared to reflect terrestrial, estuarine, and marine carbon inputs during wing molt. Females in ‘terrestrial molt’ areas had $\delta^{15}\text{N}$ values (mean = $7.07\text{‰} \pm 0.86 \text{ SE}$) reflecting lower trophic level inputs while those females in ‘marine molt’ areas had values (mean = $14.73\text{‰} \pm 1.19 \text{ SE}$) reflecting a marine invertebrate diet. The number of adult females sampled for this study suggests that a minimum of 9,600 adult females may have molted wing feathers in terrestrial areas prior to departure for fall migration during our sampling period. Muscle and feather $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ signatures described a potential trophic shift in diet between molting and breeding areas because their signatures did not differ during spring migration but were significantly different in fall ($\delta^{15}\text{N}$, $P < 0.0016$ and $\delta^{13}\text{C}$, $P < 0.0005$). $\delta^{13}\text{C}$ values are increasingly enriched in male King Eider primaries molted in an east to west longitudinal gradient in the Bering Sea ($R^2 = 0.802$). Gradients in $\delta^{13}\text{C}$ values within the Bering Sea and between spring and fall migrations suggest a longitudinal component that, coupled with a latitudinal isotope component or diet samples, could be used to infer geographic locations of wing molt.

74 Coulton, Clark, Hobson & Larivière

* Sources of recruitment to local parkland Mallard populations: identifying natal origin using δD , $\delta^{13}C$ and $\delta^{15}N$ values in feathers. DANIEL W. COULTON, *Dept. Biol., Univ. Saskatchewan, Saskatoon, SK*, ROBERT G. CLARK, KEITH A. HOBSON, *Canadian Wildl. Serv., Saskatoon, SK*, and SERGE LARIVIÈRE, *Delta Waterfowl Found., Portage la Prairie, MB*.

Reproductive success of Mallards apparently is insufficient to maintain local populations in the absence of immigration in many areas of the Canadian prairies. However, population stability in these same areas suggests that demographic “rescue” by immigrants may be occurring. This hypothesis has not been tested because of problems in assessing immigrant status of unmarked individuals. We used δD , $\delta^{13}C$ and $\delta^{15}N$ values from wing feathers of known and unknown-source wild yearling females to delineate natal origins. We found site differences in δD values for known-origin feather samples but no differences for $\delta^{13}C$ and $\delta^{15}N$ values. Our results for these isotopes are similar to previous work and suggest that δD values from yearling wing feathers could be used to delineate natal origin. Comparison of δD feather values for known versus unknown-origin distributions indicates that 6% of unknown-origin yearlings emigrated to the collection sites (i.e., values for unmarked birds were not contained within 2 SD of mean feather values of known-origin birds). Comparison with continental δD patterns suggests that 70% and 30% of immigrants had natal origins in prairie and boreal biomes, respectively. We plan to link our immigration estimates with mark-recapture and local reproductive data to explain patterns and sources of recruitment in the population of breeding female Mallards at Minnedosa, an area where breeding success is generally low but the population is relatively stable.

75 Griffing, Marra & Clark

* American Robin nests and mosquito exposure. SEAN GRIFFING, PETER MARRA, *Smithsonian Environ. Res. Center, Edgewater, MD*, and LARRY CLARK, *USDA-APHIS*.

Mosquitoes are important arbovirus vectors and at least 79 of the 500 recognized arboviruses have been recovered in birds. Yet the temporal and spatial patterns of mosquito feeding on birds remain unclear. Here, mosquito visitation at American Robin nests was observed with infrared cameras for 24 h periods during the spring and summer of 2003 in Washington, DC, and Baltimore, MD. Hourly mosquito visitation levels on nestlings and adult birds were recorded in relation to nestling age, brood size, nest height, vegetation, weather, and parental behavior. Early stage nests had significantly more mosquitoes on brooding adults than late stage nests. Early nestlings showed a trend towards fewer mosquitoes than late stage nestlings probably as a consequence of brooding behavior. Seasonally, mosquitoes at the nest peaked in Jun with numbers declining in Jul. Temperature and precipitation also explained some variation in mosquito nest visitation. Robin nestlings appear to be at greater mosquito exposure risk as they age. In our study, ambient variation in mosquito levels at the nest seemed to rely more on mosquito ecology than nest factors. Assessing the risk that breeding birds and their young face due to biting mosquitoes may yield important insights into the spread of zoonotic diseases.

76 vacant

77 Roberts, Holmes & Marra

* The influence of winter to summer carry-over effects on reproductive success in the Ovenbird. P. K. ROBERTS, R. T. HOLMES, *Dept. Biol. Sci., Dartmouth Coll., Hanover NH*, and P. P. MARRA, *Smithsonian Environ. Res. Cent., Edgewater, MD*.

For migratory species, differences among individuals in reproductive success have been attributed to events prior to the initiation of nesting, particularly arrival to the breeding grounds. This hypothesis proposes that occupying a high-quality winter territory enables early spring migration, early arrival to breeding areas, and higher reproductive success. We examined the relationships between stable-carbon isotope values (as an index to winter territory quality), arrival date, energetic condition and reproduction in Ovenbirds on breeding grounds in Maryland. Stable-carbon isotope values did not predict arrival date or energetic condition. Within the arrival period, arrival date and condition were not correlated. Further, early arrival and good energetic condition did not improve a male's chances of fledging young. In 2001 males with isotope values indicative of high-quality winter territory occupancy were more likely to fledge young, but this was not true in 2002 or 2003. Returning males were in better condition than new males in 2002, and arrived earlier in 2003, suggesting that experience may be important in some years. Overall, our results suggest that winter to summer carry-over effects have minimal influence on the reproductive success in Ovenbirds. Rather, individual experience and

conditions during the breeding season may be more significant in the species.

78 Blanc & Walters

* Cavity-nesting bird community interactions: a preliminary study. LORI A. BLANC and JEFFREY R. WALTERS, *Dept Biol., Virginia Tech Univ, Blacksburg, VA.*

This study examines the cavity-nesting bird community in the longleaf pine ecosystem at Eglin Air Force Base, Florida, where single-species management is conducted for the Red-cockaded Woodpecker (RCW). The potential for RCW cavity management to impact other species is high, as it may have exceptionally numerous and strong associations with other members of the cavity-nesting community. In fact, 27 species use RCW cavities. The goal of this 2-yr, preliminary study was to correlate each of Eglin's 13 cavity nesting bird species with RCW trees and determine which have the greatest potential to be impacted by RCW cavity management. In 2002 and 2003, we measured: (a) species abundance, (b) nest resource use, and (c) nest resource availability using a combination of point counts, nest searches and vegetation plots. Resulting correlational data detected 3 species that were positively and significantly correlated with pine snags and RCW trees and our nest data confirm these results. The species in this group, the Red-headed Woodpecker, Northern Flicker and Southeastern American Kestrel, are of particular interest as they have the potential to be responsive to RCW cavity management. This research has laid the groundwork for an ongoing experimental study that is using RCW cavity manipulation to test predictions about direct and indirect interactions between these 3 species and the RCW, with cavity construction and enlargement as the underlying mechanism. A better understanding of how species interactions structure communities can improve our ability to effectively design conservation management strategies.

79 Christie & Reimchen

* Incorporation of salmon-derived nutrients into the tissues of a ground-foraging passerine. KATIE S. CHRISTIE and T. E. REIMCHEN, *Biol. Dept., Univ. Victoria, Victoria, BC.*

The predictable annual spawning events of anadromous salmon (*Oncorhynchus* spp.) act as a critical link between terrestrial and marine ecosystems and constitute a substantial food source for many species. An important component of this process involves bear-mediated transfer of salmon into riparian forests and subsequent fertilization of otherwise nutrient poor systems. Using isotopic ratios of nitrogen ($\delta^{15}\text{N}$) and carbon ($\delta^{13}\text{C}$), we investigate the direct and indirect influences of salmon nutrients on passerines above and below a waterfall barrier to salmon migration on 2 rivers on the central coast of British Columbia, where concurrent studies have shown major enrichment of salmon nutrients in shrubs, trees and insects in riparian habitats. During late summer and fall 2002 and 2003, we captured birds and collected feathers for stable isotope analysis. Large temporal shifts in isotopic signatures of Winter Wrens from analysis of multiple generations of feathers suggest significant individual niche variation within this species. $\delta^{15}\text{N}$ but not $\delta^{13}\text{C}$ signatures of Winter Wrens were higher overall for birds captured below the falls compared with birds captured above the falls, indicating that wrens incorporate salmon-derived nutrients into their tissues mainly through indirect pathways. Nutrients from spawning salmon have cascading effects on multiple trophic levels of terrestrial systems and the decline of salmon populations may therefore have more far-ranging effects than previously understood.

80 Stodola, Linder, Buehler, Kim & Franzreb

* Spatio-temporal variation in prey abundance and its importance for a migratory songbird. KIRK W. STODOLA, ERIC T. LINDER, *Dept. Biol. Sci., Mississippi State Univ., Mississippi State, MS*, DAVID A. BUEHLER, DAN H. KIM, *Dept. For. Wildl. & Fish., Univ. Tennessee, Knoxville TN*, and KATHLEEN E. FRANZREB, *U.S. Forest Serv., Knoxville, TN.*

Global temperatures have warmed approximately 0.6 °C in the last 50 yr, and climatic regimes may be altered. For many migratory songbirds these changes may not be uniform across their geographic range. Climatic changes on the wintering grounds may not coincide with changes on the breeding grounds leading to a decoupling in breeding and prey phenology upon which songbird reproductive success depends. Breeding songbirds must reconcile this dilemma by either working harder to provide for young, thereby reducing individual fitness, or decrease parental effort to maintain individual fitness. For the past 2 yr we have been investigating the effects of this decoupling on the Black-throated Blue Warbler (BTBW) in the southern Appalachians of North Carolina. In this mountainous region deciduous tree bud burst varies by 3 wk across the elevational range of the BTBW. Lepidoptera emergence and growth is closely tied to bud-burst, and our surveys indicate that

peak Lepidoptera abundance is earlier at lower elevations compared with higher elevations. However, clutch initiation for the BTBW does not follow this pattern and occurs at the same time irrespective of elevation. This sets up a unique opportunity to study the impacts of this decoupling. In 2003 and 2004 we estimated parental provisioning for breeding BTBWs on 3 study plots 1100, 1300, 1500 m. Adults fed young significantly less where peak nestling demand failed to coincide with peak prey abundance, indicating that a decoupling in breeding and prey phenology may negatively impact the ability of breeding adults to provide for nestlings.

81 Liu & Nottebohm

Forebrain gene expression patterns differ for the dawn and daytime singing in Chipping Sparrows. WAN-CHUN LIU and FERNANDO NOTTEBOHM, *Field Res. Center, Rockefeller Univ., Millbrook, NY.*

Many songbirds have more variable or complex dawn song than their day song, and the dawn and daytime singing appear to have different function. Here we investigate the underpinning mechanism of dawn and daytime singing in Chipping Sparrows. Previous field observations and manipulative experiments have revealed that, in chipping sparrows, the dawn chorus and daytime singing differ in song variability, behavioral or social context, and function. Here we examined the forebrain gene expression pattern of 2 immediate early genes (IEG) – ZENK and c-fos – while territorial male sparrows were singing at different time of a day. We found that singing at dawn induced high IEG expression in the song nuclei of anterior forebrain pathway. During the daytime, however, singing did not induce gene expression in these nuclei. These results suggest that male chipping sparrows appear to have different neural mechanism for the dawn and daytime singing. The difference might be correlated with song variability or the extent of social interaction.

82 Janes & Ryker

Second category songs of Hermit Warblers structure and geographic distribution of songs and song elements. STEWART W. JANES and LEE RYKER, *Biol. Dept., Southern Oregon Univ., Ashland, OR.*

Second category songs from 350 Hermit Warblers in sw. Oregon were analyzed. The most common arrangement for second category songs was a 3-part song. Each of the 3 phrases was distinct in the number and structure of syllables. However, this "typical" arrangement characterized only 42% of all songs. The remaining songs differed in both the number of phrases (2 - 7) and their order. First category songs in the same geographic area are also variable consisting of 7 markedly different dialects. Despite the variability within both song categories and their superficial similarity, 90% of second category songs could be distinguished from first category songs using discriminant function analysis. Individual song elements also varied in form and tended to occur in discrete geographic areas, but the distribution of a particular song element did not coincide with the distribution of first category dialects or other elements from second category songs. No dialects of second category songs were obvious. The apparent independent distribution of song elements suggests a large learning component to second category songs.

83 Moseley & Wiley

Individuality in the vocalizations of the Buff-throated Woodcreeper. DANA L. MOSELEY and R. HAVEN WILEY, *Dept. Biol., Univ. North Carolina, Chapel Hill, NC.*

An important behavioral adaptation of territorial birds is their ability to recognize conspecific individuals, such as neighbors or strangers. Unlike temperate forests, tropical forests in the Americas have many species of territorial birds in phylogenetic families that do not learn their songs and thus have acoustically simple songs. One representative of these tropical suboscines is the Buff-throated Woodcreeper (*Xiphorhynchus guttatus*), a bird commonly found in the forests of the tropical Americas. To investigate the possibility for individual variation in songs of this species, I made roughly 15 h of recordings of 10 individual Buff-throated Woodcreepers at dawn and dusk from 21 Jul to 11 Aug 2002, along the Río Orosa in Amazonian Perú. From these recordings, I took different measures of frequency, time, and pattern for 5 - 10 song spectrograms of each individual. Using analysis of variance, I was able to determine that the songs varied significantly more between individuals than within individuals. Despite sounding simple to the human ear, the vocalizations of Buff-throated Woodcreepers vary consistently, even if only slightly, among individuals.

84 Dolby, Clarkson, Haas, Miller, Havens, Cox & Stechler

Are song-phrase versatility and production rate honest indicators of male parental quality in the Gray Catbird? ANDREW S. DOLBY, CHARLES E. CLARKSON, ERIC T. HAAS, JENNIFER K. MILLER, LAYNE E. HAVENS, BRANDON K. COX and KATRINA M. STECHLER, *Dept. Biol. Sci., Univ. Mary Washington, Fredericksburg, VA.*

Sexual selection theory proposes that elaborate secondary sexual characteristics, such as physical ornamentation or complex song, have evolved because they confer a mating advantage upon their bearers. Such characters may facilitate success in direct competition for mates. They may also increase the attractiveness of individuals to the opposite sex by communicating their bearers' genetic quality or ability to provide mates with material reproductive resources. Parental care is one such material resource important to the reproductive success of many birds. The Gray Catbird is sexually monochromatic. However, males produce complex song during the breeding season while females do not. We tested the hypotheses that song-phrase versatility and rate of song-phrase production are honest indicators of male parental effort. We predicted that both song-phrase versatility and rate of production would be positively correlated with chick feeding rates by males. Paternal chick feeding rates were not significantly related to song-phrase versatility. However, we found a significant positive correlation between paternal chick feeding rates and song-phrase production rates.

85 Price, Earnshaw & Webster

How low can you go? Montezuma Oropendolas emphasize aspects of song that indicate body size during vocal contests. J. JORDAN PRICE, SARAH M. EARNSHAW, *Dept. Biol., St. Mary's College of Maryland, St. Mary's City, MD,* and MICHAEL S. WEBSTER, *School Biol. Sci., Washington State Univ., Pullman, WA.*

The Montezuma Oropendola (*Psarocolius montezuma*) is a polygynous Neotropical blackbird with high levels of sexual size dimorphism and elaborate male songs. Larger males tend to have higher dominance ranks and thus higher reproductive success than smaller males. At nesting colonies males appear to compete in vocal contests, in which singers overlap the songs of other males with their own. We measured a variety of acoustic features in songs produced during these contests and in the same song types when males were singing alone. Although most features did not differ in the 2 contexts, our results show that the lowest emphasized frequency of a song was significantly lower during vocal contests. Comparative analyses including other icterid taxa suggest that this aspect of song is constrained by body size, suggesting that it could be an honest indicator of male size during vocal interactions.

86 Staicer

Signal design of the two song categories wood-warblers. CINDY A. STAICER, *Dept. Biol., Dalhousie Univ., Halifax, NS.*

Across most of the *Dendroica* and closely-related species of wood-warblers (Parulidae), males sing 2 categories of song in different contexts, suggesting a separation of inter- and intrasexual functions. If the design of these signals is related to their proposed function, the acoustical structure of songs of the 2 categories should vary in a consistent way across species. Songs of both categories were recorded from 13 species inhabiting a variety of forest types in Nova Scotia: Black-and-White Warbler, Northern Parula, Yellow Warbler, Chestnut-sided Warbler, Black-throated Blue Warbler, Black-throated Green Warbler, Blackburnian Warbler, Magnolia Warbler, Yellow-rumped Warbler, Palm Warbler, Blackpoll Warbler, Bay-breasted Warbler, and American Redstart. For both song categories, acoustical features, including time, duration, and complexity of songs and their parts, were measured from sonograms and power spectra (n = 10 males/species). Data were used to test the hypothesis that, across species, A songs (also known as First Category or Accented songs) are more stereotyped, simpler, and emphasized a higher frequency than B songs (also known as Second Category or Unaccented songs). The hypothesis was supported despite large species-specific differences in song. Selection pressures that may be responsible for maintaining the divergent features of the 2 song categories will be discussed.

87 Rothstein & O'Loughlen

A phylogenetic perspective on cowbird song development: implications for models of the evolution of song learning capacities in birds. STEPHEN I. ROTHSTEIN, *Dept. Ecol., Evol., Marine Biol., Univ. California, Santa Barbara, CA*, and ADRIAN O'LOGHLEN, *Dept. Psychology, Univ. Washington, Seattle, WA*.

The parasitic cowbirds and their sister lineage, the Northern Hemisphere *Agelaius* spp, show informative similarities and differences in their vocalizations. The perched song of cowbirds is likely homologous with the structurally similar songs of *Agelaius* spp. But another song category, the flight whistle (FW) occurs only in the 3 most recently derived cowbird species. All of these lineages have single syllable calls (SS) used over large distances. While the nonparasitic genera have nests at which males and females focus attention and the first parasitic cowbird to branch off has little need for long distance signals as males and females travel together, the 3 cowbird species with FWs must frequently communicate over long distances because males and females have no focal site at which they can reliably find one another. It is likely that frequent use of the SS over large distances and minor learned embellishments to it that were correlated with fitness indicators, such as age, resulted in selection for increased learning capacity, enhanced embellishments and the evolution of FWs, which initially were likely to be elaborations of SSs. A process in which a frequently used simple signal with a small learning component associated with a fitness indicator evolves into a new, more elaborate learned signal may be similar to the initial evolution of song learning capacities in birds.

88 Mennill

Beethoven's muse: the solo and duet songs of neotropical Rufous-and-white Wrens. D. J. MENNILL, *Lab. Ornithol., Cornell Univ., Ithaca, NY*, and *Biol. Dept., Auburn Univ., Auburn, AL*.

In many tropical birds, males and females sing coordinated vocal duets. Duetting birds present unique opportunities for understanding conflict and cooperation between the sexes, yet few investigations explore sex differences in singing behaviour. I present the first detailed account of the solo and duet singing behaviour of Rufous-and-white Wrens (*Thryothorus rufalbus*), a resident neotropical songbird. Male and female songs share a similar structure consisting of low-pitched, flute-like syllables. Male songs have lower frequency characteristics, more repeated syllables, and often sound louder than female songs. Males sing more often than females and only males show elevated song output at dawn. Males have repertoires of 11 song types, whereas females have significantly smaller repertoires of 8 song types. Both sexes share more song types with nearby individuals than with distant individuals, although males share proportionately more of their repertoire with neighbors. Breeding partners combine their solo songs to create duets. Males initiate 73% of duets. Duets assume a variety of different forms ranging from simple, overlapping male and female songs to complex combinations of multiple male and female songs. Males respond to female-initiated duets with shorter latencies than when females respond to male-initiated duets. Each pair sings certain combinations of song types in duets more often than can be explained by random association, demonstrating that Rufous-and-white Wrens have formalized duet types. The most common duet type was different for each pair. My analysis of Rufous-and-white Wren vocal behaviour demonstrates pronounced sex differences in song structure, singing activity, repertoire size, repertoire sharing, and duetting behaviour.

89 Olsen, Greenberg & Walters

Seasonal clutch size variation in Coastal Plain Swamp Sparrows: physiological constraint or strategic adjustment? BRIAN OLSEN, *Biol. Dept., Virginia Tech, Blacksburg, VA*, RUSSELL GREENBERG, *Smithsonian Migratory Bird Center, Washington, DC*, and JEFF WALTERS, *Biol. Dept., Virginia Tech*.

Seasonally decreasing clutch size accompanied by a decrease in the rate of nest success is a widespread pattern found across almost all groups of temperately breeding birds. The decrease in clutch size has been explained in 2 ways. First, it may be due to physiological constraints on the nesting female produced by seasonal decreases in necessary resources or a correlation between female quality and nest initiation date. Alternatively, it may be a result of a strategic adjustment by the female to expend less energy towards reproduction in times of decreased success probabilities. We were able to test these 2 hypotheses in the Coastal Plain Swamp Sparrow due to the lack of a linear decrease in nest success over the breeding seasons of 2002 and 2003. Steady to increasing probabilities of nest success over the 2002 season were accompanied by steady to increasing clutch size. A significant quadratic trend in the 2003 nest success rates was echoed by an early season clutch size decline followed by a late season increase. Corresponding decreases in female mass show that the birds did not experience a lifting of physiological constraints. These results indicate that birds have the ability to increase clutch size late in the season in response to increased nest success probabilities regardless of physiological parameters, therefore supporting the strategic adjustment hypothesis. As fledging probabilities did not decline with increased clutch size, increased brood size correspondingly increased the number of fledged young.

90 Risch & Robinson

Sources of egg size variation in the Eastern Bluebird. THOMAS S. RISCH and THOMAS J. ROBINSON, *Arkansas State Univ., Dept. Biol. Sci., Jonesboro, AR*.

Egg size has significant affects on the quality of chicks. Young hatching from large eggs often have increased hatching mass and growth rates than conspecifics hatching from smaller eggs. We measured the length and breath (± 0.01 mm) of eggs from 91 clutches of Eastern Bluebirds nests that were initiated between 24 Mar and 14 Jun 2003 and a markedly larger sample in 2004. We then calculated egg mass (± 0.01 g) using the formula $Mass = K \times L \times B^2$. Each egg was labeled on the day laid, thus we determined laying sequences for all nests. In 2003, most of the variation in egg size was among nests ($r^2 = 0.85$, $df = 90,337$, $P < 0.0001$, $F = 21.53$). Clutch size did not effect the average mass of eggs within each clutch ($P = 0.34$, $df = 3,87$). However laying sequence was associated with egg mass, where the first laid egg was the smallest and egg size increased with laying sequence. We investigated the relationship between date of nest initiation and egg size. Females that laid 2 clutches, produced larger eggs in their second clutch (paired t-test, $t = 7.06$, $df = 26$, $P < 0.0001$). Adults were captured, color banded, measured (tarsus ± 0.1 mm), and weighed (± 0.25 g). We relate egg size to date laid, position within the clutch, and clutch size. In 2003, egg size was related to maternal condition, but there was no significant association between paternal condition and egg size.

91 Robinson & Risch

Egg size, parental quality, and chick performance in the Eastern Bluebird. THOMAS J. ROBINSON and THOMAS S. RISCH, *Dept. Biol. Sci., Arkansas State Univ., Jonesboro, AR*.

Within avian populations, larger eggs award advantages to young. These benefits include increased growth rates and survival of offspring. Altricial species provide substantial post-hatch care to offspring. This care, we deem parental quality, likely confounds the advantages attributed to egg size. Parents that are of 'high quality' are likely to lay larger eggs and be better at post-hatch care. Thus, it has been questioned whether the benefits so often cited as being a direct advantage of large eggs are due to egg size *per se*, or are the result of the parents that lay the largest eggs also being the best in terms of providing food and care for young. To separate egg size from post-hatch care, we conducted an egg-swapping experiment, in which clutches of small eggs where swapped with clutches of large eggs. In this way, parents that are suspected of being high quality (based on egg size) will be rearing chicks that hatched from small eggs, and suspected low quality parents will be rearing chicks from large eggs. Previous studies employing this experimental design have found that the ability to lay large eggs and the ability to raise chicks often co-vary. We used the Eastern Bluebird as our model species. Unlike previous studies, we independently assess parental quality through feeding rates and measures of plumage coloration. We will present results from 2 yr of experimental switches and discuss the independent effects of egg size and parental quality on hatching success, fledging success, and chick growth.

92 Fast & Clark

* The timing of nesting and breeding success of insectivorous birds: experimental tests with Tree Swallows. MARIE FAST, *Dept. Biol., Univ. Saskatchewan, Saskatoon, SK*, and ROBERT G. CLARK, *Canadian Wildl. Serv., and Dept. Biology, Univ. Saskatchewan*.

Global climate changes vary by region, and this may affect wildlife significantly. For example, climates at avian breeding and wintering areas may change at different rates; because of timing constraints of migration journeys, migratory birds may be unable to sufficiently shift breeding date to properly time migration and breeding. Evidence suggests that increased spring temperatures may lead to a mismatch in timing of egg laying relative to food availability for nestlings, resulting in later-laying females producing fewer fledglings. We experimentally heated a subset of nest boxes to determine if increased night nest box temperature would cause Tree Swallows to initiate laying earlier and result in a mismatch of food availability relative to nestling growth requirements. Nest boxes were heated at least 10 nights before laying by an average of 6°C. However, females nesting in heated nest boxes did not advance nest initiation, increase mean clutch fresh egg mass or decrease the number of laying breaks relative to females nesting in control boxes. Since there was no shift in laying date we were unable to test predictions of the mismatch hypothesis and examine effects on female productivity. This suggests that laying females are responding to other environmental cues, such as photoperiod, food abundance, or daily temperature.

93 Murphy

Determinants of lifetime reproductive success of Eastern Kingbirds. MICHAEL T. MURPHY, *Dept. Biol., Portland State University, Portland, OR*.

I tested for behavioral and morphological correlates of lifetime reproductive success (LRS) of Eastern Kingbirds breeding in central New York, and for negative effects of enhancement of reproductive effort on LRS. LRS varied widely among both females (0 - 21 young) and males (0 - 19 young), but neither lifespan nor LRS differed between the sexes. I estimated that 21% to 24% of individuals failed to fledge young in their lifetime, and that the top 10% of most productive adults contributed 29% to 34% of young. Lifespan was the strongest correlate of LRS, followed by the annual probability of reproductive failure (nest predation). LRS of females and males was positively associated with clutch size among individuals who raised unmodified broods, but with brood size among individuals who raised enlarged broods. Male LRS was independent of dispersal behavior, body size, and all measured morphological traits. Female LRS varied positively with body size in low quality females, but negatively with body size among high quality females. Site fidelity and LRS were positively associated in the latter female group. Thus, LRS (a) varied greatly among individuals, (b) was most closely linked to lifespan and frequency of annual breeding failure, and (c) body size and behavior had important influences on female LRS. It remains unclear why females do not lay larger clutches given that enlargement of brood size enhanced LRS.

94 Fast, Gilchrist & Clark

* Habitat-specific weight loss of ground-nesting birds: an experimental test. PETER L. F. FAST, *Dept. Biol., Univ. Saskatchewan, Saskatoon, SK*, H. GRANT GILCHRIST, *Canadian Wildl. Serv. and Dept. Biol., Carleton Univ., Ottawa, ON*, and ROBERT G. CLARK, *Canadian Wildl. Serv. and Dept. Biol., Univ. Saskatchewan*.

Kilpi & Lindström (1997, *Oecologia* 111: 297-301) found incubating Common Eiders on exposed, wind-driven islands lost weight at faster rates than females nesting on wooded islands. We tested the hypothesis that common eiders gain an energetic advantage by nesting in sheltered habitats by providing artificial shelters to a random selection of nesting hens after the onset of incubation. Work was conducted on a treeless arctic nesting colony, and nest shelters were designed to approximate forest canopy cover. We predicted shelters would moderate the thermal environment at both cold and warm temperature extremes, and that sheltered hens would be in better condition than those without. As predicted, eiders nesting in shelters maintained higher body mass entering late incubation, providing support for habitat-specific rates of weight loss in Common Eiders reported by Kilpi & Lindström. However, few eiders on Mitivik Island were found to use nest sites that provided natural overhead cover, despite the fact that such nest sites existed. We hypothesize that a trade-off exists; sheltered sites may offer microclimatic advantages to nesting eiders, but they may increase vulnerability to predators by obscuring their field of view.

95 Conway & Kirkpatrick

Effects of parental activity on probability of nest depredation: a test of Skutch's hypothesis. COURTNEY J. CONWAY, *USGS Arizona Coop. Fish & Wildl. Res. Unit, Tucson, AZ*, and CHRIS KIRKPATRICK, *School Nat. Res., Univ. Arizona, Tucson, AZ*.

Skutch (1949, *Ibis* 91: 430-455) proposed that adult activity at the nest can influence the probability of nest depredation. Skutch's hypothesis has been refuted by several authors based on the observation that daily probability of nest depredation is typically the same or lower during the nestling period (a time when visitation rates are high) compared to the incubation period. We will present several reasons why comparing rates of depredation between these 2 nesting stages is not the best approach for testing Skutch's hypothesis. We will also present results from field experiments where we examined rates of nest depredation between 2 types of Red-faced Warbler (*Cardellina rubrifrons*) nests: those with adult activity (n = 18) and those without (n = 17). Probability of nest depredation was 33% for nests with adult activity, and only 18% for nests without adult activity. We will supplement these results with data from the 2004 breeding season. These results suggest that adult activity does influence the probability of nest depredation (in support of Skutch's hypothesis) and that the activity of the adults around the nest accounts for a substantial amount (47%) of the predation that occurs during the incubation period.

96 Roberts & Garton

* A comparison of over-wintering Wood Thrush survival, movement, and home range size between continuous lowland wet forest versus forest fragments in Costa Rica. DINA L. ROBERTS and EDWARD O. GARTON, *Dept. Fish & Wildl., Univ. Idaho, Moscow, ID*.

The population decline of the Wood Thrush, a Neotropical-Nearctic migrant songbird, has been attributed to habitat modification, primarily forest fragmentation and associated effects, on both breeding and wintering ranges. Yet few studies have addressed fragmentation effects on Wood Thrush populations during the over-winter period. Assessing effects on demographic parameters for all stages of the annual cycle is an important step towards determining at what stage populations may be limited. The objectives of this study were to assess the impact of fragmentation on over-winter survival and movement patterns and to compare home range estimates of birds in continuous forest, the La Selva Biological Station, with those in isolated forest remnants below 100 m in elevation on the Atlantic slope of Costa Rica. This first year's findings from our telemetry research suggest that Wood Thrush were able to use and survive in fragments of varied sizes. Over-winter survival was high for birds in both continuous forest and within the fragmented landscape. Home range size was determined using the fixed kernel method with an 80% probability. The average home range for La Selva birds was 1.09 ha, with a range of 0.32 - 2.6 ha. Birds captured in fragments also established territories and maintained an average home range of 1.23 ha, ranging from 0.35 - 2.8 ha. Our results also indicated that certain individual Wood Thrush territories in fragments comprised largely edge habitat or often overlapped extensively with other individuals.

97 Sánchez-González, Navarro-Sigüenza, Peterson & García-Moreno

Systematics and biogeography of a cloud-forest specialist: the Common Bush-Tanager (*Chlorospingus ophthalmicus*) complex from Mexico. LUIS A. SÁNCHEZ-GONZÁLEZ, ADOLFO G. NAVARRO-SIGÜENZA, *Museo de Zoología "Alfonso L. Herrera", Depto. de Biología Evolutiva, Universidad Nacional Autónoma de México, México D.F., México*, A. T. PETERSON, *Mus. Nat. Hist., Univ. Kansas, Lawrence, KS*, and JAIME GARCÍA-MORENO, *Max Planck Res. Centre for Ornithology (Vogelwarte Radolfzell), Radolfzell, Germany*.

Cloud forests are distributed under very specific ecological conditions (steep slopes with high moisture input from clouds and mist) in a highly fragmented string of islands in the New World from Mexico to Argentina. The Common Bush-Tanager (*Chlorospingus ophthalmicus*, Aves: Thraupidae) inhabits cloud forests from e. Mexico south to nw. Argentina. Morphological variation is ample and discrete, making it an excellent model taxon for exploring the evolution of cloud forest biotas. Here, we analyze geographic variation in morphological and molecular characters (mitochondrial DNA sequences) of Mexican *Chlorospingus* populations to illuminate pattern and process of differentiation, species limits, and historical biogeography of populations. Morphometric and plumage characters pointed to the existence of several quite-distinct population groups. Subsequent phylogenetic analysis of mitochondrial DNA sequences indicated coincident phylogeographic variation with deep geographic genetic structure suggestive of long periods of evolution in isolation of Mexican *Chlorospingus* populations. Geographic breaks in these various data sets were for the most part coincident from one

data set to another, suggesting the need for a review of species limits for this complex.

98 Burns & Klicka

What is a tanager? a nuclear and mtDNA perspective on the monophyly of Thraupini. KEVIN J. BURNS, *Dept. Biol., San Diego State Univ., San Diego, CA*, and JOHN KLICKA, *Barrick Mus., Univ. Nevada Las Vegas, Las Vegas, NV*.

The tanagers and tanager-finches (Thraupini) make up a major radiation of New World birds; however, the monophyly of the group has not been rigorously addressed. Species in this group show variation in plumage, behavior, bill size and shape, and many other characters. DNA sequencing studies have corroborated the monophyly of Thraupini to some extent; however, taxon and character sampling have been limited to date. In this study, we use data from the entire cytochrome b gene and intron 5 of beta-fibrinogen to assess the monophyly of the group. Bayesian analyses of the combined data indicate that, among nine-primaried oscines, tanagers are most closely related to cardinals and grosbeaks (Cardinalini). Most of the species traditionally considered cardinals and tanagers belong to a monophyletic group supported by high posterior probability values. Several molecular characters support a cardinal/tanager clade, including a 3 base pair deletion in the intron 5 sequence. Within the cardinal/tanager clade, a group containing many tanagers and tanager-finches is recovered; however, the posterior probability of this clade is not particularly strong. Although many species of traditional tanagers fall within this group, several tanagers are more closely related to other nine-primaried oscines.

99 Miller, Bermingham & Ricklefs

Historical biogeography of New World solitaires (*Myadestes*). MATTHEW J. MILLER, *Smithsonian Trop. Res. Inst. & Univ. Alaska, Fairbanks, AK*, ELDREDGE BERMINGHAM, *Smithsonian Trop. Res. Inst.*, and ROBERT E. RICKLEFS, *Univ. Missouri St. Louis, St. Louis, MO*.

New World solitaires (*Myadestes*) demonstrate high historical dispersal ability - they are distributed from Alaska to Argentina, as well as in the West Indies and Hawaii. However, species diversity in the group is relatively low. In order to understand the spatial and temporal aspects of speciation events in the group, we reconstructed a species level phylogeny using 3.6 kB of mtDNA data. Extant *Myadestes* species are old: most extant species diverged between 7.5 - 5 MYA. A finer-scale phylogeographic study of 60 individuals throughout the range of *Myadestes* shows substantial genetic structure within species, especially in the Andes. Differentiation appears well correlated with dispersal over pre-existing geographic barriers, and thus, *Myadestes* may be a useful model for understanding diversification of birds with high dispersal abilities.

100 Omland, Cheung & Baker

Combining multiple introns to test mtDNA trees and reconstruct plumage evolution in orioles (*Icterus*). KEVIN E. OMLAND, ROLAND CHEUNG and JASON BAKER, *Dept. Biol. Sci., Univ. Maryland, UMBC, Baltimore, MD*.

Most species-level molecular phylogenies in birds and other animals have relied on a single locus, mitochondrial DNA. Mitochondrial DNA sequence data have many advantages over nuclear data for species-level trees, including a rapid mutation rate and most importantly a rapid sorting rate. However, we need markers and approaches for testing mtDNA trees, especially when they are controversial and disagree with morphology, biogeography or traditional taxonomy. Our laboratory is using the approach of combining multiple independent introns to evaluate the mtDNA tree, and construct a more rigorous phylogeny for New World Orioles. To date we have sequenced 2 introns (ODC and CHD) for a subset of the species. Individual introns generally (but not always) find the same 3 major clades as mtDNA, but support values are low. Auspiciously, combining data from just 2 introns produces the same clades as mtDNA but with moderate to high bootstrap support. However, closely related species still share many alleles and are likely to be a continuing challenge. Our findings are being used in ongoing studies of plumage evolution in *Icterus*, including coordinated phylogenetic and behavioral studies of female coloration.

101 Haig & Mullins

Population genetic structure in the Snowy Plover. SUSAN M. HAIG and THOMAS D. MULLINS, *USGS Forest and Rangeland Ecosyst. Sci. Ctr, Corvallis, OR*.

While circumpolar in their distribution, *Charadrius alexandrinus*, has 2 described subspecies in North America. Molecular confirmation of these subspecies as well as characterization of Snowy

Plover population structure is critical for assessing their conservation status. Currently, a distinct population segment (DPS) has been listed under the U.S. Endangered Species Act for Snowy Plovers breeding on the west coast of North America. However, movement of birds into and out of this population suggests it may not be genetically distinct. While genetic distinctness is not an absolute criteria for listing as a DPS, clarification of the taxonomic identity and genetic status of this group relative to other Snowy Plovers may help ameliorate a current controversy surrounding this listing. Thus, we sequenced 700 bp of control region mitochondrial DNA for 226 samples from across the range of Snowy Plovers to genetically characterize the birds in North America as well as address issues related to the DPS. Results will resolve the taxonomic distinctness issues and will show the utility of using molecular markers in ESA assessments.

102 Outlaw & Voelker

Molecular systematics of *Ficedula* (Muscicapidae). DIANA C. OUTLAW and GARY VOELKER, *Dept. Biol., Univ. Memphis, Memphis, TN.*

Ficedula is a widespread genus of Old World flycatchers in the family Muscicapidae. In the most comprehensive taxonomic description of *Ficedula*, Vaurie (1953, **Bull. Am. Mus.** 100: 457-538) describes the diversity within the genus, and makes note of the fact that *Ficedula* species have been classified in up to 16 genera, testifying to the lack of unifying characters among *Ficedula* species. Vaurie (1953) also described putative sister relationships among species, relationships among these groups, and furthermore proposed alleged sister genera. More recently, several subspecies have been attributed species status within the genus: *Ficedula albicilla* and *F. subrubra* (*F. parva*), *F. elisae* and *F. beijingnica* (*F. narcissina*), and *F. disposita* (*F. crypta*; Clements 2003, **Checklist**). To explore the evolutionary history of this enigmatic genus, we reconstructed a molecular phylogeny of 28 of the 31 species (Clements 2003) using 3 mitochondrial genes: *cyt b*, ND2 and ND3 for a total of 2500 base pairs. Because of the lack of consensus about appropriate outgroup taxa, and for that matter, the monophyly of *Ficedula*, we chose to use up to 10 outgroup taxa based on family-level data (Voelker & Spellman 2003, **Molec. Phylo. Evol.** 30: 386-394). Our data show that *Ficedula* is paraphyletic, and that many supposed sister groups (*sensu* Vaurie 1953) may be the result of morphological convergence.

103 Chesser & ten Have

Continent-scale genetic variation and movement patterns in Australian waterbirds. R. TERRY CHESSER and JOSE ten HAVE, *Australian Natl. Wildl. Collection, Canberra, Australia.*

The life histories and movement patterns of Australian waterbirds differ considerably from those of waterbirds in other parts of the world. In waterbirds of the Northern Hemisphere, for example, breeding and movements are typically a response to regular seasonal factors. However, in Australia, waterbird breeding and movements are largely governed by the continent's variable climate and irregular flooding patterns. Huge concentrations of waterbirds gather in response to rainfall and flooding events, creating a boom and bust cycle of population numbers, but for most species the provenance of these birds and details of their movements are largely unknown. We are undertaking extensive studies of genetic variation in Australian waterbirds to shed light on their movement patterns, systematics, and conservation status. Our research encompasses a wide range of waterbird groups, including selected species of ducks, herons, cormorants, terns, and shorebirds. Preliminary results of this work, based primarily on sampling from southeastern and southwestern Australia, will be discussed.

104 Hughes

Calibrating the molecular cuckoo clock: Cretaceous origins or not? JANICE M. HUGHES, *Dept. Biol., Lakehead Univ., Thunder Bay, ON.*

Recent studies of avian ordinal phylogenetics based on DNA sequence analysis have suggested that many major lineages had their origin within the Cretaceous Period. This has caused considerable controversy because the fossil record supports the explosive phyletic evolution of modern bird (Neornithes) orders early in the Tertiary. To estimate the divergence date of cuculiforms, a phylogeny of cuckoos (Cuculiformes) and selected neornithine taxa is first reconstructed from mitochondrial and nuclear DNA sequences. Nonparametric rate smoothing was used to adjust for evolutionary rate differences between taxa. Divergence dates based on branch lengths were estimated using external calibration points derived from 3 basal nodes among extant birds. The results support an early Tertiary (Paleocene) origin for cuckoos about 60 million yr ago. Furthermore,

they demonstrate an Eocene divergence of both New World terrestrial (Neomorphinae) and arboreal (Coccyzinae) cuckoos. The study also suggests an origin of the Cuculinae (obligately brood parasitic cuckoos) and Crotophaginae (communally breeding cuckoos) in the Oligocene. These results show considerable corroboration with the fossil record that has confirmed specimens from the late Paleocene to early Miocene attributable to extant cuculid taxa.

105 Jennings & Edwards

Speciation history of Australian finches inferred from 30 gene trees. W. BRYAN JENNINGS and SCOTT V. EDWARDS, *Dept. Organ. & Evol. Biol., Harvard Univ., Cambridge, MA.*

The Carpentarian and Arnhemland-Kimberley Barriers in northern Australia are believed to have sundered many unrelated organismal populations leading to the formation of new species. In an effort to date these speciation events, we used Bayesian and Maximum Likelihood coalescent methods and multi-locus datasets (30 unlinked nuclear loci; 300 - 650 bp each) to date population divergence times among three closely related populations of Australian finches. Our results indicate that *Poephila cincta* (Black-throated Finches) diverged from *P. acuticauda* (Long-tailed Finches) across the Carpentarian Barrier around 0.6 million years ago, and that *P. a. acuticauda* split from *P. a. hecki* over the Arnhemland-Kimberley Barrier around 0.4 mya. The significance of these results to Australian biogeography as well as the applicability of our methods to other related evolutionary questions will also be discussed.

106 Badyaev

Evolution and development of conditional mating tactics in the House Finch. ALEXANDER V. BADYAEV, *Ecol. & Evol. Biol., Univ. Arizona, Tucson, AZ.*

Evolution of behavioral plasticity is one of the most controversial and least understood phenomena in evolutionary theory. On one hand, growing number of behavioral studies describe alternative mating tactics that enable individuals to achieve high fitness even in the most rare of breeding contexts. On the other hand, evolutionary theory shows that conditions required for the evolution of context-dependency in mating tactics are not likely to extend to fluctuating and infrequent contexts and to all individual morphologies. Especially puzzling are the situations when the same individuals employ distinct mating tactics across different breeding contexts. In a study population of the House Finches, males use distinct parental tactics depending on elaboration of their sexual ornamentation. The fitness consequences of each parental tactics depend on demographic composition of the population; and across their lifespan, males use distinct parental tactics in close correspondence with a yearly change in sexual ornamentation. I will describe the mechanisms behind the origin and evolution of these parental tactics; specifically the mechanisms that invariantly integrate parental behavior with sexual ornamentation in response to environmental cues throughout male's lifetime.

107 Benkman, Sales, Fetz & Gould

Selection by an ectoparasite drives a population of Red Crossbill from its adaptive peak. CRAIG W. BENKMAN, JOY SALES, TREVOR FETZ, *Dept. Biol., New Mexico State Univ., Las Cruces, NM,* and WILLIAM R. GOULD, *Univ. Stat. Center, Dept. Econ., New Mexico State Univ.*

Red Crossbills (*Loxia curvirostra* complex) in the South Hills, Idaho, are coevolving in an evolutionary arms race with Rocky Mountain lodgepole pine (*Pinus contorta* spp. *latifolia*). Although crossbills appear to be adapted for foraging on the cones of these lodgepole pine, their average bill depth is smaller than that predicted to be optimal. The goal of this study was to quantify the incidence of infestation by an ectoparasitic mite (*Knemidokoptes jamaicensis*) and determine whether selection by mites may have favored smaller billed crossbills and thus driven crossbills away from the optimum. We estimated annual survival of both infected and uninfected South Hills crossbills using program MARK, which allows for auxiliary variables such as bill structure and gender to be included in survival analysis. Mite infestation depressed crossbill survival, and, especially for males, caused directional selection against larger billed crossbills. Such selection can explain why crossbills have smaller bills than the optimum and why average bill size for males has decreased from 1998 to 2003. This can also explain why the extent of sexual size dimorphism has decreased by about 50% since 1998.

108 Montgomerie, Rathburn, Doucet, Shawkey & Mays

Concordant evolution of plumage colour, feather microstructure, and a melanocortin receptor gene in mainland and island populations of a fairy-wren. ROBERT MONTGOMERIE, MELANIE RATHBURN,

Dept. Biol., Queen's Univ., Kingston, ON, STEPHANIE DOUCET, MATT SHAWKEY and HERMAN MAYS, Jr., Dept. Biol. Sci., Auburn Univ, Auburn, AL.

In White-winged Fairy-Wrens, *Malurus leucopterus*, mainland males develop a striking blue nuptial plumage while males in the subspecies on nearby oceanic islands (Dirk Hartog and Barrow) have a black nuptial plumage. We investigated the proximate basis for this divergence by combining microstructural feather analysis with a study of genetic variation at the melanocortin-1 receptor locus (MC1R). Fourier analysis revealed that the medullary keratin matrix (spongy layer) of the feather barbs of blue males was ordered at the appropriate nanoscale to produce the observed cobalt blue colour by coherent light scattering. Surprisingly, the feather barbs of black males also contained a spongy layer that could have produced a similar blue colour were it not for the higher density of melanin granules in their barbs. Thus, the presence of this spongy layer suggests that black island males evolved from a blue-plumaged ancestor. We also document concordant patterns of variation at the MC1R locus, and show that 5 amino acid substitutions were perfectly associated with the black plumage phenotype. We argue that the divergence of plumage colours between mainland and island White-winged Fairy-Wrens resulted from changes in the melanocortin receptor locus in island birds. Such simple and concordant feather structure and genetic mechanisms may be responsible for other examples of plumage colour diversity in birds across broader geographical and evolutionary scales.

109 Bridge, Jones & Baker

The evolution of molt patterns in response to migratory behavior in terns. ELI S. BRIDGE, Dept. Biol., Univ. Memphis, Memphis TN, ANDREW W. JONES, Dept. Ecol., Evol. & Behav., Univ. Minnesota, St. Paul, MN, and ALLAN J. BAKER, Centre Biodiv. & Conserv. Biol., Royal Ontario Mus., Toronto ON.

The terns (Sterninae) are a cosmopolitan group of seabirds with life histories that vary from those of highly migratory, arctic-nesting species to those of sedentary, tropical species. One of the many unique and highly variable features of the terns is their wing molt. Most migratory terns of the genus *Sterna* replace some of their innermost primaries and outermost secondaries 2 or 3 times each year, in a process we call repeated molt. However roughly a third of the terns – generally the more sedentary species – molt their flight feathers according to the descendent pattern typical of most other birds, or they undergo complex wing molts, which may involve stepwise patterns or multiple molt series among the primaries. We developed a phylogeny for 35 species of terns based on 3 mtDNA regions. We used this phylogeny to investigate the evolutionary history of both migratory behavior and molt patterns among the terns with the goal of determining ancestral and derived states. We found that migratory behavior and repeated molt were both generally derived states, and that sedentary species without repeated molt probably more closely represent ancestral species. Furthermore, a contingency states test indicated that there is a strong association between repeated molt and migratory behavior, which is not due to shared ancestry. This observation is difficult to explain, but may be due to the fact that the evolution of migratory behavior introduced a high degree of seasonality into a previously aseasonal life history, resulting in longer periods between breeding attempts and perhaps more time to molt.

110 Hofmann, Cronin, Omland & McGraw

Orchard Orioles: a tale of two pigments. CHRISTOPHER M. HOFMANN, THOMAS W. CRONIN, KEVIN E. OMLAND, Dept. Biol. Sci., Univ. Maryland Baltimore Co., Baltimore, MD, and KEVIN J. MCGRAW, Dept. Animal Sci., Univ. California-Davis, Davis, CA.

Many birds use carotenoids to produce brilliant yellow, orange, and red plumage. The hue or intensity of this plumage has been demonstrated to reflect an individual's health and fitness across a wide range of taxa. This dependence upon condition has important signaling implications, especially in mate choice, and has led to carotenoids' being referred to as 'honest' indicators of condition. Most male New World orioles (genus *Icterus*) appear to have bright carotenoid-based plumage. Some orioles, such as the Orchard Oriole (*Icterus spurius spurius*), have more muted rust or chestnut colored plumage. To further investigate these color differences, a reflectance spectrometer was used to analyze adult male, yearling male, and female Orchard Oriole plumage. These measurements were compared to the bright orange plumage of the Baltimore Oriole (*I. galbula*). Spectral analysis suggests that adult male Orchard Orioles have replaced or masked their carotenoid-based plumage with a melanin-based color. Currently we are confirming this using HPLC. However, females and yearling males have carotenoid-like spectra. Therefore, only the adult male Orchard Orioles appear to have switched from a carotenoid-based to a melanin based color. The loss or masking of carotenoid color plumage in orchard orioles has important evolutionary and signaling implications. This loss raises many questions concerning the evolution of honest carotenoid signals.

111 Vézina, Speakman & Williams

* The metabolic cost of reproduction in birds: individuals reallocate energy to cope with the demands of egg formation. FRANÇOIS VÉZINA, *Dept. Biol. Sci., Simon Fraser Univ., Burnaby, BC*, JOHN R. SPEAKMAN, *School Biol. Sci., Univ. Aberdeen, and Rowett Res. Inst., Aberdeen, Scotland, UK*, and TONY D. WILLIAMS, *Dept. Biol. Sci., Simon Fraser Univ.*

Recent empirical studies show that the metabolic cost of egg production represents a 16 - 27% increase in basal or resting metabolic rate (BMR and RMR, respectively), and that this cost is repeatable. However, it is not known how a female copes with this extra energy demand in terms of her overall energy budget. The cost could be additive to daily energy expenditure (DEE), resulting in an increase in DEE in egg producing birds and potentially a need for elevated food intake. Alternatively, the demand could be compensated by reduced expenditure in some other components of the energy budget. We measured RMR and DEE in captive female zebra finches ($n = 24$) at 3 stages, non-breeding, 1-egg and chick-rearing and found marked variation in the relationship between these traits. Females that showed the largest increase in RMR during egg production decreased locomotor activity the most but yet still showed an increase in DEE from non-breeding to first-egg stage. Females having high levels of DEE at the 1-egg stage also produced large clutches. We found a significant correlation between RMR and DEE in females at the non-breeding stage, but these traits were independent in females producing eggs as a result of the individual variation in the level of compensation. Our data support the energy reallocation hypothesis at the population level. However, the extent to which reallocation fully compensates for egg production costs depends on the initial reproductive investment. These results suggest a very flexible, individually-variable system of energy reallocation to meet increased energy demands.

112 O'Brien & Dawson

* Effect of an ectoparasite on nest site selection and primary reproductive investment in Tree Swallows. ERIN L. O'BRIEN and RUSSELL D. DAWSON, *Ecosys. Sci. & Manage. Prog., Univ. Northern British Columbia, Prince George, BC.*

Cavity-nesting birds may use multiple cues to assess the ectoparasite load of potential nest sites. Most studies have focused on the influence of old nest material on nest site preference. However, birds may also use the dispersal behaviour of avian fleas as a direct cue of parasite load: early in the breeding season, adult fleas aggregate on the outside of nest sites around the cavity entrance, and this may indicate a potentially large ectoparasite population during the nesting period. Using a study population of Tree Swallows in central British Columbia, we predicted that birds would avoid breeding in nest boxes that contain adult fleas on their outer surface, and that females occupying these sites would reduce their primary reproductive investment by laying fewer eggs or producing smaller broods at hatching. We manipulated perceived ectoparasite load by affixing 20 dead fleas (*Ceratophyllus idius*) to the outside of nest boxes, beside the entrance hole. The use of dead fleas provided the desired visual cue, but avoided the direct influence of ectoparasite feeding activities on female energy reserves. Significantly more control boxes were occupied by breeding birds. Among occupied nest sites, clutch size and hatching success were marginally lower in experimental boxes, resulting in significantly smaller brood sizes at hatching relative to nests in control boxes. These differences could not be accounted for by differences in female age, or by differences in body condition of either parent. Our results support the hypotheses that tree swallows use the presence of ectoparasites on the outside of nest sites as a cue for early assessment of future potential parasite load, and that this assessment may influence initial reproductive investment by females occupying nest sites that present a high risk of ectoparasitism. Results from a second year of study will also be presented.

113 Butt, Bortolotti, Surai & Hobson

* Local environmental effects on egg size in American Coots. USNE J. BUTT, GARY R. BORTOLOTTI, *Dept. Biol., Univ. Saskatchewan, Saskatoon, SK*, PETER F. SURAI, *Avian Sci. Res. Centre, Ayr, UK*, and KEITH A. HOBSON, *Dept. Biol., Univ. Saskatchewan and Canadian Wildl. Serv., Saskatoon, SK.*

Egg size is an important component of avian reproductive effort. Research has shown that larger chicks hatch from larger eggs, and larger chicks may be able to survive better because of enhanced thermoregulatory benefits, greater mobility and larger nutrient reserves. Several experiments have attempted to experimentally manipulate egg size in birds by provisioning food to breeding adults. These studies have produced variable results. We tested whether supplemental

food had an effect on egg size in American Coots at 3 field sites of differing habitat types. Variables including laying sequence, nest initiation date and egg yolk carotenoids had site specific effects on egg volume. However, supplemental food had a negligible effect. Total carotenoids were involved in interactions relating to egg volume, but results of an experiment examining causality of carotenoids demonstrates carotenoids *per se* did not influence egg volume in our system. Carotenoids are likely correlative of a local habitat quality that some birds had access to. Carbon signatures were positively associated with egg volume furthering support for a hypothesis considering a diet quality influence on egg size. These results suggest that localized, habitat specific nutrients in coot's natural diets may have a greater impact on egg size than gross diet availability and that studies using supplementary food should consider the influence of local environmental variability.

114 Cardinal, Paxton & Theimer

* Home range, habitat use, and movement patterns of male Southwestern Willow Flycatchers in central Arizona. SUZANNE N. CARDINAL, *USGS/CPRS and Dept. Biol. Northern Arizona Univ., Flagstaff, AZ*, EBEN H. PAXTON, *USGS/CPRS, Northern Arizona Univ.*, and TAD C. THEIMER, *Dept Biol., Northern Arizona Univ.*

Effective conservation and management of any species requires an adequate understanding of habitat requirements, including estimates of home range size, and vegetation composition. Home range size has rarely been studied in detail for migrant passerines, especially through the entire breeding season, and is not well documented for the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*). We used radio-telemetry to track male Southwestern Willow Flycatchers at Roosevelt Lake in central Arizona during the summer of 2003. In 2003, we found that home range size varied from 0.1 - 7.57 ha (n = 11) using a 95% fixed-kernel contour. Home ranges were smallest during the middle of the breeding season for paired males, while home ranges were largest for pre- and post-breeding birds. We observed long-distance movements (>800 m) for 4 birds: 2 of these were unpaired birds during the middle of the breeding season, and the others were post-breeding birds. One of the post-breeding males apparently established a new home range in an area previously occupied at low density by other Southwestern Willow Flycatchers. We found that habitat use was restricted to the riparian flood plain, and mature-mixed riparian vegetation was used more than expected based on availability. Our data indicate that: 1) home range sizes fluctuate significantly through the season, 2) post-breeding movements may greatly increase the calculated area that birds use, and 3) there is little use of non-riparian habitats at our study site.

115 Crampton, Sedinger, Longland, Peacock & Herzog

* Reproductive success of Phainopeplas in the northeastern Mojave Desert: the roles of food resources, habitat structure and patch size. LISA H. CRAMPTON, JAMES S. SEDINGER, WILLIAM S. LONGLAND, M. PEACOCK, *Ecol., Evol. & Conserv. Biol., Univ. Nevada Reno, Reno NV*, and MARK P. HERZOG, *Point Reyes Bird Observ., Stinson Beach, CA*.

A variety of factors may influence the reproductive success of species, which can have profound influences on conservation efforts for declining populations. We assessed the effect of food resources, vegetation characteristics and patch size on Phainopepla reproductive effort and success at 9 sites in the ne. Mojave Desert, where Phainopepla populations are decreasing. The mean density of breeding pairs was positively correlated with patch size, with densities slightly higher in 2003, a wet year, (0.81 pairs/ha) than in 2002, a dry year (0.71 pairs/ha). Clutch size varied from 1 - 3 eggs, but no 3-egg clutches were laid in 2002. Nest survival calculated from Program MARK ranged from 46 - 56%; the major cause of nest failure was predation (>90% of nests). Nest survival models suggested that daily survival rates (DSRs) were positively correlated with patch size, nest plant height, and the amount of cover in a 5-m radius around the nest. DSRs were negatively correlated with initiation date, the volume of mistletoe in the nest plant, and the nestling phase. There was little indication that food resources (insects or mistletoe berries) were related to nest survival. However, within successful nests, the amount of mistletoe in the nest patch was positively correlated with the number of fledglings produced. The reproductive effort and success of Phainopeplas in the ne. Mojave Desert is affected by a number of factors including patch size, habitat structure and mistletoe abundance and annual variation. Conservation efforts for Phainopeplas in this region should focus on preserving large patches of habitat with big trees and moderate-abundant mistletoe.

116 Langin, Norris, Kyser, Marra & Ratcliffe

* Are Neotropical-Nearctic migrant songbirds capital or income breeders? Evidence from stable isotopes. KATHRYN M. LANGIN, D. RYAN NORRIS, *Dept. Biol., Queen's Univ., Kingston, ON, T.* KURT KYSER, *Dept. Geol., Queen's Univ.*, PETER P. MARRA, *Smithsonian Environ. Res. Center, Edgewater, MD*, and LAURENE M. RATCLIFFE, *Dept. Biol., Queen's Univ.*

Birds can meet the energetic demands of egg formation by utilizing endogenous reserves (capital breeding) or recently ingested nutrients (income breeding). We used stable-carbon isotopes ($\delta^{13}\text{C}$) to determine whether a Neotropical-Nearctic migrant songbird, the American Redstart, used endogenous reserves acquired on the tropical wintering grounds or during migration to form eggs. Such an approach is possible because the redstart wintering and breeding grounds are isotopically distinct, with the wintering grounds having heavier carbon-isotope signatures. Yolk samples from individual females' first, second and third clutches were analyzed for stable-carbon isotopes. $\delta^{13}\text{C}$ values of first-clutch eggs were significantly heavier than those of third-clutch eggs, which suggests that female redstarts use endogenous reserves acquired on the tropical wintering grounds or during migration, at least partially, to form first-clutch eggs (capital breeding) and use recently ingested nutrients to form later clutches (income breeding). However, seasonal variation in dietary $\delta^{13}\text{C}$ on the breeding grounds would also be consistent with the results. If female redstarts do employ a capital breeding strategy when forming first-clutch eggs, the continued destruction of high-quality winter habitats (e.g., mangroves) may lead to reduced resource allocation to clutch production.

117 Hebert & Golightly

Evaluation of human-related noise disturbance on the behavior and reproductive success of Marbled Murrelets in Redwood National and State Parks, California. PERCY N. HEBERT and RICHARD T. GOLIGHTLY, *Dept. Wildl., Humboldt State Univ., Arcata, CA.*

Human disturbance is known to depress reproductive success in ground-nesting alcids. However, unlike other alcids, Marbled Murrelets, nest on large branches in the upper canopy of mature forests. In 2001 - 2003 we examined human-related noise disturbance (a chainsaw) as it might affect the behavior and reproductive success of Marbled Murrelets. Behavioral observations were obtained using a video camera operated by a climber in an adjacent tree. Murrelet behavior during the 15 min disturbance period was compared to behavior during 30 min pre- and post-disturbance periods. In total, we exposed 12 incubating adults, and 4 chicks to the sound of an operating chainsaw. Adults spent a significantly ($P < 0.05$) greater proportion of time at rest during the pre- and post-disturbance periods compared to the disturbance period. Conversely, adults spent significantly ($P < 0.05$) more time with their heads raised during the disturbance period compared to the pre- and post-disturbance periods. Hatching success at experimental nests was lower compared to control nests. Chicks spent significantly less time at rest during the 15 min disturbance period compared to the pre- and post-disturbance periods, and significantly more time with their heads raised during the disturbance period compared to the pre- and post-disturbance periods. Persistent video cameras at the nest, synchronized with a persistent video camera at a trail showed that Marbled Murrelet adults and chicks did not modify their behavior due to the presence of people on nearby trails.

118 Fraser & Russell

Produced water discharges from offshore oil and gas installations on the Grand Banks, Newfoundland: have the effects to seabirds been sufficiently evaluated? GAIL S. FRASER, *Environ. Studies, York Univ., Toronto, ON*, and JANET RUSSELL, *Alder Inst., Tors Cove, NF.*

The Grand Banks, Newfoundland, is an extremely important area for many species of seabirds in the Northwest Atlantic; an estimated 40 million seabirds are in the region year round. Environmental assessments predicting the impact of offshore oil and gas activities on marine bird populations on the Grand Banks concluded that no significant effects on any marine bird population would occur from the discharge of petroleum hydrocarbons in produced water. Yet, virtually no effort was devoted to examining the interactions between these discharges and marine birds to provide a reasonable impact assessment. Discharge of produced water is a significant source of chronic oil pollution. For example, between 1997 and 2003, approximately 1,891,813 metric tons of produced water has been disposed of on the Grand Banks resulting in the disposal of approximately 126 metric tons of oil and grease into the marine environment. Oil discharge volumes are projected to increase over the next 2 decades. We examine current offshore oil waste treatment guidelines for the Grand Banks region, discuss the occurrence of oil sheens from produced water discharge, and evaluate the assessment of impacts on marine bird populations in offshore oil and gas environmental impact statements for the Grand Banks.

119 Boyne

Multiple approaches to the recovery of Roseate Terns in Canada. ANDREW W. BOYNE, *Canadian Wildl. Serv. - Atlantic Region, Dartmouth, NS.*

The implementation of the Canadian Recovery Strategy for the Roseate Tern requires the participation and cooperation of federal and provincial governments, academia, non-government groups, and private individuals. Since the species was first listed by COSEWIC in 1985, the Canadian population has remained relatively stable at between 125 and 150 pairs. Its reproductive rate is limited by delayed maturity to age of first breeding, small clutch size, low annual adult survival and low survival to first breeding. Threats to its survival include habitat displacement; predation by *Larus* gulls and other predators; possible market hunting on the wintering grounds; and, at least in some U.S. colonies, a shortage of males. The population's restricted distribution makes it vulnerable to localized threats such as human development, catastrophic weather events such as hurricanes, pollution and disease. Recovery efforts to date have focussed on habitat protection and enhancement and predator control. The majority of Roseate Terns in Canada have nested in only 2 or 3 main colonies. Similar conservation actions are required to protect and recover the species at each of these sites, however the method by which the activities are implemented varies. The largest colony of Roseate Terns in the country is stewarded by a single community member. The second major colony is managed intensely by a field crew of government and university researchers. A third site is being restored by a non-government conservation organization with support from government and the local community. This talk will highlight how the implementation of a recovery strategy can use a variety of approaches to the same end.

120 Swarthout, Driscoll & Dhondt

House Finch roosting behavior in relation to infection by *Mycoplasma gallisepticum* and season. ELLIOTT C. H. SWARTHOUT, MELANIE J. L. DRISCOLL and ANDRÉ A. DHONDT, *Lab. Ornithol., Cornell Univ., Ithaca, NY.*

In order to determine whether social roosting could contribute to disease transmission, we studied roosting behavior in a House Finch population in Ithaca, NY, in which infection with *Mycoplasma gallisepticum* (MG) decreases survival. We used radio telemetry to locate roost sites then counted the number of birds entering and leaving a roost to determine roost size. The average number of birds roosting together (1 to 11) was >3 times smaller than average daytime feeding flocks ($P < 0.001$) and birds that roosted together were more likely to be seen together during the day than randomly selected pairs ($P < 0.04$). Roost fidelity was higher in winter than fall, higher for healthy birds than birds infected with MG, and higher for adults than hatch year birds ($P < 0.03$ for all). We suggest that daytime feeding flocks are a more likely point for transmission of MG than roosting aggregations and that social structure of House Finches spans both feeding flocks and roosting aggregations. Roost fidelity increases with thermal demands of winter and we propose that fidelity increases with increasing social dominance.

121 Driscoll, Dhondt & Hochachka

Differential impact of avian conjunctivitis on native and introduced populations of the House Finch: a possible population bottleneck effect. MELANIE J. L. DRISCOLL, ANDRÉ A. DHONDT and WESLEY M. HOCHACHKA, *Lab Ornith., Cornell Univ., Ithaca, NY.*

The eastern population of House Finches has been strongly affected by *Mycoplasma gallisepticum* (MG), a bacterium that causes a form of conjunctivitis in many members of the Fringillidae. One theory about why eastern House Finches have suffered higher disease prevalence than other finch populations is that the population was founded from a small number of individuals released on Long Island in the early 1940s. A population bottleneck may have led to low genetic diversity and lowered immunity against disease, making this population more susceptible to MG. Therefore, we would expect MG to have a less significant impact on the native western population of House Finches. MG is a density and frequency-dependent disease in eastern House Finches that caused a population decline following establishment of the disease. We compared density of House Finches, prevalence of MG, and change in population size between eastern and western House Finch populations. We found that while population densities were comparable, MG prevalence was lower in the west once the disease was confirmed there. Correspondingly we saw no change in western House Finch population size or density post-disease establishment, while group sizes and densities declined in the east post-MG. Causes and implications of the differential impact of MG will be discussed.

122 Spitzer

Learning the life history of Common and Pacific Loons via sudden mortality events (especially oil spills) in marine waters. PAUL R. SPITZER, *Coop. Oxford Lab, Oxford, MD*.

The subadult years and flightless wingmolt periods of these species are not completely understood. Most of this occurs on marine waters. Sudden mortality events, especially oil spills, make samples of freshly dead and dying loons available, refining our understanding. Accumulating data from Common Loon events in Florida, North Carolina, North Carolina/South Carolina, Rhode Island, Massachusetts, and Alaska argue that: 1) Juveniles replace their remiges at least 3 times, perhaps at intervals of about 10.5 mon, before reaching the adult pattern of flightlessness sometime during winter. 2) The onset of adult winter flightlessness is a function of latitude, beginning in Jan at 30° (Florida), but not until Mar at 60° (Alaska). It is not known whether duration of adult flightlessness varies with latitude, but the photoperiod window would change dramatically as one moves north. It is known that the first and second remigial replacement molts occur in Canadian marine waters from May through Jul, during favorable photoperiod and temperature. It is hoped that detailed reports of local events will gradually refine our understanding of onset and duration, and also of habitat selection during the flightless periods.

123 Spautz, Nur & Liu

Impacts of non-native invasive pepperweed (*Lepidium latifolium*) on breeding bird distribution and reproductive success in San Francisco Bay tidal marshes. HILDIE SPAUTZ, NADAV NUR and LEONARD LIU, *PRBO Conservation Science, Stinson Beach, CA*.

Extensive habitat loss and degradation have resulted in decreases in populations of tidal marsh breeding birds in the San Francisco Estuary. The spread of non-native invasive plants such as pepperweed (*Lepidium latifolium*) has the potential to further impact sensitive bird species by changing ecological relationships such as habitat choice, food availability, and concealment from predators. Our objectives were to determine the following: 1) whether breeding birds were avoiding or selecting marshes with pepperweed; and 2) whether nest success was related to the presence of pepperweed. First, we examined the relationship between pepperweed cover and breeding bird abundance or presence at 448 points in 58 marshes throughout the estuary in 2000 and 2001. We also examined the effects of a suite of additional local and landscape variables including vegetation density and habitat configuration. Then we examined the relationship between the survivorship of over 2000 tidal marsh Song Sparrow (*Melospiza melodia samuelis* and *M. m. maxillaris*) nests and pepperweed cover at 6 marshes between 1996 and 2003. Here also we examined the effects an additional set of local and landscape level variables including ground cover, plant structure and distance to tidal channels. There is a positive association for some bird species between abundance or presence and pepperweed cover, although in some cases this relationship is not significant when taking into account other local and landscape scale habitat variables or when controlling for within-marsh variability.

124 Johnston & Holberton

Effects of three forest management practices on the physiological condition of breeding Hermit Thrushes. JASON C. JOHNSTON and REBECCA L. HOLBERTON, *Dept. Biol. Sci., Univ. Maine, Orono, ME*.

A variety of anthropogenic factors negatively impact avian populations through decreased reproductive success or survival. The mechanisms associated with these negative effects are not well understood. Measurements of physiological indicators are a direct method to measure individual birds' energetic condition. Corticosterone is the primary hormone that regulates energy balance in birds. Elevated baseline levels of corticosterone indicate physiological stress and may negatively impact nesting success or survival. To evaluate the effects of forest management on breeding Hermit Thrushes I captured birds during 2001 and 2002 during the following stages: pre-breeding, incubation, nestling stage, and post-breeding. Birds were captured in 3 replicated habitat types: extensive selection, shelterwood and even-aged (clearcut) managed plots. Blood samples were collected within 3 min of capture to measure baseline corticosterone. Preliminary results suggest that baseline corticosterone is not affected by habitat type. Furthermore, while females lost a significant amount of mass between the incubation and nestling stages, this was not associated with a difference in baseline corticosterone.

125 Shirley

The influence of habitat diversity and structure on bird use of riparian buffer strips in coastal forests of British Columbia. SUSAN SHIRLEY, *Dept. Zool., Univ. British Columbia, Vancouver, BC.*

I investigated the role of habitat structure in explaining bird species richness and abundance in riparian buffer strips of old-growth coniferous forest on w. Vancouver I., BC. Using buffer strips of varying widths and a control from undisturbed riparian forest, I tested the hypothesis that vegetation differs in buffer strips of varying width. I selected 10 summary variables to represent broad-scale vegetation attributes of riparian habitat. Deciduous tree density was higher and shrub richness was lower in wide buffers compared to narrow buffers. I then used Akaike information criterion to examine if vegetation structure or buffer width best explained patterns of bird richness and abundance in riparian habitats. Species richness and abundance in several foraging guilds were explained better by buffer width than by vegetation. Abundances of 3 bird habitat guilds: riparian specialists, forest interior and open-edge species and 6 of 10 species were best explained by specific vegetation features. Differences in vegetation, particularly deciduous tree density and shrub cover, explained part of the variation in abundance of several riparian forest-dwelling species and may be useful in evaluating specific forest management practices. Because deciduous tree density is also positively correlated with buffer width, wide buffers (>100 m) may benefit not only those species associated with coniferous upland forests and forest generalists sensitive to buffer width, but also those species whose abundance is associated with deciduous trees.

126 Brennan & Schnell

Multiscale analysis of tyrannid abundances and landscape variables in the Central Plains. SARAH P. BRENNAN and GARY D. SCHNELL, *Sam Noble Oklahoma Mus. Nat. Hist. and Dept. Zool., Univ. Oklahoma, Norman, OK.*

Effects of scale on relationships between organisms and their environments are of considerable contemporary interest. In studying bird abundances, we evaluated Breeding Bird Survey (BBS) data and landscape measures derived from aerial photographs to determine how relationships changed over a continuous range of 16 spatial scales. Analyses incorporated 1985 - 1994 data (mean no. birds/stop) for 8 flycatchers for each of 50 stops on 198 BBS routes in the Central Plains. Lands along each route were classified into 6 cover types. Landscape metrics of area-weighted mean patch fractal dimension, edge density, patch density, and percent class area were calculated, summarizing some using principal components. The degree of associations of bird abundances with landscape variables changed gradually with small changes in scale. Edge density had significant associations with abundances of 3 of the birds (Eastern Phoebe, Great Crested Flycatcher, and Western Kingbird), suggesting that this landscape characteristic is important for certain species. Fractal dimension and component II, the latter reflecting amounts of closed forest versus open country, exhibited the highest correlations with abundances of the greatest number of species. In general, correlations of abundances and landscape variables were greatest at larger spatial scales, 13.68 - 40.23 km (segment lengths 17 - 50, with a segment referring to a given number of stops). Evaluating > 2 or 3 spatial scales can provide insight into relationships of abundance of a species with potentially influential environmental factors.

127 Kearns, Hall & Silverman

Relationships of understory vegetation and breeding songbird abundance in northern hardwood forests. LAURA J. KEARNS, *Archbold Biol. Stat., Lake Placid, FL*, KIMBERLY R. HALL, *Dept. Fish. & Wild., Michigan State Univ., E. Lansing, MI*, and EMILY D. SILVERMAN, *School Nat. Res. & Env., Univ. Michigan, Ann Arbor, MI.*

Balsam fir (*Abies balsamea*) understory may be an important component of breeding habitat for Black-throated Blue Warblers in hardwood forests of n. Michigan because it is rarely browsed by the region's abundant white-tailed deer (*Odocoileus virginiana*). We examined the abundance, age-ratio (older to yearling), and return rates of Black-throated Blue Warblers in 16 hardwood forest plots of variable composition within a heavily-browsed region of the Hiawatha National Forest. Our plots varied in overstory density and size class, understory cover, understory composition (primarily percentage of balsam fir vs. browsed hardwoods), and understory height. We concluded that the most important vegetation variables for explaining increases in warbler abundance were an increase in overstory density of medium-sized trees, a decrease in overstory density of large-sized trees, and an increase in understory cover. Our results suggested that an average of 20% understory cover is needed for warbler breeding. Warbler abundance was positively correlated with balsam fir understory

but not height; abundance was higher on plots that averaged >10% balsam fir cover. Warbler return rate was positively related to balsam fir cover; age-ratio was not. Understory cover was also positively related to bird species richness, bird abundance, and shrub-nesting bird abundance; balsam fir understory cover was also positively correlated with shrub-nesting bird abundance. We recommend future research manipulating densities and heights of balsam fir understory to further explore the role of balsam fir in maintaining source populations of blue warblers and similar bird species in heavily browsed forests.

128 Hall

Identifying management "experiments" to link a songbird's demography with key habitat characteristics in a region with abundant deer. KIMBERLY R. HALL, *Dept. Fish. & Wild., Michigan State Univ., East Lansing, MI.*

Inferring the mechanistic links between habitat features and a species' demography requires large-scale experiments, which are rarely pursued because they are expensive and logistically challenging. Correlative relationships can help narrow the range of key relationships to be explored, facilitating a ranking of hypotheses that can be tested through an adaptive management approach. Here I identify key experiments for informing management to favor Black-throated Blue Warblers, a species of conservation concern in the Great Lakes region. These warblers are sensitive to both timber cutting methods and white-tailed deer densities, because they nest and forage in understory vegetation. Based on 7 yr of demographic data from n. Michigan, I suggest that although habitats in both high and low browse-pressure zones can be of high quality, the key habitat features for management in these zones differ. In less-browsed (LB) sites, nest success, and breeding-site fidelity of yearling birds was significantly lower than in heavily-browsed (HB) sites, although average number of fledglings/territory and other demographic parameters did not differ. Based on these results, management experiments in LB sites should focus on evaluating (1) how different post-harvest treatments influence nest predator densities and nest success, and (2) if increasing the diversity of cut-area sizes can promote more diverse understory vegetation characteristics, leading to reduced overlap in nest heights with heterospecifics, and potentially increased nest success. In HB zones, the key factors to examine include the importance of browse-resistant understory conifers, which are positively correlated with warbler relative abundance. Thus, management experiments should focus on comparing methods for increasing understory conifer abundance, with monitoring focused on detecting changes in warbler density.

129 Driskell, Prum & Pruett-Jones

The evolution of black plumage in the White-winged Fairy-Wren: feather morphology, nanostructure and genetic control. AMY C. DRISKELL, *Sect. Evol. & Ecol., Univ. California, Davis, CA*, RICHARD O. PRUM, *Dept. Ecol. & Evol. Biol., Yale Univ., New Haven, CT*, and STEPHEN PRUETT-JONES, *Dept. Ecol. & Evol., Univ. Chicago, Chicago, IL.*

The White-winged Fairy-Wren (*Malurus leucopterus*) exhibits striking plumage colour variation between the Australian mainland, where adult males are bright blue, and 2 islands off the coast of Western Australia, where adult males are black. As previously reported, DNA-sequence-based phylogenetic analysis of relationships among populations of white-wings found the black-plumaged island subspecies did not form a monophyletic group: birds from Dirk Hartog island were more closely related to mainland blue-plumaged populations. Feather morphology and nanostructure of the 2 island populations are also different. Phylogenetic analysis of the family Maluridae, based on both mitochondrial and nuclear sequence data, shows that 2 additional black-plumaged fairy-wren species (*M. melanocephalus* and *M. alboscapulatus*) are more closely related to the White-winged Fairy-Wren than are other blue-plumaged fairy-wren species. However, transmission electron micrographs from all White-winged populations and other black- and blue-plumaged fairy-wrens species show that unlike the other closely-related black fairy-wren species, black-plumaged White-wings are actually structurally blue (like their blue-plumaged conspecifics), and their black feather color arises from an over-production of melanin in the feather barbs. We also have sequence of the melanocortin-1 receptor gene from White-winged and other fairy-wrens and show that amino acid changes related to the over-production of melanin are found in the black-plumaged White-winged Fairy-Wrens. Mapping feather morphology, nanostructure and genetic information onto our phylogeny for the family we have developed a well-supported hypothesis for the evolution of black plumage in the Maluridae.

130 Dingle, Lovette & Smith

Elevational zonation and the phylogenetic relationships of the *Henicorhina* wood-wrens. CAROLINE E. DINGLE, *Biol. Dept., San Francisco State Univ., San Francisco, CA*, IRBY J. LOVETTE, *Cornell Univ., Ithaca, NY*, and THOMAS B. SMITH, *Univ. Calif. Los Angeles, Los Angeles, CA*.

The *Henicorhina* wood-wren complex currently consists of 3 taxonomic species. Two of these (the Gray-breasted Wood-Wren *H. leucophrys* and White-breasted Wood-Wren *H. leucosticta*) are widespread throughout central and n. South America, with *leucophrys* occurring at higher elevations in regions where both occur. A third recently described species (the Bar-winged Wood-Wren *H. leucoptera*) occurs only in several isolated cordilleras in se. Ecuador and ne. Peru, where it replaces the Gray-breasted Wood-Wren at the highest elevations. We used mitochondrial DNA sequences to explore the phylogenetic relationships among populations of these taxa and to draw inferences about the evolutionary origins of elevational zonation. We found substantial mitochondrial diversity within both *leucophrys* and *leucosticta*. Differentiation across the Andes in *leucophrys* was negligible, but populations from Central America and from nw. Ecuador showed substantial differentiation. Three highly differentiated haplotype groups were also present in *leucosticta*, corresponding to populations in the e. Andean lowlands, Central America, and the Chocó region of nw. Ecuador; these populations may each warrant taxonomic species status. Bar-winged haplotypes nested within the mitochondrially diverse *leucosticta* group, where they were most closely allied to the geographically distant Chocó haplotypes. This *leucoptera-leucosticta* affinity is not consistent with previous inferences based on plumage and behavioral similarities that grouped *leucoptera* and *leucophrys* as sister species. These reconstructions refute the hypothesis that elevational zonation in this clade has originated from in situ speciation along an elevational gradient, and instead highlight the role of complex changes in geographic distributions in fostering phylogenetic and ecological diversification.

131 Arnaiz-Villena, Zamora, Ruiz-del-Valle, Moscoso, Serrano-Vela, Lowy, Allende, Guillen & van-den-Elzen

Both morphological and molecular characters support speciation of South American siskins by sexual selection. ANTONIO ARNAIZ-VILLENA, JORGE ZAMORA, VALENTIN RUIZ-DEL-VALLE, JUAN MOSCOSO, IGNACIO SERRANO-VELA, ERNESTO LOWY, LUIS ALLENDE, JORGE GUILLEN, *Dept. Immunol. & Mol. Biol., Medicina, Universidad Complutense, Madrid, Spain*, and RENATE VAN-DEN-ELZEN, *Alexander Koenig Zool. Mus., Bonn, Germany*.

South American siskin radiation was studied by both mitochondrial cytochrome b (mt cyt b) DNA sequencing and homologous phenotypic characters; the latter were coded separately according to sex. Mixed phenetic and molecular (total evidence) dendrograms were constructed and the corresponding analyses suggest that speciation started with a north to south separation (*Carduelis notata* / *Carduelis barbata*) along the Andean spine. A second split may have taken place around the Peruvian Andean mountains, corresponding to the present distribution pattern of *C. olivacea*. The most recent speciation events seem to have occurred in 3 sister species pairs: 1) *C. xantogastra* / *C. atrata*, 2) *C. magellanica* / *C. yarrellii*, and 3) *C. cucullata* / *C. crassirostris*. Accumulation of consistent characters in both morphological and molecular data at the basal nodes of the dendrograms indicate that speciation events occurred within a short period of time. Our data also suggest that speciation probably occurred by sexual selection through female mating choice in this radiation. Additionally, studies of variable amino acid residues in the mt cyt b molecule show that the 3 variable amino acids are placed in the mitochondrial transmembrane region, which is also part of the hypervariable region in mammals. Each of the 3 amino acid changes occur in each of the 3 postulated evolutionary groups.

132 Johansson

The historical causes of regional differences in warbler diversity along the Himalayas. ULF S. JOHANSSON, *Dept. Ecol. Evol., Univ. Chicago, Chicago, IL*.

The Himalayas is one of the most species rich areas in the world. However, within this region there is a prominent decline in species richness from the southeast to the northwest. Although the difference in the number of species between the east and the west is almost two-fold, it is not associated with replacement of phylogenetically dissimilar species, but rather with loss of members from multiple clades. One clade that follows this pattern is the Old World Leaf Warblers (*Phylloscopus* and *Seicercus*) with >20 species breeding in the Himalayas. In this study 2 areas (250 x 250 km) along the Himalayan range were compared; one eastern including the states of Sikkim and north West Bengal, India and one in the west that includes parts of the state Himachal Pradesh, India. At the

western site, 11 species of *Phylloscopus* and *Seicercus* have been found. All but one of these are also present in the east. At the eastern site 16 species breed, 6 of which are confined to the east. Phylogenetic reconstruction indicates that the basal split in the phylogeny is between a group with most members confined to the east at predominately low elevations and a group of species that have spread to the west and occur at predominately high elevation. A model is proposed whereby the group originated in the southeast and speciated and spread west in association with mountain uplift.

133 Milot, Bernatchez & Weimerskirch

Documenting dispersal events and population structure in albatrosses. EMMANUEL MILOT, LOUIS BERNATCHEZ, *Dept. Biol., Univ. Laval, Québec, QC*, and HENRI WEIMERSKIRCH, *Centre d'études biologiques de Chizé, Villiers en Bois, France*.

Albatrosses have huge dispersal capabilities, yet they are highly philopatric. How these opposed traits shape population structure at different geographic scales remains unclear. While it has been suggested that some species may exhibit metapopulation dynamics, dispersal rates are only known for a limited number of colonies, mainly because of logistic constraints associated with long-term monitoring on remote islands. Nevertheless, this information is crucial not only to uncover global dynamics of populations, but also to better predict their susceptibility to threats. Many populations are indeed threatened by fishing bycatch and dispersal might play a role in the fate of individual colonies. We assessed the potential utility of AFLP markers for identifying individual migrants in breeding colonies of the Wandering Albatross from the Indian Ocean, as well as for documenting population structure at different scales. Preliminary results show that this species exhibit limited levels of polymorphism as compared to other birds. This suggests that a bottleneck and small colony sizes have led to a genetic depauperation of populations which may hamper their potential for an adaptive response to environmental threats. Weak genetic structuring likely reflects the recent history leading to this reduced genetic variation. It also indicates that the detection of individual migrants through assignment methods should be possible for some populations, but will require a large number of markers. This information should prove useful in estimating current dispersal rates between populations, as well as providing a way to identify birds of unknown origin.

134 Emslie & Patterson

Major shift in Adélie Penguin eggshell isotope values in Antarctica: evidence for diet change ~200 years ago. STEVEN D. EMSLIE, *Dept. Biol. Sci., Univ. North Carolina, Wilmington, NC*, and WILLIAM PATTERSON, *Dept. Geol. Sci., Univ. Saskatchewan, Saskatoon, SK*.

Abandoned Adélie Penguin (*Pygoscelis adeliae*) colonies have been identified in numerous coastal, ice-free regions and islands in Antarctica and often contain a well-preserved record of organic remains including penguin bones, feathers, tissue, and eggshell. This record has been used to infer episodes of climate change that have affected the distribution and abundance of penguins in Antarctica for millennia. Dietary remains recovered from ornithogenic (bird-formed) soil at these sites include otoliths and squid beaks, but no remains of krill (*Euphausia* spp.) are preserved. Thus, the primary diet of this species in the past has been difficult to infer without additional evidence. Stable isotope analyses now allow assessment of seabird diet using eggshell, bone or keratin. However, isotope analyses of fossil remains is often compromised from lack of preservation. We used ancient and modern Adélie Penguin eggshell collected from 3 major regions in Antarctica to examine variation in nitrogen and carbon isotopes over the past 9000 yr. Our results indicate that a major shift in eggshell isotopic values, with a significant loss of enrichment in carbon and nitrogen, occurred in the late Holocene, or within the last 200 yr, but before 1917. We hypothesize that depletion of baleen whales and seals during the whaling era, beginning in the 1820s, caused a ecological response in penguins and shift in diet primarily from fish to krill. Additional research on this response is warranted.

135 Prum

The evolution of color producing nanostructures in the barbs of *Lepidothrix* manakins (Pipridae). R. O. PRUM, *EEB & Peabody Mus., Yale Univ., New Haven, CT*.

Structural colors of avian feather barbs are produced by constructive interference of light waves (i. e., interference) by arrays of nanometer scale air bubbles in the medullary layer of feather barbs. Typically, the arrays of air bubbles exhibit a quasiordered nanostructure in which the dimensions of the air bubbles and the distances between neighboring bubbles are unimodally distributed, but the arrays lack laminar or crystal-like nanostructure. The manakin genus *Lepidothrix* exhibits a diversity of structurally colored crown and rump colors including various shades of blue,

white, and incredibly brilliant opalescent silver-gold. Within the genus, the primitive crown color is likely blue with brilliant white and opalescent as derived. The nanostructure of the medullary layer of the structurally colored feather barbs of *Lepidothrix* species reveals that the blue and brilliant white feathers are quasiordered. However, the nanostructure of opalescent feather barbs of *L. iris* exhibit a perfect hexagonal or tetrahedral array of spherical air bubbles. This nanostructure is previous unknown in any bird feathers. The transition from quasiordered to crystal-like nanostructure is associated with extraordinary optical effects and likely evolved by intersexual selection on crown color.

136 Rhymer, Williams & Kingsford

Implications of phylogeography and population genetics for subspecies taxonomy of Grey (Pacific Black) Duck *Anas superciliosa* and its conservation in New Zealand. JUDITH M. RHYMER, *Dept. Wildl. Ecol., Univ. Maine, Orono, ME*, MURRAY J. WILLIAMS, *Dept. Conserv., Wellington, New Zealand*, and RICHARD T. KINGSFORD, *New South Wales Natl. Parks & Wildl. Serv., Hurstville, New South Wales, Australia*.

Subspecies delineations may not reflect actual intraspecific diversity; an issue that becomes important when conservation of populations and/or subspecies that face severe declines is involved. The Grey Duck in New Zealand is considered a separate subspecies *Anas superciliosa superciliosa* from the Pacific Black Duck *A. s. rogersi* of Australia, even though poorly differentiated morphologically. Because the New Zealand and Australian populations of *A. superciliosa* are considered taxonomically distinct, the decline of New Zealand's Grey Duck and its hybridization with the introduced Mallard *A. platyrhynchos* has led to assignment of "endangered" conservation status. Taxonomic distinction and absence of periodic gene flow between the Australian and New Zealand populations are crucial for acceptance of this status. We used phylogeographic analysis of mitochondrial DNA control region sequences to determine whether haplotypes representing current subspecies are unique or are more consistent with populations in the 2 countries being considered the same subspecies. Two highly divergent genetic lineages of Grey Duck occur in New Zealand. One lineage (Group I) is found only in New Zealand primarily on North Island, while the other (Group II), occurs in populations throughout New Zealand and Australia. The split between Group I and II lineages is on the order of that found between some avian species. Even though subspecific designations of *A. s. superciliosa* and *A. s. rogersi* do not hold up based on molecular data, we identify a need for Grey Duck in New Zealand to be conserved to maintain the historical diversity within the species.

137 Papes

* Conservation strategies for endangered and threatened birds in central and eastern Europe assessed using ecological niche modeling. MONICA PAPES, *Nat. Hist. Mus. & Biodiv. Res. Center and Dept. Ecol. & Evol. Biol, Univ. Kansas, Lawrence, KS*.

Comprehensive biodiversity surveys are unavailable for most Central and Eastern European countries. Although birds are generally well-studied, distributional information for species in the region is sparse and out of date. I used museum specimen records and environmental data to produce distributional hypotheses under present and future climate conditions for 36 threatened bird species by applying a genetic algorithm (GARP) that models species' ecological niches. Comparisons between the present-day and climate change predictive distributions showed considerable decline in the distribution of 6 species. The distributional maps obtained were used to address strategies for conservation of threatened birds via simple heuristic reserve network coverage algorithms based on complementarity and rarity considerations. These analyses identified areas situated along the lower Danube River, as well as others across the region, as clear priorities for conservation action; notably, these areas are not included in the region's existing network of reserves.

138 Zoller & Stouffer

* Seasonal differences in bird communities of a Louisiana swamp. JASON A. ZOLLER, *Dept. Biol. Sci., Southeastern Louisiana Univ., Hammond, LA*, and PHILIP C. STOUFFER, *School Renew. Nat. Res., Louisiana State Univ., Baton Rouge, LA*.

The avian communities of the wetlands surrounding Lake Maurepas, LA, have been influenced by dramatic alterations of the landscape. Large continuous tracts of baldcypress-tupelogum forest historically dominated this area until the late 1800s, when all of the forested wetlands were logged. The resulting landscape is a mosaic ranging from open marsh to naturally regenerated forested wetlands. Vegetation variables were used to establish 3 broad habitat types: marsh sites, transitional sites, and forest sites. In each habitat type, we used point counts to characterize the

winter and breeding bird communities. During the winter, birds were most abundant at the lake and transitional sites, while the breeding season showed the opposite trend with highest abundance detected at the forest and transitional sites. Abundance of neotropical migrants dropped by >40% in marsh sites compared to the transitional and forest sites. There was also a significant trend for a greater richness of bird species at the forest and transitional sites during both winter and breeding season. Analyses of vegetation variables showed that bird distribution was best explained by canopy structure. Conclusions from this study show that transitional swamp forests currently support bird communities similar to those in forest sites, but could change dramatically if forest deterioration continues.

139 Powell

* Effects of prescribed burns on breeding bird abundances in tallgrass prairie. ALEXIS F. L. A. POWELL, *Dept. Ecol. Evo. Biol., and Nat. Hist. Mus., Univ. Kansas, Lawrence, KS.*

Grassland birds have declined more than any other avian assemblage in North America, with nearly every species showing negative population trends. In the Flint Hills of Kansas, the largest remnant of the tallgrass prairie ecosystem, prescribed burning of pastures on a 2 - 3 yr cycle has recently been replaced by a regime of annual burning. I examined effects of burning on Jun abundances of grassland birds at Konza Prairie Biological Station by conducting transect surveys in 2002 and 2003, and using a 22-yr dataset from the station's Long Term Ecological Research program. Analyses of both sets of data found a significant effect of fire on abundances of all 5 species, with 4 being eliminated from or relatively scarce at sites in the breeding season immediately following burning. Although fire is a natural force that maintains tallgrass prairie, its action was, until recently, intermittent and patchy, so grassland birds have not necessarily adapted to its immediate impacts. If the vast Flint Hills prairie is to serve as a grassland bird stronghold, the region-wide practice of annual burning must be replaced with alternatives that restore heterogeneity to the landscape.

140 Hughes & Capen

* Effects of local- and landscape-scale variation on the distribution of three area-sensitive forest songbirds in Vermont. MEGAN E. HUGHES and DAVID E. CAPEN, *Rubenstein School Environ. & Nat. Res., Univ. Vermont, Burlington, VT.*

As a landscape becomes increasingly fragmented, average forest tract size decreases, leaving area-sensitive bird species vulnerable to loss of suitable habitat because they avoid small patches and edge habitat. It is, therefore, important to understand the multiple factors, at both the local and landscape scale, that may influence habitat quality. We examined distribution of 3 area-sensitive songbirds, Black-throated Blue Warbler, Ovenbird, and Red-eyed Vireo, across a gradient from edge to interior habitat in forest patches located in landscapes with 3 different levels of fragmentation. Relative abundance of all 3 species increased with distance from the edge, a response that appeared to be magnified by decreases in forest cover in the surrounding landscape. At the patch level, we quantified habitat quality through vegetation measures and prey abundance and biomass. Ground arthropod and Lepidoptera larvae biomass was higher in edge habitat, and larval abundance and individual biomass were greater in the most fragmented landscapes. Of the vegetation characteristics, understory woody stem density and canopy cover decreased and ground cover increased with distance from the edge, while woody stem density increased with landscape-level fragmentation at distances closest to the forest edge. We, therefore, recommend consideration of both local- and landscape-scale habitat variables when determining appropriate conservation strategies for area-sensitive forest songbirds in the region.

141 Cox

Effects of summer burning on Bachman's Sparrow. JAMES COX, *Tall Timbers Res. Sta., Tallahassee, FL.*

Recent studies have suggested prescribed burns conducted from May to Aug (i.e., growing-season burns) might be harmful to populations of Bachman's Sparrow. I studied the effects of growing-season burns on a sparrow population in an old-growth pine forest by monitoring color-banded males (n = 45) and performing constant-effort mist and pre- and post-burn surveys in 2003 and 2004. Banded males left burned areas but returned when ground cover vegetation exceeded 0.7 m approximately 5 wk after the burn. A few individuals returned to territories held prior to the prescribed burn. Once vegetation recovered, male territory sizes within burned areas were similar to territory sizes monitored on unburned areas. Furthermore, many family groups (adults and fledged young) moved into and made extensive use of burned areas. Constant-effort mist-netting showed that

hatch-year birds and adults were nearly twice as common on the burned area once vegetation recovered. The number of singing males recorded on surveys also did not differ between burned and unburned sites after vegetation recovered. Growing-season burns obviously disrupt Bachman Sparrow nesting, but a more complex picture emerges from my study. Growing-season burns also may provide excellent post-breeding habitat.

142 Male & Nol

Impacts of roads associated with North America's first diamond mine, the Ekati Diamond Mine, Northwest Territories, on reproductive success and breeding habitat of Lapland Longspurs. SEAN K. MALE, *Watershed Ecosys. Grad. Prog., Trent Univ., Peterborough, ON*, and ERICA NOL, *Dept. Biol., Trent Univ.*

Since the first mine opened in 1998, the diamond-mining industry in the Canadian arctic has been undergoing a period of steady growth, yet our understanding of the environmental impacts of these operations is limited. To address whether ecological impacts may exist, we examined the effects of roads associated with the Ekati Diamond Mine, NT, on reproductive success and breeding habitat of Lapland Longspurs by comparing study sites located directly beside and at least 5 km away from roads. No significant differences between roads and reference sites were detected for first egg dates, clutch size, average nestling mass on day 7 following hatch, or daily nest survival. Recorded frequencies of male song overlapped substantially with the harmonics of heavy truck noise. Snow water equivalent and percent moss cover were significantly higher on reference sites, while soil moisture, and dust deposition were higher on road sites. Currently, there appears to be no measurable effect of roads associated with the Ekati Diamond Mine, on Lapland Longspurs. Observed differences in habitat characteristics between reference and road sites suggest that long-term changes in the vegetative community may occur that could affect longspur nest-site selection.

143 Burger

Application of radar surveys in the management of nesting habitat for Marbled Murrelets in British Columbia. ALAN E. BURGER, *Dept. Biol., Univ. Victoria, Victoria, BC*.

Radar is valuable for counting Marbled Murrelets as they commute between the sea and inland nest sites, and for analysing landscape-level associations between murrelet numbers and available habitat in old-growth forests. I analysed radar counts at 101 watersheds from 5 independent studies in British Columbia, covering the northern, central, and southern mainland, and 2 areas on the west coast of Vancouver Island. Mean counts totalled 18,129 birds (24 - 33% of the estimated provincial population). Areas of suitable nesting habitat in each watershed were estimated from algorithms, recommended by the Canadian Marbled Murrelet Recovery Team, applied to a forest-cover GIS database. General Linear Models showed significant positive correlations between murrelet counts and areas of habitat in all 5 areas, and for pooled data. The models consistently showed regional differences between the British Columbia mainland and West Vancouver Island, and murrelet densities were significantly higher in the latter region (respectively 0.044 birds/ha \pm 0.038 SD and 0.090 birds/ha \pm 0.060 SD of apparently suitable nesting habitat). Commuting distance to likely foraging areas was a significant co-variate on the mainland but not on West Vancouver Island. Habitat associations and densities derived from radar counts are valuable for management; they reveal past reductions in local populations with habitat loss, and provide baselines for long-term monitoring of populations and the effects of continued logging of old-growth forests.

144 Fair, Keller & Fettig

Piñon pine tree mortality, tree thinning, and summer avian use in piñon-juniper woodlands in New Mexico. JEANNE M. FAIR, DAVID C. KELLER, *Los Alamos Natl. Lab., Risk Reduction & Environ. Stewardship, Ecol. Group, Los Alamos, NM*, and STEPHEN M. FETTIG, *Bandelier Natl. Monument, Los Alamos, NM*.

The drought of 2000 - 2002 in the sw. U.S., although not unprecedented has been one of the most severe in 50 yr that has lead to a severe outbreak of bark beetles that has resulted in high mortality levels in ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*) and piñon pine (*Pinus edulis*) trees. Many areas in piñon-juniper habitat have had the entire stand of piñon die leaving only juniper. The Pajarito Plateau, where Los Alamos National Laboratory is located, has an average 80% tree mortality for trees over 1.5 m tall from 2002 to 2003. We compared avian use in areas on Los Alamos National Laboratory and Bandelier National Monument with high pine tree mortality, low tree mortality, areas that had also been thinned in the past year with high and low tree

mortality. Our objective was to estimate summer avian use of these piñon-juniper habitat types using both the point count method and mist netting of breeding birds. The average percent of tree mortality ranged from 24% to 97% on the 9 study sites. The percentage of juniper trees to piñon trees ranged from 5 to 54%. The total number of trees/plot ranged from 92 on a thinned area to 436 on an unthinned site. The major result of this study was the increase in avian use of the mechanically thinned areas on Los Alamos National Laboratory. On average, these areas contained almost double the number of individuals as the unthinned neighboring areas. Although our data are correlative and thus do not imply causality, they suggests that there is an increase in avian use of piñon-juniper habitat treated by mechanical thinning. The data also suggests that avian use was not impacted significantly during the first year of a large bark beetle infestation and resulting mortality of piñon pines.

145 Gibbons

Abundance and distribution of selected wintering waterbirds in Redfish Bay, Texas. RICHARD E. GIBBONS, *Corpus Christi, TX*.

Wintering abundance and habitat preferences and avoidances were studied for Common Loon, Eared Grebe, Pied-billed Grebe, Double-crested Cormorant, Red-breasted Merganser and American Coot. These species comprise a loose guild of non-duck, obligate or facultative diving waterbirds that spend considerable time afloat and that winter in the estuaries of the central Texas Gulf Coast. Approximately 27 km² in sw. Redfish Bay including seagrass beds, unconsolidated bottom, emergent marsh, and natural and dredge material islands was censused 7 times between 11 Nov 2001 and 11 Oct 2002. Observations (n = 608) were recorded with a Global Positioning System (GPS) and entered into a Geographic Information System (GIS). The U.S. Fish and Wildlife Service National Wetland Inventory (NWI) wetland habitat types data were used in the GIS to determine proportions of each species within the 4 aqueous habitat types. The GIS generated data were analyzed using a modified Bonferroni's preference/avoidance statistic (Haney & Solow 1992, **J. Field Ornithol.** 63: 43-52). Eared Grebe, Double-crested Cormorants, and American Coots preferred estuarine subtidal aquatic beds and avoided the estuarine subtidal unconsolidated bottom habitats. Common Loon, American White Pelican, and Red-breasted Mergansers avoided estuarine subtidal aquatic beds and preferred estuarine subtidal unconsolidated bottom. Pied-billed Grebe showed no significant preference for any habitat. All species avoided the estuarine emergent marsh. Species abundance over time showed various peaks generating questions and offering insights regarding estuarine staging, molting, stopover habitat, salinity, and the effects of tidal regimes.

146 Radomski & Thomson

Can manipulating pond color minimize Double-crested Cormorant depredation at fishponds? ANDREW A. RADOMSKI, *USDA, Agr. Res. Serv., Stuttgart, AR*, and STEVEN J. THOMSON, *USDA, Agr. Res. Serv., Stoneville, MS*.

Recent advancements in studies on the acuity of avian visible spectrum and remote sensing have allowed ornithologists a unique opportunity to conduct field experiments within the birds' perceived environment. This study was an attempt to correlate cormorant use and avoidance with pond constituents (surface condition, secchi reading, depth, pH, temperature, salinity, dissolve oxygen, total phosphorus, TAN, nitrite, nitrate, hardness, and chlorophyll a) and digital values from pond images obtained using low-altitude aerial digital video. During this winter (2004), Double-crested Cormorants, a major predator at aquaculture farms in the se. U.S., were quantified at 3 commercial fish farms in Arkansas. These farms were typical of commercial production, in that the farms had >40 fishponds, ponds were 6 ha, and stocked with single- or multiple-age class channel catfish (*Ictalurus punctatus*). Cormorants were quantified for 2 mon at each farm and then the ponds were classified as preferred or avoided. After classifying the ponds, the treatment (AquashadeTM, an approved dye for use in aquaculture) was applied to 4 ponds (2 preferred, 2 avoided) at each farm. Subsequently, cormorants were quantified for 2 mon post-treatment at each farm. The primary objectives of this study were to determine if cormorants could be deterred from aquaculture ponds treated with this dye and quantify any deleterious water quality changes to the ponds.

147 Rose, Nol, Winn & Leary

Site fidelity, survivorship and local movements of overwintering Semipalmated Plovers in a southern estuary. MELISSA A. ROSE, ERICA NOL, *Dept. Biol., Trent Univ., Peterborough, ON*, BRAD WINN, *Georgia Dept. Nat. Res.*, and PATRICK LEARY, *Fernandina Beach, FL*.

The degradation of estuarine systems in North America and consequent dwindling of high-quality winter habitat has raised concern for populations of migratory shorebirds that may express site fidelity to specific overwintering habitats. We individually color-banded 60 Semipalmated Plovers overwintering in the Cumberland Sound estuary in s. Georgia during the years 2003 - 2004. 42 (70 %) of the marked birds stayed within the area that they were banded during the winter season of 2003, and 39 (65 %) returned again during the winter of 2004. Birds traveled between 2 - 4 km daily following tidal fluctuations within the estuarine system. Though a small number of marked Semipalmated Plovers were observed both to the north (8 km) and south (25 km) of the Cumberland system, most birds remained within a small local area upon settling in their wintering grounds. A percentage of the birds (31%) remained within the area during the 2003 breeding season, implying important year-round use of the estuarine system as a staging ground for non-breeding, and possibly juvenile, birds. Use of the surrounding saltmarsh, beach and mudflat habitat by banded birds suggest that a regional mosaic of foraging and roosting habitat is important for maintaining populations of wintering and non-breeding Semipalmated Plovers, as variation in site availability requires a sufficient network of viable habitats.

148 Rowell-Garvon & Withers

The relationship of shorebird and invertebrate abundance among five estuarine habitats, in Corpus Christi, Texas. SHANNON R. ROWELL-GARVON and KIM WITHERS, *Center for Coastal Studies, Corpus Christi, TX*.

Resident and migratory populations of wading birds use freshwater and marine habitats on the central Texas Gulf coast for foraging, roosting, and breeding. The focus of this study was to describe wading bird community structure in a coastal mosaic and determine linkages among habitats. Indian Point and Sunset Lake parks, Corpus Christi, TX, contain 5 estuarine habitats tidally influenced and depressional ponds, uplands, an excavated salt water "lake", an undeveloped bay beach, and a saltmarsh. Wading birds were censused twice monthly from 15 Aug 2002 thru 27 Jul 2003 using instantaneous scan sampling. A test based on Bonferroni's inequality was used to determine habitat preference and avoidance. Habitat breadths were calculated using a formula based on the Shannon-Weiner diversity index. Overall, 10 species of waders and a total of 1,083 individuals were counted within the 5 habitat types. Significantly more waders were found in the tidal ponds in comparison to the isolated ponds, lakeshore, and bayshore ($F = 24.5$, $df = 4$, $P = 0.001$). Of the 6 most common species, Great Blue Herons, Snowy Egrets, Tricolored Herons, Great Egrets, Reddish Egrets, and Roseate Spoonbills, 4 preferred the tidal ponds and all 6 avoided the lakeshore and bayshore. In general, wader habitat breadths indicated generalist strategies, with only 2 species appearing to specialize. These 2 parks are important to wading birds because suitable habitat is limited in this area, due to coastal development and shrinking wetlands.

149 Slater

* Sage-grouse, fire, and coyote control in southwestern Wyoming. STEVEN J. SLATER, *Wyoming Coop. Res. Unit, Univ. Wyoming, Laramie, WY*.

There is considerable disagreement as to the appropriateness of the use of fire in sage-grouse habitats. I found sage-grouse were willing to make use of 2 recent prescribed burns and 2 older wildfires present in sw. Wyoming. The burns were used by 22% of nesting, 47% of brood rearing, and 33% of summering female sage-grouse in 2000 - 2002. Nest sites from within and outside the burns were structurally similar. Female sage-grouse movements suggest that the burns may have provided attractive brood rearing and summer habitat. Observations of male and female burn use throughout the spring and summer revealed that feeding and loafing sage-grouse were rarely found >60 m from the burned/unburned edge. Coyote control is currently conducted on many rangelands also used by sage-grouse, although little is known about the effects of this type of predator control on the species. I found that a study site with coyote control had fewer coyotes, but more badgers than a nearby study site without organized control in 2001 - 2002. Despite these differences, the importance of the various nest predator species was similar in both areas. The badger was the primary nest predator during the study and accounted for 33 - 55% of all nest predation. The coyote accounted for little nest predation in either area. Sage-grouse nest success and predation rates and productivity were similar at both study sites.

150 Mong & Sandercock

* The Upland Sandpiper: not just on the fence post anymore. TONY W. MONG and BRETT K. SANDERCOCK, *Div. Biol., Kansas State Univ., Manhattan, KS.*

Upland Sandpipers are an indicator species for healthy prairie ecosystems because they depend on native grasslands for breeding and are sensitive to habitat fragmentation. We studied nesting and radio-marked sandpipers to determine habitat use and home range size at Konza Prairie Biological Station (3,487 ha) in ne. Kansas. Radio-telemetry data from 20 (M = 12, F = 8) individuals with a total of 967 (mean = 48 points/individual \pm 13 SD) locations were used to determine home range. Over the entire breeding season, male home range size (mean = 202.9 ha \pm 135.2 SD, n = 12) was significantly larger than that of females (mean = 95.3 ha \pm 71.8 SD, n = 8, Mann-Whitney U-test, $X^2_1 = 6.79$, $P = 0.009$). However, during pre-laying and incubation, home ranges of males (mean = 76.8 ha \pm 36.7 SD, n = 5) and females (mean = 58.9 ha \pm 38.3 SD, n = 9) were not significantly different (Mann-Whitney U-test, $X^2_1 = 0.77$, $P = 0.38$). Radio-marked females abandoned their mate and young shortly after nests hatched and males provided sole parental care of broods. During 2001 - 2003 nests (n = 88) were more likely to be located in unburned grasslands (n = 59) than in grasslands burned the same spring (n = 29) (binomial test, $P = 0.002$). However, there was significant annual variation in nest site selection and more birds nested in burned areas in 2003 (n = 26 out of 36, $G_4 = 35.0$, $P < 0.0001$). These data show that upland sandpipers prefer areas with accumulated litter but, are flexible and can adjust their nesting habits. Sensitivity to habitat fragmentation may be linked to the large home range size required to nest and raise chicks. These data will assist management efforts for sandpipers and healthy tallgrass prairie ecosystems.

151 Cruz-Angón, Sillett & Greenberg

* Testing habitat selection in a tropical ecosystem: epiphyte removal induces net emigration in Common Bush-Tanagers. ANDREA CRUZ-ANGÓN, *Instituto de Ecología, Veracruz, Mexico*, T. SCOTT SILLETT and RUSSELL GREENBERG, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC.*

Epiphytes have often been thought to play a role in supporting higher bird diversity in tropical versus temperate forests. Although avian ecologists have documented varying degrees of specialized use of epiphytes for food or nest sites, no study has provided detailed information about how individual birds select habitat based on the presence of epiphytes. We used multistate, capture-recapture models to investigate how the experimental removal of epiphytes affected monthly survival and movement probabilities of 2 resident bird species (Common Bush-Tanager, CBTA, and Golden-crowned Warbler, GCWA) in a Mexican shade coffee plantation. We established 2 matching pairs of epiphyte removal and control. Data were based on the monthly resighting of 113 color-banded CBTA and 87 GCWA from May 2000 - Mar 2002. CBTA forage and nest primarily in tree canopies, whereas GCWA nest and forage in the understory. In both species, survival rates were not dependent on habitat, although mortality was concentrated during the breeding season, when birds were not in mixed-species flocks. We found that CBTA were at least 5 times more likely to emigrate from plots where epiphytes were removed compared to control plots. Habitat-specific movement patterns were not detected in the GCWA. However, unlike the warbler, CBTA depend upon epiphytes for nest sites and (seasonally) for foraging. These dispersal patterns imply that active habitat selection based on the presence or absence of epiphytes occurs in the CBTA on our study area. Our results emphasize the importance of epiphytes as a bird resource in Neotropical coffee agroecosystems.

152 Grenier & Greenberg

A biogeographic pattern in sparrow bill morphology convergent adaptation to tidal marshes. J. LETITIA GRENIER, *Dept. Environ. Sci., Policy & Manage., Univ. California, Berkeley, CA*, and RUSSELL GREENBERG, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC.*

The study of ecological convergence, or the evolution of similar traits on multiple occasions in response to similar conditions, is a powerful method for developing adaptive hypotheses. Such convergence forms the basis for biogeographic rules. However, despite the great attention paid to geographic variation and the foraging ecology of birds, surprisingly few cases of convergent feeding adaptations have been discovered. In this paper, we document a biogeographic pattern of convergent bill morphology across several sparrow taxa endemic to tidal marshes. Tidal marshes present profound adaptive challenges and abundant food rewards to the terrestrial vertebrates that attempt to colonize them. All North American sparrow taxa endemic to tidal marshes display differentiation from

close relatives in other habitats in their bill morphology, in some cases without any evidence of geographic structure in molecular genetic markers. This pattern suggests that selection may be intense on certain morphological traits. We compare bill length and depth, while controlling for body mass, of 10 tidal marsh taxa and their closest upland relatives, and we broaden the comparison to include other species in Emberizidae. Tidal marsh sparrows have longer, thinner bills than their non-tidal-marsh counterparts, which is probably an adaptation for consuming more invertebrates and fewer seeds, as well as for probing in sediment crevices to capture prey. This morphological differentiation is most pronounced between sister taxa with the greatest divergence times. We speculate that tidal marsh ecosystems are likely settings for ecological speciation.

153 Cooper, Hochachka & Dhondt

Nest attendance prior to clutch completion: when does incubation begin? CAREN B. COOPER, WESLEY M. HOCHACHKA and ANDRÉ A. DHONDT, *Bird Population Studies, Lab. Ornithol., Cornell Univ., Ithaca, NY.*

Passerine incubation is a set of variable and intermittent parental-care behaviors, aimed at ensuring embryo development. We quantified day and night attendance patterns associated with the onset of incubation in 58 nests of female bluebirds (*Sialia* sp.) from 10 locations across the U.S. during the 2003 breeding season. We examined the relationship among the high variation in attendance to egg-laying sequence, clutch size, clutch-initiation date, geographic location, and ambient temperature using general linear mixed models, accounting for repeated measures on the same nest. We inferred female attendance patterns based on temperature fluctuations recorded in the nest cups of bluebirds 3 d prior to and 3 d after clutch completion. Night attendance was strongly influenced by egg-laying sequence and resembled an all-or-nothing dichotomy. Day attendance was highly variable and influenced by ambient temperature. Our results have implications for the egg-viability hypothesis. Further research is needed to examine the function of day attendance during laying and its influence on the duration of the incubation period and hatching success.

154 Woodcock, Rathburn & Ratcliffe

Mate choice in Black-capped Chickadees: female preference is black and white. LISA WOODCOCK, MELANIE K. RATHBURN and LAURENE M. RATCLIFFE, *Dept. Biol., Queen's Univ. Kingston, ON.*

Bright plumage colors have received considerable attention from researchers of sexual selection but the signal function of achromatic plumage (black, white and gray) has generated much less interest despite the large number of species with achromatic plumage. Research on the signal function of Black-capped Chickadee plumage found that variation in male plumage was associated with social rank. Dominant, high-ranking males had significantly darker black plumage patches (Mennill et al. 2003, *Behav. Ecol. Sociobiol.* 53: 350-357). In this study, we investigated the role of male plumage variation in female mate choice among Black-capped Chickadees. Young, inexperienced females were placed in a mate choice arena and allowed to choose between 2 experienced males, unknown to the female. Spectral characteristics of males' plumage were collected with a spectrometer that measures plumage reflectance in the UV and human visible wavelengths. Behavioural observations indicated that females had a strong preference for 1 particular male and this preference was related to male plumage characteristics. Females preferred to associate with males that had black plumage that reflected significantly more UV-chroma. There was no significant effect of male vocalizations on female preference nor was female preference related to a particular side of the aviary. Subsequent to female preference tests, we allowed males to interact and recorded dominance interactions. There was concordance between dominance and female preference with respect to male plumage. Females consistent preferred to associate with males later determined as the dominant individual. Thus, females appears to use plumage cues to assess male social status.

155 Johnson, Rauch & Dellone

The process and causes of fledging in House Wrens. L. SCOTT JOHNSON, ROBIN L. RAUCH and SARA DELLONE, *Dept. Biol., Towson Univ., Towson, MD.*

Fledging remains one of the least-studied events in the passerine reproductive cycle. We used continuous videotaping of nests to document fledging in House Wrens. Fledging began 14 -19 d after the day hatching began. Slower-developing broods fledged later than faster-developing broods. Fledging typically began within 5 h of sunrise. All nestlings fledged on the same day at 65% of nests and over 2 - 4 d at remaining nests. No evidence suggested that fledging was triggered by changes in parental behaviour. Parental rate of food delivery to nestlings did not decline during the hours leading

up to fledging, nor was the rate of feeding just prior to the first fledging lower than the rate 24 h earlier. Parents also did not slow the rate of food delivery to nests after part of the brood had fledged. In our study population, hatching is asynchronous creating a marked age/size hierarchy within broods. At most nests, the first nestling to fledge was the most well-developed nestling (or nearly so). This suggests that fledging typically begins when most well-developed nestlings reach some threshold size. However, at about a fifth of nests, the first nestling to fledge was only moderate in size. At these nests, severe competition for food may have caused smaller, less competitive nestlings to initiate fledging.

156 Mee, Beestman, Junker & Smith

I'm too sexy for my mate: extra-pair behavior in California Condors. ALLAN MEE, *Zool. Soc. San Diego, San Diego CA*, COLLEEN BEESTMAN, STEPHANIE JUNKER and TESSA SMITH, *U.S. Fish & Wildl. Serv., Ventura CA*.

The California Condor is one of world's most endangered birds. Beginning in 1992, reintroductions have sought to re-establish wild populations and recent breeding efforts have allowed the opportunity for intensive study of breeding behavior. Here, we studied courtship behavior from late Nov through to egg-laying (mid-Feb to early Apr) when most displays and copulations ceased. Displays were recorded up to 124 d prior to egg-laying although such early displays rarely led to mounting and attempted copulations. Copulations were recorded up to 25 d prior to egg-laying. Extra-pair females often solicited courtship by approaching and interacting with males. Males usually displayed to extra-pair females when their social mate was out of sight. Where pair females were present, they disrupted such displays or copulation attempts. Most extra-pair events (75%) involved a single male, the highest ranked male in the population. Thus, social rank appears to strongly influence a male's attractiveness. Although extra-pair behavior has not been previously documented in wild condors, this may have been because observations were biased towards nest sites where encounters with extra-pair birds are rare. Alternatively, the propensity for such behavior may be enhanced in this reintroduced population because of increased opportunity for social interaction related to supplementary feeding, mate incompatibility due to limited mate choice or attempts to mate with less genetically similar mates.

157 Smith & Conway

Function of manure-scattering behavior of Burrowing Owls. MATTHEW DENMAN SMITH and COURTNEY J. CONWAY, *Arizona Coop. Fish & Wildl. Res. Unit, Univ. Arizona, Tucson, AZ*.

Birds are well known to collect materials for use in nest-building. These materials generally function to hold and insulate developing young. However, some birds collect particular materials (both related and unrelated to nest-building) that provide important adaptive functions beyond structure and insulation. Burrowing Owls routinely collect dried mammal manure, and scatter this manure at the entrance to their nest burrow and in the tunnel leading to their underground nest. Manure-scattering is commonly thought to reduce nest depredation by camouflaging the scent of Burrowing Owls. Yet, this hypothesis has never been rigorously tested. Hence, I tested 4 alternative hypotheses to explain the function of the manure-scattering behavior. The mate-attraction hypothesis states that manure attracts females. Manure-scattering did not begin prior to pair formation, as predicted, but began 9 d after pair formation. The burrow-occupied hypothesis states that manure functions as a signal given by resident males to indicate an occupied burrow, and may reduce conflicts with conspecifics. Tests of this hypothesis were not statistically significant, but trends were in the predicted direction. The olfactory-concealment hypothesis states that manure conceals odors of an active nest, and thus reduces the risk of nest depredation. Juvenile survival was not higher, nor was depredation lower, in manure-supplemented nests compared to manure-removed-nests. My results support the prey-attraction hypothesis, suggesting that manure attracts insect prey. Pit-fall traps at manure-supplemented sites contained 76% more insect biomass than traps at non-manure sites.

158 Johnson & Oring

Killdeer parental care when either parent desert. MATTHEW JOHNSON, *Dept. Biol. Virginia Polytechnic Inst. & State Univ., Blacksburg, VA*, and LEWIS W. ORING, *Dept. Env. & Res. Sci., Univ. of Nevada, Reno, NV*.

We observed unmanipulated mate and brood desertion by both sexes in Killdeer, which allowed us to examine variation in parental behavior under 3 distinct parental care systems: biparental care, maternal care, and paternal care. When there is great disparity in parental investment between the sexes, sexual selection may result in distinct reproductive strategies for each sex. Study of mate

and offspring desertion has implications to understanding the evolution of cooperation and life history. Examining the conditions leading to desertion provides an avenue to explore the evolution of parental care as well as a life history trade-off between current and future reproductive success. Moreover, parents with disparate objectives face the evolutionary puzzle of how to allocate time and resources between cooperative and noncooperative behavior to effectuate higher fitness compared to other individuals in the population. We observed 26 broods 3 times daily until fledging or mortality. Within the population, we observed labile parental care strategies in the 2 sexes, involving male or female desertion of offspring and mate. Prior to the male deserting, females exhibited greater parental investment in the brood and males reduced care when compared to pairs in which neither parent deserted. We also found that uniparental females exhibited greater parental effort compared to uniparental males. When common and conflicting parental interests arise, the behavior of one parent may be a facultative response to the behavior of the other. Our results support the hypothesis that allocation of parental care may depend, in part, on assessment of mate parental behavior.

159 Hazler, Cooper & Twedt

Risky business: territory selection by Acadian Flycatchers. KIRSTEN R. HAZLER, ROBERT J. COOPER, *Warnell School For. Res., Univ. Georgia, Athens, GA*, and DANIEL J. TWEDT, *USGS Patuxent Wildl. Res. Center, Vicksburg, MS*.

Territory quality is determined not only by habitat structure and the availability of resources, but also by the inter- and intra-specific social environment -- competitors, cooperators, predators, and parasites. We hypothesized that songbirds are able to assess the relative local risk of avian nest predation and brood parasitism, and that minimizing risk is an important factor in territory selection. To test this hypothesis, we conducted intensive spot-mapping of Acadian Flycatchers (territory selectors), Red-bellied Woodpeckers (nest predators) and Brown-headed Cowbirds (brood parasites) during the period of territory settlement in a 56-ha study area within extensive bottomland hardwood forest. This allowed us to construct "risk maps," and to determine the order of territory settlement in relation to risk. After controlling for habitat structure, we predicted that the first territories settled would be in areas of lowest risk (= highest quality), with later settlers forced to establish territories in areas of higher risk (ideal preemptive settlement pattern, Pulliam & Danielson 1991, *Am. Nat.* 137: S50-S66). Similarly, we predicted that females would preferentially settle with males on lower-risk territories. Preliminary analysis of data from one breeding season indicated that male Acadian flycatchers preferentially settled on territories that were relatively "safe" from woodpeckers. We expand our analysis to include male and female settlement patterns over 3 breeding seasons.

160 Evans & Stutchbury

* Mating tactics in the Wood Thrush: the role of guarding and off-territory forays. MELISSA L. EVANS and BRIDGET J. M. STUTCHBURY, *Dept. Biol., York Univ., Toronto, ON*.

Recent studies have documented the behaviors associated with extra-pair mate choice in songbirds. However, the movements of socially monogamous songbird pairs remain unstudied, and how the behavior of an individual is affected by that of its social mate is still poorly understood. We measured the movements of Wood Thrush pairs ($n = 11$) using radiotelemetry, to determine if (1) the off-territory foray rates and (2) the extent of "mate-guarding" or "consortship" behavior exhibited by Wood Thrush differed between the female's fertile and non-fertile nesting stages. We found that pairs spent a significantly higher proportion of time together during the female's fertile period, although males did not increase foray rates during the non-fertile period. Females forayed off-territory alone, and with the social male, during the fertile period (mean alone = 0.16 forays/h \pm 0.06 SE, mean pair = 0.12 forays/h \pm 0.04 SE). No social pair off-territory forays were observed during the non-fertile period, and the foray rates of solitary females (0.02 forays/h \pm 0.02 SE) were significantly lower during the nonfertile period. These results suggest that males pursue extra-pair copulations regardless of their social female's fertility status and that female extra-territorial forays function in the search for extra-pair mates.

161 Bonter & Rosenberg

Survival in resident birds: is winter the limiting season? DAVID BONTER and KENNETH V. ROSENBERG, *Lab. Ornithol., Cornell Univ., Ithaca, NY*.

Harsh winter conditions are generally thought to be a major limiting factor for populations of resident temperate birds. By comparing overwinter survival estimates with annual survival rates, the relative importance of this season in the annual cycle can be quantified. Further, patterns of weekly

survival can help us distinguish between potential limiting factors, such as extreme climatic conditions, limited food supply, and predation. To quantify survival probabilities, we banded 319 Black-capped Chickadees at 13 study sites in central New York during autumn 2003. Volunteer observers recorded the presence/absence of marked individuals during fixed count periods on a weekly basis from Nov 2003 - Feb 2004. Site-based mark-recapture analyses indicated constant weekly survival rates throughout the winter (Cormack-Jolly-Seber analyses using Program MARK), suggesting that extreme climatic events did not strongly affect survival in these populations. Average weekly survival estimates varied among sites (range 0.92 - 1.00). Thus, overwinter survival estimates ranged from 0.31 - 1.00, based on a 14-wk winter and constant weekly survival probabilities. Because supplemental food was provided at all sites, the site-based differences in survival indicate that limited access to food may not be the primary factor limiting these populations. Rather, the observed patterns are most consistent with mortality associated with constant predation pressure throughout winter. Estimates of overwinter survival at most sites were comparable to published annual survival rates for this species, suggesting that populations are indeed limited during winter.

162 Peplinski & Ramsay

A comparison of bird communities in urban and rural forest fragments. PAULA PEPLINSKI and SCOTT M. RAMSAY, *Dept. Biol., Wilfrid Laurier Univ., Waterloo, ON.*

This study is a comparison of bird communities in urban and rural forest fragments in Waterloo Region. Habitat fragmentation involves the division of large contiguous areas of habitat into smaller patches that are isolated from one another. This can be a major concern because as habitat becomes more fragmented, the species depending on it lose places to live. Furthermore, the landscape between fragments may act as a barrier to dispersal. I compared the bird communities in 8 fragments and a large contiguous forest located in Grey Co., ON. I predicted that the forest fragments in the rural areas would have higher diversity scores because the urban landscape has a greater intensity of human disturbance. In May and Jun 2003, the forests were censused using point counts between 05:30 and 09:30 on a weekly basis for 4 wk. Diversity was no different in urban forests compared to rural or control forests. I found a weak but significant association between community similarity and forest location. A multiple regression model including ground level density, species number of snags, and variation in litter, and shrub cover explained over 96% of the variation in bird diversity. I conclude that the differences in human disturbance in the urban and rural matrix do not explain the diversity in fragmented forests, but habitat structure does affect diversity.

163 Arnett, Tanner & Prizzia

Comparisons of wintering and breeding bird communities along a post-thinning chronosequence of managed pinelands at Ft. Benning Army Reservation, Georgia. JOHN E. ARNETT, Jr., GEORGE W. TANNER and ANNA M. PRIZZIA, *Dept. Wildl. Ecol. & Cons., Univ. Florida, Gainesville, FL.*

Thinning is a commonly prescribed silvicultural operation used to meet a variety of forest management objectives, including habitat enhancement for endangered species (e.g., Red-cockaded Woodpecker), yet the effects of thinning on non-target wildlife species remain unclear. We examined the vegetation structure and avian community of thinned pinelands at the Ft. Benning Army Installation in sw. Georgia, during the winter (24 Jan - 13 Mar) of 2004. Study sites were assigned to 3 categories according to number of growing seasons (GS) since thinning (0 to 2 GS, n = 30; 4 to 7 GS, n = 32; 10 to 16 GS, n = 30). Canopy cover ($P < 0.05$) and density of shrubs above 1 m in height increased ($P < 0.05$) with time after thinning. Amount of woody debris decreased ($P < 0.001$) with time after thinning. Avian data were collected following the protocol and assumptions of program DISTANCE. Preliminary analyses described here were performed with species abundance data. A total of 2187 individuals representing 46 bird species were observed. Overall abundance (bird detections/study site) did not differ ($p > 0.05$) among thinning groups, nor did abundances of ground, bark, foliage, or aerial foragers. Avian community diversity, estimated with the Shannon index, was highest in recently thinned stands, lowest in intermediate stands, and differed significantly ($P < 0.001$) among all thinning groups. Preliminary results suggest that forests with reduced vertical heterogeneity and a diverse ground cover support the highest diversity of birds that winter in managed pinelands. We are currently collecting breeding season data. Forthcoming analyses will incorporate the effects of prescribed fire and landscape-scale variables on the wintering and breeding bird communities of Ft. Benning.

164 Mika, Belk, White & Schaalje

The effect of food resource quality on parental and juvenile condition, provisioning rate, and reproductive output in Flammulated Owls. MARKUS MIKA, *Dept. Biol. Sci., Univ. Nevada, Las Vegas, NV*, MARK C. BELK, CLAYTON M. WHITE, *Dept. Integrative Biol., Brigham Young Univ., Provo, UT*, and G. BRUCE SCHAALJE, *Dept. Stat., Brigham Young Univ.*

While raising young, parents are facing significant energetic trade-offs. Increased provisioning rates may drain reserves in adult birds while their juveniles experience improvements in individual growth or numbers of successful fledglings. Breeding locations in areas of high quality food resources can offset the need for more food deliveries by parents while still enhancing reproductive output or accelerating juvenile growth rates. Sub-optimal foraging habitat may decrease clutch sizes unless parental care is improved during nesting periods. Due to their semi-colonial breeding distributions in western North America, Flammulated Owls are excellent study organisms to investigate foraging and breeding relationships in nocturnal raptors. Although delivery rates/nestling do not increase in larger clutches, high quality nesting locations affect reproductive output. By applying nonlinear mixed models, we observe a relationship between parental investment as measured in weight loss of females and either growth rates of young or numbers of successful fledglings. Female condition early in the season appears to be better at nest locations with larger clutches and decreases less severe near higher quality foraging sites.

165 Bortolotti, Negro & Sarasola

Deceptive plumage signals in birds: manipulation of predators or prey? GARY R. BORTOLOTTI, *Dept. Biol., Univ. Saskatchewan, Saskatoon, SK*, JUAN JOSÉ NEGRO and JOSÉ HERNÁN SARASOLA, *Dept. Applied Biol., Estación Biológica de Doñana, Sevilla, Spain.*

Several species of raptors have 2 ocelli (eye-like patches) in the back of their head, giving them the appearance of a false face, although this trait has rarely been reported. These markings are widespread in the family Falconidae, some *Accipiter* hawks, and some owls (e.g., *Glaucidium*, *Athene* and *Surnia*). In some species, ocelli can be hidden at will by the flattening the occipital feathers, whereas in others they are always present. In both cases, ocelli appear to increase conspicuousness. Most raptors with ocelli are relatively small in size and typically include a large proportion of passerine birds in their diets. In this paper we outline general classes of hypotheses that may account for ocelli on the heads of raptors. The most frequently evoked general hypothesis is that ocelli offer protection. For example, an attacker may abort the effort or be deflected by the ocelli. We find little support for this idea. We propose 2 novel alternatives. The false faces may have evolved to aid in the hunting of small birds by actually provoking a mobbing response. The benefit of doing so may either be immediate as there are numerous accounts of mobbers being killed, or the benefit may be postponed if the predator is using mobbing as a means of evaluating hunting prospects in a given area.

166 Clinchy, Zanette, Boonstra, Wingfield & Smith

Balancing food and predator pressure induces chronic stress in songbirds. MICHAEL CLINCHY, LIANA ZANETTE, *Dept. Biol., Univ. Western Ontario, London, ON*, RUDY BOONSTRA, *Centre Neurobiology of Stress, Univ. Toronto, Toronto, ON*, JOHN C. WINGFIELD, *Dept. Biol., Univ. Washington, Seattle, WA*, and JAMES N. M. SMITH, *Dept. Zool., Univ. British Columbia, Vancouver, BC.*

The never-ending tension between finding food and avoiding predators may be the most universal natural stressor wild animals experience. The 'chronic stress' hypothesis predicts: 1) an animal's stress profile will be a simultaneous function of food and predator pressures given the aforesaid tension; and 2) these inseparable effects on physiology will produce inseparable effects on demography due to the resulting adverse health effects. This hypothesis was originally proposed to explain synergistic (therefore inseparable) food and predator effects on demography in snowshoe hares (*Lepus americanus*). We conducted a 2 x 2, manipulative food addition plus natural predator reduction experiment on Song Sparrows that was the first to demonstrate comparable synergistic effects in a bird: added food and lower predator pressure in combination produced an increase in annual reproductive success almost double that expected from an additive model. Here we report the predicted simultaneous food and predator effects on measures of chronic stress in the context of the same experiment: birds at unfed, high predator pressure sites had the highest stress levels; those at either unfed or high predator pressure sites showed intermediate levels; and fed birds at low predator pressure sites had the lowest stress levels.

167 Nocera, Forbes & Milton

* Public information acquisition through post-fledging prospecting directs habitat selection by social grassland birds. JOSEPH J. NOCERA, GRAHAM J. FORBES, *Biol. Dept., Univ. New Brunswick, Fredericton, NB*, and G. RANDY MILTON, *Nova Scotia Dept. Nat. Res., Wildl. Div., Kentville, NS*.

That birds use "Public Information" (PI; information gained by observing others) when selecting habitats has been well tested and supported. However, we know little about timing of information acquisition (prospecting) that leads to these choices. Moreover, the degree to which PI influences habitat selection is unknown. We asked: at what point does a bird decide that PI is less / more important than satisfaction of other life history requirements? We developed models for 2 grassland bird species (Bobolink and Nelson's Sharp-tailed Sparrow). To determine importance of prospecting and PI, we conducted 2 annually replicated experiments employing social attraction techniques (i.e., providing PI) in the fall and prior to the spring breeding season. These treatments were stratified by residency/vacancy in the previous year and across types of habitat quality, such that our 'worst' sites were habitats previously unassociated with the species. Response was measured as the degree of new territorial establishment, aggregation, segregation, and/or departure from observed theoretical distributions (e.g., Ideal-Free, Ideal-Despotic). While 2004 results are still pending, the first year experiments show Nelson's Sharp-tailed Sparrow (a non-social species) had no response to treatments. Conversely, inexperienced second-year Bobolinks showed 100% response to fall trials, and 0% response to spring trials. No after-second-year birds showed response to treatments. This represents strong evidence that Bobolinks gather PI (prospect) in the fall of their hatch year, to assist with habitat selection the following spring. It follows that private information (experience) supercedes new information only for adult birds.

168 Studds & Marra

* Winter habitat quality and year-round population processes: insights from individual upgrade experiments with a long-distance migratory bird. COLIN E. STUDDS, *Program Behav., Ecol., Evol. & Syst., Univ. Maryland, College Park, MD and Smithsonian Environ Res. Cent., Edgewater, MD*, and PETER P. MARRA, *Smithsonian Environ Res. Cent.*

Evidence is accumulating that habitat quality on the non-breeding grounds is critical in shaping the annual population dynamics of migratory birds. In Jamaica, behaviorally dominant, adult male American Redstarts exclude females and younger males from high quality black mangrove forest, forcing them to occupy sub-optimal second-growth scrub habitat. In 2002 and 2003, we experimentally upgraded redstarts from low to high quality habitat by permanently removing birds from mangrove forest, allowing individuals from scrub to colonize vacated territories. Relative to control birds that overwintered exclusively in second-growth scrub, redstarts upgraded to mangrove forest maintained body mass from winter to spring, departed earlier for spring migration, and had higher apparent annual survival. Our results provide the first experimental evidence of the importance of non-breeding season habitat quality to overall population-level processes. Restricted access to high quality winter habitat for females may underlie biased sex ratios on breeding grounds and limit annual survival of that sex, factors that together could help structure population dynamics.

169 Eaton

* Hidden sexual dichromatism: the rarity of sexually monochromatic passerines. MUIR D. EATON, *Dept. Ecol., Evol. & Behav., Univ. Minnesota, St. Paul, MN*.

Recent advances in our understanding of avian visual capabilities and colors call into question our traditional assessments of feather colors and plumage patterns. The goal of this study was to test historical assumptions of sexually monochromatic plumages for 139 passerine species using objective measurements of color. Analysis of plumage reflectance data with a model of avian visual capabilities found that 84 - 88% of human perceived monochromatic species sampled were in fact sexually dichromatic from an avian visual perspective. These results strongly suggest that visually distinguishable (to birds) sexes represent the ancestral condition in many avian lineages. Furthermore, current and future avian research should consider the possibility of sex specific plumage signals on many human perceived monochromatic species.

170 Duckworth

* Fitness cost to competitive behavior in Western Bluebirds. RENEE A. DUCKWORTH, *Biol. Dept., Duke Univ., Durham, NC*.

Identifying causes and consequences of variation among individuals in competitive traits is

essential to understanding their evolution. Western Bluebirds aggressively defend their nest sites from territorial intrusions by Tree Swallows, a competitor for limited nest cavities. Here, I examined ecological causes and fitness consequences of variation in resource defense by simulating swallow intrusions and measuring the aggressive response of bluebirds across a gradient of competition intensity. I found that pairs in which the male was highly aggressive had lower reproductive success compared to pairs in which the male was less aggressive. Persistent differences among males in aggression and the lack of a direct link between the intensity of competition and fitness indicate that this cost may be due to the effects of aggression in contexts other than resource defense. These findings suggest that selection across different contexts shapes competitive behavior and maintains variation in its expression.

171 Kuehn, Rothstein & Peer

* The presence of antiparasite strategies in an unparasitized population of Yellow Warblers.

MICHAEL J. KUEHN, STEPHEN I. ROTHSTEIN, *Dept. EEMB, Univ. California, Santa Barbara, CA*, and BRIAN D. PEER, *Dept. Biol., Simpson Coll., Indianola, IA*.

We investigated the extent to which populations of Yellow Warblers, breeding apart from brood parasitic Brown-headed Cowbirds in central Alaska, exhibit 4 behaviors typically directed towards cowbirds by warblers in areas where the 2 species coexist. Nesting warblers were presented with the stimuli responsible for eliciting the behaviors in 2 types of experiments: Artificial egg addition experiments and taxidermic mount presentations. Warblers abandoned nests (via nest desertion and egg burial) at a significantly higher rate after addition of 2 cowbird-sized blue eggs, when compared with control nests in which warbler eggs were handled to control for disturbance. A significantly higher proportion of female warblers gave cowbird specific "see!" alarm calls when presented with a taxidermic cowbird mount, as opposed to mounts of various non-threatening control species. More female warblers performed nest protection behavior toward taxidermic cowbird mounts than toward non-threatening control mounts. Our results suggest that warblers breeding in central Alaska have retained these defenses against brood parasitism in the absence of that selection pressure. Selection against such traits appears to be minimal due to their low maintenance costs and the fact that the traits are rarely exercised in the absence of stimuli that elicit them.

172 Balakrishnan

* An experimental test of song-based reproductive isolation among brood-parasitic indigobird species.

CHRISTOPHER N. BALAKRISHNAN, *Dept. Biol., Boston Univ., Boston, MA*.

Recent molecular analyses suggest that the brood parasitic indigobirds evolved in a recent and rapid radiation precipitated by the colonization of new hosts. Adult male indigobirds mimic songs of their host species, while female indigobirds also learn host song and use it to choose both their mates and the nests they parasitize. Song learning and mimicry therefore result in the cohesion of indigobird species utilizing a particular host species and also provide a mechanism for the formation of new, reproductively isolated populations after the colonization of a new host. However, it is not clear to what extent the general lack of genetic differentiation among indigobirds is due to retained ancestral polymorphism versus ongoing hybridization. I conducted a playback experiment to test whether male indigobirds discriminate between conspecific and heterospecific song. If female indigobirds mate exclusively with males mimicking the appropriate host song, then a male indigobird mimicking the song of a different host will not represent a competitive threat to a territorial male. Thus a comparison of male responses to conspecific versus heterospecific songs provides an indirect test of assortative mating among indigobirds based on song. Playbacks were conducted with the Cameroon Indigobird (*Vidua camerunensis*), including 2 "song populations" parasitizing Black-bellied Firefinch (*Lagonosticta rara*) and African Firefinch (*Lagonosticta rubricata*), and the Jambandu Indigobird (*Vidua rariicola*), which parasitizes Goldbreast (*Amandava subflava*). Nine males of each species (and song population) were challenged with recordings of all 3 song types. My results suggest that male indigobirds discriminate between conspecific and heterospecific song, a result consistent with reproductive isolation due to association with different hosts.

173 Stahl & Oli

* Relative importance of avian life-history variables to population growth rate. JUSTYN T. STAHL and MADAN K. OLI, *Dept. Wildl. Ecol. & Con., Univ. Florida, Gainesville, FL*.

The dynamics of biological populations are determined by life-history variables, but life-history variables differ with respect to their potential influence on population dynamics. Several predictions

have been made regarding the relative influence of life-history variables on the growth rate of a population. However, these predictions have not been empirically tested for birds. Based on life-history data for 103 populations of birds, we estimated asymptotic growth rate (λ) and elasticity of λ to changes in 4 life-history variables: age at maturity (α), juvenile survival (P_j), adult survival (P_a), and mean fertility (F). Elasticities were then used to test theoretical predictions regarding the relative influence of life-history variables on the population growth rate. No life-history variable was most important to λ in a majority of the populations. Instead, α and F were most important in species that matured early and had a low probability of adult survival; survival, mainly of adults, was the most important variable in species that matured late. Our analysis also yielded 3 useful metrics for predicting the relative importance of life history variables to λ , λ/α , F/α , and λ/P_a , with the latter having the strongest predictive power.

174 Hill & McGraw

The evolution of carotenoid pigment systems: a biochemical and phylogenetic approach. GEOFFREY E. HILL, *Dept. Biol. Sci., Auburn Univ., Auburn, AL*, and KEVIN J. MCGRAW, *Dept. Anim. Sci., Univ. California-Davis, Davis, CA*.

More elaborate or costly sexually selected traits are commonly thought to evolve from less exaggerated or expensive character states, but rarely can we trace evolutionary patterns of sexual signaling at a mechanistic level to uncover the true trajectories of trait evolution. Carotenoid-based colors in birds offer the unique opportunity to investigate the phylogenetic history of sexual ornaments because we can determine the types of carotenoid molecules that are deposited into the integument. Some species acquire their bright plumage using basic dietary carotenoids while others deposit more costly, metabolically derived pigments in feathers. We used published phylogenies and data on the carotenoid content of feathers to examine the evolution of pigment systems across a genus-level phylogeny of cardueline finches and a family-level phylogeny of oscine passerines. Outgroup and basal members for both cardueline finches and a subgroup of oscine passerines used only dietary carotenoids to color their feathers yellow; metabolically derived yellow and red feather colorants appeared later in more derived taxa. These results demonstrate a pattern of directional color evolution and provide biochemical support for the prediction that more costly animal signals evolve from those that are comparatively easier to develop.

175 Edwards & Dillon

Recombination rates at nuclear loci in birds: evidence from blackbirds (*Agelaius*) and implications for phylogeography. SCOTT V. EDWARDS, *Mus. Comp. Zool., Harvard, Cambridge, MA*, and MEGAN DILLON, *Dept. Biol., Univ. Washington, Seattle, WA*.

Recombination and linkage disequilibrium (LD) are generally regarded as ugly terms by ornithologists, yet the magnitudes of these parameters have important implications for a variety of fields, including phylogeography and behavioral ecology. By examining sequence variation at 7 nuclear loci both inside and outside the major histocompatibility complex (Mhc) in Red-winged Blackbirds, we provide the first systematic estimates of recombination rates in birds and provide a glimpse into the extent of hitchhiking in the avian genome. Single nucleotide polymorphisms (SNPs) were scored at 4 loci known to occur within a 40-kb region linked to a polymorphic Mhc gene, as well as at 3 presumably unlinked loci. Recombination rates (ρ per site = $4Nc$) were estimated within and between loci using 2 likelihood and 1 Bayesian approach. In general estimates of ρ fell in the range of 0.005 - 0.05, which is similar to levels estimated for *Drosophila* and between 1 and 2 orders of magnitude higher than that estimated for human genes. In addition, as in *Drosophila*, the number of estimated recombination events per mutation event often exceeded 1, and the extent of hitchhiking and LD appear negligible. We suggest that the larger effective population size of blackbirds versus humans only partially explains these results, and that the actual crossover rate (c) in blackbirds may exceed that in humans. These results suggest that recombination is a potent force in the blackbird genome, with important implications for population genetic and phylogeographic studies.

176 Friesen, Poland, Ibarguchi, Piatt & Hovey

Molecular evidence for recent, in situ differentiation in Pigeon Guillemots. VICKI FRIESEN, *Dept. Biol., Queen's Univ., Kingston, ON*, VERONICA POLAND, *School Biol., Univ. St. Andrews, Edinburgh, UK*, GABRIELA IBARGUCHI, *Dept. Biol., Queen's Univ.*, JOHN PIATT, *USGS, Alaska Sci. Center, Anchorage, AK*, and ANDREW HOVEY, *Dept. Fish. & Wildl., Oregon State Univ., Corvallis, OR*.

The importance of Pleistocene glaciers in diversification of north-temperate birds is highly

controversial. Guillemots (Alcidae: *Cephus*) exhibit marked geographic variation in morphology, and a previous study of mitochondrial control region variation in Black Guillemots (*C. grylle*) revealed strong population structure. This structure is unusual for north-temperate seabirds given both their generally high dispersal abilities and recent glaciation of nesting areas. Kidd & Friesen (1998, *Mol. Biol. Evol.* 15: 61-70) attributed population genetic structure in Black Guillemots to fragmentation of the species into multiple refugia during the Pleistocene. Pigeon Guillemots (*C. columba*) also exhibit marked geographic variation in morphology, which Udvardy (1963, in Gressitt, *Pacific basin biogeog.*, Bishop Mus.) attributed to fragmentation by Pliocene glaciers. However, Storer (1952, *Univ. Calif. Publ. Zool.*, 52: 121-222) argued that the nesting distribution of guillemots (small coastal colonies) would restrict gene flow compared to species such as murrelets (*Uria* spp.; scattered, large colonies), enabling local adaptation. We analyzed sequence variation in the mitochondrial control region and 7 nuclear loci (introns and microsatellites) among 198 guillemots sampled between the Aleutian Islands and California. Results indicated strong population genetic structure, with marked isolation-by-distance. Some phylogeographic structure exists, but there is little evidence for historical fragmentation. Rather, population differences appear to have arisen *in situ* following recession of the Wisconsin glaciers.

177 Grubb

On preferential 1,2-omnivory in Carolina Chickadees. THOMAS C. GRUBB, Jr., *Dept. Evol., Ecol., & Organ. Biol., Ohio State Univ., Columbus, OH.*

Terminology is introduced to remove the present ambiguity about the definition of "omnivory." Although much is known about the diets of wild birds, little is known about whether such diets are exhibited by preference or by necessity. Under controlled aviary circumstances in the presence of ad libitum shelled sunflower seeds and mealworms, wintering Carolina Chickadees preferred 1,2-omnivory to herbivory or carnivory, but did not follow predictions deduced from first-generation optimal foraging or complementarity models of diet selection. Caching of food items was essentially non-existent. Explanatory models for the extent of a bird's omnivory were evaluated with Akaike's information criterion. Parameters of potential biological importance examined in these models were age, sex, time of day, day of winter, and ambient temperature.

178 Liu & Hill

Does immune response relate to structural plumage color in Eastern Bluebirds? MARK LIU and GEOFFREY E. HILL, *Dept. Biol. Sci., Auburn Univ., Auburn, AL.*

Male Eastern Bluebirds have brilliant blue/ultraviolet structural coloration on their heads, backs, rumps, wings and tails. This structural plumage color has been shown to be an honest signal of male condition. The relationship between immunocompetence and structural color is still remains unexplored in this or any species. To better understand the relationship between body condition and plumage color of free-living adult and nestling Eastern Bluebirds, we used 2 different non-pathogenic antigens, SRBCs (sheep red blood cells) and PHA (phytohemagglutinin), to test how immune response related to structural color. The results showed different patterns in adults and nestlings. In adult males, SRBCs response is significantly positive correlated to blue chroma ($n = 15$, $P = 0.018$) on their rumps, but PHA swelling did not relate to plumage color. Among nestlings, PHA reaction was negatively related to the brightness of their growing wing feathers ($n = 11$, $P = 0.05$), while SRBCs did not correlate with nestling's plumage color. In this study, we suggest structural plumage color might be a reliable indicator to immunity in Eastern Bluebirds.

179 Lombardo

Assortative mating by size and ectoparasite load in Tree Swallows. MICHAEL P. LOMBARDO, *Dept. Biol., Grand Valley State Univ., Allendale, MI.*

Assortative mating occurs when mates share either similar or dissimilar phenotypes more often would be expected if mate choice were random with reference to phenotype. Mate choice that simultaneously balances the benefits of maintaining parental adaptations to the local environment and avoiding the costs of inbreeding should be favored by natural selection. I measured body dimensions and counted parasites on Tree Swallows breeding in nest boxes during 10 breeding seasons in west Michigan. There were significant positive correlations between mates in subadult female-pairs in wing and tail fork lengths suggesting positive assortative mating for size. There were significant positive correlations between mates in adult female-pairs in ectoparasite loads suggesting positive assortative mating for parasite load. There were few statistically significant correlations between mates in size or

ectoparasite load and reproductive performance in subadult and adult female-pairs, respectively. Males had significantly longer wings and tail forks than did females. Subadult females had shorter wings and tail forks than did adult females. Females had significantly greater tail feather parasite scores than did males. There were no differences between males mated to subadult or adult females in parasite loads. However, subadult females had greater parasite scores than did adult females.

180 Morand-Ferron, Lefebvre, Veillette, Elvin, Reader & Sol

Dunking behaviour in Carib Grackles. JULIE MORAND-FERRON, LOUIS LEFEBVRE, MELISA VEILLETTE, SANDRA ELVIN, *Dept. Biol., McGill Univ., Montréal, QC*, SIMON M. READER, *Behav. Biol., Utrecht Univ., Utrecht, Netherlands*, and DANIEL SOL, *CREAF, Univ. Barcelona, Barcelona, Spain*.

The use of tools to obtain or modify food items have long been thought to be restricted to primates, but over 100 bird species have now been reported to use tools in the wild. We present the results of the first study on avian dunking behaviour (the immersion of food items in water), a behaviour considered to be proto-tool use. In experiments conducted in captivity and in the field on 90 banded Carib Grackles (*Quiscalus lugubris*) in Barbados, we demonstrated that (1) dunking rate in the field was influenced by food type and that moistening dry food seems to be one of dunking's major benefits; (2) most dunking observed in the field is performed by a minority of individuals, but the vast majority (86 %) of grackles tested in captivity were capable of dunking; (3) a higher density of conspecifics at a water source was associated with a lower dunking rate and an increased risk of kleptoparasitism when dunking; and (4) there were consistent individual differences in dunking and stealing frequency.

181 Silverman, Nevitt & Reid

Nearest neighbors as foraging cues factors affecting behavioral associations in the southern ocean. EMILY D. SILVERMAN, *School Nat. Res. & Environ., Univ. Michigan, Ann Arbor, MI*, GABRIELLE A. NEVITT, *Center Neurosci., Univ. California, Davis, CA*, and KEITH REID, *British Antarctic Surv., Cambridge, UK*.

We explore the foraging behavior of 8 species of Antarctic seabirds: Prion *Pachyptila* spp., diving petrel *Pelecanoides* spp., White-chinned Petrel *Procellaria aequinoctialis*, Wilson's Storm Petrel *Oceanites oceanicus*, Blue Petrel *Halobaena caerulea*, Soft-plumaged Petrel *Pterodroma mollis*, Cape Petrel *Daption capense*, and Black-browed Albatross *Thalassarche melanophris*. We quantify conspecific associations, as well as associations with albatross, penguins, and marine mammals, using data from replicated strip transects conducted in 2 distinct study areas near South Georgia over the course of 3 breeding seasons. This research extends previous results suggesting that birds forage co-operatively with conspecifics and use feeding albatross as resource cues. We present analyses demonstrating the extent to which conspecific foraging groups and heterospecific feeding associations vary between years and with location, as well as how these associations depend on oceanographic features, conspecific abundance, predator community structure, and prey distribution and abundance.

182 Beckmann & Brigham

The effects of perceived predation risk on incubation behaviour in two species of passerines. CHRISTA BECKMANN and R. M. BRIGHAM, *Dept. Biol., Univ. Regina, Regina, SK*.

This study contrasted the behavioural response of Mountain Bluebirds and Tree Swallows to predator presence during the incubation period. Mountain Bluebird males provision the incubating female whereas male Tree Swallows do not. Theory predicts that incubating females or provisioning males must tradeoff the benefits of these behaviours with the risk of attracting predators when feeding. Previous studies have not looked at the reaction of incubating females in species where males do not provision. In the presence of a predator, I predicted increased nest attentiveness, with an associated reduction in activity around the nest. Preliminary results show that female Tree Swallows altered their behaviour when in the presence of a predator, increasing the length of both their on- and off-bouts. Female Mountain Bluebirds varied greatly in their response to the predator model. Male bluebirds showed a slight reduction in number of feeding trips made to the nest when in the presence of a predator.

183 Perlut, Donovan & Strong

The effects of hayfield management on the social mating system of Savannah Sparrows. NOAH G. PERLUT, THERESE M. DONOVAN, *USGS. Vermont Coop. Fish & Wildl. Res. Unit, Burlington, VT*, and ALLAN M. STRONG, *Rubenstein School Environ. & Nat. Res., Univ. Vermont, Burlington, VT*.

Obligate grassland species like the Savannah Sparrow are experiencing precipitous annual population declines (-1.7%/yr) throughout New England. In Vermont, current declines may be linked to the intensification of grassland management. Current grassland management includes earlier first-haying dates (late-May) and shorter intervals between haying events (35 d). These management practices have severe repercussions for songbirds because early-haying results in nest failure. However, Savannah Sparrows typically renest following haying and initiate new nests synchronously. This synchronous renesting may alter the mating system of traditional polygynous species. We studied the social mating system of Savannah Sparrows in 2 grassland management types, early-hayed and late-hayed hayfields. We monitored the social mating system of color-banded adults, identifying the number of females associated with each male before and after a haying event. Prior to haying, 61% of females were monogamously paired. Renesting patterns were variable between years. However, between 95 and 100% of all Savannah Sparrows adopted a monogamous mating system after early-haying caused complete failure. On the late-hayed fields, 53 to 57% of pairs were monogamous. These renesting decisions may be critical in the ability to successfully reproduce on early-hayed fields. This study provides information on how hayfield management affects the behavioral ecology of Savannah Sparrows nesting in intensively managed agricultural ecosystems.

184 Murphy

* Functional significance of elaborate plumage traits when expressed in both sexes: a case study of the Turquoise-browed Motmot. TROY G. MURPHY, *Dept. Neurobiol. & Behav., Cornell Univ., Ithaca, NY*.

Elaborately decorated monochromatic and monomorphic species have captured the attention of many researchers over the last decade, and there are 2 camps offering an explanation as to why both sexes maintain elaborate traits. The genetic correlation camp hypothesizes that females express elaborate traits non-adaptively due to shared genetics, and strong sexual selection on male characters. The adaptive camp hypothesizes that sexual selection can operate on both sexes (mutual sexual selection), and that both male and female plumage traits can confer a competitive advantage. In addition to sexual selection maintaining trait elaboration, natural selection could maintain elaborate traits in both sexes. To address these possibilities, I studied the adaptive value of the elaborate tail of the Turquoise-browed Motmot (*Eumomota superciliosa*). Both males and females of this striking species have a number of equally exaggerated plumage characters. The most notable of these is an elongate tail that terminates in large oval-shaped rackets that extend far below the body of the bird. Field studies and manipulative experiments were performed to test if the elaborate racket-tipped tail functions in a sexually selected context as a signal utilized in competition for mates, or if it functions in a naturally selected context.

185 Francis, Hebert, Zemplak & Stoeckle

Can Canadian birds be identified with a single genetic marker? CHARLES M. FRANCIS, *Natl. Wildl. Res. Centre, Canadian Wildl. Serv., Ottawa, ON*, and PAUL D. N. HEBERT, TYLER S. ZEMLAK, *Dept. Zool., Univ. Guelph, Guelph, ON*, and MARK Y. STOECKLE, *Rockefeller Univ., NY*.

Uniquely identifying bird species from a simple genetic marker could be valuable for identifying partial samples, such as remains from airplane strikes, blood meals in mosquitoes, or meat samples confiscated from hunters, as well as for detecting cryptic species. We tested the utility of a ~650 base pair sequence of the cytochrome oxidase I (COI) mitochondrial gene for identification of Canadian birds. This gene was selected because it is found in all animal life forms, and thus has the potential to be a universal marker for all animal life (a genetic "barcode"). All of the 260 species we sequenced had unique markers, with inter-specific differences generally >2%. However, there were a few species pairs (oystercatchers, crows) as well as 1 species complex (white-headed gulls, *Larus* spp.), for which differences were small, and may not prove to be reliable. Intra-specific differences (examined in 120 species) were generally much smaller (< 0.25%) than inter-specific differences. The exceptions were 4 species that may prove to represent species pairs: Warbling Vireo, Marsh Wren, Eastern Meadowlark, and Solitary Sandpiper (the first 3 have been previously recognized as distinct by some authors). These results indicate that this marker not only can identify birds, usually down to individual species, but can also assist with determining species boundaries.

186 Lampila, Orell, Koivula & Belda

Importance of adult survival, local recruitment and immigration in a declining boreal forest passerine, the Willow Tit. SATU LAMPILA, MARKKU ORELL, KARI KOIVULA, *Dept. Biol., Univ. Oulu, Oulu, Finland*, and EDUARDO BELDA, *Univ. Polit., Valencia, Spain*.

We studied population growth rate and its components in the Willow Tit *Parus montanus* in n. Finland. We used capture-recapture statistical models to estimate population parameters. From 1991 to 2002, the population growth rate (λ) was close to 1.0 with considerable temporal process variation (mean = 0.988, Coefficient of Variation, CV = 0.20). Adult survival (0.593, CV = 0.07) had the highest relative contribution (0.64) to the population growth rate and it was the least variable trait. Immigration had higher relative contribution (0.22) to λ than local juvenile survival (0.14). Variance in growth rate was related to variation in local juvenile survival and immigration. Thus, variation in recruitment determines the variation in λ above its magnitude set by adult survival. Taken into account information from long-term census data, the results suggest that the Willow Tit is approaching the "Vulnerable" status in Finland according to IUCN criteria. Population projections, considering time spans of varying lengths imply that if the present processes continue the population will most likely decline. We also discuss if observed variation in survival probabilities or population growth rate can be partly explained by climate. We use North Atlantic Oscillation index to describe the conditions.

187 Allen, Burt & Conner

Bachman's Sparrow, Brown-headed Nuthatch and Pine Warbler habitat preferences in east Texas. ROBERT J. ALLEN, D. BRENT BURT, *Dept. Biol., Stephen F. Austin State Univ., Nacogdoches, TX*, and RICHARD N. CONNER, *Southern Res. Sta., U.S. Forest Serv., Nacogdoches, TX*.

We present data on habitat preference patterns of Brown-headed Nuthatches and Bachman's Sparrows. Both species show range-wide population declines and are species of management concern. We contrast the habitat preferences of these species to that of Pine Warblers, a species with stable populations. The nuthatch and sparrow show strong preferences for pine savannah habitats with little hardwood midstory or understory and a high percentage of tall grasses. Bachman's Sparrows show a preference for a certain degree of canopy cover that still allows for growth of a grassy understory. Pine Warblers are more tolerant of hardwood intrusion. Bachman's Sparrows also use clearcut habitats but further studies are needed to document the suitability of this habitat for successful nesting.

188 Betts, Diamond, Forbes & Gunn

Predicting site occupancy of forest birds using air-photo-derived forest inventory data. MATTHEW G. BETTS, *Fac. Forestry, Univ. New Brunswick, Fredericton, NB*, ANTHONY W. DIAMOND, *Dept. Biol., Univ. New Brunswick*, GRAHAM J. FORBES, *Fac. Forestry, Univ. of New Brunswick*, and JOHN GUNN, *Round River Ecology, Bethel, ME*.

An essential tool in species conservation is reliable knowledge about the spatial distribution of animals at large scales. However, the time required to collect information on distributions of species at fine resolutions (individual forest stands) across large scales is often prohibitive. We developed predictive spatial models at multiple scales for 20 forest bird species based on air-photo-derived forest inventory data using Geographic Information Systems (GIS) in s. New Brunswick. We compared the predictive success of these models to models that used ground-based vegetation inventory data as independent variables. We also asked whether incorporating spatial dependency into models (via autologistic regression) would increase prediction success. Local prediction success was tested using 10-fold cross validation. Within-region prediction success was tested on independent data from n. New Brunswick (~250 km distant). Prediction success ranged from 59 to 85% for GIS models (mean 74.0% \pm 1.7 SE) and from 62 to 88% for ground-based vegetation models (mean 75.9% \pm 1.4 SE). Prediction success of ground-based vegetation models was significantly better than GIS models for 3 of 20 species. Models accounting for spatial dependency had superior prediction success to logistic models in all cases, but only significantly so for Black-throated Green Warbler and Yellow-bellied Flycatcher. We conclude that for many relatively common forest bird species, air-photo-derived GIS data can be used to successfully predict forest bird site occupancy at fine resolutions. Such models may be useful to managers interested in monitoring the direction and magnitude of habitat change in relation to forest management activities.

189 Lampila, Mönkkönen & Desrochers

Demographic responses by birds to forest fragmentation. PETRI LAMPILA, MIKKO MÖNKKÖNEN, *Dept. Biol., Univ. Oulu, Oulu, Finland*, and ANDRÉ DESROCHERS, *Faculté de foresterie et de géomatique, Univ. Laval, Sainte-Foy, QC*.

We studied demographic responses of birds to forest fragmentation with a meta-analysis of survival, fecundity and nesting success data obtained from scientific literature. Birds were divided into subgroups on the basis of region, nest site, biogeographical history and migration strategy. Species most sensitive to fragmentation were ground- or open-nesters nesting in shrubs or trees. Residents were equally sensitive to fragmentation in the Nearctic and Palearctic regions, but Nearctic migrants were more sensitive than Palearctic migrants. Responses of Old World and New World faunal types differed, which was predicted based on the history of forest fragmentation on these 2 continents. Pairing success was the variable most associated to fragmentation, suggesting an important role of dispersal. Fledgling number or condition, timing of nesting and clutch size were not associated with sensitivity to fragmentation, suggesting that negative fragmentation effects on birds do not generally result from diminished food resources with increasing level of fragmentation. However, data available at present, and associated inferences, are mostly restricted to boreal and temperate regions and thus may not apply elsewhere.

190 Gannon, Cooper & Moore

* The importance of flooding on depredation of Prothonotary Warbler nests in a bottomland hardwood forest: a proportional hazards model. JILL GANNON, ROBERT J. COOPER, *Warnell School For. Res., Univ. Georgia, Athens, GA*, and C. T. MOORE, *Warnell School For. Res. and USGS Patuxent Wildl. Res. Center*.

Prothonotary Warblers breed within the seasonally flooded bottomland hardwood forests of the Mississippi Alluvial Valley, have exhibited population declines in this region, and are a Partners In Flight species of concern. Nest depredation is the most important mortality factor for this songbird. The likelihood of nest depredation may be influenced by physical characteristics surrounding the nest site. We developed a Cox regression model to assess the importance of various habitat characteristics at multiple spatial scales (micro-scale, macro-scale, and landscape-scale) on the depredation likelihood of Prothonotary Warbler nests. We used data collected during 1996 - 2000 within the White River National Wildlife Refuge, Arkansas. Nest depredation was the leading cause of nest failure, accounting for >80% of nest terminations over all years. The hazard of nest depredation was related to several physical characteristics of the nest site, including hydrological variables that described the timing, spatial extent, and duration of flooding. The hazard of nest depredation was negatively related to water at all 3 spatial scales, suggesting that water affords protection to nests. Proposed water management projects affecting the White River may change the existing flooding regime and have the potential to negatively affect productivity of the Prothonotary Warbler in this area.

191 Zimmerman, Lahaye & Gutiérrez

Finite study areas and vital rates: sampling effects on estimates of Spotted Owl survival and population trends. GUTHRIE S. ZIMMERMAN, WILLIAM S. LAHAYE and R. J. GUTIÉRREZ, *Dept. Fish., Wildl. & Cons. Biol., Univ. Minnesota, St. Paul, MN*.

Permanent emigration from study areas of finite size can bias estimates of survival and population trend. Management and conservation decisions about Spotted Owls are sometimes based on population trajectories that were calculated using survival estimates from finite study areas, which has led to controversy over their conservation. We used mark-recapture to monitor an insular population of owls in s. California, for which we knew the approximate true survival rate. We defined study areas of varying size by subsampling territories, and then estimated apparent survival for owls within each sample study area to assess how sampling finite study areas may influence estimates of survival and population trends from stage-based Leslie matrices (λ_{pm}). Annual apparent survival rates of territorial owls were similar for the smallest subsample ($\phi = 0.776$ estimated from 20 territories) and the entire mountain range ($\phi = 0.806$ estimated from 143 territories). Territorial owls had low annual emigration probabilities from all sample study area sizes (range = 0.003 - 0.031). In contrast, emigration probabilities of juveniles were high for most sample study areas (range = 0.026 - 0.651), which resulted in an increasing probability of juvenile apparent survival ($\phi_{min} = 0.121$, $\phi_{max} = 0.331$) as a function of sample study area size. Estimates of λ_{pm} gradually increased from 0.834 to 0.906 as subsample size increased from 20 to 143 territories. Confidence intervals of these estimates did not overlap the estimate obtained using all territories until sample area was 730 km² (70 territories).

192 Hanowski, Brown, Host & White

How can we use bird species historic population ranges to set conservation priorities? JOANN HANOWSKI, TERRY BROWN, GEORGE HOST and MARK WHITE, *Nat. Resources Res. Inst., Univ. Minnesota, Duluth, MN.*

Almost all conservation models developed for bird species include an assessment of the current population trend. Species with declining trends are usually given higher conservation priority than species with increasing trends. Often the only population trend available for conservation assessments is from Breeding Bird Surveys (BBS) conducted across North America over the past 35 yr. Although population trends from these surveys are statistically reliable for many species, the reference time used to calculate trends may not always be appropriate. We calculated historic ranges of bird populations for 40 breeding species in n. Minnesota. We compared these values to a calculated current population, BBS trends, and trends from a regional monitoring program. We found that current populations of species that prefer early-successional forests are above the maximum number that occurred in the region historically, including species that are declining in population based on BBS. In contrast, current populations of species that occur in late-successional, conifer dominated forests are lower than their minimum historic populations. Some of these species have increasing BBS trends. Our examples show that regional conservation priorities for birds should consider historic ranges of species populations as a benchmark rather than trends calculated from any one point in time.

193 Spellman, Riddle & Klicka

* Genetic consequences of the Late Quaternary: lessons from phylogenetic and coalescent analyses of the Mountain Chickadee. GARTH M. SPELLMAN, BRETT RIDDLE and JOHN KLICKA, *Barrick Mus. and Dept. Biol. Sci., Univ. Nevada Las Vegas, Las Vegas, NV.*

Since the late 1990s, molecular techniques have fueled debate about the role of Pleistocene glacial cycles in structuring contemporary avian diversity in North America. The debate is still heated; however, there is widespread agreement that the Pleistocene glacial cycles forced the repeated contraction, fragmentation, and expansion of the North American biota. These demographic processes should leave genetic "footprints" in modern descendants suggesting that detailed population genetic studies of current species provide the key to elucidating the impact of the Late Quaternary (late Pleistocene - Holocene). We present a detailed coalescent analysis of the mtDNA variation in the Mountain Chickadee (*Poecile gambeli*) in an attempt to examine the genetic evidence of the impact of the Late Quaternary glacial cycles. Phylogenetic analyses reveal 3 strongly supported clades of *P. gambeli*. The first split occurs between *P. gambeli* in the Sierra Nevada and Southern Cascade Ranges and those in the Rocky Mountains and Great Basin Ranges (as demonstrated before, Gill et al. 1993, **Evolution** 47: 195-212.). The other clade is a monophyletic lineage comprised of individuals from the mountains of s. California, and coalescent analysis suggests it diverged from the larger more widespread Sierra Nevada clade within the last 400,000 to 300,000 generations with little to no recurrent gene flow between the populations. Coalescent analysis of the Rocky Mountain and Great Basin clade suggests: 1) that it has undergone a recent and explosive population expansion; 2) southern and proposed refugial populations harbor the most genetic diversity; 3) migration rates into the Great Basin populations exceed the migration rates out of the Great Basin suggesting a source-sink dynamic.

194 Meadows, Emslie & McCartney

Molecular sexing and sex-ratio analysis of Royal Terns nesting on the U.S. Atlantic coast. MELISSA G. MEADOWS, STEVEN D. EMSLIE and MICHAEL A. McCARTNEY, *Dept. Biol., Univ. North Carolina at Wilmington, Wilmington, NC.*

Royal Tern populations that breed on the east coast of the U.S. are currently threatened by human encroachment in their breeding areas as well as by marine pollutants (Blus et al. 1979, **Biol. Cons.** 18: 301-320; Maness & Emslie 2001, **Waterbirds** 24: 352-360). These birds are long-lived, have low reproductive rates, and only breed in a specific environment (Buckley & Buckley 1972, **Ibis** 114: 344-359). Decadal averages since the 1970s indicate about a 13% decline in nesting terns (Maness & Emslie 2001). With populations declining and threats mounting, it is important to know as much about the population as possible. This study estimates the sex-ratio of current populations as well as how they have changed over the past 5 yr. Since Royal Terns are sexually monomorphic, sexing was accomplished molecularly utilizing CHD-Z and CHD-W genes on the sex chromosomes.

Results indicate that Royal Terns may have a female-biased chick sex-ratio and a male-biased adult sex-ratio. Female-biased adult mortality may occur in this species, and the female-biased chick sex-ratio may be an adaptive attempt to correct the adult male-bias. It also is possible that endocrine disruption, caused by pollutants, is bringing about population-level changes in sex-ratios.

195 Drapeau, Leboeuf & Imbeau

Habitat use of birds in highly fragmented landscapes of the Canadian eastern boreal forest. PIERRE DRAPEAU, MICHEL LÉBOEUF, *Département des sciences biologiques, Université du Québec à Montréal, Montréal, QC*, and LOUIS IMBEAU, *Département des sciences appliquées, Université du Québec en Abitibi-Témiscamingue*.

Negative effects of the configuration (size, shape and isolation) of remnant forests within disturbed areas begin to influence populations at specific levels of habitat disruption. In landscapes fragmented by agriculture this may not occur until >70% of the original habitat is removed. In landscapes under extensive forest management, studies have found so far that avian species mainly respond to the regional loss of forest cover whereas response to the configuration of forest remnants is weak. This lack of relationship of birds with landscape configuration may partly reflect the fact that on a regional scale, the forest cover rarely falls below the 30% threshold. Hence, configuration effects on birds may be dampened by the proximity to large blocks of unmanaged forest. Here, we examine the response of birds associated with mature and older forest cover types in timber harvested landscapes embedded in a highly fragmented regional context (6,500 km² area where 85% of the forest cover has been harvested) of the Canadian eastern boreal forest, in the Abitibi region, Québec. We surveyed birds in habitat remnants (linear cutblock separators, riparian buffers and forest fragments) with point counts and song playbacks. Our results indicate that forest associates are tolerant to forest fragmentation in this ecosystem, with detection probabilities of single species being higher than expected given the high degree of habitat fragmentation. However, these birds are significantly affected by the configuration of habitat remnants in the transformed matrix (isolation from large forest tracts >500 ha). We discuss the consequences of these results on the spatial distribution of cutover areas and the retention of large continuous forest tracks in managed forest landscapes.

196 Thomson, Forsman & Mönkkönen

Breeding predators influence the spatial dynamics and reproductive success of their prey. ROBERT L. THOMSON, JUKKA T. FORSMAN and MIKKO MÖNKKÖNEN, *Dept. Biol., Univ. Oulu, Oulu, Finland*.

Little is known about the influence of avian predation risk at larger scales, in particular, how prey habitat selection and resulting fitness is related to predator spatial dynamics. In birds, habitat selection is of critical importance to reproductive success and determines the foraging conditions for the breeding season. Breeding avian predators pose a threat to adult individuals, however, they may also provide protection from destructive nest predators. Therefore, an optimal territory location may exist where the risk and protection effects are at a trade-off. We determine the effect of a proposed "predation risk landscape" and optimal territory location on the initial habitat selection, and resulting fitness in the Pied Flycatcher (*Ficedula hypoleuca*). By placing nest boxes at different distances from breeding *Accipiter* spp. we found that flycatchers showed avoidance in habitat selection of 'high threat' hawk species nests. Furthermore, the earliest arriving individuals showed preference for sites at intermediate distances, resulting in a unimodal relationship with distance from hawk nest. The non-lethal effects of predation risk, expressed by nestling quality, showed a positive relationship with distance. Flycatchers close to 'high threat' hawk species nests produced smaller offspring than those further away. Evidence suggested that flycatchers do not actively seek 'low risk' hawk species nests which could provide protection against nest predators. Our results support the existence of a predation risk landscape and we emphasise the importance of predation risk related decisions at the macro-scale.

197 Damania, Phillips, Henson & Hayward

Habitat patch occupancy dynamics of Glaucous-winged Gulls: a continuous-time model. SMRUTI P. DAMANIA, KARL W. PHILLIPS, *Biol. Dept., Andrews Univ., Berrien Springs, MI*, SHANDELLE M. HENSON, *Dept. Math., Andrews Univ.*, and JAMES L. HAYWARD, *Biol. Dept., Andrews Univ.*

The diurnal distribution and abundance dynamics of loafing Glaucous-winged Gulls were examined at Protection Island National Wildlife Refuge, Washington. Asynchronous movement of gulls between 3 habitat patches dedicated to loafing was modeled as a function of environmental

variables using differential equations. Multiple time scale analysis then led to the derivation of algebraic models for habitat patch occupancy dynamics. The models were parameterized with hourly census data collected from each individual habitat, and the resulting model predictions were compared to observed census data. The 4-compartment model, which was based solely on the strength of environmental cues to direct gull movement across different habitats, explained 36% of the variability of the observations from the mean. Models that predict the dynamics of organism distribution and abundance enhance the understanding of the temporal and spatial organization of ecological systems, as well as the decision-making process in natural resource management.

198 Smith, Burke & Nol

The effects of silvicultural practices on the reproductive success of a neotropical migrant, the Rose-breasted Grosbeak, in a fragmented landscape. LYNDSEY A. SMITH, *Watershed Ecosys. Grad. Prog., Trent Univ., Peterborough, ON*, DAWN M. BURKE, *Ontario Ministry Nat. Res., London, ON*, and ERICA NOL, *Dept. Biol., Trent Univ.*

In a fragmented landscape songbird populations are at risk of low reproductive success due to increased nest parasitism and predation rates. In most highly fragmented landscapes many of the remaining small woodlots are at risk of further degradation and stress due to logging practices. The Rose-breasted Grosbeak is a species that breeds in the interior and edges of deciduous woodlands and is becoming a conservation concern in North America due to recent population declines. From 2000 - 2003 we monitored 118 Rose-breasted Grosbeak nests in 19 woodlots. Eight woodlots were reference sites which have not been harvested for 25 yr, 5 woodlots have been harvested by standard selection according to OMNR Silvicultural Guidelines and 6 woodlots have been harvested by heavy cut methods. These harvests occurred from 1995 - 1999. Daily nest survival estimates were not found to be affected by silvicultural treatment type (reference 0.944, standard selection 0.932, diameter limit 0.937). Rates of nest predation were high across all sites (71%). Nest parasitism rates by Brown-headed Cowbirds varied by treatment type (reference 22%, standard selection 7%, diameter limit 13%) but these results were not significant. The mean number of Brown-headed Cowbird eggs/nest and the mean number of fledglings produced/successful nest did not differ between reference sites, standard cut sites and heavy cut sites. These results show that on the local scale, daily nest survival of this species is not affected at a stage of 5 - 9 yr post-harvest.

199 Haribal & Dhondt

Uropygial gland secretions of antbirds. MEENA HARIBAL and ANDRÉ DHONDT, *Lab. Ornithol., Cornell Univ., Ithaca, NY*.

Uropygial gland secretions of several species of antbirds – Slaty Antshrike, Fasciated Antshrike, Dusky Antbird, White-bellied Antbird, Chestnut-backed Antbird and Bicolored Antbird (family *Thamnophilidae*) – and Black-faced Antthrush (family *Formicariidae*) were collected in Panama and were analyzed for their chemical contents. The chemical composition varied among the species, although there were some similarities in some of the species. The secretion of Black-faced Antthrush was considerably different from some of the species of *Thamnophilidae*. The compositions of antbirds also differed considerably from those of the birds of temperate regions. The differences in chemistry of secretions suggest different ecological functions.

200 Devlin & Diamond

Sexing seabirds: how useful are discriminant functions? CATHERINE M. DEVLIN and ANTONY W. DIAMOND, *Dept. Biol. and Atlantic Coop. Wildl. Ecol. Res. Network, Univ. New Brunswick, Fredericton, NB*.

As field biologists we seek ways of identifying our study species as quickly as possible. Many of our questions deal with differences between the sexes, and with some species telling them apart is often a challenge. Many seabird species are difficult to sex because males and females are of similar color and size. However, differences between the sexes can be found through the use of genetics and morphometrics. We examined the sexual size dimorphism of Arctic Terns from a breeding colony in northern North America. Each bird was sexed using DNA extracted from feathers. Body morphometrics recorded included mass, natural wing chord, head-bill, tail fork, culmen, depth of bill at the gonys, and tarsus. Two discriminant functions identified head-bill and bill depth as the best measurements to identify the sexes. Male Arctic Terns were generally larger in head-bill and bill depth than female Arctic Terns; however we did not find evidence for assortative mating. It is possible to calculate the probability of sexing individuals and this can help determine the usefulness of the discriminant functions. For some species where there is a high degree of size overlap between sexes, it may be

necessary to use a combination of morphometrics and genetic analysis to obtain the highest accuracy of sexing individuals correctly. Comparison of the morphometrics of northeastern North American and British populations of Arctic Terns suggests that the discriminant functions we developed can be applied to both.

201 Mather, Ward & Barboza

* Winter body morphology of Pacific Black Brant: phenotypic plasticity associated with costs of migration and wintering location. DANIELLE D. MATHER, *Dept. Biol. & Wildl., Univ. Alaska, Fairbanks, AK*, DAVID H. WARD, *USGS, Alaska Sci. Center, Anchorage, AK*, and PERRY S. BARBOZA, *Inst. Arctic Biol., Univ. Alaska, Fairbanks, AK*.

We examined body morphology and composition of adult female brant (*Branta bernicla nigricans*) collected between late Oct 2002 and early May 2003. Brant were collected concurrently in Alaska and Baja California, Mexico, to compare differences in body morphology associated with 2 wintering strategies: 1) to remain in an unstable and harsh environment but close to breeding grounds or 2) to migrate long distances to a stable and mild environment, but distant from breeding grounds. Birds resident in Alaska lost body mass (179 g) in early winter whereas migrants maintained mass in Mexico. Mean body masses were the same in mid-winter, regardless of location. Both groups then gained mass in late winter (140 - 151 g). Alaska birds lost visceral adipose (52 g) through early winter while Mexico birds maintained adipose. Conversely, Mexico birds gained visceral adipose (53 g) before migration and Alaska birds maintained adipose. Although mass of lean body components remained relatively constant over time and between locations, weights of gonads and liver of Alaska birds were greater than those of Mexico birds at the end of winter. These data indicate that Alaska birds begin preparation for breeding before Mexico birds. Furthermore, net adipose loss in Alaska during early winter was equivalent to adipose gains in Mexico during late winter, which suggests that the net energy reserves for wintering in Alaska is equivalent to the reserves required for migration. Brant use the same plasticity of adipose tissue to support 2 contrasting strategies: potentially breeding earlier at the risk of a severe winter versus migrating long distances at the lesser risk of a mild winter.

202 Butler, Rohwer & Speidel

* Quantifying body feather structure to address ecological, evolutionary, and life history questions. LUKE K. BUTLER, SIEVERT ROHWER, *Burke Mus. Nat. Hist. and Dept. Biol., Univ. Wash., Seattle, WA*, and MARKUS SPEIDEL, *Honolulu, HI*.

Body feathers are important to numerous interactions birds have with their physical and social environments. Despite the importance of body feathers, we largely lack a system for quantifying their structural variation and assessing its functional significance. We developed a method for quantifying structural variation in body feathers, according to the size, number, and arrangement of feather elements such as the barbs and the rachis. We applied our method to adults and juveniles of 1 woodpecker and 9 passerines. Interspecific and age class differences explained most of the variance in most structure measurements, and within a species and age class, there was relatively little effect of the individual or feather that was sampled. Our method can be applied to plucked feathers and to feathers attached to museum specimens. Furthermore, because our method provides a way to quantify the structural quality of feathers, it may offer a way to test the hypothesis that extended breeding activities in the current breeding season result in the production of low-quality body feathers in the subsequent molt, which in turn has costs for future survival and reproduction (Nilsson & Svensson 1996, *Proc. Royal Soc. Lond.* 263B: 711-714). We discuss some simple but interesting patterns in feather structure, with the overall aim of demonstrating that systematic study of body feather structure may offer important insights into avian physiology and life history.

203 Ardia

* Factors affecting nestling immune responses: body condition, spleen size and parental quality. DANIEL R. ARDIA, *Dept. Ecol. & Evol. Biol., Cornell Univ., Ithaca, NY*.

The quality of offspring is a prime determinant of reproductive success. I examine factors affecting an important measure of offspring quality, immunocompetence, through a cross-fostering brood manipulation in European Starlings. I first found that exposure to a cell-mediated immune challenge of PHA did not lead to increased spleen size, thus making comparisons between spleen size and immune function valid. Nestlings in higher body condition or with proportionally larger spleens tended to mount stronger immune responses to PHA. An examination of the immune performance of nestlings born and raised in their home nest versus nestlings born in the home nest

but raised elsewhere revealed 2 influences on immune function: body condition and clutch size (an indicator of female quality). As the difference in body condition between siblings increased, the magnitude of the difference in immune response also increased. Home-reared nestlings raised in nests with a large positive difference in clutch size between home-reared and out-reared nests tended to mount stronger immune responses than did their out-reared siblings. This paper provides the first evidence that relative spleen size is linked with immune function. Overall, nestling immune function appears to be strongly influenced by maternal quality through genetic and environmental influences.

204 Perkins & Holberton

* Patterns of hormone secretion reflect shared parental effort in a monogamous Arctic-breeding shorebird. DEBORAH E. PERKINS and REBECCA L. HOLBERTON, *Dept. Biol. Sci., Univ. Maine, Orono, ME.*

To better understand how high latitude breeders successfully regulate energy reserves, we investigated hormonal mechanisms associated with energy demand and sex-specific parental effort in Ruddy Turnstones in Nunavut. Unpredictable changes in energy demand trigger production of corticosterone (CORT), the major hormone associated with energy regulation in birds. Plasma CORT levels rise rapidly within minutes of a disturbance ("the adrenocortical response"). Previous studies have shown some Arctic-breeders reduce this response during critical breeding stages, possibly delaying the onset of life-saving behaviors that may compromise breeding success (e.g., desertion). Birds were trapped and sampled at the mid-incubation, late incubation, and early brooding stages to measure the strength of the adrenocortical response. Relative incubation effort was assessed by 24-h watches during mid- and late incubation. Males and females contributed equally to incubation. The sexes did not differ in their patterns of CORT secretion during mid-incubation or early brooding. Males and females (sexes pooled) showed a significant difference in their CORT profiles between mid-incubation and early brooding. Baseline CORT was significantly higher during early brooding compared to mid-incubation. In contrast to previous information, male and female turnstones share incubation duties equally, and this is reflected in their similar patterns of CORT secretion. Caring for precocial young can be demanding for high latitude breeders; an increase in baseline CORT during brooding may be the proximate mechanism to meet the higher demands of parental care by facilitating additional foraging and feeding. The reduced adrenocortical response during brooding may be a mechanism to increase the threshold for abandonment when faced with few or no renesting opportunities.

205 Holloran & Anderson

* Spatial distribution of Greater Sage-Grouse nests in relatively contiguous sagebrush habitats. MATTHEW J. HOLLORAN and STANLEY H. ANDERSON, *Wyoming Coop. Unit, Univ. Wyoming, Laramie, WY.*

Protection of suitable Greater Sage-Grouse nesting habitat within 3.2 km of occupied leks has been a standard management recommendation since the 1970's, and the current sage-grouse management guidelines (Connelly et al. 2000, *Wildl. Soc. Bull.* 28: 967-985) recommend using leks as focal points for management efforts in areas with uniformly distributed habitats. We investigated greater sage-grouse nest spacing and the spatial distribution of nest relative to lek location using radio-marked birds residing in relatively contiguous habitats in w. Wyoming. Observed numbers of nests became less than expected (based on random point distributions) 4.5 to 5.0 km from the lek. Lek-to-nest distance tended to be greater for successfully hatched vs. predator-destroyed nests. Nests tended to be clustered on the landscape relative to random points. Although the probability of destruction did not differ between clustered and scattered nests, pairs of clustered nests tended to experience the same fate (i.e., both successfully hatched or both destroyed). Females nesting in consecutive years positioned subsequent year's nest closer to previous year's nest compared to average nest-to-nest distances for separate individuals, suggesting site area fidelity. However, if the previous year's nest was destroyed, females moved farther to nest the subsequent year compared to females successfully hatching the previous year. These results suggest that in contiguous habitats (1) a 3.2 km buffer around leks might not accurately delineate selected nesting areas; (2) the direct identification of selected nesting areas might be required to adequately delineate potential nesting habitat; and (3) the quantity of suitable nesting habitat could be important for increased hatching success probabilities.

206 Fisher & Wiebe

* Opposing selection pressures on nest site choice by Northern Flickers: effects of predation and eviction. RYAN J. FISHER and KAREN L. WIEBE, *Dept. Biol., Univ. Saskatchewan, Saskatoon, SK.*

Nest predation is often a major source of nest loss for birds and thus may significantly reduce parental fitness. One way to combat nest predation is to choose a safe nest site based on habitat cues associated with nest success. We examined whether certain nest site characteristics of Northern Flickers were associated with an increased probability of predation (mainly by red squirrels, *Tamiasciurus hudsonicus*) or eviction by European Starlings. We measured a suite of nest site characteristics at 4 progressively larger habitat scales and then used logistic regression to compare successful versus depredated nests and successful versus nests lost to eviction. Nest cavities were safer from mammalian predators if they were higher, deeper, more concealed, and further from coniferous edges. While proximity to conifers appeared to increase predation risk, nests that were safe from eviction were closer to conifers, further from edges and had a higher percentage of conifers in the clump. Our results suggest that flickers face opposing and complementary nest selection pressures in a community with variable predators and nest competitors. Flickers may face a trade-off in nest choice to avoid either predation or eviction.

207 Beissinger, Cook & Arendt

The "shelf life" of bird eggs: experimental analysis of egg viability using a tropical climate gradient. STEVEN R. BEISSINGER, MARK I. COOK, *Ecosystem Sci. Div., Univ. California, Berkeley, CA*, and WAYNE J. ARENDT, *USDA Forest Service, Palmer, PR.*

Studies testing adaptive functions of brood reduction assume eggs are protected by their shells and nascent, but initiating incubation before clutch completion may be necessary to maintain viability of early-laid eggs, which diminishes over time due to putative effects of ambient temperature. We tested effects of exposure on egg viability using an altitudinal climate gradient in Puerto Rico by exposing eggs to a critical set of thermal environments: daily maximum temperatures always exceed developmental zero in the lowland forest, but rarely in the cloud forest and at intermediate altitudes. We removed 382 freshly laid Pearly-eyed Thrasher (*Margarops fuscatus*) eggs, exposed them for 1 - 7 d, and returned them to nests to be incubated. Hatching success of control eggs (82.0%) testing for effects of handling and movement did not differ from unmanipulated eggs (84.9%). Hatching success of experimental eggs exposed for 1 d (78.6%) was high, but declined very strongly after exposure for 3 d (41.9%), 5 d (11.5%) and 7 d (2.1%). Hatchability of eggs held at the cloud forest did not differ from eggs held at the lowland site, but was lower for eggs exposed at mid-elevation. Eggs held at the lowland had shorter developmental periods than eggs held at other sites. Most embryo mortality (80.8%) occurred at early stages and timing did not differ among sites. Our results demonstrate viability of unincubated eggs in moist tropical conditions declines strongly, indicate maintenance of egg viability may contribute to latitudinal declines in clutch size, and suggest ambient temperature is not the sole mechanism responsible for viability declines.

208 Cox

Snakes, fire, and the cooperative breeding system of the Brown-headed Nuthatch. JAMES COX, *Tall Timbers Res. Sta., Tallahassee, FL.*

The cooperative breeding system of the Brown-headed Nuthatch has not been well studied. I have color-banded adults ($n = 145$) and nestlings ($n = 123$) in a population in n. Florida and monitored 158 nesting attempts since 2001 to help elucidate aspects of the breeding system. The percentage of social breeding groups ranged from 10 - 38% annually, and some groups contained >3 adults. Morphometric analysis suggests most helpers were males born the previous year, though at least 1 helper was a second-year individual. The preponderance of male helpers suggests a shortage of available mates leads to cooperative breeding. This hypothesis is supported by higher annual mortality observed among females. Female mortality appears to be especially high during the nesting season when females were incubating and brooding. In 2004 I observed rat snakes killing adult females ($n = 3$) who were incubating/brooding. Mortality and depredation events were most common for second nests initiated late in the nesting season. Most re-nesting attempts occurred because prescribed fires destroyed earlier nests. Additional aspects of the nuthatch breeding system are discussed.

209 Schoech, Reynolds & Bowman

Food, stress, and sex: food supplementation, corticosterone, and reproduction in Florida Scrub-Jays. STEPHAN SCHOECH, JAMES REYNOLDS, *Dept. Biol., Univ. Memphis, Memphis, TN*, and REED BOWMAN, *Archbold Biol. Sta., Lake Placid, FL*.

A number of food supplementation studies confirm the importance of resources in the timing of reproduction. Our earlier studies have shown that supplemented Florida Scrub-Jays breed earlier than unsupplemented controls (CNT), and suggest that protein availability is critical in timing reproduction. We assessed the role of protein by providing free-living scrub-jays in natural habitat (wildlands) with supplemental diets that were high in fat and protein (HFHP) or high in fat but low in protein (HFLP). Jays in both supplemented treatments bred earlier than CNT jays, and HFHP jays bred earlier than HFLP jays. Endocrine mechanisms whereby nutritional information might affect reproduction was assessed by measuring testosterone in males, estradiol in females, and corticosterone (CORT) in both. HFHP males had higher testosterone than HFLP and CNT males, but estradiol levels of females did not differ by treatment. A long-term study of nearby suburban jays with year-round access to human-source foods found that these jays always breed earlier than wildland jays. Also, a pilot study of suburban jays suggests that CORT levels are lower in this human-altered habitat. We compared CORT levels across treatments and between populations. Suburban jays' CORT levels were lower than HFLP and CNT jays but did not differ from HFHP jays. CORT in HFHP jays was lower than HFLP and CNT jays. The differences in the timing of breeding, both between suburban and wildland populations and between food supplemented groups in the wildlands, may result from differences in the spatial and temporal predictability of food, the nutritional content of the diets, or both. Given that CORT and the upstream neuroendocrine secretions that lead to CORT secretion can negatively affect reproduction, we hypothesize that nutrient availability (especially protein), CORT, and timing of reproduction are inextricably linked.

210 Giacomo, Moss & Buehler

* Breeding bird populations in early-successional habitats at Fort Campbell Military Reserve, Kentucky/Tennessee. JAMES J. GIOCOMO, DANIEL MOSS and DAVID A. BUEHLER, *Univ. Tennessee, Knoxville, TN*.

Fort Campbell Military Reserve, located on the border of Kentucky and Tennessee, maintains various types of early-successional habitats to facilitate military exercises including airborne training, ground-based infantry, light-mechanized training, and various artillery range exercises that require open lands. Many of the open, early-successional habitats provide ideal training conditions due to their durability, greater visibility, and can be effectively managed with the use of fire. Providing suitable conditions for training activities also coincidentally provides excellent conditions for breeding bird habitat. Between 1999 and 2003, we monitored nesting success and productivity of 107 Yellow-breasted Chat, 79 Prairie Warbler, 91 Indigo Bunting, and 26 Blue Grosbeak nests. Nest success varied between 19% for Yellow-Breasted Chats to 38% for Prairie Warblers for all years, and Brown-headed Cowbird parasitism rates were relatively low, ranging from 4% for Prairie Warblers to 15% for Indigo Buntings. Predation was the primary cause of nest failure (85%). Other causes for nest failures included weather (4%), parasitism (1%), military training activity (3%), and abandonment (7%). Information collect during this study will be used to create population models to incorporate management for early-successional bird nesting habitat into the land management plans at Fort Campbell.

211 vacant**212 Rich**

Comparing the mean vulnerability of landbird avifaunas in North America's Bird Conservation Regions. TERRELL D. RICH, *U.S. Fish & Wildl. Serv., Boise, ID*.

The bird conservation initiatives in North America have agreed upon a set of polygons to use in bird conservation assessment and planning. These Bird Conservation Regions (BCRs) are seamless among Canada, the U.S., and Mexico. Partners in Flight also has updated its species assessment of landbirds whereby all species are scored from 1 (low vulnerability) to 5 (high vulnerability) on 6 pertinent factors, for example, population size and population trend. Thus, a highly vulnerable species is scored 30 and a secure species, 6. It is now possible to examine the pattern of mean vulnerability of landbird avifaunas among the 37 BCRs for which species assessment is complete. These BCRs cover all of Canada and the U.S., and that portion of n. Mexico that is included

in cross-border BCRs. Mean landbird species vulnerability ranged from a low of 12.08 in BCR3 to a high of 15.07 in BCR 34. Although there was a significant difference in mean vulnerability across BCRs ($F = 4.88$, $P < 0.0001$), there were large overlapping subgroups of BCRs whose mean scores were not significantly different. Mean vulnerability was positively correlated with westerly and southerly attributes of the BCRs and negatively correlated with area. This broad-scale analysis suggests that while mean landbird species vulnerability is greatest in the sw. U.S., geographic differences in vulnerability across the study area are not dramatic.

213 Powell & Taylor

Songbird movement in naturally heterogeneous and harvested landscapes. KRISTIN G. POWELL and PHILIP D. TAYLOR, *Biol. Dept., Acadia Univ., Wolfville, NS.*

Little is known about songbird movement patterns during the breeding season or the effects of clearcutting on these movements. We examined how landscape structure influenced patterns of bird movement at both the local (within-territory, non-dispersal movements, associated with raising young) and the landscape (between territory movements, juvenile dispersal) level by mist-netting. 2 harvested and 2 natural landscapes in w. Newfoundland were netted during the 2003 breeding season in order to quantify bird movement. Analyses were conducted to examine differences in movement frequency and pattern among different species and sexes in the 2 landscape types. Movements of many species were constrained in clearcut landscapes relative to natural landscapes. As well, landscape type was a significant predictor of the number of individuals recaptured. Results from these analyses can potentially be used to improve forest management strategies to minimize negative impacts on songbirds.

214 Parker, Stansberry, Gipson & Becker

Forest patch area and distance to edge related to settlement patterns of forest-nesting Neotropical migrant songbirds in eastern North America: range-wide patterns determined from meta-analyses. TIMOTHY H. PARKER, BROOKE M. STANSBERRY, PHILIP S. GIPSON, *Div. Biol., Kansas State Univ., Manhattan, KS*, and C. DUSTIN BECKER, *Dept. Hort., For. & Recreat. Res., Kansas State Univ.*

We incorporated all available published data in meta-analyses of forest edge and area effects on site occupancy patterns for 26 Neotropical migrant forest-nesting songbirds in eastern North America. All studies assessed an effect of edge on site occupancy, but some of these studies (putative area studies) were confounded by effects of area. Effect sizes tended to be higher for area studies than edge studies, and more species showed significant avoidance of small patches than of edges. Differences between edge and area studies may, in part, be due to distinct biological processes related to patch size versus forest edge. Studies of edge effects tended to be carried out in landscapes with higher forest cover than those of area effect, but this difference does not appear to be an important factor contributing to the different effect sizes in edge and area studies; when we analyzed area and edge effects separately, landscape forest cover did not tend to influence the strength of small patch or edge avoidance.

215 Guillemette & Larsen

Using post-development experiments to test the impact of an offshore wind park on sea ducks. M. GUILLEMETTE, *Dépt. Biologie, Univ. Québec à Rimouski, Rimouski, QC*, and J. K. LARSEN, *Kyed Consult, Skaneborg, Denmark.*

The development of offshore wind parks is set to expand rapidly in many European countries and U.S. Because marine wind parks are erected in shallow waters where most sea ducks feed, potential conflicts between sea ducks and wind parks is a genuine concern. In the context of a general impact assessment, we designed post-development experiments aiming to test the development of offshore wind parks is set to expand rapidly in many European countries and U.S. Because marine wind parks are erected in shallow waters where most sea ducks feed, potential conflicts between sea ducks and wind parks is a genuine concern. In the context of a general impact assessment, we designed post-development experiments aiming to test the effect of a small offshore wind park on sea ducks. The wind park was located in western Kattegat Sea (Denmark) and was mostly used by Common Eiders as a wintering area. During winter 1996 - 1997, we tested if (1) the abundance of ducks and (2) the spatial distribution of ducks changed in relation to running (on = treatment) and passive (off = control) turbines. No significant differences were found between the control and the treatment for these 2 variables. This result was further supported by a behavioral

experiment where flight and swimming behavior were recorded when turbines were switched-on from a motionless condition. In another experiment, we tested the effect of wind turbines on the flight behavior of Common Eiders by deploying "patch" of decoys at increasing distances from the wind park. Significant reductions of landing frequency and flight frequency at close distance (100 m) from the wind park indicate that Common Eiders avoid flying and landing in the immediate vicinity of the wind park. These results are discussed in relation to the development of future offshore wind parks.

216 Erwin, Molina & Nichols

Gull-billed Terns on the edge? population declines and colony-site dynamics. R. MICHAEL ERWIN, *USGS Patuxent Wildl. Res. Center, Univ. Virginia, Charlottesville, VA*, KATHY C. MOLINA, *Los Angeles Co. Mus. Nat. Hist., Los Angeles, CA*, and JAMES D. NICHOLS, *USGS Patuxent Wildl. Res. Center*.

We conducted a status assessment of the Gull-billed Tern in North America, and found significant declines in breeding numbers in Virginia, North Carolina, and Florida since the mid-1970s. Breeding populations appear to be holding fairly stable in recent (10 - 20) yr in California, South Carolina, w. Mexico, and in Texas; in the latter state, however, numbers can vary wildly even between consecutive years. Threats to breeding populations include contaminants (Salton Sea, CA), human disturbance, sea-level rise, and mammalian predation (mid-Atlantic). In Virginia, we use a long-term database to examine how colony-site habitat (marsh vs. barrier island), colony size, and predator expansion (on barriers) affect colony-site turnover, i.e., the probability of a colony site being occupied in year $t + 1$, but not being occupied the previous year t . We follow similar Markov model methods to those used earlier (Erwin et al. 1998, *Auk* 102: 970-978). The ability of this species, with moderately low site tenacity, to move to different colony sites has become constrained in most areas because of predator presence, flooding threats, and inadequate management of dredge material islands.

217 Eggert, Terwilliger, Fleischer, Woodworth & Hart

Genetic structure in Hawaiian forest birds along an elevational gradient. LORI S. EGGERT, LAUREN TERWILLIGER, ROBERT C. FLEISCHER, *Genetics Prog., Smithsonian Natl. Mus. Nat. Hist., Washington, DC*, BETHANY WOODWORTH and PATRICK HART, *USGS Pacific Island Ecosys. Res. Center, Hawaii Natl. Park, HI*.

The introduction of exotic parasites and pathogens to Hawaii has had a significantly negative impact on native forest bird species. Those that have been most strongly affected are species whose populations inhabit low elevation habitats where warm temperatures allow the mosquito, *Culex quinquefasciatus*, to breed. At higher elevations, where temperatures are too low for mosquitoes, honeycreepers and other susceptible avian species have thus far escaped massive losses. Recently, fragmented but otherwise apparently stable populations of Amakihi (*Hemignathus virens*) have been seen in low-elevation habitats. Using microsatellite loci, we investigated population structure in 3 native forest birds, the Amakihi, the Apapane (*Himatione sanguinea*), and the liwi (*Vestiaria coccinea*), and 1 introduced species, the Japanese White-eye (*Zosterops japonicus*), along an elevational gradient on the Big Island of Hawaii. In the Amakihi, but in none of the other species, we found significant genetic structure. In the Apapane and liwi, our results match expectations based on behavioral observations. Genetic results for the Amakihi suggest that this species may be evolving resistance to avian malaria and possibly other exotic pathogens.

218 Kuntz, Gremillet, Berteaux, Butler, Woakes & le Maho

Physiological adaptation of Great Cormorant diving in Greenlandic waters. G. KUNTZ, *Chaire de Conservation des Ecosystèmes Nordiques, Univ. Québec à Rimouski, Rimouski, QC*, and *Centre d'Ecologie et Physiologie Energétiques, CNRS, Strasbourg, France*, D. GREMILLET, *Centre d'Ecologie et Physiologie Energétiques, CNRS, D. BERTEAUX, Chaire de Conservation des Ecosystèmes Nordiques, Univ. Québec à Rimouski*, P. J. BUTLER, A. J. WOAKES, *School Biol. Sci., Univ. Birmingham, Birmingham, UK*, and Y. LE MAHO, *Centre d'Ecologie et Physiologie Energétiques, CNRS*.

Great Cormorants live as far North as Greenland. Because of their wettable plumage, the thermoregulatory costs of Great Cormorants diving in cold arctic waters are supposed to be particularly high. These energy losses might be compensated via specific foraging techniques. We hypothesized that Great Cormorants from Greenland also present physiological adaptations to diving. Depth, heart rate and abdominal temperature were recorded in free-ranging birds using an implanted data-logger. Compared to birds from a temperate area in France, birds from Greenland performed

longer and deeper dives ($19 \text{ s} \pm 4 \text{ SD}$ and $8.9 \text{ m} \pm 2.5 \text{ SD}$). Values recorded during resting periods were similar to those known for Great Cormorants from other localities or from other cormorant species. During the entire dive cycle, heart rate ($236 \text{ beat/min} \pm 25 \text{ SD}$) was higher than during resting. However, during $65\% \pm 12 \text{ SD}$ of dives heart rate decreased below the resting value. Abdominal temperature fell progressively; the minimum value recorded being 17°C . The recorded bradycardia suggests a reduction in the metabolic rate that might enable Great Cormorants from Greenland to dive under harsh conditions despite their poor insulation. Hypothermia does not occur in Great Cormorants from other locations. Thus, this phenomenon might be involved in the metabolic rate reduction of Great Cormorants diving in Greenland.

219 Sillett & Runge

Predicting the effects of future changes in the El Niño Southern Oscillation on population dynamics of a migratory songbird. T. SCOTT SILLETT, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC*, and MICHAEL C. RUNGE, *Patuxent Wildl. Res. Center, U.S. Geol. Sur., Laurel, MD*.

In Black-throated Blue Warblers, demographic rates vary with fluctuations in the El Niño Southern Oscillation or ENSO. Adult survivorship, adult fecundity, and juvenile recruitment are lower than average in El Niño years and higher than average in La Niña years. We built a population model using demographic rates estimated from long-term field studies of this species. The model included mechanistic relationships for variation in demographic parameters driven by ENSO. We found that changing only the temporal autocorrelation of ENSO events can strongly affect both the variance and mean population density of warblers on breeding grounds; changing the variance and mean of ENSO events greatly magnifies this effect. We then linked our population model to output from climate model that projected changes in the ENSO cycle as a result of global warming. Our goal was to investigate the potential effects of future changes in the ENSO cycle on warbler population dynamics. Current climate models predict that the frequency and severity of El Niño years will increase, that is, the mean, variance, and autocorrelation of the ENSO cycle will change. When propagated through the population model, these forecast changes in ENSO lead to a lower mean and higher temporal variation in population density of Black-throated Blue Warblers.

220 Savard & Savard

A comparison of avian point count and spot mapping results in old and second growth forests of the Pacific Coast. JEAN-FRANÇOIS SAVARD, *Dept. Biol., Univ. Maryland, College Park, MD*, and JEAN-PIERRE L. SAVARD, *Canadian Wildl. Serv., Québec Region, Québec, QC*.

Point counts have become the preferred monitoring method for birds because of their field efficiency in terms of sampling effort. How well they estimate the breeding population, or at least provide an index of population size, is still debated. We analyzed a data set collected in the coastal forests of British Columbia to compare birds of old growth (>200 yr old) and second growth (40 - 80 yr old) forest stands. 4 point counts (75 m radius; 12 min. duration; 3 - 4 surveys) were located within each of the 23 spot mapping plots (13 - 20 ha) surveyed (6 - 10 surveys). For the 18 breeding species adequately surveyed there was a significant positive relationship between point count and spot mapping results, although the strength of the relationship varied between species (R^2 ranged from 0.92 for Red-breasted Sapsucker to 0.30 for Brown Creeper). However, relationships between the 2 methods were not always consistent between habitats for all species. For some species, there was a positive correlation in second growth forests but not in old growth stands (Pacific-coast Flycatcher, Winter Wren, Chestnut-backed Chickadee), while in others the reverse was shown (Blue Grouse, Hairy Woodpecker, Brown Creeper). These results suggest that the strength of the relationship between these 2 methods may vary with breeding density for some species. This study largely supports the expected general positive relationship between point count and spot-mapping methods. However, the strength of this relationship can differ markedly between species and between habitats and thus caution is advised when precise measures of abundance are required in specific monitoring or research endeavours.

221 Diefenbach, Marshall, Mattice & Brauning

Availability of singing male grassland sparrows for detection during abundance estimation. DUANE R. DIEFENBACH, *U.S. Geol. Serv., University Park, PA*, MATTHEW R. MARSHALL, *Natl. Park Serv., University Park, PA*, J. A. MATTICE, *New Jersey Audubon Soc., Ringwood, NJ*, and DANIEL W. BRAUNING, *Pennsylvania Game Comm., Harrisburg, PA*.

Researchers studying grassland songbirds have typically counted singing males to index

abundance and infer numbers of breeding pairs. Methods that estimate detection probability (e.g., distance sampling or double-observer methods) adjust counts to provide an estimate of abundance. However, if birds are not available to be detected (i.e., not singing or visible) then these estimates of abundance will remain underestimated. We observed the behavior of color-banded male Henslow's and Grasshopper sparrows (some fitted with radio-transmitters) to estimate availability rates during May - Jul 2002 and 2003. Grasshopper Sparrows were available to be detected 17.92% (SE = 2.36%, range 0 -80.2%) of the time and Henslow's sparrows were available to be detected 35.6% (SE = 3.38%, range 0 -92.0%) of the time. However, availability declined seasonally for Henslow's Sparrow's from 51% (SE = 11.85%) in late May to 9.2% (SE = 5.07%) by late Jun. These data can be used to correct abundance estimates for availability. Moreover, these results indicate that abundance of singing males can be greatly underestimated even during peak singing activity during the breeding season and that indices of relative abundance may not be comparable among species.

222 Walters & Daniels

A method to measure demographic connectivity between populations. JEFFREY R. WALTERS and SUSAN J. DANIELS, *Dept. Biol., Virginia Tech, Blacksburg, VA.*

Defining populations is an interesting, general biological problem that has important political and legal consequences when applied to endangered species management. Accepted methods exist for determining whether 2 subunits constitute a single genetic population, but determining whether they constitute a single demographic population (i.e., whether their dynamics are independent) is more problematic. The endangered, cooperatively breeding Red-cockaded Woodpeckers in the North Carolina Sandhills comprise a single genetic population, but this population is divided into 2 subunits separated by 5 - 20 km, between which relatively little dispersal occurs. Using data collected from 225 groups of color-banded birds over 23 yr, we measured the effect of this gap by comparing the direction from which replacement breeders came in groups bordering the gap to those in the middle of a subunit. Tests for uniform distribution of direction of origin revealed no biases for groups in the middle of subunits, but there was a significant bias in all tests involving groups at the edge of gaps. The nature of the bias always was fewer than expected dispersals from the direction of the gap, and more than expected from other directions. This bias disappeared only 1 territory removed from the gap. This method produces a measure of reduction in connectivity caused by a gap that may be of general use as an indicator of relative demographic independence of population subunits.

223 Gammonley, Ryder & Sanders

Band recoveries and band wear on American White Pelicans killed by a hailstorm in southeastern Colorado. JAMES H. GAMMONLEY, *Colorado Div. Wildl., Fort Collins, CO*, RONALD A. RYDER, *Colorado State Univ., Fort Collins, CO*, and TODD A. SANDERS, *Colorado Div. Wildl.*

Over 1,600 migrating American White Pelicans died during a hail storm in Otero Co., CO, on 17 Sep 2001. We obtained banding information on 35 leg-bands recovered from these pelicans. Most (63%) were from breeding areas in Colorado; the remaining bands were from 6 sites in the U.S. and Canada. Recoveries ranged in age from young of the year to 13 yr old; the average age of these 35 recovered pelicans was 4.5 yr. For size 9 small bands (approximately 15 mm height), band weight declined at a rate of 0.235 g/yr \pm 0.019 SE (F = 143.5, P < 0.0001, r^2 = 0.87); band thickness declined at a rate of 0.055 mm/yr \pm 0.004 SE (F = 232.3, P < 0.0001, r^2 = 0.92). For size 9 regular bands (approximately 30 mm height), band weight declined at a rate of 0.456 g/yr \pm 0.049 SE (F = 86.5, P < 0.0001, r^2 = 0.89); band thickness declined at a rate of 0.048 mm/yr \pm 0.005 SE (F = 100.1, P < 0.0001, r^2 = 0.90). Several other bands were worn too thin to be identified, and were not included in our analyses. Pelicans appear to be susceptible to mass mortality events throughout the annual cycle. Banded birds recovered from these events can provide information on pelican migration and population dynamics, but we caution that band wear and loss complicates the interpretation and value of banding data.

224 Ecton & van Riper

* Evaluating migratory routes of neotropical migrants using stable isotopes. KRISTINA ECTON, *USGS Colorado Plateau Res. Sta. and Dept. Biol. Sci., Northern Arizona Univ., Flagstaff, AZ*, and CHARLES van RIPER III, *USGS Sonoran Desert Res. Sta., Univ. Arizona, Tucson, AZ.*

Migration is a critical time period for neotropical migrants and understanding how the migration period is related to other parts of the annual cycle could advance our knowledge of the factors influencing population regulation mechanisms operative on these species. Tracking neotropical

migrants, over large distances by traditional methods such as banding has produced little useful recovery data, but recent studies have shown that stable isotopes can be used to understand large scaled migration patterns. In the west, many studies have observed the importance of riparian corridors as critical stopover habitat during migration, but this habitat type is also the most heavily disturbed habitat in the west. Disturbances of riparian habitats can have effects on birds that breed and winter directly within these habitats, but also breeding populations of neotropical migrants that use these riparian corridors during migration. We used stable isotopes to examine spring migration patterns at 4 riparian corridors in the southwest for the following species: Wilson's Warblers, MacGillivray's Warbler, and Nashville Warbler. In this presentation, we will focus on the following topics) 1) Relationship between breeding locations and the timing of migration at individual riparian corridors for the 3 target species. 2) Differences in migration routes in the southwest for breeding populations of the target warbler species.

225 Boulet, Gibbs & Hobson

* Stable-hydrogen isotopes and genetic markers reveal migratory connectivity and flyways in Yellow Warbler populations. MARYLÈNE BOULET, *Dept. Biol., McMaster Univ., Hamilton, ON*, H. LISLE GIBBS, *Dept. Evol., Ecol. & Org. Biol., Ohio State Univ., Columbus, OH*, and KEITH A. HOBSON, *Prairie & Northern Res. Centre, Canadian Wildl. Serv., Saskatoon, SK*.

Stable isotopes and genetic markers are techniques that can be used to determine the level of migratory connectivity between breeding and wintering areas. To date, few data have been obtained for Neotropical migrants. Here, we used stable-hydrogen isotopes (δD) measurements and fixed east/west genetic differences to assess migratory connectivity in breeding Yellow Warblers. We conducted δD analysis on 441 bird feather samples collected from 8 wintering sites, 6 spring stopovers and 5 fall stopovers. We genotyped 407 of these samples to determine if birds belonged to the East or West mitochondrial DNA lineages thus identifying the longitudinal breeding region they were from. We used geostatistical analyses to overlay a continent-wide map of δD contours (Wassenaar & Hobson 2001, *Env. Sci. & Tech.* 35: 1845-1850) with a map of genetic contours based on predicted probabilities of observing a given lineage on the breeding grounds. This procedure created lineage-specific isotopic sub-regions to which birds were assigned. The isotopic and genetic tags revealed weak connectivity between the following wintering and breeding regions: w. Mexico and w. North America; Mexican Gulf Coast and n.-central North America; Panama and Venezuela with e. North America. The markers identified 3 flyways in spring (Trans-Gulf: East migrants passing through New York and Louisiana; Circum-Gulf: East and West migrants passing through Veracruz; Western: West birds passing through Nevada) and 2 flyways in fall (Trans-Gulf: East migrants passing through Alabama; Western: West migrants passing through New Mexico and California). In summary, the isotopic and genetic tags provided sufficient resolution to uncover broad-scale patterns of migratory connectivity in this species.

226 McGrath & van Riper

* Influences of riparian tree phenology on foraging choices of spring migrating insectivorous birds in southwestern Arizona: evidence of flower cueing. LAURA J. McGRATH, *Northern Arizona Univ., Flagstaff, AZ*, and CHARLES van RIPER III, *USGS/SBSC, Sonoran Desert Res. Sta., Univ. Arizona, Tucson, AZ*.

Shifting tree phenology during spring migration presents avian insectivores with an assortment of visual cues and foraging opportunities. At Cibola National Wildlife Refuge we examined phenological patterns and insect abundance and richness of dominant riparian tree species to test whether leaf-gleaning insectivorous birds are attracted to the flowering condition of those trees in choosing foraging locales. We predicted that flowering trees would host more insect prey resources, and would thus show increased visit rates, length-of-stays and attack ratios of migrant avian insectivores, and that arthropods would be found in the stomach contents of the birds in the ratio that they were present on utilized trees. Paired trees of honey mesquite displaying heavy and light degrees of flowering were observed to test these predictions. To determine if birds were tracking arthropods directly or if they were using flowers as a proximate cue, we removed flowers from selected trees and paired these treated trees with neighboring high flowering trees. Avian foraging behavior, avian diets, arthropods, and phenology data were collected at the same time to control for temporal differences in insect availability, plant phenology, and differences in stopover arrival timing of birds. Our results demonstrate that the flowering condition is one cue migrant avian insectivores utilize on the Colorado River to find abundant arthropod prey while in transit during spring.

227 Bowlin, Wikelski & Cochran

Physiological telemetry of nocturnal migration in the Swainson's Thrush. MELISSA S. BOWLIN, MARTIN WIKELSKI, *Dept. Ecol. & Evol. Biol., Princeton Univ., Princeton, NJ*, and WILLIAM W. COCHRAN, *Illinois Nat. Hist. Surv., Champaign, IL*.

Migratory flight, though less costly than early theoretical models predicted, still represents a significant investment in terms of energy and time for small passerines. We used ~1 g radio transmitters to obtain continuous recordings of heart rate and wingbeat frequency during the nocturnal flights of naturally-migrating Swainson's Thrushes in Illinois. Recordings were also made during nights without migratory flight and during pre- and post-flight periods. We found both inter- and intra-individual variation in heart rate and wingbeat frequency, likely reflecting variation in the birds' altitudes, atmospheric conditions, behavior, and individual morphology. Heart rate (and thus energy expenditure) was highest during ascent and the latter part of descent; wingbeat frequency was correlated with heart rate, both within and between individuals. Heart rate on cool nights (5 – 10°C) approached that of actual migratory flight. The results we have obtained so far suggest that physiological telemetry will offer important insights into the energy use and efficiency of small, free-ranging birds during many activities, including migration.

228 Gauthreaux, Belser & Welch

Atmospheric trajectories and spring bird migration across the Gulf of Mexico. SIDNEY A. GAUTHREAUX, Jr., CARROLL G. BELSER and CHRISTOPHER M. WELCH, *Dept. Biol. Sci., Clemson Univ., Clemson, SC*.

We recorded the arrival patterns (timing and geographical location) of spring trans-Gulf migrations on the northern coast of the Gulf of Mexico using data from 10 WSR-88D radars (weather surveillance radar-1988-Doppler) from Brownsville, TX, to Key West, FL. We used the NOAA Air Resources Laboratory (ARL) HYSPLIT transport and dispersion model at the READY website (<http://www.arl.noaa.gov/ready.html>) to generate backward atmospheric trajectories based on archived atmospheric data. The migration of birds across the Gulf of Mexico in spring was related to wind transport by starting the backward trajectories at the altitudes where radar indicated the greatest concentrations of arriving migrants. The backward trajectories ran for a period covering the previous 24 h and were generated for each radar station that recorded an arrival event. By knowing the atmospheric trajectories we were able to: 1) determine likely source areas of trans-Gulf migrants south of the Gulf of Mexico, 2) document winds conditions associated with departures, and 3) predict the timing and geographical locations of landfall for future trans-Gulf flights.

229 Neuman & Safran

Is there a positive relationship between male tail-streamer length and paternity in a population of North American Barn Swallows? COLBY R. NEUMAN and REBECCA J. SAFRAN, *Prog. Evol. Biol., Lab. Ornithol., Cornell Univ., Ithaca, NY*.

For nearly 15 yr, tail-streamers in Barn Swallows (*Hirundo rustica rustica*) from Europe have served as a classic illustration of sexual selection in animals. Females prefer to mate with the longest-tailed males both as social and extra-pair partners and by breeding earlier and completing more seasonal breeding attempts, long-tailed males produce the most offspring within a year. However, tail streamer length, a sexually dimorphic character, varies considerably among Barn Swallow populations. North American Barn Swallows (*H. r. erythrogaster*) have shorter tail streamers than do individuals in European populations at similar latitudes and tail-streamers do not appear to function in the same fashion in North American Barn Swallows populations as they do in European populations. A recent study found no relationships between tail streamer length and patterns of mating or seasonal reproductive success in a population of North American Barn Swallows. Because extra-pair copulations are prevalent in this species in both European and North American populations, we wanted to investigate whether there are differences in the genetic and social mate choice of females and, if differences exist, how genetic mate selection decisions are influenced by male tail streamer length. Using 5 microsatellite loci, we performed parentage analysis on 549 individuals from 70 Barn Swallow families that were sampled in Tompkins Co., NY, in 2002. We will use these genetic data to address the following research question: Are female Barn Swallows paired with shorter-tailed males more likely to engage in extra-pair copulations with other males?

230 Robillard & Murphy

Influence of age, weather, and body size on reproduction of Tree Swallows in the Willamette Valley, Oregon. KEITH A. ROBILLARD and MICHAEL T. MUPHRY, *Dept. Biol., Portland State Univ., Portland, OR.*

We studied the reproductive ecology of Tree Swallows in a climatically mild portion of their range in the Willamette Valley, OR. We tested the hypotheses that age effects would be pronounced (due to lack of climatic stress), and that weather and body size would have little influence on reproduction. Older females produced larger clutches, but there were no differences in timing of breeding, egg mass, or fledging success in comparisons of age classes. Weather had no influence on clutch size, egg mass, or fledging success, except possibly for deaths due to heat stress. Interruptions in laying were also associated with lower maximum daily temperatures, and incubation length was inversely related to temperature during incubation. We found no relationship between body mass and reproductive traits, and the only trait to vary significantly (positively) with wing chord was egg mass in ASY females. However, we found consistent inverse relationships between measures of productivity and tarsus length. Among ASY females, number of fledged young varied inversely with tarsus length ($P = 0.011$). Clutch size of SY females was inversely related to tarsus length in both first ($P = 0.006$) and second clutches ($P = 0.006$). Thus, for this population, age effects are similar to what has been described in eastern portions of the range. Weather had little effect on reproduction except during egg-laying and incubation, but body size appeared to influence reproductive success, a finding not reported elsewhere.

231 Nielsen, Parker & Gates

* Intraspecific nest parasitism of Wood Ducks in natural cavities: a comparison with parasitism in nest boxes. CHARLOTTE ROY NIELSEN, PATRICIA PARKER, *Dept. Biol., Univ. Missouri- St. Louis, St. Louis, MO*, and ROBERT GATES, *School Nat. Res., Ohio State Univ., Columbus, OH.*

Wood Duck hens sometimes lay eggs in the nests of other Wood Ducks. Low levels of this intraspecific nest parasitism can increase duckling production, but at high levels, the increased numbers are offset by reduced hatching success and elevated nest abandonment. Such effects have been observed in nest boxes, inciting interest in the role of parasitism in natural cavities. We estimated surprisingly high rates of parasitism (85% of nests) in natural cavities by applying microsatellite genetic markers. Clutch sizes, number of parasites/nest, and the number of parasitic eggs deposited/nest differed between upland and floodplain habitats ($P < 0.05$), though parasitism rates were similar ($P > 0.05$). We also compared our data to almost 40 yr of published data for Wood Ducks using nest boxes. Clutch sizes in natural cavities were smaller than those reported in nest boxes ($P < 0.05$), but not when just floodplain nests were considered ($P > 0.05$). Only 1 study reports higher parasitism rates (95%) than we found. We suggest that the high parasitism rates observed in natural cavities reflect the importance of parasitism to wood duck nesting biology and the accuracy of microsatellite techniques relative to other methods.

232 Mock, Schwagmeyer & Parker

Males deliver more food to experimentally subsidized offspring. DOUGLAS W. MOCK, P. L. SCHWAGMEYER, *Dept. Zool., Univ. Oklahoma, Norman, OK*, and G. A. PARKER, *Univ Liverpool, Liverpool, UK.*

We explored behavioural adjustments made by parent House Sparrows when the nutritional condition of their dependent nestlings was improved experimentally. Male parents responded to artificially supplemented broods by increasing food deliveries, while their mates continued matching the already-high rate of Control females. Thus, parental care was not truncated in the face of fortified offspring, but actually escalated (ca 17% more adult food deliveries overall). Supplemented nestlings showed a marginal tendency ($0.10 > P > 0.05$) to recruit into the adult breeding population more than controls. We propose that one important reason why male parents responded more strongly than their female partners centers on the lower marginal costs for additional male post-hatching investment. Our results suggest the need for re-evaluating current views on how and when parents adjust effort and whether offspring signal 'honestly' about their true, fitness-related needs.

233 Hannon

The secret life of the American Redstart. SUSAN J. HANNON, *Dept. Biol. Sci., Univ. Alberta, Edmonton, AB.*

Many aspects of the breeding biology of passerine birds have been unrecorded because they

occur rapidly or at night, when observers are not present. The use of infra-red camera systems at nests has presented opportunities to observe rare events and to speed up tedious data collection. Using 4 yr of video recorded at American Redstart nests, I will show tapes of events such as fledging, predation, polyandry and removal of eggs by the female. In addition, I document when females are off nests during incubation and brood rearing. Females were most likely to be off nests from 07:00 - 11:00 and from 16:00 - 19:00 MST and this did not appear to vary from early to late incubation. Time off nest increased during the brood rearing period and was relatively constant from 06:00 through 21:00. These data are used to determine the best times to find nests.

234 Mattsson & Cooper

Evaluating drivers of Louisiana Waterthrush breeding biology in the Georgia Piedmont. BRADY J. MATTSSON and ROBERT J. COOPER, *Warnell School Forest Res., Dept. Biol., Univ. Georgia, Athens, GA.*

The Louisiana Waterthrush is a stream bank-nesting songbird that consumes benthic macroinvertebrates along forested streams. Waterthrushes are of particular interest because they are an infrequently studied riparian obligate species, and riparian habitats are threatened ecosystems in the fast-developing Southern Piedmont. In 2002 and 2003, we studied waterthrush populations in 13 forested headwater drainages of the Georgia Piedmont. Field assistants monitored 88 active waterthrush nests, of which 59 fledged between 1 and 5 young. During a drought in 2002, steep drainages with gravel-dominated riffles had higher juvenile waterthrush densities than drainages with sand-dominated riffles. In 2003, rainfall was at all-time record highs, and the drivers of juvenile densities among sites were unclear. In 2004, we will investigate the effects of timber harvest, urbanization, and cattle grazing on vital rates of waterthrushes. From our results, we will provide management recommendations for land managers in the Georgia Piedmont to protect bird populations and a diverse assemblage of riparian biota.

235 Chiver, Morton & Stutchbury

Male incubation and territory defense in Blue-headed Vireos. IOANA CHIVER, *Dept. Biol., York Univ., Toronto, ON*, EUGENE S. MORTON, *Conserv. & Res. Center, Smithsonian Inst., Front Royal, VA*, and BRIDGET J. M. STUTCHBURY, *Dept. Biol., York Univ.*

Biparental care is common in passerines, however the extent and type of male care varies among species. Blue-headed Vireo males contribute equally in all aspects of parental care including incubation. In other temperate migratory passerines, females incubate alone while males advertise their territory and defend it against intruders. Does male incubation in Blue-headed Vireos represent a significant cost in terms of territory defence? Male song output decreases significantly following incubation commencement (10.4 min/h during incubation vs. 21.4 min/h during the fertile period). In this study, we conducted playback experiments ($n = 7$) to simulate territorial intrusions. Playbacks were conducted in a paired design while the males were on the nest incubating versus off the nest during the incubation period. As predicted, we found that incubating males' response time to intruders was significantly longer while on the nest incubating. Males waited for their mates to relieve them before responding to intruders and on average were delayed in defending their territory by 16 min. Thus males chose to remain on the nest and incubate the eggs while they delayed territorial defence. Male incubation increases nest attendance, which is important in avoiding predation by Blue Jays. Compared to other neotropical migratory passerines species, male Blue-headed Vireos have higher prolactin levels throughout the season, which suggests that they may have evolved to be more parental at the cost of decreasing territory defence.

236 Woolfenden, Stutchbury & Morton

Effects of varying degrees of social isolation on the mating behaviour of Acadian Flycatchers. BONNIE E. WOOLFENDEN, BRIDGET J. M. STUTCHBURY, *Dept Biol., York Univ., Toronto, ON*, and EUGENE S. MORTON, *Smithsonian Inst., Front Royal, VA*.

Most of the current research related to extra-pair (EP) mating behaviour in passerine birds uses inter-specific and inter-sexual comparisons to investigate the evolutionary causes and consequences of the behaviour. Only a relatively few studies have attempted to quantify the individual costs and benefits of extra-pair mating behaviour and even fewer have investigated how ecological and social conditions may influence the extra-pair mating behaviours of populations of a single species breeding at different densities with differing degrees of social isolation. Here we compare the mating strategies of male Acadian Flycatchers breeding in populations that span a gradient of social landscapes to determine how differing degrees of social isolation affect social mating arrangements, extra-pair mating behaviours and reproductive success. We used genetic parentage analysis and radio-tracking to quantify the rates of extra-pair mating and the identity of extra-pair sires on 10 study sites of various sizes, degrees of woodlot isolation and densities of breeding pairs. Our results indicate that there are striking differences in the mating systems of populations breeding at high densities compared to those in smaller, socially isolated populations. In a large population (>30 pairs) most males are monogamously mated with only a few unmated (9%) and polygynous (3%) males. EP mating was common with 58% of nests containing EPY (extra-pair young) and 40% of nestlings being EPY. The EP sire was a neighbour in only 24% of nests with EPY and our results indicated that EP sires came from territories >500 m away. In contrast, in the smaller populations (1 - 8 pairs) 24% of males are polygynously mated (2 - 3 females/male) while 12% of males remained unmated. Only 20% of nests contained EP young and 13% of young resulted from EP matings. As expected most EP sires were males residing in the same wood lot but a few came from surrounding woodlots. We discuss how the social environment can impact the costs and benefits of pursuing EP matings which will, in turn, influence the relative contributions of variance in EP mating success to overall male RS.

237 Eimes, Parker & Brown

Why do female Mexican Jays have extra-pair fertilizations? JOHN A. EIMES, PATRICIA G. PARKER, *Dept. Biol., Univ. Missouri-St. Louis, St. Louis, MO*, and JERRAM L. BROWN, *State Univ. New York at Albany, Albany, NY*.

Our previous report on extra-pair fertilizations (EPFs) in the Mexican Jay showed a positive relationship between EPF occurrence and genetic similarity of social mates (*ms submitted*). If female Mexican jays produce EPFs more often when genetic similarity with their social mates is relatively high, and there is a significant cost associated with inbreeding, there should be a measurable gain in fitness that has favored this behavior. However, average brood size did not differ between 14 nests with EPF (3.07) and 17 without EPF (3.10). Using minisatellite DNA fingerprinting to estimate genetic similarity, we defined inbred social pairs as those having a band-sharing value greater than the mean band-sharing value of non-relatives plus 1 standard deviation above the mean ($0.23 + 0.07 = 0.30$). In 19 nests without an EPF there was a significant cost of inbreeding; 7 inbred pairs had an average brood size of 2.50 and 12 non-inbred pairs an average of 3.36 (Mann-Whitney U-Test $P < 0.05$). Average brood size (3.0) in nests of inbred social pairs that had an EPF ($n = 9$) was not significantly greater than brood size (2.5) of inbred pairs that did not ($n = 10$; Mann-Whitney U-Test, $P > 0.10$). If females are more likely to have EPFs when they are genetically similar to their social mates, then their EPF partners should, on average, be less genetically similar to themselves than the social male. Preliminary results from 11 paternal assignments show that the trend is for EPF males to be less genetically similar to the female (mean band-sharing of 0.29) than the social male (mean band-sharing of 0.34), but at $P = 0.10$.

238 Kellam, Lucas & Wingfield

Testosterone-mediated social behavior in Downy Woodpeckers during winter. JAMES S. KELLAM, *Dept. Biol., Franklin & Marshall Coll., Lancaster, PA*, JEFFREY R. LUCAS, *Dept. Biol. Sci., Purdue Univ., W. Lafayette, IN*, and JOHN C. WINGFIELD, *Dept. Biol., Univ. Washington, Seattle, WA*.

Studies of male testosterone (T) in birds have typically focused on the sexual behavior of males while courting and aggressive behavior of males as they compete for resources, and ultimately mates. These avenues tend to ignore males in species that are year-long residents that may invest in both mate and territory long before breeding. As a result, the function of T in these species during the non-breeding season is poorly understood. To explore this issue, we gave free-living male Downy

Woodpeckers T implants during the winter to determine whether elevated levels of T increased a male's ability to exclusively occupy territory-based resources, and whether elevated T strengthened a male's investment in an existing pair bond relationship. We found little difference between control and T-implanted males with regard to home range exclusivity. Likewise, mean home range overlap between mates did not differ among the treatment groups. Surprisingly, male-male display rates were significantly lower in T-implanted males than in control males. Call rates in T-implanted males were also lower than in control males. Elevated T affected social interactions with the male's mate: T-implanted males that experienced high intrusion rates from other males maintained closer and more frequent spatial association with their mate, suggesting that T facilitates male behaviors that restrict the mate's access to other male birds. This study clearly indicates that exogenous T during winter affects a variety of behaviors in male woodpeckers. Further study is needed on the proximate basis of winter pair bond maintenance, a field that is relatively unexplored.

239 Webster & Pruett-Jones

Sexual selection in monogamous fairy-wrens: are EPP the source? MICHAEL S. WEBSTER, *Biol. Sci., Washington State Univ., Pullman, WA*, and STEPHEN PRUETT-JONES, *Ecol. & Evol., Univ. Chicago, Chicago, IL*.

Sexual selection is thought to be the primary evolutionary force causing sexual dimorphism, but also is expected to be weak in monogamous species. Paradoxically, most birds are socially monogamous and yet show pronounced sexual dichromatism. Darwin proposed 2 processes that might lead to sexual selection in monogamous species: variance in mate quality and biased breeding sex ratios. More recently, genetic studies have suggested a third alternative: extra-pair paternity (EPP). Although many researchers have accepted the EPP explanation, the evidence supporting this hypothesis is equivocal and few studies have critically evaluated these alternatives in a single population. We studied a population of socially monogamous Splendid Fairy-Wrens (*Malurus splendens*) breeding in South Australia. By using a panel of 6 hypervariable microsatellites, we were able to determine the sire of most offspring, and therefore could assess the effects of the contribution of EPP to total male reproductive success. Here we discuss these results and the effects of mate quality, breeding sex ratios, and EPP on the opportunity for sexual selection in this species.

240 Scholes

Extreme complexity in the courtship of Carola's Parotia Bird of Paradise: a video-based ethological analysis. EDWIN SCHOLE, III, *Dept. Ecol. & Evol. Biol., Yale University, New Haven, CT*.

Birds of paradise (Paradisaeidae) are renowned for having a great diversity of extraordinary, often bizarre, courtship rituals. The evolution of these displays is of great interest to ornithologists, ethologists, and evolutionary biologists alike, but is largely unresolved due to a lack of detailed ethological descriptions necessary for modern evolutionary ethological analysis. Here I present the results of a video-based ethological description of 2 populations of Carola's Parotias (*P. carolae*) in Papua New Guinea. *P. carolae* was found to have an extremely complex courtship repertoire. Complexity stems from 4 factors: (1) overall repertoire size, (2) the multipart nature of displays, (3) the highly detailed intricacy of individual displays, and (4) the existence of inter-population variation in courtship. In all, 14 behaviors were identified. Most displays are multipart in nature with multiple versions, phases or both. A striking finding is the highly detailed intricacy of individual displays. A total of 43 distinct behavioral elements were identified among the displays alone. Inter-population differences were observed in vocalizations and parts of the courtship repertoire, including qualitative and quantitative aspects of shared displays. The results of this descriptive analysis, combined with others of similar detail, will allow for future research aimed at understanding the evolution of the extraordinary diversity of courtship related phenotypes for which the birds of paradise are renowned.

241 Hsu, Lin, Severinghaus & Li

Genetic mating system of Lanyu Scops Owl (*Otus elegans botelensis*) on Lanyu Island, Taiwan. YU-CHENG HSU, YAO-SUNG LIN, *Inst. Ecol. and Evol. Biol., Natl. Taiwan Univ., Taipei, Taiwan*, LUCIA LIU SEVERINGHAUS, *Inst. Zool., Academia Sinica, Taipei, Taiwan*, and SHOU-HSIEN LI, *Dept. Life Sci., Natl. Taiwan Normal Univ., Taipei, Taiwan*.

Although most species of birds are socially monogamous, extra-pair fertilization (EPF) has been found a common phenomena in most species studied. In Strigidae, genetic mating systems have been studied in only a few species, and most of the results have shown them highly genetic monogamous. The Elegant Scops Owl is a small-sized owl distributed on only a small number of western Pacific islands. We have been studying an endemic subspecies (*O. e. botelensis*) on Lanyu Island since 1985. During breeding season, owl density is very high in breeding sites. Although socially monogamous, extra-pair copulations have frequently been observed. To determine if EPF exists in this species, we used 10 microsatellite loci in this study. Between 1999 - 2002, we collected blood samples from 69 families including a total of 110 offspring. The results showed that, most Lanyu Scops Owls were genetically monogamous. Only 2 cases of parentage mismatch were found. In the first case, 1 offspring was sired via EPF; in the second case, 2 different pairs laid eggs in the same cavity; however, only 1 of the pairs was observed to be involved in the incubation and rearing of young.

242 Green, Middleton & Morrissey

Sex-specific breeding dispersal decisions in a partial migrant, the American Dipper. DAVID J. GREEN, HOLLY A MIDDLETON, *Centre Wildl. Ecol., Simon Fraser Univ., Burnaby, BC*, and CHRISTY A MORRISSEY, *Canadian Wildl. Serv., Delta, BC*.

We investigated the factors influencing site and territory fidelity in a population of American Dippers breeding in British Columbia. This population is made up of sedentary individuals that occupy permanent territories on the Chilliwack River and migratory individuals that make seasonal movements between wintering areas on the river and breeding territories on higher elevation creeks. Sedentary individuals have higher reproductive success than migrants. We therefore expected migratory individuals to have lower site and territory fidelity than sedentary individuals if (1) migration limits the ability of birds to return to a breeding site or (2) breeding dispersal decisions are influenced by reproductive success. Counter to expectations we found that migratory behaviour, examined alone or after controlling for reproductive success, had no effect on either site or territory fidelity. The territory fidelity of female and male dippers however varied in response to different factors. Territory fidelity of female dippers increased as reproductive success increased. In contrast, variation in the territory fidelity of male dippers was dependent on the return of their mate. Sex-differences in the dispersal decision rules of American Dippers appear to be driven by sex-differences in the predictability of breeding success and differing effects of mate fidelity on male and female reproductive success. Only female breeding success is predictable between years whereas only male breeding success declines if they breed with a new mate.

243 Joos & Weseloh

Breeding numbers and migration of Little Gulls in eastern North America. R. JOOS, *Univ. Toronto, Toronto, ON*, and D. V. C. WESELOH, *Canadian Wildl. Serv., Downsview, ON*.

As one of the rarest gulls in North America, Little Gull breeding behavior, migratory patterns, and population status are not well known. After rediscovering the nesting area of Little Gulls in the Hudson Bay lowlands, we documented behavior and nesting at the only known breeding colony in the western hemisphere. In this paper we quantitatively compare breeding numbers from the subarctic with spring and fall migration data from the lower Great Lakes (2000 to 2004). We show that despite a small breeding population, 5 breeding pairs in a colony of 24 birds, Little Gull numbers seem to be stable at this subarctic site. Larger numbers of Little Gulls, 114 and 116 individuals respectively on 25 Apr 2002 and 1 May 2003 in spring migration suggest further, currently unknown, breeding population(s). Still larger numbers, 266 and 250 respectively on 7 Nov 1989 and 25 Nov 2002 during fall migration also suggest additional populations, or greater reproductive success than previously understood, or, alternatively, an ongoing influx from the larger European/Asian populations. Given that 2 Scandinavian-banded Little Gulls were found in North America in the last 15 yr, there may be an irregular flow of birds from Europe. Based on our data and other records, however, we estimate that the current North American population is approximately 400 birds. With these numbers, and its 180 yr history in North America, we suggest that the species warrants conservation status in the western

hemisphere.

244 Stapleton & Robertson

Relatedness, heterozygosity and extra-pair mating in Tree Swallows. MARY K. STAPLETON and RALEIGH J. ROBERTSON, *Dept. Biol., Queen's Univ., Kingston, ON.*

Multiple mating is a common reproductive tactic, yet the benefits females receive are not yet fully understood. The genetic compatibility hypothesis has been suggested as an explanation for why female birds engage in extra-pair mating. Tree Swallows are ideal for examining the potential role of genetic compatibility in female mate choice. They are socially monogamous, yet show extremely high levels of extra-pair mating. This study utilizes microsatellite data to examine genetic relationships between females and both their within-pair as well as extra-pair mates. Levels of relatedness and heterozygosity with respect to mate choice and the production of extra-pair offspring will be presented.

245 Salgado-Ortiz, Robertson & Marra

The timing of breeding of a tropical resident warbler: the effects of weather and food availability. JAVIER SALGADO-ORTIZ, RALEIGH J. ROBERTSON, *Dept. Biol., Queen's Univ., Kingston, ON.*, and PETER P. MARRA, *Smithsonian Environ. Res. Center, Edgewater, MD.*

The question of how tropical birds adjust the timing of reproduction in response to seasonal events remains poorly understood. Rainfall has been proposed to stimulate the onset of breeding but few studies have explored factors associated with rainfall that may be more directly involved with initiating breeding events. The food availability hypothesis proposes that breeding is timed to coincide when food is most abundant for raising offspring. We explored these 2 hypotheses on a breeding population of the Mangrove Warbler (*Dendroica petechia erithachorides*) at Celestún Biosphere Reserve in Yucatan, Mexico, from Feb to Aug in 3 consecutive years (2001 - 2003). We found that Mangrove Warbler's restricted their breeding to the months of Apr through Jul. In each year, breeding commenced during the last portion of the dry season when arthropod biomass was low and prior to the start of the rainy season. Arthropod biomass significantly increased at the onset of the rainy season and this coincided with the period when most warblers were raising young. The cues triggering breeding in this system are not apparent because warblers began breeding in the absence of rain and when food levels were low. Given that the nestling period was timed to coincide with the period of greatest food availability suggests the onset of breeding may be controlled by other environmental factors (e.g., photoperiod) or possibly endogenous cues.

246 Reudink & Curry

Do extra-pair fertilizations confound measures of reproductive success in a chickadee hybrid zone? MATTHEW W. REUDINK and ROBERT L. CURRY, *Dept. Biol., Villanova Univ., Villanova, PA.*

The study of hybridization enables researchers to investigate fundamental issues about speciation and reinforcement of isolating mechanisms. Hybridization between Black-capped and Carolina Chickadees has been observed for many years; however, the reasons why chickadees would choose to interbreed have been unclear because hybridization is generally thought to result in fitness costs such as reduced reproductive success. Extra-pair fertilizations (possibly representing part of an adaptive strategy for minimizing costs of hybrid pairing) may represent a confounding influence on measures of reproductive success in hybrid zones, yet few studies have taken genetic parentage of offspring into account when in assessing costs of hybridization. Since 1998, we have monitored a population of hybridizing chickadees breeding in se. Pennsylvania and have collected blood samples from all breeders and nestlings (average of 33 nests/yr, 2000 - 2003). We used 6 microsatellite loci to determine rates and patterns of extra-pair paternity within the hybrid zone. Extra-pair offspring occurred in 50% of nests and comprised 26% of the all offspring. These results indicate that extra-pair copulations are sufficiently frequent to confound simplistic estimates of fitness costs based on social pairings alone. We are now using microsatellite data to evaluate whether genetic similarity of the social pair influences extra-pair mating tactics in chickadees.

247 Badzinski

Seasonal and temporal changes in Hooded Warbler nest success and cowbird parasitism in southern Ontario. DEBRA S. BADZINSKI, *Bird Studies Canada, Port Rowan, ON.*

From 1988 - 2003, 371 Hooded Warbler nests were located and monitored at 2 sites in s. Ontario. Aikake's Information Criterion was used to examine the effects of year, linear time trends, quadratic time trends and incidence of cowbird parasitism on clutch size, hatching success and

fledging success. Program MARK was also used to model daily nest survival as a function of site, year, linear and quadratic time trends and cowbird parasitism. No seasonal pattern in clutch size was apparent; variation was primarily explained by year. However, all best fitting models of hatching success, fledging success, nest survival, and incidence of parasitism contained a quadratic time trend. The probability of a Hooded Warbler nest successfully hatching or fledging was low for early and late nests, but peaked mid-season. Hooded Warbler nests that were parasitized by Brown-headed Cowbirds followed the same seasonal pattern but were less likely to hatch or fledge any young. The number of young hatched and number of young fledged from successful nests also followed a quadratic time trend with mid-season unparasitized nests hatching and fledging the most eggs or young respectively. There was no annual variation in nest survival rates. Best models for nest survival contained a site term and a quadratic time trend. Results of this study demonstrate that cowbirds are negatively affecting nests, but that Hooded Warblers partially compensate with high rates of double brooding.

248 Horton & Holberton

Changes in corticosterone secretion may support behavioral adjustments to changing parental demands in breeding White-throated Sparrows. BRENT HORTON and REBECCA HOLBERTON, *Dept. Biol. Sci., Univ. Maine, Orono, ME.*

Changes in corticosterone secretion often mirror changes in energy reserves in birds. During breeding, however, both sexes may face different time and energy constraints due to changing parental responsibilities. Variation in corticosterone secretion and body mass may reflect sex-dependent changes in breeding demands. To better understand variation in corticosterone secretion during breeding, we measured body condition and plasma corticosterone in White-throated Sparrows across 3 stages of reproduction: pre-incubation, incubation, and nestling provisioning. Female body condition declined as breeding stage progressed while male condition did not change. The decline in female body condition may reflect the cumulative effects of an energetic investment in egg production and incubation not shared by males, unequal provisioning efforts, or both. However, baseline corticosterone levels increased in both sexes when provisioning young, and were negatively correlated with body condition in females and independent of body condition in males. These results suggest that increased baseline corticosterone need not always be in response to, or necessary for, a decline in energy stores. Rather, increased corticosterone may promote behavioral changes to meet the increased foraging activity necessary for provisioning young. Both sexes reduced the intensity of the stress response when provisioning young, which may deter the abandonment of provisioning behavior in the face of environmental perturbation. It is currently unknown if these elevated baseline corticosterone levels or reductions in the stress response pose a personal risk to either sex.

249 James & Patterson

West Nile virus of little or no consequence on bird populations. DOUGLAS A. JAMES and C. JOAN PATTERSON, *Dept. Biol. Sci., Univ. Arkansas, Fayetteville, AR.*

Blue Jay, American Crow, and Carolina Chickadee and Black-capped Chickadee populations from Christmas Bird Counts at 13 sites infested with West Nile virus were compared to non-virus sites by pairing with 13 count locations outside the virus zone. Counts were standardized by conversion to number of birds/10- field party-hr. Using 2 x 2 contingency table analyses, the averaging of Christmas Count results for 5 yr (winter 1991 - 1992 to 1995 - 1996, the pre-virus years at both sites) was compared to the count results for winter 2001 - 2002 (the virus year for the virus site in each pair). Chi-square values showed no difference in population trends between virus and control sites for the majority of pairings. Most the pairings that did show significant differences resulted because species unexpectedly increased greatly at virus sites or decreased markedly at control sites. Only 2 pairings out of the 39 (13 sites x 3 species/site) supported the expectation of an effect of West Nile virus, both with the crow.

250 Hochachka & Dhondt

Are House Finches their own worst enemies? host sociality and disease impact. WESLEY M. HOCHACHKA and ANDRÉ A. DHONDT, *Lab. Ornithol., Cornell Univ., Ithaca, NY.*

Many disease organisms that affect animals are most efficiently transmitted between hosts in close proximity, and transmission rates of diseases are typically higher at high host densities. Thus, the social system of a host species can affect rates of disease transmission, and ultimately the impact

of the disease organism on host population dynamics. We investigated the role that social aggregation has played in the declines in House Finch abundance caused by a novel pathogenic bacterium (*Mycoplasma gallisepticum*) in eastern North America. Across the ne. U.S. and adjacent Canada, group sizes of House Finches in winter have declined most markedly in environments that historically had contained the largest aggregations of House Finches, consistent with density- or frequency-dependent disease transmission. House Finches still preferentially aggregate at some sites while occurring in low numbers at even nearby sites, and mycoplasma disease is currently in higher prevalence at sites with the larger aggregations of finches. Surprisingly, as winter progressed, flock sizes increased more at sites with initially larger finch groups (and higher disease prevalence). Thus, the finches' tendency to aggregate is capable of feeding local outbreaks of mycoplasma disease. In contrast, the finches' high sociality also appears to limit the spread of disease outbreaks from one site to adjacent sites: high-density sites were not clustered, and we detected no spatial autocorrelation in disease prevalence even over distances of a few kilometers.

251 Cooper, Williams, Dececco & Marshall

The effects of *Bacillus thuringiensis* application on the breeding biology of Worm-eating Warblers. ROBERT J. COOPER, ALAN B. WILLIAMS, JENNIFER A. DECECCO and MATTHEW R. MARSHALL, *School Forest Res., Univ. Georgia, Athens, GA.*

From 1996 - 1999, we examined the potential reproductive, behavioral and survival effects of an experimental reduction in Lepidoptera larvae on Worm-eating Warblers in the George Washington National Forest, Virginia. 3 of 9 200-ha study plots were aerially sprayed with *Bacillus thuringiensis* var. *kurstaki* during May of 1997 and 1998 following gypsy moth (*Lymantria dispar*) management protocols. These applications reduced Lepidoptera larvae abundance by almost 90%. On treated plots, adult birds fed fewer Lepidoptera larvae to nestlings, and tended to make more total trips with fewer prey items/trip, than on the untreated plots. By day 5, the average weight of all nestlings within a nest was 0.36 g lower on the treated plots than the untreated plots. Although we did not observe evidence of brood reduction due to starvation on the treated plots, the number of young fledged on treated plots was lower from 1997 - 1999 compared with the untreated plots, most prominently in 1998. This was primarily due to a lower percentage of young that fledged from a given clutch size and fewer large clutches fledging young on the BT plots that year. Although we did not observe any dramatic effects of BT application on Worm-eating Warblers, lower food availability during 2 yr of spraying may have caused subtle negative effects on survival of young in the second year of treatment and adult survival in the year following treatment. We discuss results relative to forest insect pest management.

252 Bird, Charest, Dibbernado, Spithill & Lindsay

Presence of West Nile virus antibodies in wild nesting American Kestrels in southern Québec. DAVID M. BIRD, *Avian Sci. Conserv. Centre, McGill Univ., Ste-Anne-de-Bellevue, QC*, HUGUES CHAREST, *Lab. Santi Publ. Québec/INSPQ, Ste-Anne-de-Bellevue, QC*, ANTONIA DIBERNADO, *Natl. Microbiol. Lab., Winnipeg, MB*, TERENCE W. SPITHILL, *Inst. Parasitol., McGill Univ.*, and ROBBIN LINDSAY, *Natl. Microbiol. Lab., Winnipeg, MB.*

West Nile virus (WNV), originating in the West Nile region of Uganda in 1937, entered North America in 1999 and since then, this mosquito-borne pathogen has killed at least 241 people and infected a wide variety of hosts, including over 200 species of birds in the wild and in zoos. Corvids appear to have little immunity to the disease. Birds of prey have also been hard hit, possibly because WNV can be transmitted from prey to predator simply by ingestion. American Kestrels are among the Falconiformes known to become infected with WNV and suffer mortality. In an effort to determine the prevalence of WNV infections in this species, as well as to evaluate its value as an experimental animal for WNV research, we drew blood samples from adults and nestlings in 14 wild-nesting pairs (9 adults and 44 nestlings) in the Montréal area as well as from 88 captive birds (including 17 young produced in outdoor aviaries in 2003) held at McGill University before and after exposure to mosquitoes. Plaque reduction neutralization tests (PRNT) performed on serum dilutions (140) showed that 6 of the 9 adult wild birds (4F; 2M) trapped had significant WNV neutralizing antibody titres (>320). WNV-specific immunity was not detected in any of the wild nestlings. Only 1 individual of the captive flock maintained solely on day-old cockerels was positive post-exposure. Wild kestrel testing will be replicated in 2004, which will hopefully include birds returning from migration.

253 Stewart, Westneat, Djojo, Young & Mickelson

Passive surveillance of West Nile virus in a wild population of House Sparrows. IAN STEWART, DAVID WESTNEAT, FABIOLA DJOJO, MATT YOUNG and NATALIE MICKELSON, *Dept. Biol., Univ. Kentucky, Lexington, KY.*

West Nile virus has now been confirmed from dead birds throughout most of the continental U.S., although little is known about its prevalence in free-living individuals. In 2002 - 2003 we screened blood samples obtained from a nest box population of the House Sparrow, a species of particular significance for the transmission of WNV because of its close association with humans and farm animals. We used both single step and nested RT-PCR to detect WNV in blood samples taken from over 400 adults, nestlings and juveniles. The nested PCR detected WNV in approximately 25% of sparrows, with a higher prevalence among juveniles and a late summer peak in infection rates. The single step PCR detected WNV in a low proportion (c. 5%) of sparrows. We will discuss these differences and the implications of the patterns of WNV incidence.

254 vacant

255 vacant

256 vacant

257 Bednekoff & Woolfenden

Florida Scrub-Jays compensate for the sentinel behavior of others. PETER A. BEDNEKOFF, *Biol. Dept., Eastern Michigan Univ, Ypsilanti, MI*, and GLEN E. WOOLFENDEN, *Archbold Biol. Sta., Lake Placid, FL.*

In Florida Scrub-Jays, individuals spend time perched as sentinels while other members of their group are active. Sentinel behavior is coordinated in that individuals overlap as sentinels far less than expected by chance. Previous work has shown that birds are sentinels far more in the half hour after they have been supplementally fed. Here we fed 1 member of a mated pair and then followed the behavior of the other member of the pair. Florida Scrub-Jays were sentinels less when their mates had been fed, and presumably were being sentinels more. This rapid compensation for changes in behavior would lead to coordination of sentinel behavior. Compensation and coordination are probably facilitated by soft, guttural calls between birds. Secondarily, males from recently established groups were sentinels considerably less often than males from groups with a longer history.

258 Stutchbury & Klatt

Does incubation feeding in Scarlet Tanagers result in a low frequency of extra-pair matings? BRIDGET J. M. STUTCHBURY, *Dept. Biol., York Univ., Toronto, ON*, and PAUL H. KLATT, *Dept. Biol., Univ. North Dakota, Grand Forks, ND.*

Virtually all Neotropical-Nearctic migrant passerines studied to date have very high levels of extra-pair paternity (average of 31% EPY, with 46% broods containing EPY). Scarlet Tanagers may be the exception to the "rule". Male tanagers are unusual among Neotropical migrant passerines in that they attend their mates very closely during both nest building and incubation, and also feed the young extensively. Almost all males (13 of 15) were observed feeding their mates at or near the nest during incubation, with some males making over 10 trips/h to the nest. We temporarily removed males (n = 6), for 2 h, to determine the female's response to the male's absence. All 6 females gave prolonged bouts of "chik-burr" alarm calls the very first time they came off their nest and found the male absent. One female even permanently abandoned her nest (and the territory) during a temporary male removal experiment. This suggests that males who do not attend their mate closely during incubation risk being deserted, and this close attendance may also prevent males from seeking EPCs.

259 Willson

Eciton burchelli versus *Labidus praedator*: army-ants and the community ecology of five obligate army-ant-following birds of Amazonian Peru. SUSAN K. WILLSON, *Dept. Biol., Colgate Univ., Hamilton, NY.*

From 1997 through 2003, I studied a guild of 5 coexisting obligate army-ant-following bird species (*Phlegopsis nigromaculata*, *Myrmeciza fortis*, *Rhegmatorhina melanosticta*, *Gymnopithys salvini*, and *Dendrocincla merula*) in Amazonian Peru, where guild diversity is among the highest in the Neotropics. I asked whether bird species preferentially forage with 1 of the 2 available species of

swarm-raiding army ants (*Labidus praedator* and *Eciton burchelli*). I also asked, for both a high and low bird density year, whether community-wide spatial foraging constraints are decreased through usage of both ant species as beaters of arthropod prey. Two bird species showed significant preferences among ant species (*M. fortis* for *L. praedator*, and *D. merula* for *E. burchelli*), and these preferences were reflected in each bird species' behavioral ecology. *Labidus praedator* ants significantly increased the amount of foraging space/100 ha available to the bird community. For example, in the high bird density year, individuals could only average 0.36 m/bird along antswarm fronts if all birds exclusively used *E. burchelli* antswarms. Data for this season show birds tripled their average space/bird along antswarm fronts by using available antswarms of both ant species. These results show the importance of the army ant *Labidus praedator* to both population density and species coexistence for obligate army-ant-following guilds.

260 Charette & Diamond

Spatial and temporal comparisons of sympatric Common and Arctic Tern diets using stable-isotope analysis and observational data. MATHIEU R. CHARETTE and ANTONY W. DIAMOND, *ACWERN and Dept. Biol., Univ. New Brunswick, Fredericton, NB.*

In long-lived seabirds with extensive migrations, variations in diets at different spatial and temporal scales potentially affect body condition of adults and ultimately influence breeding success. Common Terns and Arctic Terns are closely-related seabirds with similar life-histories and overlapping breeding ranges, but different migration routes and wintering grounds. We want to understand why Common Terns generally have greater breeding success than Arctic Terns in the Canadian Maritimes. On their shared breeding colonies, Common Terns and Arctic Terns are subjected to the same weather conditions, prey, habitats and predator pressures. This suggests that the factors responsible for differences in breeding success may operate away from the breeding grounds. We want to determine how the 2 species differ in diet during the breeding season and on the wintering grounds and whether they differ in body condition (inferred by Principal Component Analysis). We compare the 2 species breeding on 2 islands, using samples of eggs, adult blood and feathers, and adult morphometrics collected in 2003 on Machias Seal Island, NB, and Country Island, NS. We want to determine whether females of the 2 species differ in endogenous and exogenous energy reserves used during egg production, and whether adults differ in body condition. Stable isotopes carbon [$^{13}\text{C}/^{12}\text{C}$] and nitrogen [$^{15}\text{N}/^{14}\text{N}$] will allow us to compare diet on the wintering grounds inferred by breast feathers (which are grown in winter), during egg production (inferred from the eggs and on the breeding grounds (inferred from blood).

261 Dana, Budden & Beissinger

Nestling begging intensity in Green-rumped Parrotlets. C. E. DANA, A. E. BUDDEN and S. R. BEISSINGER, *ESPM Ecosys. Sci. Div., Univ. California, Berkeley, CA.*

Begging is often seen as a costly behavior for nestlings because it may attract predators and result in energetic costs. Parental allocation in asynchronous breeding Green-rumped Parrotlets (*Forpus passerinus*) is partly based on nestling size and also on nestling begging intensity. In an experiment on Green-rumped Parrotlets, we investigated the effects of food deprivation on nestling begging intensity in the presence of an artificial stimulus. Using both hand-fed and parent-fed nestlings, we found that in general nestlings increase begging response when food deprived. Begging response was gauged by factors such as maximum height above mean, begging duration, and the length of time it took the nestling to respond to the stimulus. This increase in begging response would hypothetically result in greater parental allocation towards that nestling. Begging has the potential of being a costly behavior for nestlings and thus begging should be reserved only for times of need. Because of the size difference between the nestlings as a result of asynchronous breeding in the species, competition is heightened for the younger nestlings. These nestlings as a result show an increase in begging intensity.

262 Gonzalez Voyer & Drummond

A test of the effect of feeding method on aggressive competition in the Cattle Egret. A. GONZALEZ VOYER and H. DRUMMOND, *Laboratorio de conducta animal, Instituto de Ecología, Universidad Nacional Autónoma de México, México D.F., México.*

In a minority of birds, chicks compete for parentally provided food by pecking and biting (aggressive competition) in addition to begging and scrambling. It is hypothesised that selection should favour the use of aggression when chicks receive small monopolizable food parcels directly from the parents' beak rather than when indirectly fed, i.e., food deposited on the nest floor (feeding

method, or "prey size" hypothesis; Mock 1985, *Am. Nat.* 125: 327-343). Cattle Egret chicks compete aggressively for parentally provided food and present a developmental transition from indirect to direct feeding. We tested whether (1) the frequency of aggression associated with feeding increases with the proportion of direct feeds, and (2) aggression is more profitable (dominant chicks secure larger proportion of food) during direct than indirect feeds. We recorded nestling aggression and feeding in 9 broods of 2 chicks 5 to 20 d old. The prediction and assumption were both contradicted (1) the rate of pecking by senior chicks did not increase with the proportion of direct feeds. On the contrary, it peaked at the beginning of the transition phase from indirect to direct feeding and then declined and remained at low levels when feeding was predominantly direct. (2) Aggression was not more profitable during direct feeds than during indirect feeds. Thus there does not appear to be a proximate influence of feeding method on aggression.

263 Brown & Sherry

Experimental evidence for dry-season food limitation of Jamaican resident birds. DAVID R. BROWN and THOMAS W. SHERRY, *Dept. Ecol. & Evol. Biol., Tulane Univ., New Orleans, LA.*

We studied the effects of experimentally manipulated food availability on resident birds during the dry season in a coastal scrub forest on Jamaica. Food availability was increased (2 - 3 plots), decreased (2 - 3 plots), and held constant (2 plots) on 1 ha plots through 2 dry seasons (2003, 2004). We increased food availability by maintaining piles of cut oranges distributed on the ground at 25 m intervals throughout supplementation plots. In addition to being a source of sugar-water, oranges increased arthropod activity in the vicinity of piles. Food reductions targeted ants and roaches through a one-time broadcast application of a baited respiratory-inhibiting pesticide that is carried back to the colony and kills the entire colony. Birds were sampled before and 5 wk following the initiation of manipulations. We measured effects on bird community diversity, abundance, and persistence over 2 dry seasons and effects on body condition and breeding activity over 1 dry season. Manipulations had no detectable effect on bird community diversity. However, several frugivorous species responded to supplementation treatments with increased abundance. Among these species, corrected body mass and fat did not differ among treatments. Food supplementation induced early breeding activity in Bananaquits (*Coereba flaveola*). These results demonstrate a functional response by frugivores to dry-season food availability, and suggest that food availability may contribute to population limitation in some species.

264 vacant

265 Hobson, Aubry & Wassenaar

Migratory connectivity in Bicknell's Thrush: locating the missing population with hydrogen isotopes. KEITH A. HOBSON, *Canadian Wildl. Serv., Saskatoon, SK*, YVES AUBRY, *Canadian Wildl. Serv., Sainte-Foy, QC*, and LEONARD I. WASSENAAR, *Environment Canada, Natl. Water Res. Inst., Saskatoon, SK.*

The measurement of the abundance of naturally occurring deuterium (δD) in feathers grown in North America can provide geographical information on location where the feather was grown. Previously, we used this technique to link populations of Bicknell's Thrush breeding in northeastern North America with wintering grounds in the Dominican Republic. That study indicated the presence of a subpopulation of wintering birds with more depleted (i.e., -125 to -100 ‰) feather δD values than those measured on their known breeding grounds. This suggested either a more northerly and/or a higher altitude breeding source population than previously measured. We located 2 populations of Bicknell's Thrush in Québec, at Mine Madeleine (49° 16' N, 66° 06'W) and at Mount Gosford (45° 18' N, 70° 52'W). The Mine Madeleine birds had feather δD values overlapping those of the missing population identified in the Dominican Republic. At Mount Gosford, HY birds were more depleted in their feather δD values than ASY birds suggesting their more northerly origins and capture during the early migration period. Our study demonstrates how the stable isotope approach can be used in a forensic sense to establish connectivity between breeding and wintering populations of migratory birds.

266 Zimmerman, Meyer & Chandler

The importance of Cuba and the Yucatan Peninsula as stopover sites for migrating Swallow-tailed Kites. GINA M. ZIMMERMAN, *Dept. Biol., Georgia Southern Univ., Statesboro, GA*, KENNETH D. MEYER, *Avian Res. & Conserv. Inst., Gainesville, FL*, and C. RAY CHANDLER, *Dept. Biol., Georgia Southern Univ.*

The Swallow-tailed Kite is a rare Neotropical migrant raptor that breeds in the U.S. and winters in South America. Because Cuba and the Yucatan Peninsula lie along the kites' migratory route after long (400 - 770 km) over-water crossings, they may be potentially important stopover sites needed for rest and energy replenishment. We predicted that the kites would have slower migration rates and wander more widely in Cuba and the Yucatan than elsewhere along their route, and that they would choose specific locations and habitats over others. We used location data from 29 satellite-tracked breeding kites from the U.S. to quantify migration rates (movement, progress, and net migration rate) and movements (stopover index) in each of 12 sections representing the 8,000 km southbound migration pathway. Swallow-tailed Kites did not stopover on Cuba, but they traveled slower and with less directed movements on the Yucatan than in any other section. These same locations plus those of birds tracked by VHF telemetry were used for a GIS analysis of habitat use versus availability in the Yucatan. Kites selected lowland forests and open water/wetlands and avoided disturbed areas, areas without vegetation, and agricultural fields. In Belize, heterogeneous landscapes were preferred.

267 Allen, Hussell, Hobson, Wassenaar & Nol

Stable-hydrogen isotope analysis identifies breeding origins of migratory songbirds at Long Point, Ontario. MARTHA L. ALLEN, *Watershed Ecosys. Grad. Prog., Trent Univ., Peterborough, ON*, DAVID J. T. HUSSELL, *Ontario Min. Nat. Res., Peterborough, ON*, KEITH A. HOBSON, *Canadian Wildl. Serv., Saskatoon, SK*, LEN I. WASSENAAR, *Natl. Water Res. Inst., Environment Canada, Saskatoon, SK*, and ERICA NOL, *Biol. Dept., Trent Univ., Peterborough, ON*.

Birds passing through Long Point, Ontario, during migration are believed to be largely from populations breeding in Ontario and w. Québec, however there is little direct evidence supporting this assumption. Previous stable isotope studies have shown that deuterium to hydrogen ratios (δD) from tail feathers, correlated with growing-season average δD signatures in rainfall, can help identify geographic origins of migratory birds. During stopovers at Long Point, in 2000 and 2001, 400 feathers were collected from 9 species of medium- and long-distance migrant songbirds to determine their previous breeding (for ASY) or natal (for SY) origins across Canada. The δD values indicated that Blackpoll Warblers originated from a wide range across n. Canada; the majority likely from western provinces, and only a small proportion from breeding grounds in s. Québec or the Maritimes. Swainson's Thrushes also traveled from a wide range, with over 30% that originated in breeding grounds outside Ontario. The isotope signatures in Ovenbirds and White-throated Sparrows suggested the majority came from their northern breeding grounds in Ontario and Québec, with < 5% originating from breeding ranges in western Canada. These data suggest that songbirds from many different breeding populations across Canada travel through Long Point during migration, offering valuable revelations about population trends observed at this migration monitoring station.

268 Boulet, Potvin, Shaffer & Bernatchez

Conservation genetics of the threatened Horned Grebe population of the Magdalen Islands, Québec. MARYLÈNE BOULET, CATHERINE POTVIN, *Dépt. Biol., Univ. Laval, Québec, QC*, FRANÇOIS SHAFFER, *SCF / Canadian Wildl. Serv., Québec, QC*, and LOUIS BERNATCHEZ, *Dépt. Biol., Univ. Laval*.

The Horned Grebe population of the Magdalen Islands in the St. Lawrence Gulf has declined from about 40 individuals in the 1950s to about 18 individuals in the 1990s. It is the only breeding population of this species in eastern North America. We used 3 types of genetic markers: mitochondrial (mt) DNA ND2 sequence, α -enolase intron sequence, and 25 amplified fragment length polymorphism loci (AFLP) to quantify the level of genetic diversity within the Magdalen Island population, to assess the genetic differentiation of this population relative to populations from w. Canada (5 sites) and Iceland (1 site), and to determine its origin. The Magdalen Island population retained a comparable amount of genetic diversity to the average diversity observed across all populations in all markers. Horned grebe mt-DNA sequences formed a single phylogenetic group. However, we observed significant population-level differences between the Magdalen Islands and other populations in mt-DNA ($F_{st} = 0.14$) and in AFLP markers ($F_{st} = 0.12$ and 0.08 depending on method used) but not in α -enolase intron ($F_{st} = 0.01$). Frequency data in mt-DNA and AFLP markers

pointed 3 significant regional groups (western sites, Québec, and Iceland). We suggest that the Horned Grebe Québec population may be derived from a group of individuals from the western populations that pioneered the Islands some time ago. Alternatively, it may represent a remnant population from the last glaciation. For conservation purposes, we suggest that the Magdalen Islands population should be recognized as a designatable unit under the Canadian Species at Risk Act.

269 Badzinski

A citizen science based approach to monitoring nocturnal owl populations in Canada. DEBRA S. BADZINSKI, *Bird Studies Canada, Port Rowan, ON.*

Owls are considered good indicators of forest health because of their position at the top of the food chain and their dependence on relatively large tracts of forest. However, there is little known about the abundance and population status of most nocturnal owl populations in Canada. As a result of their unique biology, most owl species, in particular those breeding in boreal forests are not well monitored by existing bird monitoring programs such as the Breeding Bird Survey and Christmas Bird Count. For these reasons, the National Nocturnal Owl Survey was initiated. The National Nocturnal Owl Survey is a roadside survey conducted by volunteer citizen scientists across Canada. A variety of protocols are used but a standardized 2-min silent listening period allows data to be compared across Canada. Owl survey data are used to calculate population trends and to investigate owl habitat associations. In Ontario, for example, Boreal Owl numbers tend to fluctuate on a 4 yr cycle whereas Barred Owl populations are relatively stable. Using citizen scientists to monitor nocturnal owls is a cost effective way of monitoring owl populations while also increasing public awareness and understanding of owl conservation.

270 Laing, Bird, Chubbs & Humphries

Migration of juvenile Bald Eagles and Osprey from central Labrador. DAWN K. LAING, D. M. BIRD, T. E. CHUBBS and D. G. HUMPHRIES, *Avian Sci. & Conserv. Centre, McGill Univ., Ste. Anne de Bellevue, QC.*

To date, research on raptors in Labrador has been focused on feeding and breeding activities at the nest. This study documents annual and partial migratory cycles of 9 juvenile Bald Eagles and 5 hatch-year Osprey from central Labrador between 15 Aug 2002 - 31 Dec 2003, using satellite telemetry. Average autumn departure dates were 20 Oct 2002 and 13 Nov 2003 for the eaglets and 13 Oct for both 2002 and 2003 Osprey. Osprey travelled at an average rate of 200 km/d during the fall, however, transmissions were lost prior to recording their full migration cycle and further analysis could not be completed. The eaglets travelled an average distance of 1200 km over 40 d at 81 km/d, wintering as far south as Virginia. All eaglets used the Gulf of St. Lawrence as a stopover site enroute south in the fall, and north in the summer, with one remaining year round. Using an average of 5 stopovers to reach wintering areas, eaglets wintered in Virginia, New York State and Maryland. Eaglets departed wintering areas by 25 Mar 2003 and travelled at an average rate of 76 km/d. Averaging 5 stopovers in the spring, eaglets used similar waterways, river-valleys and corridors as taken in the fall to reach summering grounds within 143 d. 6 of the eaglets summered along the north-shore of the Gulf of St. Lawrence, 1 summered in north-central New Brunswick, and 2 returned to original natal areas. Eagles captured in 2002 spent an average of 113 d on 2003 summering grounds.

271 Bélisle

Predicting forest bird movement under landscape anisotropy. MARC BÉLISLE, *Dep. biol., Univ. Sherbrooke, Sherbrooke, QC.*

Traditional indices describing the composition and configuration of landscapes have been shown to be of limited use to predict the ease with which forest birds move across fragmented landscapes. This stems partly from the fact that these metrics assume that landscape structure is isotropic. Here, we assess if implementing gap-crossing decision rules into a spatially-explicit, individual-based model can help better predict the movements of forest birds. Decision rules were derived experimentally by (1) measuring the probability that birds lured by playbacks would move a certain distance within continuous forest cover and in open habitat separating 2 forest patches; and (2) by measuring how far from the forest edge birds accepted to travel in order to get to a destination (playbacks) reachable by either crossing an open area or taking a longer route under forest cover. Decision rules were implemented into a biased, correlated random-walk model. Cyber-birds were asked to cross 2 sets (n = 201 and 42) of 'real' landscape sections in which territorial, mated male birds had been experimentally translocated (1 - 4 km). The instantaneous rate at which cyber-birds crossed the 'real' landscape sections was then used to predict the actual time it took for translocated

birds to return to their territories. The predictive ability of this simulated, instantaneous homing rate metric, as well as of 'conventional' landscape composition and configuration indices, was finally compared under an information-theoretic approach using Cox regressions. The simulated, instantaneous homing rate metric performed better than most, if not all, conventional landscape indices.

272 Smith & Friesen

Differentiation of sympatric populations of the Band-rumped Storm Petrel in the Galapagos Islands: an examination of morphology, vocalizations, and genetics. ANDREA L. SMITH and VICKI L. FRIESEN, *Dept. Biol., Queen's Univ., Kingston, ON.*

In at least 2 locations within the Galapagos Islands, breeding Band-rumped Storm Petrels (*Oceanodroma castro*) form 2 distinct populations, which use the same colony at separate times of year for reproduction. The temporal segregation of these populations raises the possibility that they are reproductively isolated and thus represent cryptic species. We examined the morphology, vocalizations, and genetic structure of storm petrel populations nesting 6 mon apart on the islet of Plaza Norte in the Galapagos. Cool and hot season populations differed in 5 morphological variables and displayed low levels of genetic differentiation in the mitochondrial control region, but did not vary in either male or female vocalizations. Gene flow was estimated to be relatively high between the 2 populations, with 13.8 females exchanged per generation. The breeding populations appear to have been separated for < 2000 yr and are unlikely to be at genetic equilibrium. As a result, the high gene flow estimate could be a reflection of the historical association of cool and hot season populations and not contemporary genetic exchange. Both breeding populations appear to have experienced recent population expansions, although mark-recapture data revealed that their present population sizes are relatively low. These temporally segregated populations are probably in the early stages of divergence from one another on Plaza Norte. Consequently, we recommend that cool and hot season populations be considered as separate management units.

273 Maddox & Weatherhead

Brood reduction in Common Grackles: a double bet-hedging strategy? J. DYLAN MADDOX and PATRICK J. WEATHERHEAD, *Prog. Ecol. & Evol. Biol., Univ. Illinois, Champaign, IL.*

We repeated the seminal research of H. F. Howe on the maternal effects of brood reduction in Common Grackles. We found that egg size increased with laying order in clutches of 5 and 6, but not in clutches of 3 and 4. Because incubation began before clutch completion in 5- and 6-egg clutches, last-hatched nestlings in these clutches incurred a significant size and strength disadvantage that frequently resulted in starvation. Thus, last-hatched nestlings are disadvantaged by hatching order, but favored by egg size. We found no annual variation in starvation rates in 5-egg clutches, whereas annual starvation rates in 4-egg clutches varied significantly. This pattern of intraclutch egg size variation and onset of incubation could be a double bet-hedging strategy. In "bad" years, last-hatched nestlings frequently die and reduce the occurrence of whole brood failure. However, in "good" years, egg size facilitates the survival of last-hatched nestlings which are often able to overcome the disadvantages of hatching order. Our results are nearly identical to Howe's in regard to intraclutch egg size variation and incubation patterns, but differ with regard to annual variation in starvation rates. Whereas Howe concluded that 5-egg clutches were more susceptible to starvation than 4-egg clutches, we found the opposite pattern.

274 Rompré & Robinson

Predation, parental investment, and long incubation periods of Neotropical birds. GHISLAIN ROMPRÉ, *Centre de recherche en biologie forestiere, Univ. Laval, Québec, QC,* and W. DOUGLAS ROBINSON, *Dept. Fish. & Wildl. and Oak Creek Lab. Biol., Oregon State Univ., Corvallis, OR.*

Many tropical bird species have paradoxically long incubation periods, despite high time-dependent mortality risk to eggs that theoretically should select for rapid development. One solution to the paradox is that adults reduce mortality risk to themselves by decreasing time at the nest, increasing future breeding opportunities. Based on analyses of continuous videotaping to quantify nest attentiveness of 2 antbird species in Panama, we suggest a new, but complementary, alternative explanation derived from parental investment theory for long incubation periods. Nest predation risk was not constant through the nesting cycle. Predation was up to 6 times greater the first 6 d after egg-laying than later in the nesting cycle, despite a 5- to 10-fold increase in activity at nests with young. Adults virtually ignored their nests for the first 6 d of incubation. Once nests survived beyond the first

week, attendance increased from <50% to 85%. Adult mortality at nests was extremely low and nest defense was ineffective. By reducing incubation when risk of nest loss is highest, parents may lengthen incubation periods, but they also increase future opportunities for success by investing more in nests surviving past the first week and having a predictably greater probability of fledging.

275 Houston

Eighteenth-century naturalists of Hudson Bay. C. STUART HOUSTON, *Univ. Saskatchewan, Saskatoon SK.*

Involved in some of the earliest stirrings of science on the continent, the Hudson's Bay Company fur-traders studied weather and natural history at isolated fur-trading posts on Hudson Bay for 2 centuries. The fur traders and Aboriginal people worked together in a remarkable symbiosis. George Edwards' colour paintings in 1743 of type specimens of 16 new bird taxa collected by James Isham placed the Hudson Bay area second only to Charleston in the number of new North American bird species given binomials by Linnaeus in 1758. Forster in 1772 described another 4 new species collected by Andrew Graham. Hudson Bay Company fur returns over 2 centuries also demonstrated, first and best, the 10-yr hare and lynx cycles, later shown to involve Ruffed Grouse, Spruce Grouse, and especially the Great Horned Owl. The swan trade (skins for powder puffs and quills for lawyer's pens) almost extirpated the Trumpeter Swan. Meteorologic data and weather information recorded at the Hudson Bay Company trading posts provide the largest and longest consecutive series available anywhere in North America, one that can help us understand the mechanisms and amount of climate change today.

276 Sutherland

A reading study of the journal **The Auk**. JAMES M. SUTHERLAND, *Sci. & Tech. Library, Univ. Manitoba, Winnipeg, MB.*

In May of 1999, 2000 of the approximately 4500 subscribers of **The Auk** were sent a list of the 19 articles in the Jan 1999 issue of **The Auk** (Vol. 116, No. 1). Subscribers were asked to indicate which articles were read. A total of 421 usable surveys were returned. Based on these surveys, an average of 21.5% of the articles in the Jan 1999 issue of **The Auk** were read. Thus an article in **The Auk** has about a 1 in 5 chance of being read by a subscriber in the first 3 mon after publication. The mean number of articles read by a subscriber was 4.1. Note that this survey excludes articles which were read by library patrons. Also, the results do not include articles read >3 mon after publication. This study is discussed in relation to similar surveys.

277 vacant

278 vacant

279 Bourque & Desrochers

Spatial aggregation of forest songbird territories and possible implications for area-sensitivity. JULIE BOURQUE and ANDRÉ DESROCHERS, *Dept. Sciences du bois et de la forêt, Univ. Laval, Québec, QC.*

Habitat area requirements by forest songbirds vary greatly among species, but the causes of this variation are not well understood. High area requirements could result from advantages for certain species to settle their territories near those of conspecifics, thus resulting in spatial aggregations much larger than single territories. The objectives of this study were twofold: (1) to seek evidence for territory clusters for forest birds, and (2) to evaluate whether the tendency to be in clusters is simply the result of spatial aggregation of habitat. Locations of singing males of 9 out of 14 species were significantly clustered in at least one spatial scale, even when the spatial structure of habitat variables was incorporated in the analyses. We conclude that territorial aggregation is a common phenomenon in forest songbirds, that it does not depend solely on habitat distribution, and that it should be addressed in the study of avian responses to forest fragmentation.

280 Roux & Marra

The presence of lead and its potential effects on birds across an urban to rural land-use gradient. KARIN E. ROUX and PETER P. MARRA, *Smithsonian Env. Res. Center, Edgewater, MD.*

Wildlife poisoning by the heavy metal lead has been well investigated in the realm of sports fish and waterfowl. The urban environment is another important source of lead poisoning for wildlife

and has yet to be fully explored. Lead-based paint and leaded gasoline have largely been phased out of use in the U.S.; however, lead is still found at high levels in the soil of urban environments due to its persistent properties. We analyzed blood samples from American Robins, Gray Catbirds, Northern Cardinals, Song Sparrows and House Sparrows breeding across an urban to rural land-use gradient. Significant differences in blood lead were determined for adult and nestling songbirds inhabiting lead contaminated environments versus uncontaminated environments. Birds uptake lead through their diet and inadvertent soil consumption. The presence of lead in blood can have serious health consequences for birds including reduced weight gain for nestlings, reduced organ growth and a reduced ability to sustain necessary metabolic functions. At elevated levels, lead contamination can result in nestling and adult death. Understanding the challenges that urban birds must face lends insight as to how an increasingly urban world will affect bird populations.

281 Withey & Marzluff

American Crow survival probability across a gradient of urbanization. JOHN C. WITHEY and JOHN M. MARZLUFF, *Coll. For. Res., Univ. Washington, Seattle, WA.*

American Crow population growth across North American has corresponded positively with urbanization, and many cities are inhabited by breeding crows. Previous studies suggest that survival is generally high for crows, except for populations affected by West Nile virus. We color-banded 812 crows from 1998 to 2003 in sites across an urban gradient in the Seattle, WA, area. We also attached radiotransmitters to 62 juvenile (hatch-year) and 77 adult (after second-year) crows. To investigate the effects of age, sex, and natal habitat on survival estimates, we jointly analyzed live resightings, dead recoveries, and radiotracking data using Program MARK. Natal habitat was classified by urbanization metrics including dominant land cover type (forest/urban forest/urban), contagion, and human population density. All supported models suggested that sex did not have an effect on survival probability and that juveniles had a lower survival probability than adults. Within age groups survival probability was similar across the urban gradient. These results support previous research in our study area suggesting that reproduction and dispersal drive local population change rather than differences in survival.

282 Li & Yao

The genetic demography of a montane avian community. SHOU-HSIEN LI, *Dept. Life Sci., Natl. Taiwan Normal Univ., Taipei, Taiwan*, and CHENG-TE YAO, *Endemic Species Res. Inst., Taiwan.*

Current climate change is driving the shift of species range globally. To properly project the genetic consequence of current climatic trend, it would be critical to understand how the genetic diversity of organisms was affected by the climate change in the past. In the current study, we examined the historical demography for 15 avian species in the forest community of Taiwan. We sequenced the entire mitochondrial cytochrome b gene for >20 individuals of each species. Coalescent-based methods were used to infer the historical population change. Our results suggest that birds inhabiting forests higher than 2,500 m tend to have very limited nucleotide and haplotype diversities; in contrast to species that live in the forest below 2,500 m which have higher nucleotide and haplotype diversities. The genetic demography analysis suggests corresponding historical population reduction for higher altitude birds and population growth for birds living lower altitude. Our results are highly congruent with the pollen fossil record, the expansion of broadleaf evergreen forest and shrinkage of boreal forest in Taiwan, since the last glacial maximum. Our results probably provide the first case to document how historical climatic had changed affected the genetic structure of an avian community as a whole. It should have important implications to project the consequence of current global change.

283 Yeung, Li, Yao, Wang & Hsu

How bad was a bottleneck? - the historical population size of Black-faced Spoonbills revealed by mitochondrial DNA diversity. CAROL YEUNG, SHOU-HSIEN LI, *Dept. Life Sci., Natl. Taiwan Normal Univ., Taipei, Taiwan*, CHENG-TE YAO, *Endemic Species Res. Inst., Taiwan*, JIANN-PYNG WANG, *Dept. Biol., Natl. Cheng Kung Univ., Taiwan*, and YU-CHENG HSU, *Inst. Zool., Academia Sinica, Taiwan.*

The Black-faced Spoonbill (*Platalea minor*) is an endangered species whose census population size has been recorded to be as low as 288 in the late 1980s. World populations of Black-faced Spoonbills are thought to have experienced a dramatic reduction possibly due to anthropogenic disturbances such as the Korean War or drainage of wetlands. The degree, however, to which such

disturbances have affected the population size and genetic diversity, remains poorly understood. Here we adopted a coalescent method to estimate the population size parameter θ ($2N_e\mu$) based on the genetic diversity of 2,369 bp mitochondrial genome of the current population ($n = 87$). Genetic diversity was low ($\pi = 0.00033$, $h = 0.409$). The θ value and other parameters such as substitution rate, N/N_e ratio, and average generation time were then incorporated in a series of Monte-Carlo simulation to estimate the historical population size of the Black-faced Spoonbill. Our results revealed that current level of genetic variation correspond to a population size of 32,848 individuals: a near 30-fold larger population than is currently observed ($n = 1069$). This striking incongruence implies a rather recent bottleneck and the vulnerability of the species in response to environmental changes, thus calls for a more aggressive conservation program for the Black-faced Spoonbills.

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285 Brawn, Libsch, Robinson, Robinson, Robinson, Styrsky & Angehr

Reproductive ecology of lowland forest birds in Panama. JEFFREY D. BRAWN, MICHAEL LIBSCH, *Prog. Ecol. & Evol. Bio, Univ. Illinois, Champaign, IL*, SCOTT K. ROBINSON, *Florida State Mus., Gainesville, FL*, W. DOUGLAS ROBINSON, TARA R. ROBINSON, *Dept. Fish & Wildl. Oregon State Univ, Corvallis, OR*, JENNIFER NESBITT STYRSKY, *Dept. Biol. Sci, Auburn Univ., Auburn, AL*, and GEORGE ANGEHR, *Smithsonian Trop. Res. Inst., Panama*.

Understanding the reproductive ecology of species breeding at tropical latitudes is important for diverse issues in the evolutionary ecology and conservation of birds. Few studies have been presented, however, that offer even baseline data on a multi-species sample. Working in central Panama over a 5-yr period, we located and monitored nearly 2000 nests in moist and dry lowland forest habitat. Nests of over 60 species were observed but, for most questions, samples sizes were adequate for about 10 species. This sample included antbirds, antwrens, manakins, and flycatchers. Overall, rates of nest success reflected high probability of predation. Preliminary analyses identified significant sources of variation in rates of nest success among years, species, and seasonally over the course of a breeding season (typically, Apr through Sep). The unusually dry El Niño and wet La Niña events in 1998 and 1999, respectively, did not appear to affect rates of nest success, but did affect the phenology of nesting and length of the breeding season for several species.

286 Twedt & Somershoe

Prescribed timber harvest to enhance bottomland hardwood forest habitat for birds in Louisiana. DANIEL J. TWEDT and SCOTT G. SOMERSHOE, *USGS Patuxent Wildl. Res. Center, Vicksburg, MS*.

We surveyed breeding and wintering birds via counts and mist-nets within forest stands on Tensas River National Wildlife Refuge in relation to 3 types of forest management: unharvested, thinned to a basal area of 16 - 20 m²/ha, or thinned with embedded 0.4 - 1.2 ha clear-cut patches. During winter, along 2 100-m wide x 250 m long transects per stand, we detected more birds in patch-cut stands (10.2 spp., 39.5 indiv.) than on unharvested (7.5 spp., 25.2 indiv.) or thinned stands (9.7 spp., 25.4 indiv.). During summer, on 6 point counts/stand, we found more species and individuals on patch-cut stands (30 spp., 186 indiv.) than on unharvested (27 spp., 153 indiv.) or thinned stands (28 spp., 158 indiv.). During winter 2002 - 2003 and 2003 - 2004 respectively, the number of captures/100 net-h was 73 and 8 on unharvested sites, 97 and 37 on thinned stands, and 61 and 46 on stands with patch cuts. During summer 2003, we captured an average of 34 birds/100 net-h on unharvested stands, but much higher rates of 57 and 73 birds were recorded for thinned and patch-cut stands, respectively. Breeding and wintering birds generally used thinned stands with embedded patch-cuts more than unharvested stands.

287 Cabrera-Garcia & Seutin

Breeding success and nest site selection in the endangered Sierra Madre Sparrow: a multiple scale approach. LEONARDO CABRERA-GARCIA, *Dept. Geog., McGill Univ., Montréal, QC*, and GILLES SEUTIN, *Parks Canada, Hull, QC*.

The Sierra Madre Sparrow (*Xenospiza baileyi*) is one of the most endangered bird species in the world with an estimated population size below 5000 individuals and a distribution restricted to about 30 km² of high-elevation, fragmented bunchgrass in central Mexico. The sparrow's habitat has been shaped and is maintained by pastoral activities (i.e., grazing and burning). Thus, influencing local land use practices is instrumental for maintaining the bunchgrasses habitat and the sparrow.

Multiscale habitat assessment offers a comprehensive and practical approach to define species habitat and formulate habitat management recommendations. Our objective was to describe Sierra Madre Sparrow's nesting habitat at biological relevant scales: nest supporting plant, habitat patch (100 m²), and landscape. We assessed nesting success through standard nest monitoring techniques and compared nesting sites (n = 31) against random sites. Daily nest survival probability was 0.9657 ± 0.0094 SE, and survivorship was 0.5924. Survivorship was lower in post-fire recovering patches (~1.5 yr after fire). Preference for specific habitat conditions was exhibited at all scales. At the plant scale, the sparrow preferred tall *Festuca lugens* plants that had a high ground cover score and basal diameter ($X^2 = 287.03$, df = 14, P = 0.0001). Patches where nesting occurred had taller vegetation and higher coverage of bunchgrasses than random sites. At the landscape scale, mature grasslands patches (= 3 yr without fire) located far from agricultural patches were favored over the other conditions (G = 21.07, df = 3, P = 0.0001). Habitat management recommendations at each spatial scale can be derived from these results. Conditions for nesting by the Sierra Madre Sparrow can be improved by reducing fire frequency (from 1 yr to 3 yr) and maintaining a mosaic of grassland conditions of the right size and configuration. This information has been shared with local communities and official land managers.

288 Marra, Holberton, Hobson & Greenberg

Assessing physical condition and habitat suitability in migratory birds during the non-breeding season in Belize. PETER P. MARRA, *Smithsonian Env. Res. Center, Edgewater, MD*, REBECCA L. HOLBERTON, *Dept. Biol. Sci., Univ. Maine, Orono, ME*, KEITH A. HOBSON, *Canadian Wildl. Serv., Saskatoon, SK*, and RUSS GREENBERG, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC*.

Data on how habitat occupancy impacts the physical condition and survival of migratory birds on their wintering grounds are critically needed. Most approaches to date require multiple captures within a season to assess changes in condition. We used a single capture approach to assess several parameters associated with body condition (e.g., size-corrected body mass, plasma baseline corticosterone, triglyceride levels, and hematocrit) in several species of migratory birds wintering in citrus and early and late succession tropical forest habitats. Within each habitat type we also quantified sex ratios for each species. Stable-carbon isotope values confirmed that birds captured in a particular habitat had actually spent time in that habitat type. Condition indices, sex ratios and bird densities varied depending upon species and habitat type. Our research confirms that a single-capture approach combined with rigorous physical condition measures provide important insights and offer useful tools for assessing habitat suitability for migratory birds. Such knowledge is essential for understanding the significance of the non-breeding period to migratory birds and for the development of habitat management priorities.

289 Martin & Harrison

Ecology of independent juveniles movements and survival of alpine and forest grouse in relation to habitat fragmentation in western Canada. KATHY MARTIN and SCOTT HARRISON, *Forest Sci. Dept., Univ. British Columbia, Vancouver, BC*.

The period from juvenile independence to the first breeding season is a critical but understudied life history period for almost all birds. Grouse are resident species with a modest spatial scale, and it is possible to monitor radio-tagged juveniles to address this question. The onset of brood break up and independence of juveniles varies from 6 to 12 wk of age and from late Aug to mid-Oct. Independent juveniles are social, joining flocks of the same age and sex, but generally not their siblings. Parental behaviour, presence of post-breeding birds and perhaps hunting facilitate brood break up. Little is known of the consequences of this variation for juvenile dispersal, habitat selection and survival. Juvenile grouse have larger home ranges, make longer dispersal movements and have higher over winter mortality than adults in both alpine and forest grouse. Survival did not vary with connectivity in alpine ptarmigan. In boreal forest habitat fragmented by cutting, survival of radio-tagged spruce grouse juveniles to spring was 74% in medium connectivity landscapes vs 36% in low connectivity, whereas adult survival (69%) did not vary with connectivity. Data on processes influencing the ecology of independent juveniles are vital to understanding population dynamics, especially when ecological or habitat conditions change.

290 Swift & Hannon

Critical threshold responses of resident songbirds and woodpeckers to forest proportion and configuration. TRISHA L. SWIFT and SUSAN J. HANNON, *Dept. Biol. Sci, Univ. Alberta, Edmonton, AB.*

Habitat loss may be the largest global threat to biodiversity, but how does the impact of habitat loss change as the amount of habitat remaining becomes progressively less? Do wildlife populations decline in direct proportion to habitat loss (i.e., linearly) or are there "critical thresholds" in habitat, below which populations decline more rapidly than above the threshold? We investigated how the abundance of resident (year-round) songbirds and woodpeckers changed along a gradient of forest cover, ranging from 0.6% to 89%, in a series of 100 ha landscapes in an agricultural region of Alberta. Six of 8 forest specialists showed evidence of a critical threshold response, decreasing more rapidly below a threshold of 10 - 40% forest cover (depending on the species). These findings imply that resident songbirds and woodpeckers are sensitive to moderate to severe levels of forest loss. Further, if critical threshold responses to habitat loss are prevalent among avian or other wildlife species, this has important implications for conservation and wildlife monitoring. A species that has appeared stable despite progressive losses in habitat may decline rapidly once habitat loss exceeds some critical level. If such responses are not anticipated, such rapid changes in a species' status may preclude effective conservation measures.

291 Overington, Griffin, Sol & Lefebvre

Does exposure to a high diversity of predators select for larger brains and more complex cognition? SARAH OVERINGTON, ANDREA GRIFFIN, DANIEL SOL and LOUIS LEFEBVRE, *Dept. Biol., McGill Univ., Montréal, QC.*

Exposure to predators varies greatly between species. Amongst birds, this variation has been explained in terms of location of the nest, group size, body size, and aggressive behaviour of the prey. To date, however, the specific effects of predation on cognitive abilities across species have not been investigated. While constant predation by a single predator might eventually select for innate responses in the prey, social learning may be more important for species exposed to novel predators. The capacity for social learning is associated with larger brain size and greater innovation in primates and in birds. If predation does indeed select for social learning, species exposed to a greater number of predators would be expected to have larger brains, and greater cognitive abilities. Alternatively, diversity of predators might be a consequence of increased brain size, where larger brained generalist species are exposed to a greater number of predators as they utilize a greater variety of habitats and food types. To test these hypotheses, we carried out a comparative analysis of 326 species of North American species of birds, quantifying the variety of predators on each species, as well as the variety of breeding habitat types used and the number of food types eaten. We examined these ecological variables as a function of brain size and innovation rate, an operational measure of cognition. A linear regression of log-brain size against variety of predators showed that smaller brain size was associated with exposure to a greater number of predators ($p < 0.001$), contrary to our initial hypothesis. However this relationship disappeared when phylogenetic relationships were included in the general linear mixed model. Smaller brained birds with the largest number of predators were concentrated within the orders Gruiformes, Galliformes, and Anseriformes, such that common ancestry confounded any relationship that might exist between brain size and predation pressure. Phylogeny did not account for all patterns in our data. Wider diet breadth was found to be associated with greater innovation, a relationship that remained significant when phylogenetic relationships were included in the analysis ($P = 0.0233$), indicating that generalist species are more innovative than specialists. Further, while breeding habitat breadth was not found to be associated with greater innovation, the use of urban habitats was. Birds using urban habitats have significantly higher innovation rates than those not living in urban environments ($P = 0.0133$). These results are consistent with other known correlates of innovation, including invasion success, in which birds are faced with new food types and are often introduced into human modified habitats.

292 Perkins & Servello

Nocturnal nest attentiveness of Least Terns in Maine. J. C. PERKINS and F. A. SERVELLO, *Dept. Wild. Ecol., Univ. Maine, Orono, ME.*

Least Tern colonies are frequently disturbed by predators or other activity at night, which affects nest attentiveness. Extended periods of poor nest attentiveness may reduce breeding productivity and is a potential concern in Maine where breeding success is low. We documented nest attentiveness at 3 Least Tern colonies in Maine during the nocturnal period (21:00 - 04:30 h) in 2002

and 2003, and pooled data across colonies for analyses. We monitored 119 Least Tern nests for a total of 5,424 h. Of the 723 nocturnal periods monitored, 64% (n = 463) had 1 to 4 departures per period with 84% having 1 departure. The mean probability of a nest having an absence at least once on a monitored night was 40%. The mean number of absences/nest/night for nests with absences was 1.7, and mean absence length was 113 min. Mean departure length varied little among the 1st, 2nd, and 3rd weeks of incubation. Adults either returned at dawn or within 1.5 h after departure, regardless of departure time. Nest predation rates varied among colonies, but there did not appear to be a relationship with nest attentiveness. Poor nocturnal nest attentiveness was prevalent for Least Terns in Maine, but did not appear to affect productivity. Further research is needed to determine the causes of nocturnal departures and potential differential effects on departure lengths.

293 Villard & Robichaud

Do migratory passerines actually disperse farther than more sedentary species? MARC-ANDRÉ VILLARD and ISABELLE ROBICHAUD, *Chaire de rech. du Canada en conservation des paysages, Dép. de biol., Univ. Moncton, Moncton, NB.*

Many authors assume that migratory species disperse farther than more sedentary ones. To test this assumption, we reviewed finite-area studies documenting dispersal and return rates of solitary-nesting passerine birds while accounting for study design. Using regression trees, we compared median natal and breeding dispersal distances among 22 and 36 species, respectively, as well as return rates of individuals banded as nestlings/fledglings (75 species) or as breeding adults (103 species). We hypothesized that (a) dispersal/site fidelity would be independent of migratory tendency owing to the fundamental differences between these movement types; and that (b) both dispersal distance and return rate would increase with sampling effort. As expected, dispersal distance did not increase with migratory tendency and it increased with the spatial extent of study areas. However, residents had a significantly higher return rate than migrants. These results indirectly support the assumption that migratory species disperse farther than more sedentary ones, but they suggest that most finite-area studies do not adequately sample the dispersal movements of migratory species.

294 Budden & Dickinson

Cryptic sub-adult plumage in Western Bluebirds? AMBER E. BUDDEN and JANIS L. DICKINSON, *Mus. Vert. Zool., Univ. California, Berkeley, CA.*

Theories of sexual selection have long been tested through investigation of secondary sexual characteristics such as plumage colouration, and there is growing evidence that 'cryptic' ultra violet reflectance plays an important role in avian mate choice. In this study, we investigated the extent of variation in visual and ultra-violet reflectance from multiple body regions of male Western Bluebirds breeding in Carmel, CA. We found significant correlation between colour measures hue, brightness and chroma across body regions and reveal the highest proportion of ultra-violet reflectance is found in the blue contour feathers as opposed to flight feathers. Furthermore, we demonstrated a relationship between plumage reflectance and male age and examined the interactions between reflectance, patch size and body condition, and explore the potential for multiple signalling across body regions.

295 Friesen, Birt, Garner, Piatt, Newman, Golightly, Gissing & Peery

Population genetic structure in Marbled Murrelets and the delineation of "discrete populations" for conservation. VICKI FRIESEN, TIM BIRT, SHAWN GARNER, *Queen's Univ., Kingston, ON*, JOHN PIATT, *USGS, Anchorage, AK*, SCOTT NEWMAN, *Wildlife Trust, Palisades, NY*, RICK GOLIGHTLY, *Humboldt State Univ., Arcata, CA*, GRAEME GISSING, *Queen's Univ.*, and ZACH PEERY, *Univ. California, Berkeley, CA.*

Marbled Murrelets are coastal seabirds that nest in old growth forest from California through British Columbia to the Aleutian Islands. They are highly vulnerable to oil pollution, logging, gill netting and nest predation, and their populations are declining in British Columbia and the Pacific Northwest. Protection and management of this species requires information about the distribution of genetic variation within and among populations. Previous studies indicated that murrelets breeding in the Aleutian Islands differ genetically from those in mainland Alaska and British Columbia, but samples from the Pacific Northwest were not available. We are comparing variation in the mitochondrial control region and several nuclear loci (including microsatellites and introns) among murrelets from throughout their range. Preliminary results indicate that the species includes at least 3 discrete populations or genetic management units: (1) the Aleutian Islands, (2) mainland Alaska and British

Columbia, and (3) California. These units are supported by several types of analyses on all 3 types of loci. Tree- and ground-nesting populations do not differ at neutral molecular markers. Population decline does not appear to have affected genetic variability within populations yet.

296 Breitwisch

Ornamentation in socially monogamous birds: predictor of parental quality, genetic quality, or both? RANDALL J. BREITWISCH, *Dept. Biol., Univ. Dayton, Dayton, OH.*

Birds are among both the most ornamented and most parental of animals. Because the large majority of bird species are both socially monogamous and biparental, avian ornamentation should predict parental quality. At the same time, there are theoretical reasons why avian ornamentation should also predict genetic quality. Two existing hypotheses (Good Parent vs Differential Allocation) predict that one or the other of these 2 aspects of quality will predominate in mate choice. This presentation will review the evidence for these 2 hypotheses and attempt to establish a broader view of ornamentation in socially monogamous, biparental birds that incorporates both hypotheses.

297 Oh & Badyaev

Is there someone for everyone? evolutionary consequences of genetic complementarity in mate choice in a passerine bird. KEVIN P. OH and ALEXANDER V. BADIYAEV, *Dept. Ecol. & Evol. Biol., Univ. Arizona, Tucson, AZ.*

Most sexual selection models suggest that preferential access to matings creates the strong directional selection necessary for the evolution of elaborate secondary sexual traits. Such models predict that mate preference within a population should converge on one "best" mate – the one with the most elaborate ornament. However, the "best" mate for 1 individual may not be the "best" for another. Specifically, if pair fitness is dependent on particular combinations of traits, selection should favor self-referential mate choice. Here, we use microsatellite genotyping and detailed morphological data to examine patterns of mate choice in relation to both genetic (individual genetic diversity and relatedness of partners) and phenotypic traits in a population of House Finches. Specifically, we ask how pair fitness is influenced by different combinations of phenotypes and genotypes. Additionally, we analyze remating trends to assess if costs of searching might limit individuals' ability to achieve such complementary pairings.

298 Marzluff & Angell

Crows, ravens and culture. JOHN M. MARZLUFF, *Coll. Forest Res., Univ. Washington, Seattle, WA,* and TONY ANGELL, *Seattle, WA.*

What do Van Gogh, Shakespeare, Noah, the Norse God Odin, the Hopi People, The Atlantic Spice Company, Mark Twain, and the rock band The Counting Crows have in common? They have all drawn inspiration from crows and ravens. In fact members of the genus *Corvus* have profoundly affected our culture since people evolved. We explore these affects and show that this influence is not unidirectional: people also profoundly influence crow culture, ecology, and evolution. We describe the relationship between *Corvus* and people using a new concept, cultural coevolution. Cultural traits that stimulate each others' cultural evolution are said to be culturally co-evolved. Take the interaction between early fishers and ravens for example. Fishers that dried salmon on racks certainly lost part of their catch to clever ravens. In response they posted children and eventually scarecrows to reduce losses. Ravens figured strongly in these people's culture as the creator and chief trickster, possibly in part because of the challenges in keeping this intelligent competitor from their food. The behavior of scavenging from people and circumventing their scare tactics was likely learned through individual trial and error and social transmission. Social learning in ravens is especially likely as young follow their parents to novel foods. Thus the culture of northwest native fishers and ravens has coevolved. Cultural coevolution is most likely to occur between people and animals we regularly interact with that are long-lived, intelligent, and social. It may occur for utilitarian reasons, but this is not common in our interactions with crows. We identify 6 major pulses to the coevolution between *Corvus* and people: hunting and gathering, expansion of agriculture, war and aggression, urbanization and recreation, hunting for recreation, and bird feeding. In North America, and perhaps worldwide, our culture currently is stimulated by crows more profoundly than by ravens.

299 **Barker & Lanyon**

Polymorphism of mtDNA and a Z-linked intron in Red-winged Blackbirds. F. K. BARKER and S. M. LANYON, *Bell Mus., St. Paul, MN.*

Although Red-winged Blackbirds (*Agelaius phoeniceus*) are one of the most common species on the North American continent, examination of their mtDNA diversity using RFLP techniques revealed surprisingly little variation, suggesting a recent, substantial population expansion. One alternative explanation for this pattern is the action of purifying or positive selection on the mtDNA. Single-locus analyses of mitochondrial control region (CR) sequences of 30 individuals from Minnesota, s. California, and Mexico, along with sequences from 10 Tricolored Blackbirds (*Agelaius tricolor*, the sister species of *A. phoeniceus*) reveals little evidence for selection. Indeed, rooting of the Red-winged Blackbird mitochondrial tree with Tricolored Blackbird alleles suggests that the basal lineages are distributed in Mexico, consistent with a recent population expansion from the south. However, the comparative levels of polymorphism and divergence at the intron of a Z-linked nuclear locus (MUSK) suggest a deficiency of mtDNA variation. Non-monophyly of Red-winged Blackbird MUSK intron alleles suggests that this locus might not have attained coalescence, but restriction of Tricolored Blackbird-like alleles to the sample from s. California may indicate ongoing or historic hybridization. The observed levels of polymorphism at this locus and others suggest that Z-linked genes might be of particular use in studies of avian populations.

300 **Doherty, Kendall, Sillett, Gustafson, Flint, Naughton, Robbins & Pyle**

Demographic parameter estimates of Black-footed Albatross and implications for future data collection. PAUL F. DOHERTY, Jr., *Dept. Fish. & Wildl. Biol., Colorado State Univ., Ft. Collins, CO*, WILLIAM L. KENDALL, *USGS Patuxent Wildl. Res. Center, Laurel, MD*, T. SCOTT SILLETT, *Smithsonian Migratory Bird Center, Washington, DC*, MARY GUSTAFSON, *USGS Patuxent Wildl. Res. Ctr., Laurel, MD*, BETH FLINT, *USFWS, Honolulu, HI*, MAURA NAUGHTON, *USFWS, Portland, OR*, CHANDLER S ROBBINS, *USGS Patuxent Wildl. Res. Ctr., Laurel, MD*, and PETER PYLE, *Oceanic Soc., Pt. Reyes, CA.*

The effects of fishery practices on Black-footed Albatross (*Phoebastria nigripes*) continue to be a source of contention and uncertainty. Some of this uncertainty is due to a lack of estimates of albatross survival and population growth. To address this uncertainty a database of albatross banding and recapture records for the last 40 yr was constructed. Using these data and contemporary analytical tools, we were able to generate estimates of survival, population growth, age-specific breeding probabilities, and the probability of skipping breeding seasons for subsets of years from 1963 - 2001. Our results suggest annual survival probabilities were high in the 1960s, low during the 1980s until the banning of drift nets (1993) and possibly rising since 1993. A population matrix model, parameterized with our estimates of survival, indicates albatross populations declined during the 1980s, but the results for years since then are ambiguous. Due to uncertainty concerning data collection and validity of assumptions required for these analyses, our results should be considered with caution. Although estimates of survival and population growth are of interest to many, band-loss rates, temporary movement rates and discontinuous banding effort can confound these estimates. Through the process of analyzing these data, a number of improvements in data collection became evident that could help ameliorate these problems. We will present suggested improvements for field methods and study designs, including the use of double banding and collecting data using a 'robust' design. The advantages from these changes could markedly improve the estimates of parameters of interest.

301 **Meyer, Zimmerman & Bennetts**

Adult survival and timing of mortality of Swallow-tailed Kites. KENNETH D. MEYER, GINA M. ZIMMERMAN, *Avian Res. & Cons. Inst., Gainesville, FL*, and ROBERT E. BENNETTS, *Natl. Park Serv., Bozeman, MT.*

Estimating annual survival and identifying sources of mortality are essential for describing population trends and conserving vulnerable species. We used the Kaplan-Meier estimator with satellite (n = 19) and VHF (n = 25) telemetry to estimate survival of 44 adult Swallow-tailed Kites from the migratory U.S. breeding population. Because mortality was rarely confirmed for birds with which we lost contact before their transmitters were due to expire, we categorized each case based on the likelihood of mortality versus radio failure (e.g., signal loss during protracted water crossing in adverse winds probably indicated mortality). Four analytical scenarios ranging from least (all losses attributed to mortality) to most (no losses attributed to mortality) conservatively produced annual survival estimates of 0.61 - 0.84 (CIs ~ ± 0.22). Survival did not differ between the sexes or for birds with satellite (20 g)

versus VHF (12 g) transmitters. Losses, however, were unevenly distributed across seasons: 2 during breeding in the U.S., 10 on the winter range in South America, and 10 on south- or northbound migration. Although tentative, our estimates for the likely range of annual survival will inform population-modeling efforts. Knowing the timing and location of mortality, furthermore, will support conservation planning for the small U.S. population of Swallow-tailed Kites, which has not recovered from a severe contraction in range and number in the early 20th Century.

302 vacant

303 Bronson, Grubb & Braun

A test of the endogenous and exogenous selection hypotheses for the maintenance of the Black-capped and Carolina Chickadee hybrid zone. C. L. BRONSON, THOMAS C. GRUBB, Jr., *Dept. Evol., Ecol. & Organ. Biol., Ohio State Univ., Columbus, OH*, and MICHAEL J. BRAUN, *Dept. Zool., Natl. Mus. Nat. Hist., Washington, DC*.

The contributions of genetic and environmental factors to differential reproductive success across hybrid zones have rarely been tested via direct manipulative testing in the field. This manipulative experiment simultaneously tested endogenous (genetic-based) and exogenous (environmental-based) selection within a hybrid zone. We transplanted mated pairs of Black-capped and Carolina Chickadees and their hybrids into isolated woodlots within their hybrid zone and monitored their reproductive success. Although clutch sizes were similar, based on an estimate of genetic compatibility of a pair, hybrid pairs produced fewer nestlings and fledglings than did pairs of either parental species. According to a linear model generated from the data, a pure pair of either parental species would be expected to produce 1.91 or 2.48 times more fledglings/nesting attempt, respectively, than the average or least compatible hybrid pair in the experiment. Our result of decreased reproduction for hybrid pairs relative to parental species pairs within the same environment supports the endogenous selection hypothesis for maintenance of this hybrid zone. Because the experiment was conducted entirely within the hybrid zone (i.e., the same environment for parental and hybrid pairings), our data do not support the exogenous selection hypothesis as it predicts either all pairings doing poorly or the hybrids being more successful than the parental pairs.

304 Turcotte & Desrochers

Landscape-dependent distribution of forest birds in winter. YVES TURCOTTE and ANDRÉ DESROCHERS, *Centre de recherche en biologie forestière, Univ. Laval, Québec, QC*.

We evaluated the effects of landscape structure, along a broad gradient of deforestation, on the spatial distribution of forest birds exposed to winter climatic conditions, in Québec. Concurrently, we conducted an experiment to determine if these effects would persist if an unlimited source of energy, provided by food-supplementation, became available. We analyzed these effects at the population level, using count data of Black-capped Chickadees, but also at the community level, referring to species richness. In 1 of the 2 yr of the study, before food-supplementation began, "forest integrity" (a composite of forest cover and edge density) was positively associated with chickadee abundance and species richness. Each year, forest integrity was also positively associated with chickadee abundance and species richness in landscapes that were supplemented. However, in control landscapes, during the food-supplementation period, chickadee abundance and species richness tended to decrease with an increase in forest integrity. We argue that the more forested control landscapes facilitated winter emigration of juveniles and transient birds. Conversely, our results further suggest that, in the highly deforested and fragmented control landscapes, birds became "gap-locked" when rigorous winter climatic conditions exacerbated already existing movement constraints.

305 Tellkamp

A prehistoric bird assemblage from the Ecuadorian highlands. MARKUS P. TELLKAMP, *Dept. Zool., Univ. Florida, Gainesville, FL*.

The zooarchaeological record of birds from the Andes in Ecuador is scant. Although >200 bird bones were recovered from the 3,100 m high La Chimba site in n. Pichincha Prov., only a handful of them had been previously identified. Here I report on 193 bird bones identified to date. La Chimba has a diverse bird fauna that is dominated by tinamous, probably of the genus *Nothoprocta*. Pigeons, Eared Doves and 1 Band-tailed Pigeon, constitute the next most important group. Other families represented are the Anatidae, Accipitridae (including a large *Buteo* and a large eagle), Cracidae

(Andean Guan), Scolopacidae (Upland Sandpiper), Psittacidae (large parrots), Tytonidae (Barn Owl), Strigidae (Short-eared Owl), and Ramphastidae (Toucanet). Of the Passeriformes I have identified specimens belonging to the Turdidae (a medium-sized thrush), Thraupinae (including a *Buthraupis* mountain-tanager), and Icterinae (a large oropendula). The bird component of the archaeological excavation at La Chimba suggests a tree-line habitat with both paramo and forest birds. The forest cover in the inter-Andean valley appears to have been more extensive in the past as some of the forest and forest edge birds do not occur in the area anymore. This study increases considerably the total number of known avian taxa from the prehistoric northern Andes.

306 Bonaccorso & Peterson

Pleistocene history of Amazonian birds as reconstructed by ecological niche modeling. E. BONACCORSO and A. T. PETERSON, *Nat. His. Mus. & Biodiv. Res. Center, and Dep. Ecol. & Evol. Biol., Univ. Kansas, Lawrence, KS.*

Geographic distributions of endemic birds in the Amazonian forests led Haffer to propose the Pleistocene Refugium Hypothesis (PHR), which states that speciation of birds in the Amazon has been produced by cycles of expansion and contraction of forests during the Pleistocene. However, recent analyses of Pleistocene vegetation contradict the PRH, showing that the Amazon was forested in glacial times as it is now. Alternate hypotheses to the PRH argue that speciation in the Amazon Basin was produced by the broadening of river valleys and marine transgressions during the Pleistocene, or by Amazonian rivers *per se*. Herein, we use models of ecological niches of forest and savanna birds to test how changes in temperature and precipitation during the last glacial maximum and interglacial periods affected the potential distribution of bird species in Amazonian forest and adjacent savannas. Ecological niches were modeled with the Genetic Algorithm for Rule-set Prediction (GARP). Ecological niche models were based on occurrence points for 5 species of savanna birds and 5 species of forest birds. Environmental data used included 5 electronic maps summarizing aspects of topography and climate. Models for the present potential distribution were developed using the present distribution occurrence points and present environmental layers, and then projected into the environmental scenarios of the Last Glacial Maximum and last interglacial period. To explore the effects of sea-level changes on bird distributions during the last glacial maximum, we simulated the decrease in sea levels by manipulating elevation data layers.

307 vacant

308 vacant

309 Renaud & Desrochers

Influence of spatial scale on apparent area-sensitivity of forest songbirds. CHRISTINE RENAUD and ANDRÉ DESROCHERS, *Centre de recherche en biologie forestière, Université Laval, Ste-Foy, QC.*

Songbird presence is explained in part by the area of forest in the surrounding landscape, but the extent of landscape that is perceived by birds is still unknown. In studies on landscape effect, forest area is often measured inside a radius of 1 km to 5 km and rarely provide results for >2 radii. We tested the response of songbirds to the area of forest measured inside 9 radii from 100 m to 24 km. We used data from Ontario's Forest Bird Monitoring Program, a long-term project initiated in 1987 consisting of annual point count surveys distributed across the province. Area of coniferous, deciduous and mixed forest was derived from a landsat image. For each bird species, we used a specific measure of the amount of forest cover in order to account for the relative preferences of birds to these 3 types of vegetation. Area sensitivity varied depending on the extent of landscape considered for a majority of species. Most species responded to the amount of forest cover inside the 24 km radius. The extent of landscape at which area sensitivity is the strongest varied a lot depending on the species. This study provides evidence that the choice of scale can influence the apparent area sensitivity of forest songbirds, and that the amount of forest cover at the regional scale is very important for many species.

310 Takekawa, Warnock & Bishop

Spring migration of Dowitchers along the Pacific Coast. JOHN Y. TAKEKAWA, *USGS, W. Ecol. Res. Center, Vallejo, CA*, NILS WARNOCK, *PRBO Cons. Sci., Stinson Beach, CA*, and MARY ANNE BISHOP, *Prince William Sound Sci. Center, Cordova, AK.*

We studied the spring migration of radio-marked Dowitchers along the Pacific coast. To

relocate individuals, we organized and coordinated 30 partners listening at migration sites from Mexico to w. Alaska. 90 Dowitchers were marked at Bahía Santa María, Sinaloa, (BSM; $n = 29$) in 2002 and San Francisco Bay, California, (SFB; $n = 40$) and Grays Harbor (GH), Washington, (GH; $n = 21$) in 2001. Average mass of captured Dowitchers was lowest in Mexico ($105 \text{ g} \pm 9 \text{ SD}$), heaviest at SFB ($125 \text{ g} \pm 11 \text{ SD}$), and intermediate at GH farther to the north ($117 \text{ g} \pm 9 \text{ SD}$). Length-of-stay (LOS) for Dowitchers at BSM averaged $18.6 \text{ d} \pm 4.8 \text{ SD}$ and did not differ by age, sex, mass or capture date. LOS at SFB and GH ranged from $6.2 \text{ d} \pm 4.6 \text{ SD}$ to $10.8 \text{ d} \pm 5.6 \text{ SD}$. Compared with smaller Dunlin and Western Sandpipers, Dowitchers migrated later and staged longer at the CRD. However, only 1 BSM dowitcher was relocated north of the banding site compared with 40-91% relocation of other marked shorebirds, suggesting that birds may have used routes through the interior. In 2002, we relocated 70% of the Dowitchers on the Copper River Delta (CRD) in Alaska, and LOS was negatively related to arrival date. 10 Dowitchers were relocated in w. Alaska in potential breeding areas.

311 Tardif & Desrochers

Is Wilson's Warbler really wetland specialist?: an eastern perspective. JACINTHE TARDIF and ANDRÉ DESROCHERS, *Centre de recherche en biologie forestière, Université Laval, Québec, QC.*

We studied habitat use by Eastern Wilson's Warbler (*Wilsonia pusilla pusilla*), in a fir forest (Forêt Montmorency), during the breeding seasons 2003 - 2004. We compared territorial male occurrence in riparian alder habitat versus clear-cuts aged < 15 yr. In 2003, Wilson's Warbler were found at the same frequency in recent clear-cuts than in alder habitats. Territorial males captured in clear-cuts were not different morphologically in comparison with the ones captured in alders, based on measures of body size and black cap size. Percentage of open habitat (dry and humid) in and around each survey site (within 50, 100, 200 and 400 m) was associated with the occurrence of singing males at each radius studied. Our 2003 results contrast with the general idea that Wilson's Warbler is a wetlands specialist, and provides the first evidence that this species is area sensitive. Results from 2004 will be presented and compared with those from 2003. According to the Breeding Bird Survey, Wilson's Warbler populations have been declining in the last 20 yr: clear-cuts may benefit them by providing alternative breeding habitat but data on reproduction will be required to evaluate the potential role of clear-cuts.

312 Hannah & Schmiegelow

Declines in the Black-throated Green Warbler: from pattern to process. THERESA A. HANNAH and FIONA K. A. SCHMIEGELOW, *Dept. Ren. Res., Univ. Alberta, Edmonton, AB.*

Habitat loss and fragmentation have been identified as primary factors contributing to the decline of many North American songbirds. In Canada, broad-scale allocation of productive forests for timber extraction has raised concerns over boreal forest bird populations. The Black-throated Green Warbler is a forest specialist, requiring older mixed-wood habitat in western boreal forests. Populations in forest fragments at Calling Lake, AB, have experienced a significant decline (~50%) as a direct result of experimental harvest. Annual surveys conducted from 1993 (pre-fragmentation) to 2003 (10 yr after fragmentation), and detailed population-level work in 2003 - 2004 are being used to evaluate hypotheses related to potential mechanisms of decline. Temporal and spatial patterns of patch occupancy will be examined using abundance measures from 11 yr of point count surveys. A basic demographic model will test whether the rate of decline is greater than expected based on occupancy patterns. Resource selection functions will be developed to evaluate habitat use between the fragmented and control sites, incorporating data from nest site, territory, and landscape scales. Habitat changes due to fragmentation will be assessed by comparing vegetation data from 1993 with that collected in 2003. Preliminary trends in both habitat use and vegetation change will be reported. Future research and implications for habitat conservation and forest management in Alberta will be discussed.

313 Larkin & Diehl

Migrating birds departing from a patch of woods in a matrix of row-crop agriculture. RONALD P. LARKIN, *Illinois Nat. Hist. Surv., Champaign, IL*, and ROBERT H. DIEHL, *Univ. Illinois at Urbana-Champaign, Champaign, IL.*

Large areas of the agricultural Midwestern U.S. are largely devoid of what is normally regarded as suitable migratory stopover habitat for birds that inhabit trees. Observations in that region with large Doppler radars arouse concern for bird conservation, indicating that migrant land birds are indeed highly concentrated in the often-fragmented patches of wooded habitat that exist. In 2 seasons

during passerine-dominated migration, we used a transportable ornithological radar to quantify the departure of individual birds at dusk from a wooded patch in Illinois vs. from adjacent row-crop agriculture. Because large-bodied migrant insects are common, we took care to discriminate birds from insects. The results support the conclusion that wooded areas are used by migrant land birds in great numbers, suggest important questions about birds' use (or not) of the agricultural matrix, and highlight the potential importance for bird conservation of tiny fragments of wooded land for neotropical migrant birds.

314 vacant

315 Hart, Woodworth, Spiegel, Lebrun, McClure, Tweed & Henneman

Patterns of 'ohi'a flowering and honeycreeper abundance across an elevational gradient on windward Hawai'i. PATRICK J. HART, BETHANY WOODWORTH, CALEB SPIEGEL, JAYMI LEBRUN, KATHERINE McCLURE, ERIK TWEED and CARLIE HENNEMAN, *USGS-BRD Pacific Island Ecosys. Res. Center, Hawaii Natl. Park, HI, and PCSU, Univ. Hawaii at Manoa, Honolulu, HI.*

'Ohi'a is the dominant tree species in Hawaiian forests and the principal nectar source for the 'Apapane, an endemic Hawaiian Honeycreeper. 'Apapane are known to be a primary reservoir for avian malaria, and the daily movement of these birds across the landscape in search of 'ohi'a bloom may have important implications for the dynamics of the disease system in Hawaii. We documented patterns of 'ohi'a nectar availability and 'Apapane abundance at 9 1-km² study areas located along an elevational gradient from 20 - 1800 m on windward Hawaii from Apr 2002 - present. 'Ohi'a flower density peaked at all elevations in Mar and Apr of each year, and generally coincided with changes in 'Apapane density. Flower abundance was significantly greater at high and low elevations but few 'Apapane were detected at low elevations even though overall flower densities and nectar flow rates were highest there. Contrary to expectations, the periodic malaria epidemics that have been reported in middle elevation forests in late summer and fall do not appear to be associated with a yearly influx of 'Apapane. The flowering pattern of 'ohi'a is associated with 'Apapane movement to some extent, but the conditions that drive the disease system vary with elevation and the composition of the bird community.

316 McDonald

The matrix recoded: an elasticity "brittleness" index for comparative life history analyses. DAVID B. McDONALD, *Dept. Zool., Univ. Wyoming, Laramie, WY.*

I propose a new measure, the "brittleness" index, to facilitate demographic comparisons among organisms with very different life histories. Matrix-based elasticity and sensitivity analyses provide a useful measure of the impact of changes in vital rates on population growth rate or fitness (Caswell 2001, **Matrix population models**, Sinauer). The degree of skew among elasticity elements determines the susceptibility of a life history to fluctuations in vital rates. For example, when adult survival is far more important/elastic than other life history transitions, a species will be very vulnerable in the face of stochastic environmental variation (anthropogenic or natural). How, though, does one compare very different life histories (warblers vs. penguins)? By condensing the life history to a 2 x 2 matrix of elasticities and by developing a skew-based measure in the interval 0 to 1, I show that one can gain interesting comparative insights into life histories and their reaction to stochasticity. Species with low "brittleness" (index near 0) will be resilient to stochasticity. Species with high "brittleness" (index near 1) will be particularly vulnerable to novel sources of stochasticity. Different species may, therefore, capitalize on the range of variability in the environment to be specialists on either variability or evenness of environmental conditions. For example, woodpeckers that specialize on fire-based stochasticity, or Australian rain opportunists, might be very vulnerable to anthropogenic change that "evens out" the environment, favoring "brittle" competitors. Having a single uniform measure for assessing response to stochasticity should be useful in a variety of evolutionary and conservation contexts.

317 Bahn, Krohn & O'Connor

The role of dispersal in shaping bird distributions. VOLKER BAHN, *Dept. Wildl. Ecol., Univ. Maine, Orono, ME*, WILLIAM B. KROHN, *USGS, Maine Coop. Fish & Wildl. Res. Unit, Univ. Maine*, and RAYMOND J. O'CONNOR, *Dept. Wildl. Ecol., Univ. Maine.*

Predictive distribution modeling is an important tool in ecological research and conservation. Spatial autocorrelation in the residuals of models solely based on environmental predictors, but not on

spatial structure, indicate inadequate fit and invalid estimates for statistics. Furthermore, spatial autocorrelation in the dependent variable carries additional information, which can improve predictions of distribution models, when appropriate spatially explicit modeling techniques are employed. Selecting appropriate models requires a thorough understanding of the underlying causes of autocorrelation. A primary cause of spatial autocorrelation in species' distributions is correlated environmental variables. If it were the only cause, traditional, non-spatial models would be adequate; when all contributing environmental factors are included in a model they implicitly capture the spatial structure in the species' distribution. However, we suggest that dispersal also leads to autocorrelation in species distributions, which then would necessitate spatially explicit distribution modeling. Since dispersal data are hard to collect at large extents, we used several well-established ecological theories (e.g., Taylor power law for population dynamics, metapopulation theory, hierarchy theory, density dependence) to predict relative dispersal rates for 28 species of birds using data from the Breeding Bird Survey. We then compared these dispersal rates to the relative strength of residual autocorrelation in the species' distributions. Our preliminary results indicate that dispersal plays a significant role in shaping the selected bird distributions and that spatially explicit distribution models outperform traditional models as determined by Akaike's Information Criterion.

318 Ortiz-Pulido, Rojas, Acevedo, Ramírez, de la Vega & Granados

Hummingbirds and its nectar source: testing spatio-temporal scales and ecological hierarchies in El Chico National Park, México. RAÚL ORTIZ-PULIDO, ALBERTO E. ROJAS, OTILIO A. ACEVEDO, AURELIO RAMÍREZ, ALMA L. DE LA VEGA and AURELIO GRANADOS, *Universidad Autónoma del Estado de Hidalgo, Hidalgo, México*.

Relationship between hummingbirds and its nectar sources had been tested few times taking into account different spatio-temporal scales and ecological hierarchies below 10,000 km². In this study we searched the relationship between both variables in a temperate dry landscape of central Mexico. In the lower levels of each scale few of the relations were significant, while in the higher levels, practically all the relationships were significant. Scaling up the spatial scale from ha to km², we found a significant relationship between abundance and richness of hummingbirds and its nectar sources at km² level. Scaling up the temporal scale from days to years, we found a significant relationship at year level. Scaling up the ecological hierarchies from species to community, we found significant relationships in the latter. Using the same design (following to García & Ortiz-Pulido 2004, **Ecography** 27: 187-196) we tested the hypothesis in a landscape far away from the first study site (near of 200 km) and we obtained similar results.

319 Gorman, Esler, Williams & Flint

Tracing nutrient allocation to reproduction in a sub-arctic breeding bird: inference from proximate and stable isotope analyses. K. B. GORMAN, D. ESLER and T. D. WILLIAMS, *Centre Wildl. Ecol., Simon Fraser Univ., Burnaby, BC*, and P. L. FLINT, *Alaska Sci. Center, U.S. Geol. Surv., Anchorage, AK*.

The use of endogenous reserves as a source of nutrients for egg production (i.e., a capital breeding strategy) has received much attention in waterfowl due to the high energetic and nutritional costs of precocial egg production. Traditional approaches for quantifying the use of endogenous reserves during egg production in waterfowl have relied on indirect methods of tracing nutrient allocation such as proximate body composition analyses. Stable isotope analyses allow for the direct tracing of both endogenous and exogenous sources of nutrients used in egg production and can provide quantitative estimates of the relative contributions of both sources. Using these 2 approaches we traced nutrient allocation to reproduction in female Greater Scaup breeding on the Yukon-Kuskokwim Delta, Alaska, with particular emphasis on the relative contribution of endogenous reserves in relation to date of rapid follicle growth (RFG) initiation. Body composition analyses indicated that early and late RFG initiating females do not use endogenous lipid and protein reserves to meet the demands of egg production; they appear to rely on daily dietary intake into egg lipid and protein. These results were corroborated with stable carbon and nitrogen isotope analyses, including quantitative mixing models and correlation analyses, where isotope signatures of reproductive lipid and protein were reflective of local breeding area food resources. Our results suggest that Greater Scaup differ from most other high latitude breeding waterfowl in utilizing an income breeding strategy.

320 Anderson, Mainwaring, Szewczyk, Polastre & Culler

Micro- and macro-habitat variation in the breeding biology of Leach's Storm Petrel. JOHN G. T. ANDERSON, *Coll. Atlantic, Bar Harbor, ME*, ALAN MAINWARING, *Intel Berkeley Lab., Berkeley, CA*, ROBERT SZEWCZYK, JOSEPH POLASTRE and DAVID CULLER, *Dept. Computer Sci., Univ. California, Berkeley, CA*.

Leach's Storm Petrel is a diminutive pelagic seabird that breeds in burrows in large colonies along the rim of the northern Atlantic and Pacific basins. While the bulk of the population is found at high latitudes, a significant fraction breeds within the Gulf of Maine. Increased development pressure coupled with lack of adequate knowledge of population sizes and preferred breeding habitat may place many of these birds at risk. We suggest that conventional habitat classification schemes tend to be biased towards easily measured parameters that are often examined at an anthropocentric scale both in time and space. Recent advances in microelectronics permit much more detailed measurements of environmental variables at scales appropriate to the organism. Here we present the results of habitat monitoring using a combination of a local Geographic Information System (GIS) and a dense network of "motes" - micro-environmental sensing units capable of recording and transmitting a wide array of data collected over a broad area. The motes were deployed in a petrel colony in eastern Maine and included both above-ground and in-burrow sensors that recorded temperature, humidity, visible light and photosynthetic active radiation (PAR). Results from the motes were then compared to conventional macro-habitat classifications and revealed a markedly greater degree of heterogeneity than expected. These results are of importance in considering potential habitat conservation strategies for this and other species of burrow nesting seabirds.

401 Cavey & Weatherhead

The influence of mate guarding on paternal care in the multi-brooded American Robin. KAREN M. CAVEY, *Prog. Ecol. & Evol. Biol., Univ. Illinois, Urbana-Champaign, IL*, and PATRICK J. WEATHERHEAD, *Dept. Animal Biol., Univ. Illinois*.

The widespread occurrence of extra-pair mating in socially monogamous birds has lead many researchers to focus on how males adjust the level of parental care they provide to young of a given nesting attempt, based on their certainty of paternity in those young. Mate guarding is a common mechanism by which male birds can increase their certainty of paternity, as they cannot assess directly the paternity of young. Multi-brooded species, in which individual nesting attempts overlap in time, provide a unique and unexplored opportunity to examine how changes in an individual male's ability to mate guard through the breeding season can affect the level of parental care he provides to young of various nesting attempts. In the multi-brooded American Robin, males are able to mate guard at first nests, but are prevented from mate guarding at second nests because they exclusively care for fledglings from first nests while females begin a second nesting attempt. We predict that males should be more likely to care for young from nesting attempts in which they are able to mate guard (higher certainty of paternity), than those from which they are unable to mate guard (lower certainty of paternity). We monitored a population of breeding American Robins over 2 yr to evaluate this hypothesis. Behavioral observations of nest defense and nestling provisioning were used as indicators of paternal care. We present preliminary results from this research to evaluate whether the parental care provided by males is affected by their ability to mate guard at a given nesting attempt.

402 Winkler, Bernroider & Leisler

Birds, brains, and behavior. HANS WINKLER, *KLIVV, ÖAW, Wien, Austria*, GUSTAV BERNROIDER, *FB Organismische Biologie, Universität Salzburg, Austria*, and BERND LEISLER, *Max-Planck-Institute of Ornithology, Radolfzell, Germany*.

The relative brain mass of birds compares, on average, well with mammalian brain size. However, variation among families seems to be more pronounced. Therefore birds are ideal subjects to comparatively study the effects of ecological and other factors on the evolution of avian brains. Previous studies comprised either gross comparisons, involving a wide range of disparate taxa, or focused on the relationships between imprinting, song, and spatial learning and those parts of the brain believed to be essential for these functions. We analyzed in several closely related groups of birds how skull dimensions, overall brain size, and the size of the forebrain relate to ecological conditions. One important finding was that migrants possess smaller brains than residents. We propose several hypotheses to explain how ecological conditions may influence brain evolution, and discuss the behavioral consequences of brain size reduction.

403 Ellison, Sealy & McGaha

Co-occurrence of cowbird nestling bill-color morphs: adaptive or neutral mechanisms? KEVIN ELLISON, SPENCER G. SEALY and HOPE R. MCGAHA, *Dept. Zool., Univ. of Manitoba, Winnipeg, MB.*

Brown-headed Cowbirds (*Molothrus ater*) are obligate brood parasites and, therefore, hosts may have selected for characters of nestling cowbirds that improve parasite fledging success when reared alongside host young. As nestling mouthparts influence adult care decisions and each subspecies of *M. ater* produces nestlings with predominately yellow (*M. a. obscurus*) or white (*M. a. artemisiae*, *M. a. ater*) rictal flanges, we determined whether ratios of cowbird flange color were different among nestlings and juveniles. We found more white-flanged young *M. ater* at a site in s. Texas where yellow-flanged *obscurus* were expected and hosts had predominately yellow-flanged young. Measurements of adults and eggs indicate that cowbirds at the site were *obscurus* and that there was no evidence of gene flow with another subspecies. Ratios were not due to differential survival with hosts. Instead, flange color was associated with cowbird sex, as found for Galapagos Finches (*Geospiza* spp.; Grant 1999, **Ecol. & evol. Darwin's finches**, 2nd ed.). Thus, we suggest cowbird flange color does not promote nestling mimicry and may instead vary neutrally as found for *Geospiza*.

404 Morrison & Westneat

The affects of signal size on aggression in male-male interactions over territory in the House Sparrow. EMILY B. MORRISON and DAVID F. WESTNEAT, *Dept Biol., Univ. Kentucky, Lexington, KY.*

In the House Sparrow, males have a black throat patch (bib) that may function as a signal of fighting ability or dominance status in aggressive interactions between males over territory. The affect of bib size on aggressive interactions over nest boxes and box ownership status was investigated using pairs of captive male house sparrows. Males were matched for natural bib size and one was assigned to an enlarged treatment (ET) while the other was assigned a control treatment (CT). Each pair was introduced into an outdoor aviary with a nest box. Aggressive behaviors were scored for each male during 3 observation periods post-introduction and box ownership status was determined at the end of each trial. Preliminary data show that ET males spent proportionately more time on the nest box than did CT males and therefore were more likely to become nest box owners. Analysis also suggests that while aggression scores between the control male and the enlarged male were not significantly different, there was a positive correlation between the average individual aggression score and proportion of time spent on the box within each pair.

405 Lombardo, Cutler, Grove, Hohman, Januchowski, Jarois, Nowak, O'Neill, Smith & Wilson

Patterns of copulation behavior in North American songbirds. MICHAEL P. LOMBARDO, BEN CUTLER, KENDRA GROVE, EMILY HOHMAN, STEPHANIE JANUCHOWSKI, DANIELLE JAROIS, HOLLY NOWAK, JANICE O'NEILL, JOAN SMITH and EVAN WILSON, *Dept. Biol., Grand Valley State Univ., Allendale, MI.*

The patterns of copulation behavior of North American songbirds vary widely. For example, some species copulate frequently and in highly visible locations (e.g., Tree Swallows) while others apparently copulate infrequently because their copulations are infrequently observed (e.g., bluebirds). We collected data on the ecological correlates of copulation behavior found in published accounts of the life histories of 299 species of songbirds that breed in North America. The data were analyzed to detect patterns in copulation behavior related to nesting habitat, mating system, and patterns of paternal care.

406 Lewis, Esler & Boyd

Nocturnal behavior of Surf and White-winged Scoters: what do these sea ducks do when the lights go out? TYLER LEWIS, DAN ESLER, *Centre for Wildl. Ecol., Simon Fraser Univ., Burnaby, BC,* and SEAN BOYD, *Canadian Wildl. Serv., Delta, BC.*

The ability to feed nocturnally increases the daily amount of time available for feeding, providing behavioral flexibility in response to environmental change. Studies have shown that some waterfowl species extend foraging into nocturnal periods when food is scarce or daylight is short. However, for most sea ducks, nocturnal behavior has not been described. The paucity of nocturnal information is mainly due to the difficulty of locating and observing sea ducks at night. Radio telemetry can be used to remotely monitor locations and feeding behavior of diving sea ducks. The radio signal

disappears when the bird is underwater and resumes when the birds resurfaces, allowing the observer to document both the presence and duration of feeding bouts. Surf and White-winged Scoters were affixed with radio transmitters in Baynes Sound on the east coast of Vancouver Island, BC, during winter 2002 - 2003. Telemetry observations revealed an almost complete lack of nocturnal foraging. In over 4000 min of observation, a total of 44 dives were observed, representing 0.37% of nocturnal time spent diving (i.e., underwater). These nocturnal data contrast sharply with daytime observations of the same radio-tagged scoters. In over 8000 min of daytime observations, scoters performed 5,565 dives, representing 27.4% of daytime spent diving. The absence of nocturnal foraging coincided with the crepuscular movement of scoters from diurnal, intertidal feeding areas to nocturnal, offshore areas.

407 Zwiers, Fleischer & Borgia

Phylogenetics of the Ptilonorhynchidae. PAUL B. ZWIERS, ROBERT C. FLEISCHER, *Univ. Maryland, College Park, MD, and Natl. Mus. Nat. Hist., Smithsonian Inst., Washington DC*, and GERALD BORGIA, *Univ. Maryland, College Park, MD*.

An improved phylogeny of the bowerbirds has been estimated using parsimony, maximum likelihood, and Bayesian criteria. The data set includes all described 19 bowerbird species and uses 3 outgroups (*Menura*, *Cormobates*, and *Xanthotis*) to polarize the topology. The data consists of 2021 bp of mtDNA sequence data (cytochrome b and NADH dehydrogenase subunit 2) and 4210 bp of nuclear intron sequences (adenylate kinase intron 5, β -fibrinogen intron 7, glyceraldehyde-3-phosphate dehydrogenase intron 11, ornithine decarboxylase introns 6 and 7, ribosomal protein 40 intron 5, transforming growth factor β -2 intron 5, and tropomyosin α -subunit intron 5) totaling 6231 bp. Trees show similar within clade topology to Kusmierski et al. (1997, *Proc. R. Soc. London* 264B: 307-313) although there is disagreement at deeper nodes. Additional species fall as such. *Amblyornis flavifrons*, a presumed extinct species, falls sister to the *Am. macgregoriae* and the 2 described subspecies of *Sericulus aureus* – *S. a. aureus* and *S. a. ardens* – fall sister to *S. chrysocephalus*. Also, *Ailuroedus buccoides* falls basal to *Ai. crassirostris* and *Ai. melanotis*, and *Chlamydera guttata* falls sister to *C. maculata*. This phylogeny will be used to address the evolution of independent characters such as sexually selected behaviors, tuning of the visual system, and the major histocompatibility complex gene family.

408 Hahn

Habitat selection by a migratory songbird, the American Redstart: the role of social facilitation and population density. BETH A HAHN, *School Nat. Res. & Environ., Univ. Michigan, Ann Arbor, MI*.

Declines in the abundance of Neotropical migratory songbirds are a serious conservation concern. For many species, loss of North American breeding habitat is believed to be a key factor underlying these declines. To breed successfully on their return to northern forests in the spring, songbirds must quickly identify and establish suitable territories. Understanding how individuals select breeding habitat is therefore critically important to the conservation and management of songbird species. This project will improve our knowledge of the role of both individual behavior and social interactions in territory establishment and population density of warblers nesting in hardwood forests. The model species is the American Redstart, which breeds in deciduous forests of the Upper Peninsula of Michigan. Through a combination of observations and song playback experiments, this project examines the extent to which birds use the presence and density of other individuals of the same species to measure habitat quality when selecting breeding territories. Expected results will provide forest managers with improved methods to (1) assess habitat quality for songbirds and (2) enhance breeding populations in targeted areas. My research will help elucidate the importance of behavioral interactions to observed bird-habitat associations.

409 Rivers, Young, Gonzalez & Fleischer

Evidence for sibling relatedness in nests multiply-parasitized by Brown-headed Cowbirds. JAMES W. RIVERS, *Dept. Ecol., Evol. & Marine Biol., Univ. Cal., Santa Barbara, CA*, SARAH YOUNG, ELENA GONZALEZ and ROBERT C. FLEISCHER, *Genetics Prog., Smithsonian Inst., Washington, DC*.

The Brown-headed Cowbird is the most generalist brood parasite known, having been raised by >140 host species. In areas of high cowbird abundance, female laying ranges often overlap, leading to multiple-parasitism of individual host nests. During the 2003 breeding season, we collected genetic data from 89 cowbird chicks in 31 multiply-parasitized nests to determine relatedness of cowbird nestmates. We used up to 5 microsatellite loci and sequences of mtDNA control region haplotypes from 87 of the chicks. Microsatellites were highly variable, ranging from 8 - 22 alleles/locus

(mean = 15) and had an average observed heterozygosity of 76.2% (n = 76 chicks genotyped for all loci). The control region had marked variability, with 12 haplotypes (n = 87 chicks sequenced). Using likelihood analysis in the program Kinship, we found that more than one-third of pairwise comparisons were found to be full siblings. In 3 nests, 3 of the nestling cowbirds were classified as full siblings, while in 1 nest, 5 of 7 eggs appeared to be full siblings. These results indicate that patterns of multiple parasitism are due both to females re-laying in nests and by several females laying in single nests. Re-laying may be a by-product of a saturated host community where females are restricted in finding additional suitable nests in which to lay, or it may be adaptive if the nests which receive multiple eggs are of higher quality and can fledge multiple cowbird chicks. This also indicates the potential for kin selection to operate through cowbird nestmate interactions.

410 Soma & Hasegawa

The effect of social facilitation and social dominance on foraging success of budgerigars in an unfamiliar environment. MASAYO SOMA and TOSHIKAZU HASEGAWA, *Dept. Cognitive & Behav. Sci., Tokyo Univ., Tokyo, Japan.*

Social foraging is a far more complex phenomenon than individual foraging because of the many social interactions and communications that affect each individual's behaviour. Social dominance and social learning markedly influence the foraging efficiency of individuals in an unfamiliar environment. This study investigated how these 2 factors affect the costs and benefits of social foraging. We presented a novel feeding environment to captive Budgerigars, *Melopsittacus undulatus*, and then compared the latency to feeding and number of pecks at the food for social and individual conditions, and for high-, middle-, and low-ranking birds. When in the social condition, birds started foraging faster and pecked more food than in the individual condition. Presumably, this lowered neophobia and enhanced foraging efficiency in the social condition was caused by social facilitation. Low-ranking birds had less resource accessibility in the social condition, probably because they were constrained by the existence of higher-ranking birds when it came to accessing the feeder. Nevertheless, the food intake of low-ranking birds almost equaled that of high- or middle-ranking birds in the social condition. In summary, high status is definitely an advantage, while low status adds some costs to individuals. Nevertheless, low-ranking birds compensate for this through enhanced foraging. It was clear that social foraging provides a great advantage to foragers of each rank, because of social facilitation.

411 Norris, Marra, Kyser & Ratcliffe

Population connectivity of a long-distance migratory bird, the American Redstart. D. RYAN NORRIS, *Dept. Biol., Queen's Univ. Kingston, ON*, PETER P. MARRA, *Smithsonian Environ. Res. Center, Edgewater, MD*, T. KURT KYSER, *Dept. Geol. Sci., Queen's Univ.*, and LAURENE M. RATCLIFFE, *Dept. Biol., Queen's Univ.*

Determining the degree of connectivity between breeding and wintering populations is critical for understanding the ecology and evolution of migratory systems. We analyzed stable-hydrogen isotopes in tail feathers of a Neotropical-Nearctic migratory passerine, the American Redstart. Samples were collected from 32 sites in 12 countries throughout the wintering range. Overall, there was a strong east-west structure: individuals in the eastern wintering range (the Caribbean, including Florida and Bahamas) bred primarily in north and southeastern North America, whereas individuals over-wintering in the west (Mexico and Central America) bred primarily in nw. U.S., British Columbia and Alberta. Within each of the 2 major regions (Central America and the Caribbean), there was also a significant amount of north-south structure. In both cases, δD was positively related to winter latitude, indicating that redstarts exhibit a pattern of chain migration where populations wintering further north were also the most northern breeders. Across all sites, first-year birds (both sexes) contributed a significantly higher proportion of the variance in δD values compared to after-first-year birds. This suggests that inexperienced redstarts are either less successful in navigating traditional migratory routes or get pre-empted from certain wintering areas by older birds. The distinctive structuring between and within the major wintering regions suggests that the population dynamics between breeding and non-breeding areas may be tightly linked, offering a unique opportunity to study population dynamics and the evolution of migration in this species.

412 Iburguchi, Lougheed & Friesen

Defeating *numts*: the avian egg as an 'almost-pure' source of mitochondrial DNA for obtaining reference sequences. GABRIELA IBARGUCHI, STEPHEN C. LOUGHEED and VICKI L. FRIESEN, *Dept. Biol., Queen's Univ., Kingston, ON.*

The presence of nuclear copies of mitochondrial genes ('homologs', 'pseudogenes', or 'numts') is a challenge in systematics and population genetic studies that employ mitochondrial markers. Numts may co-amplify with, or preferentially amplify over, true mitochondrial sequences when PCR-based methods and universal primers are employed. When mitochondrial genes and their nuclear copies have diverged recently, both may retain similar coding properties and structural domains (such as conserved blocks or stem-and-loop structures), while differing in their sequence and mode of evolution. Such recent ancestry results in difficulty in determining which is the true mitochondrial copy, making comparisons among species or populations potentially orthologous, and resulting in spurious gene genealogies and estimates of divergence times. Species-specific (and even population-specific) primers that target mitochondrial genes are a solution, but previously available reference sequences (based on purified mitochondrial DNA) are needed for their design. Traditional methods to isolate pure mitochondrial DNA (mtDNA) generally require fresh tissue (a limitation in most field studies), the methods are often time-consuming and cumbersome, and the final product is often contaminated with high quantities of nuclear DNA. Here we illustrate the use of avian eggs as almost pure sources of mtDNA when relatively freshly-laid eggs, or older, undeveloped or infertile eggs (or contents) are available. Other methods for obtaining mtDNA using kits or specific tissue extractions are also compared.

413 Iburguchi, Tubaro & Lougheed

Preliminary notes on the nesting behaviour of the Least Seedsnipe (*Thinocorus rumicivorus*: Thinocoridae, Charadriiformes). GABRIELA IBARGUCHI, *Dept. Biol., Queen's Univ., Kingston, ON*, PABLO TUBARO, *Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina*, and STEPHEN C. LOUGHEED, *Dept. Biol., Queen's Univ.*

Seedsnipes are cryptic ground-nesting shorebirds endemic to the Andes and surrounding lowlands. Their cryptic appearance and behaviour, and the inaccessibility of much of their habitat have contributed to our lack of knowledge regarding their distribution, natural history and reproductive behaviour. The Least Seedsnipe is perhaps the most commonly observed species in this family, but information regarding its nesting behaviour is conflicting. For example, whereas seedsnipes are usually described as socially monogamous, incubating duties have been assigned to the female (Fjeldsø & Krabbe 1990, **Birds of high Andes**, Copenhagen; DeJune 15, 2004; Hoyo et al. 1992, **Handbook of birds of world**, Barcelona), both sexes (Johnson 1965, **Birds of Chile**, Buenos Aires), and the male (sex-role reversal; Brooke & Birkhead 1991, **Cambridge encyclopedia of ornithology**). All other families within the Parvorder Scolopacoidea (within which seedsnipes belong) contain species where sex-role reversal is common (e.g., jacanas, painted snipes, phalaropes, plains-wander). Double-clutching, where the female in a monogamous pair lays 2 sequential sets of eggs (one incubated by the male and the other by the female) could explain the conflicting observations of the incubating sex, but this breeding system has not previously been proposed for seedsnipes, and detailed nesting behaviour studies are lacking. Here we summarize some preliminary observations on the nesting behaviour of Least Seedsnipe, we genotype a small subset of families and siblings, and we investigate a possible case of double-clutching.

414 Mackenzie

Reproductive success and breeding ecology of Prothonotary Warblers in nest boxes and natural cavities in southern Ontario. STUART A. MACKENZIE, *Bird Studies Canada, Port Rowan, ON and Dept. Zool. Univ. Guelph, Guelph ON.*

The Prothonotary Warbler is endangered in Canada, and is restricted mainly to sw. Ontario. In 1997, a trial nest box program was initiated to try to halt the decline in population size. Between 1997 and 2002, 70% of Prothonotary Warbler nests found were in nest boxes. Despite these high numbers, it is unknown how reproductive success by pairs using nest boxes compares to those using natural cavities. Akaike's Information Criterion (AICc) was used to compare the effects of nest type, habitat, site, year and date on the reproductive success of this population. There was considerable support for an effect of date nesting on clutch size, the number of chicks fledged and the proportion of eggs hatched; earlier nesters were greater in all cases. Variation in the proportion of eggs hatched was also found to be largely explained by habitat type. There were no apparent differences in these 3

measures of reproductive success between nests in boxes and in natural cavities. However, 52% of all failed nests in nest boxes were due to predation, 48% of these were attributed to House Wrens, an interspecific competitor. Only 36% of failures were due to predation in natural cavities. In conservation efforts of cavity nesting species, caution should be exercised when using nest boxes, especially when there is a high incidence of interspecific competitors.

415 Reineke

Crows in the city: adaptations to colonization of extreme urban habitat. ROBERT REINEKE, *Urban Ecol. Prog., Coll. Forest Res., Univ. Washington, Seattle, WA.*

Over the past 2 yr I have documented dense colonization of downtown Seattle by breeding crows. Observations include: 1) nearest neighbor nest distances as close as 20 m; 2) puzzling patchiness (hotspots vs. barrens) in spatial pattern of breeding territories; 3) unpredictably opportunistic nest site selection that includes puzzling choices of arboreal nest sites, uncharacteristic use of human structures, and routine reuse of nests; and 4) behavior in a few closely adjacent pairs suggestive of cooperative breeding. We are initiating investigations into the causes and consequences of observed nest site selection and behavior of marked breeding pairs: e.g., 1) Are there reliable environmental and/or biological correlates of observed patterns in urban nesting behavior? 2) Are there consistent differences in reproductive success among downtown breeders that can be attributed to differences in observed nesting behavior and as a consequence what novel selection pressures might be operating on urban breeders? 4) What might be the long term implications of increasing adaptation to extreme urban environments by breeding crows?

416 Foote & Barber

Is offspring sex-ratio of Song Sparrow nestlings related to parental quality? JENNIFER R. FOOTE, *Dept. Biol., Dalhousie Univ., Halifax, NS,* and COLLEEN A. BARBER, *Dept. Biol., Saint Mary's Univ., Halifax, NS.*

Evidence suggests that female birds can control the sex of offspring produced and in some species, females mated to more attractive males produce male-biased sex ratios. In critical-period song learners, males who were nutritionally stressed as offspring may have smaller adult repertoire sizes. If females use repertoire size for mate choice, then females paired with males who have large repertoires should have a male-biased sex ratio. These large repertoire males would be in good physical condition and able to provision at a high rate resulting in male offspring who themselves may acquire a large repertoire and will have greater future reproductive success than could female offspring. Song Sparrows are socially monogamous, multi-brooded passerines with biparental care. We determined male repertoire size. Blood samples were collected in the field from 2000 to 2003 in Sackville, NS, from 61 Song Sparrow broods (223 nestlings) of 25 males. Offspring paternity was determined using microsatellite analysis. We used a PCR based molecular sexing technique to sex the nestlings and adults (blind to identity) using the P2/P8 primer, which amplifies a region of the sex-linked CHD gene. Of the adult males and females examined, all were correctly sexed using this method. The population brood sex ratio of males to females for the 4 yr combined was 0.538 and the sex ratio for individual years ranged from 0.45 - 0.59. Results will be discussed.

417 Ruché, Imbeau & Ferron

Effect of partial cutting and nest covering behaviour on the predation risk of simulated Spruce Grouse nests. DELPHIN RUCHÉ, *Dept. Sciences appliquées, UQAT, Rouyn-Noranda, QC,* LOUIS IMBEAU, *Dept. Sciences appliquées, UQAT, Rouyn-Noranda, QC,* and JEAN FERRON, *Dept. de Biologie, UQAR, Rimouski, QC.*

Nest concealment is one of the main factors affecting nest predation risk. Partial cuts, which reduce tree density and simplifies vegetation structure, may therefore increase nest vulnerability to predation as compared to untreated stands. However, for some precocial birds, female nest covering behaviour during the egg laying period reduces nest visibility and may decrease nest vulnerability to predation. Artificial Spruce Grouse nests were used to compare predation rates in partially cut (24 to 34% basal area removed) and uncut forest in nw. Québec. Half of the artificial nests were covered, to simulate female behaviour during the egg laying period. Nest predation rate did not differ between treated (23.9%) and untreated (23.1%) stands ($p > 0.9$). When small mammals were excluded from our analysis, nest covering significantly reduced predation risk (1.6% as opposed to 9.8%), as other predators mostly detected uncovered nests ($p < 0.001$). These results suggest that nest covering behaviour should be considered in the design and interpretation of artificial nest experiments of precocial species.

418 Morse, Powell & Tetreau

* Assessing effects of recreational disturbance on the productivity of Black Oystercatchers in Kenai Fjords National Park. JULIE A. MORSE, ABBY N. POWELL, *Alaska Coop. Fish & Wildl. Res. Unit, Univ. Alaska, Fairbanks, AK*, and MIKE TETREAU, *Kenai Fjords Natl. Park, AK*.

In Alaska, national parks are generally assumed to provide high quality undisturbed wildlife habitats. However, these parks also attract recreational users, whose presence may in turn reduce the suitability of key habitats for nesting shorebirds. In Kenai Fjords National Park, the Black Oystercatcher is susceptible to human disturbance as nesting habitats are often popular campsites. In response to increasing recreational activity in coastal Alaska, we monitored Black Oystercatcher nest and chick survival from 2001 - 2003 and evaluated factors affecting daily survival rates. Annual nest and chick survival rates were highly variable ranging from 18 to 41%, and 38 to 63%, respectively. We used program Mark to evaluate factors affecting the daily survival rates of nests and chicks. Our models suggest that season date and breeding success on that territory in the previous season were important covariates of daily survival rates. With the establishment of a population of marked birds in 2003, future work will focus on estimating individual rates of productivity. Evaluating how Black Oystercatcher reproductive characteristics vary with levels of human disturbance is crucial for developing Park management plans that ensure high quality habitats for breeding shorebirds.

419 Outlaw

Limitations of exploring the evolution of migration: between- and within-species comparisons in *Myiarchus*. DIANA C. OUTLAW, *Dept. Biol., Univ. Memphis, Memphis, TN*.

There is some question as to whether or not ancestral character state reconstruction of migratory behavior actually reflects evolutionary process. One concern about these types of analyses is polymorphism for migratory behavior in many extant species, and the subsequent limitations of ancestral state interpretation at or near the base of the tree when this polymorphism may be assumed to have existed in ancestral taxa. In order to address this issue, I have used a molecular phylogeny of *Myiarchus* (Joseph et al. 2003, *J. Biogeog.* 30: 925-937; Joseph et al. 2004, *Molec. Phylo. Evol.* 31: 139-152), which includes multiple representatives from species polymorphic for migratory behaviors. Maximum likelihood and weighted parsimony ancestral character state reconstruction on the species-level tree suggests that the ancestors of polymorphic species are sedentary, but with both gains and losses of migration within-species (*M. tyrannulus* and *M. swainsoni*) that are correlated with geographic location. However, these analyses cannot accommodate either polytomies or polymorphism. I constructed statistical parsimony networks of both *Myiarchus tyrannulus* and *M. swainsoni*, then created hierarchical contingency tables within- and between-clades of migratory behaviors per individual and per clade. These analyses suggest no relationship (with one exception) between migration and either clade or nested clade structure. If the process of lineage sorting that we see within extant species reflects sorting at lower taxonomic levels, these results do suggest that polymorphism may be a factor limiting ancestral state interpretations.

420 Roth & Islam

Clustered territories in Cerulean Warblers. KIRK ROTH and KAMAL ISLAM, *Dept. Biol., Ball State Univ., Muncie, IN*.

Cerulean Warblers maintain all-purpose breeding territories in forested areas in eastern North America. Although these territories are well defined, many aspects of Cerulean Warbler territories have not been studied in great detail. Territory spacing is one such neglected characteristic of territoriality. Many observers have noted that Cerulean Warblers may breed in clusters of territories, but a statistical determination of clustered territories has yet to be conducted. We investigated distances between Cerulean Warbler territorial boundaries at Big Oaks National Wildlife Refuge, Madison, IN, during the summers of 2002 and 2003. We used a Clark and Evans analysis for the spatial placement of the territories. The Clark and Evans analysis constructs an index of aggregation based upon a comparison of neighbor distances to the expected neighboring distances if territories were dispersed randomly throughout the available habitat. In this index, a value of 1.0 represents a random spatial pattern. If clumping occurs, the value approaches zero and a completely regular pattern would have a value of 2.15. The index of aggregation in 2002 was 0.544 and in 2003 it was 0.454. These values indicate that Cerulean Warbler territories tend to occur in aggregate clusters.

421 Thatcher & Buehler

Initial response of Wood Thrushes and Kentucky Warblers to experimental selection cutting in hardwood forests on Tennessee National Wildlife Refuge. BENJAMIN S. THATCHER and DAVID A. BUEHLER, *Dept. For., Wildl. & Fish., Univ. Tennessee, Knoxville, TN.*

Tennessee National Wildlife Refuge has managed its hardwood forests with experimental selection cutting in an attempt to increase nesting and foraging substrate for mature forest songbirds. We present the results from an ongoing study designed to experimentally test the effects of this management on breeding Wood Thrushes and Kentucky Warblers. We measured habitat characteristics and collected daily nest survival, brood parasitism, and population density data within 12 20-ha research units, both prior to and following forest management. Research units represented 2 randomly applied treatments: reference (n = 4) and harvest (n = 8). Timber removal consisted of single-tree and small group selection cutting which reduced canopy cover to 70% within the forest matrix and to 40% within a series of 0.4-ha patches. Kentucky Warbler densities increased significantly (>10x) in harvest vs. reference units 2 yr post-treatment. Wood Thrush densities and nest survival rates decreased in the harvest units following treatment. The percentage of Wood Thrush nests parasitized by Brown-headed Cowbirds increased 2 yr post-treatment in both harvest and reference units. In the short-term, proactive management that increases forest structural diversity may have mixed effects on breeding mature forest songbirds. These sites will be monitored for another 2 yr to fully characterize the initial responses of Wood Thrushes and Kentucky Warblers to this treatment.

422 Revels

Male provisioning of female Swainson's Warblers at nest during incubation. MIA R. REVELS, *Biol. Dept., Northeastern State Univ., Tahlequah, OK.*

Courtship feeding has been documented in a variety of bird species. Males may feed females to demonstrate their food gathering abilities as well as to contribute to the female's nutritional reserves for breeding. Courtship feeding during incubation (i.e., incubation feeding) by males may serve additional purposes. Incubation feeding may decrease the need for the female to leave the nest to forage for food, allowing her to remain on the nest for longer periods of time. Supplemental feeding by the male might also increase her caloric intake during a time of great energetic expense. Swainson's Warblers are a shrub-nesting, socially monogamous warbler species that nest in southeastern bottomland hardwood forests. Male Swainson's Warblers have been documented feeding females during the incubation stage, but not at the nest. Here I present the first record of male Swainson's Warblers feeding females at the nest. Nests were located by systematic searching during 2001 - 2003 on the Little River National Wildlife Refuge, McCurtain Co., OK. Activity at 25 nests was videotaped during the incubation period and tapes were analyzed to determine male incubation feeding rates. Males fed females on 8 different instances during 100 h of behavior. Further investigation of incubation feeding in Swainson's Warblers will provide information about quantity and quality of food items provided by males during incubation.

423 Etterson, Bennett & Greenberg

Increasing the accuracy of Mayfield estimation using knowledge of nest age. MATTHEW A. ETTERSON, RICHARD S. BENNETT, *U.S. Environ. Protection Agency, Duluth, MN,* and RUSSELL GREENBERG, *Smithsonian Migratory Bird Center, Washington, DC.*

The ubiquitous assumption of constant-length nest-cycles in nest-survival estimation results in negatively biased overall survival rates due to Jensen's inequality. More importantly, including knowledge of age allows researchers to reduce or eliminate uncertainty arising from the unknown distributions of initiation and discovery. We describe a novel Mayfield formulation that incorporates knowledge of age of nests in estimating survival probabilities. We use computer simulations to compare this formulation to numerous existing formulations of the Mayfield estimator under varying sample size (100, 200, and 400 nests) and varying monitoring schedules (1-, 3-, and 5-d intervals between visits) and varying discovery distributions. When nests are visited daily, all models are equivalent to Mayfield's original estimator. Bias increases with monitoring interval when age is ignored, but remains small when knowledge of age is used. We apply the model to a set of 199 Wood Thrush nests monitored in central Virginia during 2001 and 2002. Model selection criteria (AIC) suggest that the best models for these data include a negative influence on nest-survival with proximity to forest edges. Models including forest area also had explanatory power, but ranged from 5 - 7 AIC units lower than the best model set. This pattern supports mechanistic hypotheses for lowered nest-

survival through increased frequency of nest-predation along forest edges.

424 Houston & Terry

Turkey Vultures nest in attics of deserted farm houses in Saskatchewan. C. STUART HOUSTON, *Univ. Saskatchewan, Saskatoon, SK*, and BRENTON TERRY, *Hugh Cairns School, Saskatoon, SK*.

Turkey Vulture pairs in Saskatchewan increasingly nest in the attics of deserted farm houses, and hence have increased in numbers and in range since the first noted instance in 1983. The first-ever 3 nestings in the Saskatoon Bird Area occurred in 2002; 20 such nesting pairs were reported across mid-Saskatchewan in 2003, some too late to visit. We have launched North America's first authorized project to place wing-tags on nestlings, after sending Brent Terry to Peter Bloom in California for hands-on instruction. In our trial year, 2003, we tagged 14 8-wk-old nestlings at 9 nests, with no bleeding or other adverse effects. Interested landowners at 8 sites read the letter-number combinations on herculite wing tags for up to 5 wk after the young learned to fly.

425 Wilder & Holberton

Testosterone and female aggression in a monogamous songbird, the Song Sparrow and the cost to females. SARAH WILDER and REBECCA HOLBERTON, *Dept. Biol. Sci., Univ. Maine, Orono, ME*.

Female Song Sparrows normally experience an increase in plasma testosterone at the beginning of the breeding season during the territory establishment and nest building stage, which is accompanied by an increase in aggression towards conspecific females. This period of aggressive behavior could function to maintain monogamy by driving away conspecific females that may choose a polygynous breeding strategy if they have not found an appropriate male and territory. After females are settled on territories and have begun laying eggs, their plasma testosterone levels and conspecific aggressive behaviors drop sharply. According to the "Challenge Hypothesis", if female Song Sparrows experience a decrease in testosterone levels, it is so they can avoid health damage that prolonged exposure to high levels of testosterone may cause. In this study I will determine if the drop in plasma testosterone levels is necessary for females to avoid high costs of testosterone exposure and if prolonged testosterone exposure results in lowered health for individuals. I will administer testosterone propionate, via implants, outside of the normal period for its expression and measure the effects of the treatment on the health of subjects through several immune related variables, and on the health and growth rates of the young of the subjects. I also will conduct behavior experiments to measure the effects of the implants on the aggression of subjects. This study not only looks at the female's influence on monogamous relationships in a songbird, but also tests the "Challenge Hypothesis" from a female perspective.

426 Sykes

The Cuban connection: the illegal cage-bird trade of the Eastern Painted Bunting (Mariposa) in the island nation at the southern limit of the bird's winter range. PAUL W. SYKES, Jr., *USGS Patuxent Wildl. Res. Center, School Forest Res., Univ. Georgia, Athens, GA*.

The Eastern Painted Bunting has been declining annually over the past 35 yr based upon results of the Breeding Bird Survey and analyses of the Christmas Bird Counts in south Florida. The keeping of colorful birds in cages as pets has been a part of Cuban culture for several hundred years. However, there are now laws in Cuba that make that practice illegal, but there is no enforcement of such laws. Sources in Cuba have revealed that the trapping of Painted Buntings for the cage-bird trade is widespread in this island nation where the buntings are being kept as pets and sold to foreign tourists and to fellow Cubans. 9 uniquely color banded Painted Buntings have been reported from Cuba since 2000 as part of a study on survival of the eastern population, and 8 of these birds are being kept in cages as pets. Given the declining trend, such trapping may be having a serious negative impact on the eastern population of the Painted Bunting.

427 Sykes, Manfredi & Padura

A source of gene-pool loss to the eastern population of the Painted Bunting: the illegal cage-bird trade in South Florida. PAUL W. SYKES, Jr., *USGS Patuxent Wildl. Res. Center, School Forest Res., Univ. Georgia, Athens, GA*, LARRY MANFREDI, *Princeton, FL*, and MIGUEL PADURA, *Miami, FL*.

The Painted Bunting has been declining annually over the past 35 yr based upon results of the Breeding Bird Survey. A cursory survey of the illegal trapping of Painted Buntings for a black market cage-bird trade in south Florida indicates that the practice is widespread and out of control. A remedy for this illegal activity is urgently needed. We have provided detailed information on our findings to the

Law Enforcement Division of the U.S. Fish and Wildlife Service and the situation is under investigation.

428 Spiegel, Hart, Woodworth, Tweed & Lebrun

Distribution and abundance of native forest birds in low-elevation areas on Hawaii island: evidence of range expansion. CALEB SPIEGEL, PATRICK HART, BETHANY WOODWORTH, ERIK TWEED and JAYMI LEBRUN, USGS-BRD *Pacific Island Ecosystems Research Center, Hawaii National Park, HI, and PCSU, Univ. Hawaii at Manoa, Honolulu, HI.*

The Hawaiian honeycreepers are an endemic subfamily of birds that were once abundant in forests throughout Hawaii, but are currently thought to be limited to elevations greater than approximately 900 m, due to the impact of mosquito transmitted avian malaria at lower elevations. Recently however, populations of 2 honeycreeper species have been reported near sea-level on Hawaii island. Here we provide an update on the status of a potentially rapidly changing lowland avifauna by documenting the distribution and abundance of honeycreepers and other forest birds within approximately 640 km² of low elevation habitat. We conducted systematic Variable Circular Plot (VCP) counts along primary and secondary roads on the east slope of Kilauea volcano (lower Puna District). We also conducted counts at 79 stations near sea-level that were last surveyed in 1995 in order to document potential low-elevation range expansion of honeycreepers. Substantial numbers of Hawaii Amakihi were distributed widely throughout the study area, while Apapane were found less frequently and in smaller numbers. Both Amakihi and Apapane were frequently found below 30 m in elevation, and Amakihi were relatively abundant and wide spread at sea-level. We detected Amakihi at approximately 42% (33 of 79) of stations, compared with 0 Amakihi at the same 79 stations reported by surveyors in 1995. This represents a significant increase of Amakihi in this area over a 9 yr period, and is evidence that these birds have expanded their range in recent years despite high levels of avian malaria.

429 de Groot & Easton

Testing the focal species approach in riparian habitat of southern British Columbia. KRISTA L. De GROOT and WENDY E. EASTON, *Canadian Wildl. Serv., Delta, BC.*

Conservation plans use a number of management approaches ranging from single, umbrella, representative and focal species, up to ecosystem and landscape level management. While ecosystem management is a widely sought ideal, many practitioners have difficulty translating the concept to make effective regional or local-scale recommendations. Species-specific and umbrella species concepts are generally considered of limited practical use, however the focal species approach outlined by Lambeck (1997, *Conserv. Biol.* 11: 849-856) has combined elements of several approaches to help inform conservation biologists and land managers of specific regional or local scale habitat needs. The focal species approach has been applied in several bird conservation plans in British Columbia. In some cases, suites of focal species have been chosen with limited local data. The caveat was added that explicit evaluation is required of both the focal species approach and the suites of focal species chosen to improve conservation recommendations. A preliminary analysis will be presented, testing the assumption that a suite of focal species in lowland riparian habitat in the south Okanagan of British Columbia represents the needs of other riparian birds in this area.

430 Scheffers, Harris & Haskell

* Do ephemeral ponds provide habitat for birds? BRETT R. SCHEFFERS, J. BERT C. HARRIS and DAVID G. HASKELL, *Dept. Biol., Univ. of the South, Sewanee, TN.*

Seasonally flooded pools known as ephemeral or vernal ponds provide important habitat for amphibians and plants, but their role in avian ecology has been little studied. We tested the hypotheses that ephemeral ponds have greater avian richness and abundance than the surrounding upland forest on the Cumberland Plateau in Tennessee. Using a paired sample design, population surveys of the avian community were conducted in the winter and spring of 2004 at vernal pools and adjacent upland forest locations. The number of individuals within the avian community at the ephemeral ponds was significantly greater than that of adjacent upland control sites. In addition, the richness of the avian community at pond sites relative to that of control sites increased linearly with increasing pond size. These data suggest that in addition to the well-documented benefits they provide for other plant and animal communities, ephemeral ponds provide habitat for birds. The findings of this study also have implications for the conservation and management of these ecologically diverse wetlands.

431 Gratto-Trevor

Winter distribution of Saskatchewan Piping Plovers 2002 - 2004. CHERI L. GRATTO-TREVOR, *Canadian Wildl. Serv., Environ. Canada, Saskatoon, SK.*

Piping Plovers are listed as endangered in Canada and threatened/endangered in the U.S. They winter almost entirely in the U.S. (Atlantic and Gulf coasts), Caribbean, and Mexico, but the relative distribution of Saskatchewan breeders is not well defined. In the summers of 2002 and 2003, 401 adults and 154 chicks were uniquely color-banded in Saskatchewan. Adults were captured on nest at several locations in Saskatchewan, primarily Big Quill Lake, Lake Diefenbaker, and the Missouri Coteau (including Chaplin Lake). By Apr 2004, 286 sightings, representing 94 individuals, were reported from wintering areas. This represents 19% of all adults and 11% of all chicks marked. 73% of all females observed were seen in Texas, compared to 81% of males and 76% of birds banded as chicks. The remaining individuals were reported from Florida and Georgia, and 1 bird each from Alabama and North Carolina. Only 6% of all observed chicks, 12% of females, and 7% of males were seen on the Atlantic coast of the U.S., while all others were reported from the U.S. Gulf coast. There was no strong evidence for sex differences in distribution of non-breeding observations. However, twice as many females as males were seen only in spring (Mar - May) or fall (Aug - Nov), not winter. This suggests that females are more transient, winter more often in non-searched areas, or are less likely to be observed compared to males due to behavioral differences. Birds from different breeding sites in SK did not have different winter distributions. Within a nonbreeding season, no bird was observed to change areas, although some local movement was reported. 14 birds were seen in both the 2002 - 2003 and 2003 - 2004 seasons. All were observed back in the same region, with minor or no differences in specific location.

432 Askins

Distribution of early successional birds in artificial openings in forests. ROBERT A. ASKINS, *Dept. Biol., Connecticut College, New London, CT.*

Many early successional bird species have declined in eastern North America because of the abandonment of farmland and the regeneration of closed-canopy forest. Originally they depended on natural disturbances such as windstorms, fires, and beaver activity that opened the forest canopy, but these disturbances are now infrequent. Substitute habitat can be created, but in many cases this is only practical in conjunction with economic activities such as powerline maintenance or timber harvesting. To determine whether powerline corridors and clearcuts support breeding populations of declining species, we completed surveys of vegetation and bird populations on standardized circular plots in se. Connecticut. Clearcuts were dominated by small trees and thus resemble blowdown sites, while powerline corridors were dominated by grass, forbs, and shrubs, and thus resemble old fields or burn sites. Both habitats supported a diversity of early successional birds, but the density of particular species differed between the habitats. For example, the density of Chestnut-sided Warblers is significantly higher in clearcuts, whereas Prairie Warblers and Field Sparrows have a higher density on powerline corridors. Our results suggest that a diversity of early successional habitats is needed to sustain regional avian diversity.

433 Wilhelm, Gilliland, Robertson, Ryan & Elliot

Age and species classification of large alcids using wing characteristics. SABINA I. WILHELM, SCOTT G. GILLILAND, GREGORY J. ROBERTSON, PIERRE C. RYAN, *Canadian Wildl. Serv., St. John's, NL*, and RICHARD D. ELLIOT, *Canadian Wildl. Ser., Sackville, NB.*

Hundreds of thousands of murres (both Thick-billed and Common) are legally hunted along the coasts of Newfoundland and Labrador. However, this harvest is not included as part of the regular North American game bird harvest monitoring program and only sporadic estimates of total murre harvest are available. Further, the similar Razorbill is occasionally taken in this harvest. To effectively monitor this hunt, a tool to derive estimates of species- and age-specific harvest is required. We collected 293 wings of murres and Razorbills from hunters between 1999 - 2004, with the goal of identifying wing characters that could discriminate between species and ages. The 2 murre species could be successfully differentiated using a discriminant function incorporating the length of the first primary and second secondary feather; this function was correct 98% of the time. Murres and Razorbills could be aged (1st winter versus older) on the basis of colour contrast between greater wing coverts and other wing feathers. Juvenile Thick-billed and Common Murres also differed in the number of pale secondary coverts (median = 14 and 3, respectively), providing another species-specific trait. This study provides the information needed to implement a species and age composition survey for murres based on wings. Once in place, the sustainability of the murre harvest and the

number of Razorbills taken can be assessed.

434 Easton, Bishop, Cannings, Morgan, de Groot & Bezener

Status and vital rates of declining riparian songbirds in the northern extent of the Great Basin. WENDY E. EASTON, CHRISTINE A. BISHOP, *Canadian Wildl. Serv., Delta, BC*, RICHARD J. CANNINGS, *Bird Studies Canada, Naramata, BC*, TAWNA MORGAN, *The Nature Trust, Penticton, BC*, KRISTA L. DE GROOT, *Canadian Wildl. Serv.*, and ANDY M. BEZENER, *Partners in Flight, Penticton, BC*.

Data from the volunteer-run Breeding Bird Survey indicate a large number of Neotropical migratory species have undergone pronounced population declines over the last 3 decades. This includes a suite of riparian-dependent, shrub-nesting songbirds in British Columbia's Great Basin. We used constant-effort mist-netting, point counts, and nest searches to assess the community composition, relative abundance and vital rates of shrub-nesting riparian birds in relation to local and landscape-level habitat variables, ecological characteristics and Breeding Bird Survey trends. Fall migration data show an unusually high proportion of adult versus fledgling captures suggesting low productivity in the local population. Nesting success is low due to high incidences of parasitism by Brown-headed Cowbirds, predation and fragmentation of riparian habitat. To date, the results infer poor production, aggravated by habitat loss and degradation, may be the cause of declining population trends. The northern extent of the Great Basin may be a sink habitat for many species of riparian, shrub-nesting birds.

435 Rock & Leonard

Foraging habitat and feeding behaviour of Roseate Terns nesting on Country Island, Nova Scotia. JENNIFER C. ROCK and MARTY L. LEONARD, *Dept. Biol., Dalhousie Univ., Halifax, NS*.

Roseate Terns were listed as endangered by the Committee on the Status of Endangered Wildlife in Canada in 1999. The Canadian breeding population of Roseate Terns is estimated at 120 pairs, one-third of which nest on Country Island, Nova Scotia. Under the Canadian Species at Risk Act critical nesting and foraging habitat must be identified for endangered bird species. Although Roseate Tern nesting habitat on Country Island has been identified, foraging areas remain unknown. The purpose of our study was to locate foraging sites and determine chick diets for Roseate Terns nesting on Country Island. Preliminary results from year 1 show that roseate terns foraged an average of 4.5 km \pm 1.8 SD from the breeding colony in waters < 5 m deep. Roseate Tern chicks were fed predominantly sand lance (41%) and hake (38%) as well as smaller proportions of herring (9%). The results of this study will provide managers with the information necessary to define critical foraging habitat for this species and to develop a better understanding of Roseate Tern feeding behaviour.

436 Fair, Keller, Hathcock & Colestock

Avian monitoring and science-based measurement of risk reduction in birds at Los Alamos National Laboratory. JEANNE FAIR, DAVID KELLER, CHUCK HATHCOCK and KAIA COLESTOCK, *Los Alamos Natl. Lab., Risk Reduction and Environ. Stewardship, Ecol. Group, Los Alamos, NM*.

Los Alamos National Laboratory (LANL) is a leader in the DOE complex for avian monitoring, compliance, and management-orientated research. Avian monitoring and compliance at LANL includes protection of Threatened and Endangered species and long-term studies to monitor avian individual and population health in response to LANL activities, potential contaminants, and the extreme drought in the region to help guide management decisions and actively measure risk reduction. An avian nestbox study from 1997 - 2003 has established the use of non-lethal biomarkers for determining contaminant effects on individuals that can be a useful management tool. In question, what were the physiological or individual responses of developing cavity-nesting birds in areas of potential concern for contaminants at LANL. In 2001 and 2002, a study was initiated to model Mexican Spotted Owl (MSO) habitat for use at LANL. Using nesting habitat within protected areas, this research developed a finer scale model that could address changes in habitat quality within individual protected areas. In 2003 we applied this research to 3 of the Laboratory's Areas of Environmental Interest (AEIs). Beginning in 1997 a Monitoring Avian Population and Survivorship (MAPS) station was established at the DARHT facility. The purpose of this station was 2 fold: to begin long-term monitoring of the bird populations around DARHT for population dynamics and survivorship and collect samples to determine the levels of contaminants in the environment surrounding this facility. The contaminant sampling has given the Laboratory a baseline for the contamination that currently exists in the area of this new facility.

437 Lindo, Brinck, Cline, Marshall, Murray, Farmer, Hess, Banko & Jarvi

Survival and uneven sex-ratios in the endangered Palila. ANDREA LINDO, KEVIN BRINCK, BRITTANY CLINE, SUSAN MARSHALL, COLLEEN MURRAY, CHRIS FARMER, *Pacific Coop. Studies Unit, Univ. Hawai'i at Manoa, USGS Pacific Island Ecosys. Res. Center, Kilauea Field Station, Hawai'i Natl. Park, HI*, STEVE HESS, PAUL BANKO, *U.S. Geol. Surv., Pacific Island Ecosys. Res. Center, Kilauea Field Station, Hawai'i National Park, HI*, and SUSAN JARVI, *Dept. Biol., Univ. Hawai'i at Hilo, Hilo, HI*.

Palila (*Loxioides bailleui*) are one of the best-studied endangered passerines in the world, with continuous annual monitoring since 1980. Long-term capture data allow us to reevaluate the results of previous demographic studies and to gain detailed insights on the social structure of Palila. Periodic evaluation of these earlier studies is crucial to the development of effective restoration models. Recently, we identified substantial methodological biases in earlier studies. Different life history characteristics emerge when we account for these biases, suggesting that Palila are much longer lived than formerly believed. Previously, annual survival was estimated to be 0.36 for HY (hatch year) and 0.63 for AHY (after hatch year) individuals. We now find Palila to have higher survival rates (HY = 0.58 and AHY = 0.77). These survival estimates are consistent with the occurrence of extremely old individuals (14 yr) in the population. Previous demographic studies that relied on plumage characteristics found that the population was significantly male-biased. New DNA evidence, however, shows an essentially even sex ratio. Data from over 10 yr of nest monitoring demonstrate that Palila exhibit delayed reproductive maturity and that social monogamy is the principal mating system. Taken together, these traits are consistent with those of long-lived animals with low reproductive capacity, and we therefore expect that Palila recovery may lag far behind habitat recovery on Mauna Kea. Management strategies to restore Palila must incorporate time frames that accommodate forest regeneration and the intrinsic slow growth potential of this population.

438 Jones, Dieni & Gouse

Annual return rates in grassland songbirds. STEPHANIE L. JONES, *U.S. Fish & Wildl. Serv., Denver, CO*, J. SCOTT DIENI, *Redstart Consulting, Evergreen, CO*, and PAULA J. GOUSE, *U.S. Fish & Wildl. Serv., Bowdoin Natl. Wildl. Refuge, Malta, MT*.

We used color-banding to index annual site fidelity for 4 species of grassland songbirds: Sprague's Pipits, and Baird's, Grasshopper, and Savannah sparrows in north-central Montana (1996 - 2003). Territorial males were captured using mist-nets and tape playback recordings of conspecific song. Across all banded adults, the proportion re-sighted was 5.9% (n = 237), with 1 individual returning 2 consecutive years post-capture. Grasshopper Sparrows had the highest proportion of returns (10.8%, n = 37), followed by Savannah Sparrows (6.5%, n = 46), Baird's Sparrows (5.4%, n = 111), and Sprague's Pipits (2.3%, n = 43). Three nestling Savannah Sparrows were re-sighted in subsequent years (1.6%, n = 181), while no nestlings were re-sighted for the other species (n = 346). Overall, our return rate index was relatively low for all species in comparison with typical reports of 30 - 60% return rates for songbird species of woodland and shrubland habitats. Migratory nomadism may explain this phenomenon, where grassland migratory birds are opportunistic in site selection, rather than faithfully returning to potentially uninhabitable former breeding sites.

439 Dietsch

A comparison of bird communities found in small and large farmer coffee landscapes of Chiapas, Mexico. THOMAS V. DIETSCH, *Smithsonian Migratory Bird Center, Natl. Zool. Park, Washington, DC*.

While shade grown coffee certification as a conservation tool is well developed conceptually and programmatically, stronger linkages need to be forged with the other major certification programs, in particular fair trade. The basis for new connections should include a scientific evaluation of the contribution to conservation from landscapes managed by small farmers, the targets of fair trade certification. Two areas where these landscapes may make contributions are in forest reserves set aside on communal lands and in the complex landscape produced by the patchwork of management practices created as each farmer makes independent management decisions. This project evaluated landscapes for their conservation potential using birds as indicator taxa. Complex and uniform landscapes produced by small and large producers (respectively) were compared as a natural experiment in landscape structure. Forest fragments found in each landscape provided a conservation baseline. An evaluation of the conservation contribution from complex landscapes produced by small farmers may provide a basis for connecting fair trade and shade grown coffee certification programs. Initial results suggest that small farmer landscapes support more diverse bird

communities than the large farms sampled. Despite a smaller sample size for both sample periods, total species richness was higher in small farmer points than in large farmer points. These preliminary results suggest that small farmer landscapes may provide important conservation benefits.

440 Desholm

Quantifying the collision frequency between birds and offshore wind turbines: the development of the thermal animal detection system. MARK DESHOLM, *Dept. Wildl. Ecol. & Biodiv., Natl. Environ. Res. Inst., Rønde, Denmark.*

The aim of the present poster is to report on the newly developed thermal animal detection system (TADS), which is an automated bird monitoring system based on real time thermal video imaging. It is developed for estimating the collision frequency between migrating birds and offshore wind turbines, and it has been tested in spring 2003 at a Danish offshore wind farm. In general, it can be concluded that the TADS are capable of recording migrating birds approaching the rotating blades of a turbine, even under conditions with poor visibility. If the TADS is used in a vertical viewing scenario it would comply with the requirements for a set-up for estimating the avian collision frequency at offshore wind turbines.

441 Robertson, Storey & Wilhelm

Evidence for male-biased mortality in breeding Common Murres. GREGORY J. ROBERTSON, *Canadian Wildl. Serv., St. John's, NL*, ANNE E. STOREY and SABINA I. WILHELM, *Dept. Psych., Memorial Univ. Newfoundland, St. John's, NL.*

Seabirds generally exhibit a life-history characterized by high adult survival rates, delayed sexual maturity, low fecundity and bi-parental care. Common Murres are typical in this regard, with both parents contributing to incubation and chick-rearing. However, males accompany the chick for months after colony departure, feeding the chick at sea. A marked population of breeding Common Murres was established on Great Island, Witless Bay, Newfoundland, and murres (40 males and 33 females) were resighted intensively in the summers of 1996 - 2003 from a permanent blind. Sex was determined behaviourally during observation periods. We used Program MARK to examine patterns of annual and sexual variation in survival rates. Goodness of fit testing was not meaningful for this analysis, as only 1 individual was seen to skip a year. The best fitting model (using AIC) showed variation in survival rates among sexes; male survival 0.927 ± 0.020 (95% PLI: 0.876 - 0.957), female survival: 0.969 ± 0.014 (0.926 - 0.987), and a constant capture rate of 0.996 ± 0.004 (0.969 - 0.999). This model was 1.6 times better supported than a model with constant survival rate. There was little evidence for annual variation in the rates. It appears that male Common Murres have a lower survival rate than females, even though both invest heavily in chick rearing. The effort of raising chicks at sea by the males may be the source of this extra mortality.

442 Robertson

Using winter juvenile/adult ratios as indices of recruitment in population models. GREGORY J. ROBERTSON, *Canadian Wildl. Serv., St. John's, NL.*

There is an increasing interest in using winter juvenile counts as indices of recruitment in species that show delayed plumage maturation, especially for species, such as dispersed breeders, where it is difficult to obtain good productivity estimates. To date, however, there has not been the needed mathematical work to assist in interpreting these winter juvenile/adult ratios. A matrix-based population model is presented that is modified to allow the fecundity component to be measured in mid- to late winter. This model is simplified to a set of equations that relate adult survival, winter juvenile/adult ratios and population growth rates, and allows an assessment of population trend with only one survival rate and age ratio data. These models have the advantage of not requiring that age of first breeding be well known. As an example, age ratios and survival rates of Harlequin Duck populations in British Columbia and Maine are presented. Models for both populations suggest recruitment of young is insufficient to compensate for adult mortality, which is contrary to observed trends in population numbers. Although some further methodological work is needed, such as better ways to estimate true adult survival and a further understanding of how to obtain unbiased estimates of juvenile/adult ratios in the field, these models may prove to be a useful tool to assess population trends when detailed demographic data are not available.

443 Flint, Runge, Richkus, Arnold & Clark

Modeling population dynamics of Northern Pintails to evaluate hypotheses about causes of low populations. PAUL L. FLINT, *USGS Alaska Science Center, Anchorage, AK*, MICHAEL C. RUNGE, *USGS Patuxent Wildl. Res. Center, Laurel, MD*, KENNETH D. RICHKUS, *USFWS DMBM, Laurel, MD*, JENNIFER M. ARNOLD, *Auburn Univ, Auburn, AL*, and ROBERT G. CLARK, *Canadian Wildl. Serv., Saskatoon, SK*.

The mid-continent population of Northern Pintails decreased from the early 1980s to the mid-1990s despite improving wetland habitat conditions, and has since remained well below its long-term average. We developed a stage-based matrix model for female pintails to evaluate the relative importance of vital rates for population growth rate (λ) in the prairie region and then contrasted these results with those obtained for Alaska, a region where the pintail population has been fairly stable. Overall, we were able to reproduce good fit to observed λ s, although this required taking estimates of fertility from the upper range of empirical observations. As expected, prospective analyses indicate the highest elasticities for annual survival, implying that proportional changes in annual survival would have the greatest influence on future population dynamics. However, variance decomposition suggests that annual variation in nesting success, followed by duckling survival, likely drives annual variation in population size. Importantly, the difference in recent trends between the Alaskan and prairie breeding populations can be explained by a reduction in breeding propensity combined with a 10% decrease in nesting success. Simulations of disease mortality suggest that die-offs of the magnitude observed in recent years have the potential to limit population recovery. Further work is needed to improve our understanding of breeding propensity, survival of females that forego breeding, and age-specific variation in vital rates, including survival from fledging to first breeding.

444 Clark, Hobson & Wassenaar

Using δD , $\delta^{13}C$, and $\delta^{15}N$ to link breeding, migration and wintering areas of Lesser Scaup in North America. ROBERT G. CLARK, KEITH A. HOBSON, *Canadian Wildl. Serv., Saskatoon, SK*, and LEONARD I. WASSENAAR, *Natl. Water Res. Instit., Environ Canada, Saskatoon, SK*.

The Lesser Scaup winters in the s. U.S. and n. Mexico and breeds principally in remote boreal forest of w. Canada and Alaska. Systematic surveys of key breeding areas indicate that the scaup population has declined by ca. 150,000 birds annually during the past 15 yr, and declines have been most pronounced in northern regions. Breeding and wintering ground hypotheses have been proposed to explain this trend, but ruling out explanations has been hampered in part because affinities of scaup from specific breeding areas to specific migration and wintering areas are uncertain. Feather samples were taken from lesser scaup ducklings captured for banding at 2 northern (Yellowknife, NT; Minto Flats, AK), 1 inter-montane (Riske Creek, BC) and 1 south-central (St. Denis, SK) locations. Strong geographic separation was detected between northern and southern known-source samples using δD ; northern sites were separated further with $\delta^{13}C$. Analyses of δD in wing feathers of 450 HY scaup obtained from the 2000 U.S. harvest survey revealed much spatial overlap in natal origins of birds across the 4 main flyways (Atlantic, Mississippi, Central, Pacific). However, more HY scaup shot in the Mississippi flyway originated from areas farther north than did those shot in other U.S. flyways (MANOVA, $F_{3, 446} = 6.63$, $P < 0.001$); Central flyway birds tended to originate from southern boreal forest and areas of the northern Great Plains. This study is the largest conducted to date on natal origins of free-ranging game birds, and illustrates the utility of stable isotope analyses to help link breeding and wintering areas.

445 Poulin & Drapeau

Short-term effects of partial cutting on birds nesting in the boreal black spruce forest of eastern Canada. MIREILLE POULIN and PIERRE DRAPEAU, *Groupe de recherche en écologie forestière interuniversitaire (GREFi), Département des sciences biologiques, Université du Québec à Montréal, Montréal, QC*.

Birds associated to older forests are facing an important habitat loss due to intensive even-aged harvesting throughout their boreal breeding range. Partial cutting could be a good alternative to clear-cutting for the conservation of these birds as it maintains a proportion of standing live and dead trees. We assessed the response of nesting birds to partial cutting in the boreal forest in nw. Québec. One third of the forest was removed (5 m wide strip cuts) in 4 50-ha blocks, during the fall of 2002. Birds were sampled during the breeding season with point counts in these 4 sites and in an uncut large forest track of 200 ha (control) before and after harvesting. We examined the species composition of assemblages, species abundance and the spatial distribution of individuals in the 4 harvested sites. Following harvesting, the richness of early seral stages associates increased and

generated the main difference between assemblages whereas late seral stage associates persisted in the treatments. However, the abundance of some late seral stage species decreased. The Golden-crowned Kinglet was the most sensitive species whereas its occurrence dropped from 76% to 16% (n = 46 sampling sites) following the partial cut. Within treatments, forest birds also relocated themselves in areas that remained more forested whereas the immigration of early seral stage species was concentrated in harvested areas. We conclude that forest birds may find some suitable habitat features in partial cuts. However, these older forest associates cannot entirely rely on such habitats, they will also require the maintenance of unharvested forest tracts within managed landscapes.

446 Stenhouse, Gilchrist, Mallory & Robertson

A drastic decline in Ivory Gulls breeding in Canada. IAIN J. STENHOUSE, *Cognitive & Behav. Ecol., Memorial Univ. Newfoundland, St. John's, NL*, H. GRANT GILCHRIST, *Canadian Wildl. Serv., Natl. Wildl. Res. Centre, Carleton Univ., Ottawa, ON*, MARK L. MALLORY, *Canadian Wildl. Serv., Iqaluit, NU*, and GREGORY J. ROBERTSON, *Canadian Wildl. Serv., St. John's, NL*.

The Ivory Gull breeds in the circumpolar Arctic and winters amongst pack ice in northern oceans. The world population is estimated at around 14,000 breeding pairs, and, in the early 1980s, Canada was believed to host up to 1,200 breeding pairs. In response to concerns raised by Inuit residents in n. Canada, who reported fewer sightings of Ivory Gulls around their communities, the Canadian Wildlife Service initiated an aerial survey of known nesting colonies in 2002 and 2003. We found that many colony locations had been completely abandoned, and, although 10 new colonies were found, they were all small. Results indicate a decline of up to 85% in Ivory Gulls breeding in Canada. Although legally protected, some Ivory Gulls are still shot during migration in west Greenland and Canada, and there are several potential threats to critical breeding habitat in Canada. Disturbance due to exploratory drilling for mineral resources may be detrimental to annual breeding success of Ivory Gulls in Canada. The influence of changes in the distribution, seasonal extent, and depth of polar pack ice on Ivory Gulls remains unknown. We suggest that international efforts should be directed at assessing population status and trends throughout the circumpolar Arctic.

447 Clotfelter, Pedersen, Cranford, Snajdr, Nolan & Ketterson

Acorn mast drives rodent and songbird population dynamics in a subalpine habitat. ETHAN D. CLOTFELTER, *Dept. Biol., Amherst College, Amherst, MA*, AMY B. PEDERSEN, *Dept. Biol., Univ. Virginia, Charlottesville, VA*, JACK A. CRANFORD, *Dept. Biol., Virginia Polytech. Inst. & State Univ., Blacksburg, VA*, ERIC A. SNAJDR, *Dept. Biol., Indiana Univ., Bloomington, IN*, VAL NOLAN Jr., and ELLEN D. KETTERSON, *Dept. Biol. and CISAB, Indiana Univ., Bloomington, IN*.

We evaluated long-term changes in acorn mast, rodent density, and reproductive success of a ground-nesting songbird in the southern Appalachian mountains in an effort to determine the ecological interactions between the 3 trophic levels. Small mammals are a dominant seed predator of oaks and respond positively to masting events, and we hypothesized that the change in abundance would have significant effects on a ground nesting songbird. In particular, we examined the following mast data from red (*Quercus rubrum*) and white (*Q. alba*) oaks; mark-recapture data from white-footed mice (*Peromyscus leucopus*), deer mice (*P. maniculatus*), and eastern chipmunks (*Tamias striatus*); and nest success of Dark-eyed Juncos as well as the number of juvenile juncos caught each year. These data were recorded from 1980 - 2003 (acorn mast and rodents) or 1985 - 2003 (juncos) at the Mountain Lake Biological Station in sw. Virginia. We found that rodent populations were significantly affected by mast crops from the previous autumn, and large rodent populations led to declines in Dark-eyed Junco nest success and the number of juvenile juncos caught in late summer.

448 Arriaga-Weiss

Preliminary notes on the birds of an important bird area: the Sierra State Park, Tabasco, Mexico. STEFAN L. ARRIAGA-WEISS, *El Colegio de la Frontera Sur, Unidad Chetumal, Mexico*.

The Sierra State Park (SSP) is a protected area in the Tapijulapa and Teapa Mountains in Tabasco, listed as 1 of the 150 Mexican Important Bird Areas. I present preliminary information on SSP avifauna's composition and structure, based on data from transect counts collected since 1999. I have registered 293 species (18 orders, 54 families) which represent 62.5% of the bird species of Tabasco. The families with highest richness were Tyrannidae (35), Parulidae (30), Accipitridae (20), Thraupidae (18) and Trochilidae (16). Regarding their conservation status, 47 species (16%) are enlisted in Mexico's official endangered species list 11 are threatened, 5 are endangered, and 31 are under special protection. Regardless its status as a protected area, human activities are continuously

modifying the original vegetation (tropical rainforest), mainly into pasture and agriculture. In a landscape geographical analysis the following elements were recognized: tropical rainforest (24.7%), secondary growth (20.1%), pastures (43.4%), agriculture (5.5%), non-vegetation areas and aquatic systems (6.3%). Though its relative rarity in the landscape, tropical rainforest exhibited the highest species richness (151 sp.), followed by secondary growth (61 sp.), pastures and agriculture (50 sp.), and aquatic systems (34 sp.). Half of the species (154 sp.) were registered in >1 habitat, but many species were also habitat restricted 58 species were registered in rainforest exclusively, 19 in secondary growth, and 43 in pastures and agriculture. Given the rate of deforestation, I consider that monitoring of rainforest birds should be continued in order to ensure conservation measures are effective.

449 Mosley, Nol & Holmes

Breeding bird communities in the boreal mixed-wood forest of Ontario: a comparison of point count and mist netting sampling techniques. ERIN MOSLEY, ERICA NOL, *Biol. Dept., Trent Univ., Peterborough, ON*, and STEVE HOLMES, *Great Lakes Forestry Centre, Canadian Forest Serv., Sault Ste. Marie, ON*.

Mist netting and point counts are 2 of the most common methods used for sampling bird species richness and relative abundance. However, point counts often detect more forest canopy dwelling species compared with mist nets, whereas mist nets can be more effective at detecting the presence of undergrowth species, particularly those that are secretive or those that vocalize less frequently. To further confound this issue, comparisons between different habitat types may be especially compromised by survey method, due to differences in vegetation structure. We compared point count and mist netting methods for measuring relative abundance of birds surveyed during the breeding period in upland and riparian habitats in the boreal mixed-wood forest of Ontario. Point counts detected 23 species (39%) not detected by mist nets, and mist nets detected 4 species (7%) not detected by point counts. Although relative abundance was underestimated by mist nets compared with point counts, for those species that were detected by both methods, there was a positive relationship between the 2 sampling techniques. In both riparian and upland habitats, total detections by mist nets were strongly correlated with total detections by point counts.

450 Rios-Muñoz

Patterns of species richness and endemism of Mexican Psittacidae: a predictive modeling approach. C. A. RIOS-MUÑOZ, *Mus.Zool., Fac. Ciencias, Universidad Nacional Autónoma de México, México D.F., México*.

The parrots (Psittacidae) are represented by 25 species in Mexico, 11 of which are endemic to the country, according to current taxonomic works, and most are threatened by the illegal trade and habitat loss. 23 species are in some risk category according to national and international criteria. The present work shows the general biogeographic patterns of species richness and endemism for the Mexican parrots, using modeled distributional areas generated through the fundamental ecological niche modelling of GARP, and then I analyzed the environmental factors involved in these patterns. The patterns of endemism revealed overlapping zones for as many as 4 species, being these sites located the eastern and western highlands. Species richness' patterns showed that a maximum of 14 parrot species is found in the Isthmus Tehuantepec lowlands and the montane region in the pacific side of Chiapas. I discuss the advantage of obtaining the geographical and ecological distributional patterns based in predictive models.

451 Robinson

Changes in abundance of birds in a Neotropical forest fragment over 25 years. W. DOUGLAS ROBINSON, *Dept Fish. & Wildl., Oregon State Univ., Corvallis, OR*.

Few data are available to evaluate the long-term effects of habitat isolation on species richness or abundances in the tropics. Barro Colorado Island (BCI), Panama, has been studied for >80 yr since its isolation from surrounding lowland forest when the Panama Canal was constructed. 35% of the 200 resident species originally present have disappeared. Although the loss of species is well-studied, changes in abundance that might help predict future losses have not been evaluated. Two studies separated by 25 yr estimated abundances of most bird species on BCI. Comparisons indicate 37 species have declined by at least 50%. 26 species of edge habitats are expected to decline as forest maturation proceeds, yet 11 forest species that are now rare may be lost soon because of huge declines in abundance. All 26 species that were present in 1970 but not detected in

the mid-1990s were rare in 1970. Thus, rarity appears to be a good predictor of extinction risk in this tropical habitat fragment.

452 DiMiceli, Johnson & Stouffer

* Seed preferences of Henslow's Sparrows wintering in southeastern Louisiana. JENNIFER K. DiMICELI, ERIK I. JOHNSON and PHILIP C. STOUFFER, *School Renew. Nat. Res., Louisiana State Univ., Baton Rouge, LA.*

Henslow's Sparrows winter almost exclusively in longleaf pine savannahs along the Gulf coast. This habitat has been reduced to <5% of its former range, possibly contributing to the decline in Henslow's Sparrow abundance. Much remains unknown regarding the winter ecology of the Henslow's Sparrow, including important aspects of diet and foraging behavior. While the breeding season diet is known to consist of mostly insects, the winter diet probably includes mostly seeds and some insects. Previous studies have shown that seed density correlates with Henslow's Sparrow winter abundance. Two grass species in particular, *Ctenium aromaticum* and *Muhlenbergia expansa*, are an important component of preferred habitat in Louisiana. We conducted multiple-offer and simple-offer seed preference experiments on captive Henslow's Sparrows. These tests showed that some seeds seemed to be preferred while others were avoided regardless of their abundance in the pine savannas. Of particular interest was that Henslow's Sparrows showed a preference for *M. expansa* but avoided eating *C. aromaticum*, suggesting that this plant is more important as a structural component than as a food source.

453 Lee, Charrier & Sturdy

Singing in the noise. TIFFANY T.-Y. LEE, I. CHARRIER and C. B. STURDY, *Dept. Psychol., Univ. Alberta, Edmonton, AB.*

With technological and industrial advancements, low-frequency background noise is also quickly rising. In order to utilize acoustic communication, urban-dwelling species such as the Black-capped Chickadee, must somehow overcome the masking imposed by the din of city life. The simple, yet familiar "fee-bee" song of the Black-capped Chickadee often shifts downward in pitch during territorial encounters. Irrespective of the absolute pitch at which a given song is produced, there is a constant frequency ratio between the start and end of the "fee" note and between the end of the "fee" and the start of the "bee" notes. Here, we report that individual male Black-capped Chickadees, forced to sing in broadband noise (0 - 4000 Hz, SPL = 63 dB) mimicking that encountered in urban areas, modify their songs in response. First, both the start frequency of the "fee" note and the frequency of the "bee" note sung in noise were shifted above that recorded in non-noise conditions. Both of these modifications altered the species-specific frequency ratios typically seen in Black-capped Chickadee song. To the best of our knowledge, this is the first investigation showing that male Black-capped Chickadees will shift components of their song upwards in frequency. However, pitch-shifting song up in frequency may impose a potential cost by lowering their social rank, further jeopardizing their ability to hold a mate and territory.

454 Haskell, Pelkey & Evans

Bird communities across a gradient of suburbanization on the Southern Cumberland Plateau, Tennessee. DAVID G. HASKELL, *Dept. Biol., Univ. of the South, Sewanee, TN*, NEIL W. PELKEY, *Environ Sci/Studies & Info. Tech., Juniata College, Huntingdon, PA*, and JONATHAN P. EVANS, *Univ. of the South.*

We used point counts to examine bird communities across of gradient of suburbanization on the Cumberland Plateau in Tennessee. We also used GIS to quantify housing density and the proportion of native forest within 150 m and 1000 m buffers around each point. Species richness increased with the density of houses at both spatial scales, but the number of Partners in Flight priority species decreased with increasing housing density. The proportion of native forest was negatively correlated with housing density, so species richness decreased with increasing forest cover and the number of PIF priority species increased. At the 150 m scale the abundance of ground-nesters was negatively correlated with the number of structures, but showed no relationship with the proportion of native forest. Cowbird and avian nest predator abundances were not associated with house density or the proportion of native forest at either scale.

455 Kapoor

Song development and female choice: sexually selected song characters and implications for partnership dynamics in the cooperatively displaying bird, *Chiroxiphia lanceolata* (Pipridae). JULIAN A. KAPOOR, *Mus. Vert. Zool., Dept. Biol., Univ. California at Berkeley, Berkeley, CA.*

Although the adaptive consequences of vocal duetting in birds is poorly understood, enhanced coordination in displays between duet partners may increase their attractiveness to potential mates. Here I address possible selective regimes associated with duetting behavior in Lance-tailed Manakins (*Chiroxiphia lanceolata*), a neotropical bird in which 2 males form long-term partnerships to display for females. A discriminant analysis of duet song characteristics has shown that partnerships involving sub-adult males sing with poorer frequency-matching (FM) than those with only adult males. Further analysis has shown that females choose to visit display areas where the occupants spend a large percent of their time singing, regardless of FM quality. These findings have important implications for hypotheses explaining the observation that adult males occasionally sing with sub-adults. If FM were an important factor for female visitation choice then singing with poorly FM sub-adults would be disadvantageous. Since FM does not appear to be playing this role, however, and singing with a sub-adult could potentially increase the percent time that song is being produced from an adult male's display area, singing with sub-adult males might be beneficial.

456 McKnight, Amirault, Shaffer, Baker, MacDonnell & Thomas

Critical recovery knowledge gathered through a common tool: insights and implications of banding endangered Piping Plover in Eastern (Atlantic) Canada. JULIE McKNIGHT, *Canadian Wildl. Serv., Dartmouth, NS*, DIANE L AMIRAULT, *Canadian Wildl. Serv., Sackville, NB*, FRANÇOIS SHAFFER, *Canadian Wildl. Serv., Sainte-Foy, QC*, KRISTA BAKER, LARRY MacDONNELL, *Canadian Wildl. Serv., Sackville, NB*, and PETER THOMAS, *Canadian Wildl. Serv., Mount Pearl, NL.*

Prior to 1998, little information existed on survival and recruitment rates, winter range, migration and dispersal of Eastern Canada (Atlantic) Piping Plovers. This knowledge was deemed critical to establish appropriate recovery targets and to evaluate success of recovery actions. Collection of these data required that individuals be marked. Piping Plovers were banded and recaptured during the breeding season from 1998 to 2003. Preliminary findings indicate that lack of recovery in the Eastern Canada population can not be explained by a loss of birds to the Atlantic U.S. Movement data suggest that plovers breeding along the South Shore of Nova Scotia may be reproductively isolated from plovers in the Gulf of St. Lawrence (NB, NL, n. NS, PE and QC). Observations of colour-marked birds has enabled identification of migration and wintering locations; however, the small number of Eastern Canadian Piping Plovers observed in the s. U.S. states suggests that many birds winter further south. Banding is generally thought to have little harmful effect (Marion & Shamis 1977, *J. Field Orn.* 48: 42-61); however, in the last year of this study (2003), 16 plovers with apparent band-related injuries, ranging from abrasion to foot loss, were observed. Banding was terminated when the severity of band-related leg problems was recognized. All injuries appeared to be related to the use of tall anodised aluminium auxiliary bands, but the exact cause remains unknown. Removal of auxiliary bands is planned for the 2004 breeding season.

457 Gullage, Staicer & McLennan

Forest birds as indicators of ecological integrity in Kejimikujik National Park. STEPHEN E. GULLAGE, CINDY A. STAICER, *Dept. Biol., Dalhousie Univ., Halifax, NS*, and DONALD S. McLENNAN, *Parks Canada, Hull, QC.*

Forest birds are sensitive to ecological changes and therefore may be used as ecological indicators. A 5-yr pilot study was initiated in Kejimikujik National Park in May 2003 to develop indicators of ecological integrity for long-term monitoring of forested ecosystems in national parks in Canada. Two zonal ecosystem types were selected for co-location of sites where a suite of indicators will be monitored. Replicate stands and sites within a stand were established in mature forest dominated by (1) eastern hemlock, and (2) red maple-red oak-white birch-white pine. The objective of this part of the study is to evaluate the use of forest bird species and species-assemblages as indicators of ecological integrity. Point count surveys were conducted at 100 sites across the park, 50 per forest type. The protocol employed was 10-min counts with distance estimation to each bird detected, 2 visits/site. Distance-sampling enables calculation of densities for the different bird species by modeling a distance-detection function for each species. The relationship between bird densities and habitat data was explored, and the variation within and among stands of the same forest type, as well as between the 2 forest types, was quantified. Species were grouped into response guilds

according to life history traits and their expected reaction to changes to their environment.

458 Bisson, Marra, Burt & Gillevet

Avian feather microbial communities in the Neotropics. ISABELLE-ANNE BISSON, PETER P. MARRA, *Smithsonian Environ. Res. Center, Smithsonian Inst., Edgewater, MD*, EDWARD H. BURTT Jr., *Dept. Zool., Ohio Wesleyan Univ., Delaware, OH*, and PATRICK GILLEVET, *Dept. Environ. Sci. & Policy, George Mason Univ., Fairfax, VA*.

Avian feathers harbor a diverse array of ectoparasitic organisms that range from larger parasites such as feather lice (Phthiraptera: Ischnocera) to smaller microscopic organisms such as feather-degrading bacteria (e.g., *Bacillus licheniformis*) and fungi (e.g., *Arthroderma* spp.). However, most ecological and evolutionary studies on avian parasites have focused on the former and very little is known about feather-degrading bacteria and fungi. In this study, we assess the diversity, abundance, and species-specificity of the microbial community in avian feathers within and among species of the Neotropics. More specifically, we compare microbial abundance and diversity at 4 levels: 1) between resident and migratory birds, 2) between resident species, 3) between migratory species, and 4) across habitats for American Redstarts, i.e., mangrove vs scrub. Our study was conducted in the Font Hill Nature Preserve in Jamaica during Mar 2004. Birds were caught using mist-nets. For each individual caught, we extracted head, ventral, dorsal, and tail feathers using sterilized tweezers. We use a PCR (polymerase chain reaction)-based method (amplicon length heterogeneity fingerprinting) to identify bacterial and fungal species present in the feathers. In this poster, we will present preliminary data particularly in relation to comparisons between resident and overwintering migrants. To the best of our knowledge, this is the first study on feather-degrading microbial communities in the Neotropics.

459 Curry

Natal dispersal in a hybridizing chickadee population in southeastern Pennsylvania. R. L. CURRY, *Dept. Biol., Villanova Univ., Villanova, PA*.

Natal dispersal is a critical demographic process, with particular relevance for the spatial dynamics of hybrid zones. Very little is known about dispersal associated with hybridization between Black-capped and Carolina Chickadees along their region of parapatric contact in the ne. U.S., yet dispersal undoubtedly is playing a major role in recent northward shifts in the contact zone's position. To begin assessing sex- and species-specific patterns of dispersal in these species, I examined detected natal dispersal across a 260 ha study area within the contact zone in se. Pennsylvania. Of 877 nestlings banded in 1998 - 2003, at least 21 settled in the study area as yearlings. This total included 11 males and 6 females, a ratio that does not differ from that expected by chance. Females moved further to their first breeding site (1247 m \pm 162 SE) than did males (811 m \pm 120 SE); average dispersal distance by both sexes was greater than expected based on the spatial distribution of artificial nest snags (n = 152) within the study area. Direction of dispersal was slightly non-random, with many detected movements paralleling the long axis of the ellipsoid study area. While the detected movements represent only the short tail of the dispersal frequency distribution, the data suggest that in these hybridizing chickadees, as in most passerines, females are the predominantly dispersing sex. Their movements, and their subsequent mate choices and breeding success, will largely determine gene flow across the contact zone, as well as geographic shifts in its location.

460 White & Gardali

Low incidence of cowbird parasitism on Swainson's Thrushes in central coastal California. JENNIFER D. WHITE, *Div. Biol. Sci., Univ. Missouri, Columbia, MO*, and THOMAS GARDALI, *PRBO Conserv. Sci., Stinson Beach, CA*.

We found a low incidence of observed Brown-headed Cowbird parasitism (4%; 9/224) on the Swainson's Thrush (in central coastal California despite the high rates (33%) reported for the sympatric Wilson's Warbler. Both species nested primarily in blackberry and ferns in similar proportions and at similar heights, but thrush nests had significantly greater mean percent concealment than warbler nests. No cowbirds fledged from thrush nests; the only cowbird nestlings observed in thrush nests were last seen at 4 and 7 d old, whereas host nestlings fledged. Parasitism significantly reduced thrush clutch size, nestling and fledgling number. We experimentally parasitized 4 thrush nests with real cowbird eggs. No rejection response was observed for naturally or experimentally parasitized nests suggesting that ejection behavior is not responsible for the low rate of parasitism at our sites.

461 George & Master

Resource partitioning and habitat use among a guild of resident and migratory riparian passerines in Costa Rica. GREGORY GEORGE and TERRY MASTER, *Dept. Biol. Sci., East Stroudsburg Univ., East Stroudsburg, PA.*

Foraging observations among Louisiana Waterthrush (*Seiurus motacilla*), American Dipper (*Cinclus mexicanus*) and Torrent Tyrannulet (*Serpophaga cinerea*) were conducted from Jan to Mar in 2003 - 2004 in and around Parque Nacional Tampanti in the Cordillera de Talamanca in Costa Rica. For each species foraging behavior, e.g., maneuver, attempt rate, substrate choice and location within the stream channel were compared. Habitat preference is based on a species' resource requirements and modified by biotic interactions including competition. During interspecific encounters the species did not appear to exclude each other from riparian habitats. The location within the stream channel and preferred maneuver to secure prey items appears to have significantly separated the foraging dynamics of the 3 species. American dippers foraged most prominently in the in-stream habitat and removed prey items from the stream bottom. Like the American Dipper the Torrent Tyrannulet occupied in-stream locations as well but preferred aerial hawking as its method to secure prey. The Louisiana Waterthrush appears to be more of a generalist occupying all 3 riparian habitat categories; in-stream, bank/edge and off-stream with surface picks the most common maneuver implemented. Attempt rates varied considerably among the species.

462 Brown & Urban

Benefits of early breeding in Mexican Jays. JERRAM L. BROWN and JULIE URBAN, *Dept. Biol. Sci., Univ. at Albany, Albany, NY.*

In order to better understand the ways by which selection might act on laying dates in birds we examined the relationships between laying date, clutch order and some components of fitness of individual, breeding female, Mexican Jays over a 35 yr period. Early laying females had significantly more annual reproductive success measured in 3 ways, 1) as nestlings of banding age, 2) as young that were known to have survived to the next breeding season and 3) to age 3 (common age of first breeding). The advantage of early laying was not dependent on the few individuals that fledged 2 broods in a year or on those individuals that laid a second clutch after failure of the first, although early clutches in these groups had more success. Earlier laying females had larger first broods but not second broods. The chance of fledging was significantly higher with later laying dates and insignificantly higher in later than first clutches. Survival rates over winter and to age 3 were significantly better for earlier than later laying dates and better for first clutches than for later clutches. Among first clutches survival was also better for earlier clutches. Among subsequent clutches survival to the next year was unrelated to laying date but was significantly higher for smaller than larger broods.

463 Renfrew, Johnson, Clay & Acheson

Wintering ecology of Bobolink. ROSALIND B. RENFREW, *Vermont Inst. Nat. Sci., Woodstock, VT,* DOUGLAS J. JOHNSON, *USGS Northern Prairie Wildl. Res. Center, Jamestown, ND,* ROB CLAY, *Guyra Paraguay, Asuncion, PY,* and NICHOLAS ACHESON, *Museo de Hist. Nat., Santa Cruz, Bolivia.*

Changes in bird populations are driven by breeding productivity and survivorship, yet the latter has not been studied for many Neotropical migrants. Despite population declines in recent decades, little is known about the most fundamental properties of Bobolink wintering ecology, such as distribution and habitat use. Potential threats include loss of native grassland habitat and exposure to pesticides. We compiled and mapped historical records of Bobolinks, and outlined the distribution of rice and sorghum fields using Modis satellite imagery for Paraguay and Bolivia. In Jan - Feb 2004, we conducted roadside surveys and recorded molt and morphometric data for 6 Bobolinks in Paraguay. Preliminary data suggest that Bobolink flocks may be relatively dispersed. Anecdotal records suggest that Bobolinks may forage in Bolivian rice fields. In Paraguay, Bobolink flocks of 17 - 160 individuals were found foraging in lightly grazed grasslands, but none were found in rice fields. These small foraging flocks joined other local flocks each evening on their way to undetermined night roosts. The Pantanal wetlands may provide important stopover habitat for Bobolinks during early northward migration. Prealternate molt was initiated earlier in southern flocks than in northern flocks. To develop a conservation strategy for Bobolinks during the nonbreeding season, we need to better define their winter distribution and key stopover areas, further assess potential use of agricultural fields, ascertain the size and characteristics of night roosts, and examine daily movement and foraging patterns.

464 Gagnon, Morneau & Whiskeychan

First confirmed breeding of Marbled Godwit in Québec. BENOIT GAGNON, FRANÇOIS MORNEAU, *Hydro-Québec, Division Équipement, Montréal, QC*, and SYDNEY WHISKEYCHAN, *Waskaganish, QC*.

In 2003, as part of the environmental studies conducted in relation to the Eastmain-1-A and Rupert diversion hydroelectric project, it was decided to clarify the breeding status of the Marbled Godwit in Rupert Bay, on the Québec side of James Bay. Two nests, 3.6 km apart, were discovered in the high marsh of Cabbage Willows Bay. The first nest was discovered on 17 Jun using the rope dragging technique; the nest contained 4 eggs and 1 adult was brooding. The second nest, discovered on 20 Jun following observation of courtship behavior, contained only 1 egg. Both nests were located in an area that is covered essentially by sweet grass (*Hierochloe odorata*). These are the first observations that confirm breeding of this species in Québec. The breeding population would appear to include at least 6 pairs in Cabbage Willows and Boatswain bays.

465 Mousseau, Benoît & Gagnon

Habitat use by breeding forest birds in seven forest biota and riparian habitats in the Rupert, Opinaca and Eastmain river basin of northern Québec. PIERRE MOUSSEAU, RÉJEAN BENOÎT, *Foramec Inc, Québec, QC*, and BENOIT GAGNON, *Divison Équipement, Hydro-Québec, Montréal, QC*.

We examined the bird population of 9 biota of the Rupert, Opinaca and Eastmain river basins in order to estimate bird densities and nesting population abundance. Stations in forest habitat (recent burnt, old burnt, regeneration area, bogs and fens, deciduous forest, black spruce forest and Jack pine forests), were selected on satellite images. Habitat polygons (1403) were identified and 577 were selected for their homogeneity and surface area. Riparian habitats (riparian grassland, shrubby riparian habitats) were identified by helicopter. Fixed radius point count (FR) and unlimited distance point count (UD) methods were used. A total of 180 stations (133 forest types and 47 riparian types) were surveyed. Because of the remoteness of the area, a non stratified sampling was chosen and paired sample sites were identified so as to drop by helicopter 2 observers near 2 forest habitats to be sampled. Birds were recorded between 19 Jun and 6 Jul 2003. 57 species were recorded and 55 were identified as nesting. In the study area, 43 species were recorded by the FR and 55 by the UD. The comparison between the forest biota showed that the black spruce biota showed the lowest density as old burnt biota showed the highest density. As for the riparian habitats, all biotas showed a highest densities than the forest biotas. The most common species in forest biota were White-throated Sparrow, Slate-colored Junco, Lincoln's Sparrow and Palm Warbler. Swamp Sparrow, Yellow Warbler and Common Yellowthroat were the most common species in riparian habitats.

466 Morneau & Gagnon

Occupancy and productivity of Golden Eagle and burnt boreal forest. FRANÇOIS MORNEAU and BENOIT GAGNON, *Hydro-Québec, Divison Équipement, Montréal, QC*.

We verified the hypothesis according to which, in the boreal forest, Golden Eagle populations may be limited by the area of open habitat, especially burn forests. The objective was to explain why nesting sites have been abandoned and to account for the productivity of this species in the watersheds of the Sainte-Marguerite and Moisie rivers on the North Shore of the St. Lawrence River in Québec. The area of open habitat was calculated within a 5-km radius from Golden Eagle nesting sites. Occupancy and productivity were assessed in 5 yr between 1994 and 2002 by means of 2 or 3 annual surveys. The number of known nesting sites increased over this period, from 10 to 15, while the number of pairs grew from 6 to 8. The area of open habitat (burn areas, dry barren land and bogs) is significantly larger ($P = 0.019$) around occupied nesting sites ($n = 6$) than in the vicinity of abandoned sites ($n = 4$). There is a trend ($P = 0.062$) whereby the burn area is more extensive around nesting sites occupied by Golden Eagles than around abandoned sites. The mean annual number of eaglets produced per site is strongly correlated with the total area of open land habitat and burn forests. The results support the hypothesis that the area of open habitat determines the occupancy and productivity of the Golden Eagle in the boreal forest. Furthermore, the recurrence of forest fires could play an important role.

467 Johnson, Dimiceli & Stouffer

* Winter territory establishment by Henslow's Sparrows in southeastern Louisiana. ERIK I. JOHNSON, JENNIFER K. DIMICELI and PHILIP C. STOUFFER, *School Renew. Nat. Res., Louisiana State Univ., Baton Rouge, LA.*

Henslow's Sparrows have declined in abundance across their breeding range, primarily due to loss of habitat, and are species of concern on their wintering grounds in the se. U.S. In the Florida Parishes of se. Louisiana, Henslow's Sparrows winter primarily in longleaf pine savannas maintained by burning. Very little is known about its wintering ecology due to its elusive behavior. To better protect this secretive species, an accurate estimation of winter home range size is necessary. Although it has been suggested that Henslow's Sparrows maintain winter territories, these results are based on relatively small sample sizes, unbanded birds, or a limited sampling period. We provide evidence for winter site fidelity from Dec through Mar during the 2003 - 2004 season, based on the capture and recapture of 138 banded birds and geographical positioning systems (GPS). Before winter territories are established by Dec, post-migration movements occur within savannas. In an extreme instance, a banded bird was recaptured 20-km east of its original location and was subsequently recaptured at its original location. In addition, a small percentage of the population may be floaters, suggesting that available winter habitat is saturated and may a limiting factor for Henslow's Sparrow populations.

468 Tittler, Fahrig & Villard

* At what scale(s) may source-sink dynamics occur between Wood Thrush populations? REBECCA TITTLER, LENORE FAHRIG, *Dept. Biol., Carleton Univ., Ottawa, ON,* and MARC-ANDRÉ VILLARD, *Canada Res. Chair in Landscape Conserv., Univ. Moncton, Moncton, NB.*

Knowledge of source-sink dynamics and the scale(s) over which they occur may be important for conservation. Most source-sink studies attempt to identify sources and sinks independently, based on rates of survivorship and fecundity, and do not identify the scale(s) over which source-sink dynamics occur. We hypothesize that if a source-sink dynamic occurs consistently over time between 2 populations, changes in abundance in source populations should result in similar changes in sink populations with a time-lag equal to the time needed for young born in the source to disperse to the sink. The spatial scale over which this occurs should correspond to the scale over which source-sink dynamics and dispersal occur. Using the BBS data, we tested for this relationship between populations of Wood Thrushes from 20 to 400 km apart. We found this relationship at scales between 70 and 160 km, indicating that source-sink dynamics and dispersal may occur over larger distances than previously suggested. Furthermore, the source populations identified had significantly higher abundances than the sinks. Future research will investigate whether such patterns exist for other songbird species. Such results may shed light on continental songbird population dynamics and aid in developing effective conservation strategies.

469 Whitfield & Nishida

A preliminary comparison of wintering Willow Flycatchers in Mexico, Central America, and Ecuador. MARY J. WHITFIELD and CATHY A. NISHIDA, *Southern Sierra Res. Sta., Weldon, CA.*

During the past 6 yr, we investigated the distribution of wintering Willow Flycatchers in Mexico, El Salvador, Costa Rica, Panama, and Ecuador. The initial purpose of our study was to identify the habitat types that wintering Willow Flycatchers use in much of their winter range. Over the past few years, we have added new objectives and have spent more time trying to capture and band the wintering birds. One of these new objectives included looking for previously banded birds when returning to areas that had been visited the previous year. We found that the habitat characteristics for Mexico and the 3 Central American countries were very similar (see Lynn et al. 2003, *Stud. Avian Biol.* 26: 41-51), with the Willow Flycatchers tending to use wet, shrubby second growth areas. Most of the Willow Flycatchers areas in Mexico and Central America showed signs of moderate to heavy human impacts. In contrast, most Willow Flycatcher areas that we found in Ecuador showed very few signs of human impacts. Almost all of the sites in Ecuador were in primary successional habitat on river islands or along the edges of the Rio Napo. These sites were typically dominated by caña (*Gynerium sagittatum*) and a tree-like species of *Tessaria*. In some of these sites, we also found wintering Alder Flycatchers using the same habitat patches as the Willow Flycatchers. This year, we were able to revisit sites in s. Mexico and Ecuador where we had previously banded birds. In Mexico, despite the clearing of 2 sites, we resighted (n = 16) or recaptured (n = 7) 64% of a possible 25 banded birds. All birds were either in or near the previous year's capture site. The sample size of

banded birds in Ecuador was too small ($n = 6$) to make a decent comparison, but we only resighted 1 banded bird. However, we banded 30 birds in 2004 and will return in 2005 to attempt to resight them.

470 Smith, Mlodinow & Self

Demise of Carolina Wren populations in managed forests within the Arkansas Ozarks during winter of 2000. KIMBERLY G. SMITH, MICHAEL MLODINOW, *Dept. Biol. Sci., Univ. Arkansas, Fayetteville, AR*, and JAN SELF, *Forest Service, Ozark Natl. Forest, Jasper, AR*.

Harsh winters can have large impacts on birds, particularly insectivores such as the Carolina Wren, a sedentary insectivore that forages most often on the ground. Snow and ice directly affect the foraging ability of Carolina Wrens, leading to starvation. However, rarely has direct evidence been presented for population declines. Here we report the simultaneous demise of Carolina Wrens on 4 different study sites within the Ozark National Forest in the Arkansas Ozarks during winter of 2000 when 2 severe ice storms occurred during a 3-wk period in Dec. These populations had been under study since 1993 in conjunction with various forest harvesting practices. We also compare our results with the nearest Christmas Bird Counts (CBC) to see if a decrease in Carolina Wrens was evident in that database as well. After the ice storms of Dec 2000, Carolina Wrens disappeared on all study sites prior to the breeding season of 2001. Wrens gradually recolonized our study sites, but one still had no breeding wrens in 2003. The demise of wren populations was evident in some CBCs, but urbanization may have ameliorated the effects of the ice storms.

471 Cotter, Aubry & Lamothe

Habitat use by breeding shorebirds at two large hydroelectric reservoirs in northern Québec. RICHARD COTTER, YVES AUBRY, *Canadian Wildl. Serv., Sainte-Foy, QC*, and PIERRE LAMOTHE, *Hydro-Québec, Montréal, QC*.

We examined the use of 2 habitats, peatland and shoreline, by breeding shorebirds at the Laforge 1 (in 2001) and Caniapiscou (in 2002) hydroelectric reservoirs in the taiga shield of n. Québec. At both sites and for each of the 2 habitat types, shorebirds were surveyed during the incubation period in plots located within 2 strata: reservoir (zone affected by the reservoir's water level) and control (unaffected by the reservoir). At both Laforge 1 and Caniapiscou the breeding guild consisted of 9 species: Semipalmated Plover, Killdeer (Laforge 1 only), Greater Yellowlegs, Lesser Yellowlegs, Solitary Sandpiper, Spotted Sandpiper, Least Sandpiper, Short-billed Dowitcher, Wilson's Snipe and Red-necked Phalarope (Caniapiscou only). The Least Sandpiper was the most abundant species in peatlands, and this was true for both strata and at both sites. For all species combined, in peatland plots at both Laforge 1 and Caniapiscou there were no differences ($P > 0.05$) between the 2 strata in the number of plots with shorebirds (PLOT) or in the mean number of shorebirds/plot (MEAN). In shoreline plots at Laforge 1, however, the reservoir stratum had significantly higher values for both PLOT and MEAN than the control stratum. For peatlands at Caniapiscou, for Short-billed Dowitcher and Wilson's Snipe, both PLOT and MEAN were significantly higher ($P < 0.05$) in the control stratum than in the reservoir stratum.

472 Lecomte, Gauthier & Giroux

Habitat effects on nest predation risks: the case of the Greater Snow Goose. NICOLAS LECOMTE, GILLES GAUTHIER, *Dept. Biol., Centre d'Études Nordiques, Univ. Laval, Québec, QC*, and JEAN-FRANÇOIS GIROUX, *Dept. Sc. Biol., Univ. du Québec à Montréal, Montréal, QC*.

Nest predation and its avoidance are critical components of an individual's fitness. Predators should affect nesting habitat selection and preys should avoid habitat patches associated with high predation risks. We tested the hypothesis that predation affects nesting habitat selection in a Greater Snow Goose (*Chen caerulescens atlantica*) colony characterized by 2 nesting habitats: mesic tundra and wetlands. Goose eggs are most vulnerable to predation by foxes and avian predators when incubating females leave their nest to drink. Our observations revealed that females nesting in mesic tundra had to travel a greater distance to find water during incubation recesses in mesic tundra (mean = $32 \text{ m} \pm 10 \text{ SE}$; $n = 34$) than in wetlands (mean = $10 \text{ m} \pm 1 \text{ SE}$; $n = 14$). Females nesting in mesic tundra were more likely to overpass the distance threshold (10 m) where predator's attacks lead to efficient egg predation. An artificial nest experiment mimicking snow goose nests suggested that differences in predation risk between habitats were not solely due to the behavioral response of females. Predation on artificial nests was higher in the mesic tundra compare to wetlands, and foxes were more efficient to eat eggs in the mesic tundra than in wetlands. Females are apparently sensitive to these differences in predation risks because a higher proportion of marked individuals nested in

wetlands compared to their availability in the colony. Further studies need to examine how much difference in predation risk between the 2 habitats affect nesting success and how this varies in function of predator density.

473 Lopes, del Lama & Haig

* Heterologous polymorphic microsatellite loci in Brazilian Jabiru Storks. IARA F. LOPES, SILVIA N. DEL LAMA, *Dept. Genet. & Evol., Univ. Federal de São Carlos, São Paulo, Brazil*, and SUSAN M. HAIG, *USGS Forest & Rangeland Ecosys. Sci. Center, OR*.

The Jabiru Stork (*Jabiru mycteria*) is the largest flying waterbird of the American continent. Three populations of this species are found in Central American, northern South American, and south-central South American. The largest population of this species is located in the Brazilian Pantanal, where has not suffered disturbance. Otherwise, the Central American population is considered regionally threatened by habitat destruction. Microsatellite markers provide tools for direct assessment of genetic variations between individuals and populations. The aim of the present study was to identify polymorphic microsatellite loci in Jabiru using primers described for Wood Stork. The amplification by PCR was tested in 10 loci; and we detected amplified PCR products of similar molecular size in both species for all of them. Six loci were screened for genetic variation and 5 microsatellite loci were polymorphic in 8 analyzed samples. Many studies have demonstrated that flanking sequences of repeats at microsatellite loci are often conserved between closely related taxa. This loci pool is suitable for determining genetic structure of the Jabiru populations by geographical variation of allele frequencies. The demonstration of cross-amplification within the species examined indicates the potential utility of heterologous primers in further population-level studies of, and conservation efforts to protect Jabiru as well as other species of the Ciconiidae family throughout the American continent.

474 Styring, Therien & Mejeur

A long-term bird monitoring program on Walt Disney World property. ALISON R. STYRING, JAY THERIEN and JAMES MEJEUR, *Disney's Animal Kingdom, Lake Buena Vista, FL*.

In Jan 2004, field work began to establish a long-term monitoring program for birds on ca. 2000 acres of conservation land at Walt Disney World near Orlando, FL. Point count censuses are conducted twice a year in Jan and Jun using distance sampling methods (Buckland et al. 2001, **Intro. distance sampling**). Road surveys occur outside of point count censuses to document rare and migrant species. During the first point count census in Jan, observers censused 61 points and observed 61 species. Data were analyzed using the program Distance (Thomas et al. 2003, **Distance 4.1**). A half normal key function with 2 cosine adjustments was selected as the preferred model using Akaike's Information Criterion. Overall population density was 18 ± 4 indiv./ha. The most abundant species were a year-round resident: Carolina Wren (3 ± 1 indiv./ha) followed by a wintering migrant: Yellow-rumped Warbler (2 ± 1 indiv./ha). Neotropical migrants began arriving by late Feb, and the number of migrant species continued to increase through early May. Numbers of migratory winter residents began to drop at the end of Mar, with the last Yellow-rumped Warblers observed on 11 Apr. Information from this program is incorporated into guest education and special events that highlight conservation issues at Disney's Animal Kingdom such as International Migratory Bird Day. These data are also provided to land managers and will aid in determining appropriate land management practices (e.g., prescribed fire) in the conservation areas.

475 Durães, Loiseau & Blake

* Are leks located in areas of high female overlap? a preliminary test of the hotspot hypothesis with *Lepidothrix coronata* manakins. RENATA DURÃES, BETTE A. LOISELLE and JOHN G. BLAKE, *Dept. Biol. and International Center for Tropical Ecol., Univ. Missouri-St. Louis, St. Louis, MO*.

The question of why males of lekking species should associate when individual chances of mating are so low has been regarded as the "lek paradox". The "hotspot model" of lekking evolution (Bradbury & Gibson 1983, in **Mate choice**, Cambridge) states that female spatial distribution is determined by resource availability, and that males settle independently where female densities are highest. A central prediction of this hypothesis is that males would establish leks in areas where the probabilities of female encounter are maximized. In this study, we tested this prediction using the Blue-crowned Manakin (*Pipridae Lepidothrix coronata*) as our model species. Using GIS tools, we modeled the spatial distribution of females in 2 100-ha study plots located in Tiputini Biodiversity Station (Ecuador) based on capture data and home range sizes estimated by radiotelemetry. We

then compared the number of female home ranges expected to overlap in lek sites vs. in randomly distributed sites. Projected female densities did not differ between observed and random lek sites; thus, our analyses do not support the idea that leks are established in areas of higher concentration of females. Patterns of female movement and distribution are believed to influence lek structure, and virtually any model of lekking evolution bear central predictions regarding these female activities. However, very few studies have attempted to determine patterns of female movement and habitat use away from male arenas. Here, we present preliminary results from a study that intends to use field and modeling data to investigate the relationship between male and female spatial structure in lekking birds.

476 Zins, Eaton & Lanyon

A comparison of UV-reflectance in males of monochromatic and dichromatic species within passerine families. CHARLES J. ZINS, MUIR D. EATON and SCOTT M. LANYON. *Bell Mus. Nat. Hist. and Dept. Ecol., Evol. & Behav., Univ. Minnesota, St Paul, MN.*

Sexual selection has often been used to explain the evolution of dichromatism in avian species. Recent findings on the visual capabilities and plumage coloration of birds suggests the possibility of UV signaling, which is beyond human perception. This possibility has been confirmed by several studies which have shown that UV reflectance plays a role in mate choice with females preferring males which reflect more strongly in the UV. If this female preference for UV-bright males is common, then we would expect to find more UV reflectance in dichromatic species. Specifically, we predicted that within a family, males of dichromatic species should reflect more UV than males of monochromatic species while controlling for human visual colors. In this study, we collected reflectance data from 208 pairs of males from monochromatic and dichromatic species representing 21 families within the order Passeriformes. Our results demonstrate that males of dichromatic species are not consistently brighter in the UV portion of the spectrum than are males of monochromatic species within the same family. While generally we reject our hypothesis, we did find a few examples of families in which dichromatic species possessed plumage patches that were consistently brighter in the UV.

477 Arnaiz-Villena, Lowy, Ruiz-del-Valle, Moscoso, Serrano-Vela, Varela, Guillen, Allende & Zamora

Phylogeography of crossbills, bullfinches, grosbeaks and rosefinches. ANTONIO ARNAIZ-VILLENA, ERNESTO LOWY, VALENTIN RUIZ-del-VALLE, JUAN MOSCOSO, IGNACIO SERRANO-VELA, PILAR VARELA, JORGE GUILLEN, LUIS ALLENDE and JORGE ZAMORA, *Dept. Immunol. & Mol. Biol., Universidad Complutense, Facultad de Medicina, Madrid, Spain.*

Mitochondrial cytochrome b DNA from 24 Carduelini species including crossbills, bullfinches, grosbeaks, rosefinches and other related, but not conclusively classified, species was sequenced. These sequences were also compared with all the available sequences from the genera *Carduelis*, *Serinus* and *Passer*. Phylogenetic analyses consistently gave the same groups of finches and the calculated divergence times suggest that speciation of the studied species occurred between 14 and 3 million yr ago (Miocene-Pliocene), appearing before the *Passer*, *Carduelis* and *Serinus* genera. Pleistocene glaciations may have been important in subspeciation. Crossbills are integrated within the genus *Carduelis*, forming a single group with redpolls; the Common Crossbill shows subspeciation with *Loxia japonica* in the Pleistocene Epoch. *Pinicola enucleator* groups together with bullfinches and is probably the extant ancestor of the group. Hawfinch is only distantly related to the studied groups and might either represent an isolated genus or be related to the New World genus *Hesperiphona*. The grosbeak genera *Eophona* and *Mycerobas* are clearly sister groups and species belonging to the former might have given rise to *Mycerobas* species. The isolated (in classification) *Uragus sibiricus* and *Haematospiza sipahi* are included within the genus *Carpodacus* (rosefinches); *Carpodacus nipalensis* is outside the genus *Carpodacus* in all molecular analyses.

478 Robinson & Robinson

Life histories in a Neotropical suburb: clutch size, developmental periods, nesting success, and predators. TARA RODDEN ROBINSON and W. DOUGLAS ROBINSON, *Dept. Fish. & Wildl., Oregon State Univ., Corvallis, OR.*

To understand the potential influence of urbanization on tropical bird life histories and populations, we studied passerines nesting in and near Gamboa, Republic of Panama, including 680 nests of 74 species in 2003. Clutch sizes of species breeding in and around town were an average of 1 egg larger than those of forest interior species. Incubation periods were shorter than periods of forest interior birds, as were nestling periods. Most of these differences probably result from the different taxonomic compositions of the communities. Forest communities are dominated by suboscines, whereas town and edge communities contain mostly oscine lineages. Nesting success, which should be largely independent of evolutionary constraints, was greater in suburbia than in the forest. Most observed predation events in town were by birds and house cats, but available evidence suggests forest birds lose most nests to snakes. Our results indicate that birds breeding in towns have life history characteristics and breeding productivity closer to that of temperate species than do Neotropical forest-breeding birds.

479 Bull, Friesen & Gaston

The genetic uniqueness of Haida Gwaii Orange-crowned Warbler populations and patterns of differentiation across their breeding range. ROGER D. BULL, VICKI L. FRIESEN, *Dept. Biol., Queen's Univ., Kingston, ON*, and ANTHONY J. GASTON, *Canadian Wildl. Service, Ottawa, ON.*

The Haida Gwaii archipelago of British Columbia is a hotspot of unique populations in w. Canada, harbouring many distinct forms of mammals, birds, insects, plants, and lichens. Genetic research has focused on these differences in a few groups including black bears and ground beetles. Few genetic studies have focused on birds. We are analyzing genetic variation in Orange-crowned Warblers (*Vermivora celata*). We expect *V. celata* from Haida Gwaii to be distinct from those of the adjacent British Columbia mainland. We are also analyzing genetic differentiation across the breeding range of *V. celata*. This will allow us to measure gene flow and genetic differences among 3 of the 4 currently accepted subspecies, *V. c. celata*, *V. c. orestera* and *V. c. lutescens*. We are genotyping 300 individuals from 8 geographical areas at 8 microsatellite markers. Should we find a pattern of differentiation, it could be due to 2 broad categories of processes: historical isolation or differentiation *in situ* through genetic drift and/or selection. This project has potentially important implications to conservation, historical biogeography, and our understanding of the biology of *V. celata*. Uniqueness of Haida Gwaii populations would lend support to the theory of differentiation of local populations through isolation in a Hecate Strait refugium during the Wisconsin glaciation.

480 Murray

On the relationship between clutch size and lifetime reproductive success. BERTRAM G. MURRAY, Jr., *Population Dynamics Research, Somerset, NJ.*

The Murray-Nolan clutch-size equation indicates an inverse relationship between clutch size and lifetime reproductive success. Seemingly, any trait that increases lifetime reproductive success (increasing survival or reproduction) should be selected for. Contrary to conventional wisdom, however, a larger clutch size decreases lifetime reproductive success. This result is consistent with Murray's hypothesis that "*Selection favors those females that lay as few eggs or bear as few young as are consistent with replacement because they have the highest probability of surviving to breed again, their young have the highest probability of surviving to breed, or both.*" Because the breeding season is a finite time period, the advantages of a smaller clutch size are (i) an increase in the probability that any young will leave a nest, (ii) a greater number of replacement clutches that could be laid after clutch failure, (iii) a greater number of broods reared in multibrooded species, (iv) a greater likelihood that a female will lay a replacement clutch after having laid a small clutch than a large clutch, (v) the time interval between consecutive clutches is shorter with smaller than with larger clutches, (vi) better protection of young that have left the nest, and (vii) the production of heavier young, which may increase the survival of young through their first year. The only benefit of a larger clutch is the greater number of fledglings reared per successful clutch.

481 Peters, Humphries, Cheung & Omland

Star-like mtDNA phylogeny in Gadwall population: expansion or selective sweep. JEFFREY L. PETERS, ELIZABETH HUMPHRIES, ROLAND CHEUNG and KEVIN E. OMLAND, *Dept. Biol. Sci., Univ. Maryland Baltimore Co., Baltimore, MD.*

Mitochondrial DNA (mtDNA) phylogeographic studies often reveal star-like phylogenies that contain a common, central haplotype that differs from many rare haplotypes by a few substitutions. These phylogenies are overwhelmingly interpreted as evidence for a recent population expansion. However, a selective sweep of mtDNA also can generate this pattern. For example, a selectively advantageous mutation can quickly spread through a population, creating the appearance of an extreme bottleneck. To distinguish between a bottleneck followed by an expansion and a selective sweep, it is necessary to evaluate multiple autosomal loci. A bottleneck decreases genetic diversity throughout the entire genome, whereas a selective sweep only decreases genetic diversity at the locus on which selection is acting and closely linked loci. We investigated mtDNA diversity among the Holarctic distributed Gadwall, and we found a star-like mtDNA phylogeny in North American Gadwall, but a more branching pattern in Eurasian Gadwall. We sequenced 3 nuclear loci for Gadwall sampled from both North America and Eurasia, and found that all 3 loci were less variable in North America. The nuclear DNA confirms that North American Gadwall underwent a recent bottleneck, relative to Eurasian Gadwall, and the mtDNA star-like pattern is best interpreted as a recent population expansion. These data suggest that the North American population recently was founded by Eurasian Gadwall.

482 Kondo & Omland

Phylogenetic reconstruction of migration in New World Orioles. BEATRICE KONDO and KEVIN E. OMLAND, *Dept. Biol. Sci. Univ. Maryland Baltimore Co., Baltimore, MD.*

New World orioles (genus *Icterus*) are a speciose genus, with species exhibiting migratory behaviors ranging from sedentary and partial migration to short-distance and long-distance migration. This genus provides an ideal model system for examining evolutionary changes in migratory behavior within a single clade. Using a molecular phylogeny of New World Orioles (Omland et al. 1999, **Molec. Phylogen. & Evol.** 12: 224-239; Allen & Omland 2003, **Auk** 120: 961-969), we predict the likely migratory behavior of the common ancestor of all New World Orioles using multiple ancestral state reconstruction methods (parsimony, likelihood, and Bayesian). These methods also allow elucidation of the likely course of changes in migratory behavior along the evolutionary path from the ancestral oriole to the extant species. If gains and losses of migration are equally likely, and if changes in migratory distance are unordered, then the common ancestor was probably a non-migratory tropical resident. Conversely, if migratory change is ordered (proceeds from non-migrants and partial/seasonal migrants, through short- to medium- to long-distance migrants), then it becomes possible that the ancestral *Icterus* may have been migratory. Additionally, if losses in migratory behavior are more likely than gains in migratory behavior, it becomes more likely that the common ancestor was a migratory oriole. Regardless, the genus *Icterus* exhibits frequent changes in migratory behavior and provides a good model group to examine the evolution of migration.

483 Rowell-Garvon & Withers

* Wading bird (Ardeidae) habitat use along the central Texas Coast. SHANNON R. ROWELL-GARVON and KIM WITHERS, *Center for Coastal Studies, Corpus Christi, TX.*

Resident and migratory populations of wading birds use freshwater and marine habitats on the central Texas Gulf coast for foraging, roosting, and breeding. The focus of this study was to describe wading bird community structure in a coastal mosaic and determine linkages among habitats. Indian Point and Sunset Lake parks, Corpus Christi, TX, contain 5 estuarine habitats tidally influenced and depressional ponds, uplands, an excavated salt water "lake", an undeveloped bay beach, and a saltmarsh. Wading birds were censused twice monthly from 15 Aug 2002 thru 27 Jul 2003 using instantaneous scan sampling. A test based on Bonferroni's inequality was used to determine habitat preference and avoidance. Habitat breadths were calculated using a formula based on the Shannon-Weiner diversity index. Overall, 10 species of waders and a total of 1,083 individuals were counted within the 5 habitat types. Significantly more waders were found in the tidal ponds in comparison to the isolated ponds, lakeshore, and bayshore ($F = 24.5$, $df = 4$, $P = 0.001$). Of the 6 most common species, Great Blue Herons, Snowy Egrets, Tricolored Herons, Great Egrets, Reddish Egrets, and Roseate Spoonbills, 4 preferred the tidal ponds and all 6 avoided the lakeshore and bayshore. In general, wader habitat breadths indicated generalist strategies, with only 2 species appearing to

specialize. These 2 parks are important to wading birds because suitable habitat is limited in this area, due to coastal development and shrinking wetlands.

484 Clarke & Staicer

Bird-habitat relationships in a managed forest landscape in eastern Nova Scotia. MATT CLARKE and CINDY A. STAICER, *Dept. Biol., Dalhousie Univ., Halifax, NS.*

Birds were sampled in stands of 4 types (coniferous, conifer-dominated, hardwood-dominated and hardwood) and 6 age classes (clearcut, regenerating, immature, young, mature, and overmature) in a managed forest landscape, the Liscomb Game Sanctuary. A total of 159 sites were sampled twice from 10 Jun to 8 Jul 2003 using 10-min point-distance counts. Laser rangefinders were used to facilitate distance estimation. Detections were assigned to 9 distance intervals (0 - 15 m, 15 - 30 m, 30 - 45 m, 45 - 60 m, 60 - 80 m, 80 - 100 m, 100 - 125 m, 125 - 150 m, and >150 m). Habitat was quantified in four 5 x 10 m quadrats within 50 m of each point. Trees were counted, identified, and their dbh and height measured. Percent cover was estimated for 5 vegetation layers and for other ground features (e.g., needles, leaves, rock, mosses, woody debris). Based on the amount of similar habitat <150 m radius of the point, 99 sites were classified as homogeneous, the other 60 as patchy. Of the 48 species for which densities could be calculated, highest densities were found for Magnolia Warblers in the homogeneous sites, Black-throated Green Warblers in patchy sites, and Bay-breasted Warblers across all sites combined. Many species in this study showed no affiliation to one stand age and/or type, and most were well represented in most stands throughout the study area. Multivariate analyses using Primer software showed that bird communities were not very distinct. A protected area imbedded in this landscape showed notable differences in breeding bird species.

485 Rodríguez-Contreras

Avifauna of Nizanda, Isthmus of Tehuantepec, Oaxaca, México. VICENTE RODRÍGUEZ-CONTRERAS, *Mus. Zool., Fac. Ciencias, Universidad Nacional Autónoma de México, México D.F., México.*

The state of Oaxaca, s. Mexico, holds the greatest avian diversity in the country, mainly due to the ecological and topographic complexity of the region. I studied the distribution of the avifauna in Nizanda, Oaxaca, a region located in the Isthmus of Tehuantepec, that represents a contact zone between humid and arid habitats, as well as of western and eastern biotas in Mesoamerica. Species richness was analyzed by comparing the avifaunas of the 4 basic vegetation types present in the region: tropical deciduous forest, tropical semideciduous forest, riparian vegetation and savanna. The biogeographical affinities of the avifauna were categorized in Pacific and Atlantic slopes. A total 132 avian species were recorded in the 30 km² surveyed, basically located in the dry, Pacific region. The species present included the first Oaxaca record of Golden-cheeked Warbler *Dendroica chrysoparia*, and large healthy populations of 2 microendemic species: Rosita's Bunting *Passerina rositae* and Cinnamon-tailed Sparrow *Aimophila sumichrasti*. The avifauna from each vegetation type is different from each other according to the Jaccard similarity index. For only 50 species it was possible to clearly assign an Atlantic or Pacific affinity. From these, 19 species are typically Atlantic, 13 of which are restricted to humid habitats, and are concentrated in the region only in the small patches of tropical semideciduous forest, that is surrounded by tropical deciduous forest. Some species are herein recorded the pacific region for the first time, and others appear to be out of their previously known distribution areas.

486 Hartman, Maehr, Larkin & Cox

Habitat selection, territory structure, and pairing success of the Cerulean Warbler in eastern Kentucky. PATRICIA J. HARTMAN, DAVID S. MAEHR, JEFFERY L. LARKIN and JOHN J. COX, *Dept. Forestry, Univ. Kentucky, Lexington, KY.*

The Cerulean Warbler has exhibited precipitous declines throughout its range since 1966 (49.5% overall). Long associated with large tracts of mature hardwood forest, the cerulean's decline is most often attributed to habitat loss and degradation. However, an overall lack of local data on demography and habitat selection poses a challenge to the development of strategic conservation plans for the species. Further, due to its habit of foraging and nesting high in the canopy, there is a paucity of basic life history information on the Cerulean Warbler. We present first-year findings of a study examining Cerulean Warbler habitat use, territory selection, and pairing success in the Daniel Boone National Forest of e. Kentucky. We conducted line transect censuses through 10 1-km² grids in a 1600-ha forest patch to survey for Cerulean Warbler occupancy. We compared vegetative and

landscape attributes at the patch level in use versus non-use patches using standard methodology. Additionally, we assessed pairing success, mapped territories, and attempted to locate nests of 30 male Cerulean Warblers occupying the study area. We compared habitat characteristics of known cerulean warbler territories with paired unoccupied potentially suitable "territories." The results from this study will provide land managers with critical information regarding cerulean warbler habitat needs and nesting ecology from which they can design and implement conservation plans.

487 Swartzentruber & Master

The effects of hemlock woolly adelgid on breeding populations of three species of eastern hemlock dependent songbirds. BETH A. SWARTZENTRUBER and TERRY L. MASTER, *Dept. Biol. Sci., East Stroudsburg Univ., East Stroudsburg, PA.*

Hemlock woolly adelgid (*Adelges tsugae*) is an exotic Asian insect pest currently decimating eastern hemlock (*Tsuga canadensis*) throughout the ne. U.S. Recent studies have demonstrated that several species of songbirds, including the Black-throated Green Warbler, Blackburnian Warbler and Blue-headed Vireo are obligate hemlock species during the breeding season. In this study, line transect detection rates, and resulting densities of these species were compared among transects differing in degree of hemlock woolly adelgid infestation and hemlock condition in order to determine the effect of varying hemlock woolly adelgid impact levels on their breeding populations. Correlations of measures of impact with measures of bird abundance indicate that effects vary considerable and that a "crowding effect" may be occurring as the condition of the trees declines.

488 Boucher

Habitat selection of the Black Guillemot. SARAH BOUCHER, *Augusta, ME.*

Research was performed on Great Duck Island, located approximately 28 km south of Bar Harbor, Maine. Great Duck Island is approximately 1.6 x 0.4 km with a variable berm. Nest sites ranged from inside cliff crevices to under rock jumble about 1 m from the water line. Nest clustering correlated with berm type. Nests of Black Guillemots occurred most frequently in areas of berm with a mixture of large boulder slabs and rock jumble. Nest clustering was also highest in this berm type.

489 Sheehan & Master

Acadian Flycatcher nesting ecology in a threatened eastern hemlock ecosystem. JAMES SHEEHAN and TERRY L. MASTER, *Dept. Biol. Sci., East Stroudsburg Univ., PA.*

Published accounts indicate the Acadian Flycatcher is a relatively recent addition to the breeding avifauna of ne. Pennsylvania and n. New Jersey, and in fact may have re-colonized formerly occupied habitat. In this region it almost exclusively inhabits eastern hemlock (*Tsuga canadensis*) mesohabitats although deciduous habitat similar to where it breeds elsewhere is present. However, hemlock habitat is patchily distributed and comparatively rare within the deciduous forest dominated landscape of the region and is imperiled with degradation and eventual loss, largely due to the exotic hemlock woolly adelgid (*Adelges tsugae*). In order to collect baseline data on the nesting requirements of this species within this habitat, we located 102 nests at sites that varied in topography, adelgid impact, and relative hemlock dominance. Over 90% of the nests were placed in hemlock and nest survival rates were uniformly high in comparison to those found by most studies elsewhere in its range. In addition, nesting populations at sites most impacted by the adelgid appear to have declined. This study suggests the Acadian Flycatcher's long term presence in this region is in doubt due to the adelgid threat and provides insights into factors that may be responsible for both nest-site and habitat selection within the region.

490 Carey & Mills

Nest-site selection of Field Sparrows in a rapidly changing old-field habitat. MICHAEL CAREY and JEFFREY MILLS, *Dept. Biol., Univ. Scranton, Scranton, PA.*

The breeding biology of a Field Sparrow population in ne. Pennsylvania has been closely monitored since 1987. In that time much of the study site has changed from open grassy fields with scattered shrubs and small trees to areas almost completely overgrown with shrubs and/or large trees. As this old field succession has occurred, the Field Sparrow population has declined from a maximum of 33 breeding territories to 9. In order to determine possible factors involved in this decline, we compared nest site characteristics of Field Sparrows to vegetation on the study site in general. We also compared nest site and general field characteristics in fields of different successional ages, ranging from 11-30 years since last cultivation or mowing. We measured 30 different habitat

parameters in 25 square meter plots around each nest and compared them to the same measures made at random plots throughout the site. The few differences between nest site and random plots were found only in the oldest of the fields. Nest sites there had significantly more dogwood, fewer honeysuckle, and lower tree heights than in random plots. Nest site characters did not significantly change with field age.

491 Doucet & Morneau

Comparison of predation rate of bird nests between edge and forest along a powerline right-of-way in the boreal forest. G. JEAN DOUCET, *TransÉnergie, Montréal, QC*, and FRANÇOIS MORNEAU, *Saint-Basile-le-Grand, QC*.

As part of TransÉnergie's research program on biodiversity in high voltage powerline rights-of-way in the Québec boreal forest, we compared predation rate of ground bird nests in the forest/right-of-way edge to that in the adjacent forest. The study was conducted in 6 different sites within a 15 km section of right-of-way to avoid the possible effect of a single predator. The sampling unit consisted of 1 artificial ground nest with 4 eggs: 3 Common Quail (*Coturnix coturnix*) eggs and 1 plasticine egg to identify predators. Half the nests were located in the forest, 100 m from the right-of-way while the other half were located in the woods, 1-6 m from the edge of the right-of-way. Sample sizes were 114 nests in 1999 and 136 nests in 2000. Small mammal abundance was evaluated by means of trapping, while red squirrel abundance was estimated using the point count method. Results showed that predation rate was not different in the forest edge than in the forest itself. Predation rate was lower in 1999 than 2000 and was not similar for all 6 study sites. Main predators were Gray Jay and probably red squirrel (*Tamiasciurus hudsonicus*). Small mammal abundance seemed to influence predation rate of ground nests. Small mammal capture/100 trap-nights was 53.5 in 1999 and 4.2 in 2000. Estimated red-squirrel relative abundance was 1.64/ha in 1999 and 0.48/ha in 2000.

492 Hughes & Conway

The influence of nest-placement on the probability of nest depredation in Band-tailed Pigeons. KATIE M. HUGHES, *School Nat. Res., Univ. Arizona, Tucson, AZ*, and COURTNEY J. CONWAY, *Arizona Coop. Fish & Wildl. Res. Unit, Tucson, AZ*.

Breeding Bird Survey data suggests that Band-tailed Pigeons have declined throughout their range by >3%/yr since 1966. We know very little about the interior subspecies of Band-tailed Pigeon, and understanding the basic breeding habitat requirements will help agencies develop management plans to reverse these population declines. For example, no studies have attempted to quantify important habitat characteristics associated with nest sites or examined the ecological processes influencing nest-site selection. I examined the vegetative characteristics and landscape features that influenced Band-tailed Pigeon nest-site selection. I used artificial Band-tailed Pigeon nests to compare the probability of nest depredation between 2 plant communities (oak woodland and coniferous forest) commonly used by Band-tailed Pigeons. Most natural nests were found in old growth mixed-conifer forests with 84% canopy cover. Nest trees averaged 20 m tall and 65 cm diameter at breast height. Nests were found in 3 tree species and nest heights ranged from 5 - 23 m at elevations ranging from 1717 - 2691 m. Nest depredation rates were lower in coniferous forests than in oak woodlands.

493 Nguyen, Nol & Abraham

Nest success and habitat selection of the Semipalmated Plover on Akimiski Island, Nunavut. LINH P. NGUYEN, ERICA NOL, *Dept. Biol., Trent Univ., Peterborough, ON*, and KENNETH F. ABRAHAM, *Ontario Ministry Nat. Res., Peterborough, ON*.

We studied nest site selection by Semipalmated Plovers to compare microhabitat characteristics at nest and random sites, and successful and unsuccessful nests on the north shore of Akimiski Island, Nunavut, during 2002. Nesting birds selected sites with more pebbles and less vegetative cover than available in the environment. Nest sites also had smaller percentage of bare mud than random sites. Plovers selected sites within 100 m of Arctic Terns more often than expected based on the distribution of random sites in the study area. 23 of 41 (56%) nests hatched successfully. None of the microhabitat features that we measured predicted nest success. All 10 nests near the colony of Arctic Terns hatched, suggesting that interspecific associations are more reliable than habitat features for predicting nest success.

494 Cornelius & Blake

* Effects of habitat alteration on habitat use and nest site selection on the Thorn-tailed Rayadito (Furnariidae) in the temperate rainforest of southern Chile. CINTIA CORNELIUS and JOHN G. BLAKE, *Biol. Dept., Univ. Missouri-St. Louis, St. Louis, MO.*

Habitat alteration may affect the distribution, abundance and fitness of species especially if they rely on resources that are intensively exploited. The Thorn-tailed Rayadito (*Aphrastura spinicauda*) is a cavity nester associated with large trees in forests, suggesting that disturbed forests in which large trees have been removed are habitats of low quality. We determined the effects of forest structure, modified by logging and fire, on the abundance, nest site selection, and reproductive success of Rayaditos during the 2003 - 2004 austral breeding season (Sep - Feb) in Chiloé, s. Chile. 2 9-ha plots were established in undisturbed forests and 2 9-ha plots in disturbed forests. Undisturbed forests had more alive large trees (>40 cm dbh) than snags and more alive trees than disturbed forests, but the number of alive trees between disturbed forest plots differed, suggesting different levels of perturbation. The abundance of Rayaditos was higher in undisturbed than disturbed forests. In disturbed forests more nests were on snags (62.5%) than on alive trees (37.5%), and nest site selection reflected availability of tree species and snags in the forest. Contrarily, in undisturbed forests a low proportion of nests were found on snags (20%) and all alive nest-trees (80%) were *Nothofagus* trees. Rayaditos significantly selected alive *Nothofagus* trees over other available tree species and snags as nesting sites in undisturbed forests. Moreover, nests on alive trees were more successful than nests on snags, suggesting that selection of cavities in alive trees has a positive effect on fitness. More information is needed to confirm these observations, but results suggest that logged and burned forests are low quality habitats for this cavity nester in this rainforest.

495 LeClerc, Vézina, Dion, Sénéchal & Lamothe

Boreal land bird habitat description using very-high-resolution airborne images. J. LECLERC, *Service canadien de la faune, Québec*, A. VÉZINA, J.-P. DION, E. SÉNÉCHAL, *Inst. tech. Agroalim. La Pocatière*, and P. LAMOTHE, *Hydro-Québec, Montréal, QC.*

In this study, we compared breeding land bird communities along the shoreline habitats of 4 large hydro reservoirs of the boreal forest of n. Québec, with communities of adjacent control lakes. As part of this study, we made habitat description of land bird breeding grounds using very-high-resolution airborne images. Images were acquired from an aircraft equipped with a DuncanTech MS-3100-CIR numerical camera (lens Tokina 17 mm) between 28 Jun and 13 Jul 2003. Planned flight altitude was 1829 m above ground in order to obtain a 0.5 m/pixel resolution. Image analysis was conducted with the Image Processing Toolbox of the software Matlab 6.5.1. The original images which were in the RGB color space were transformed to the Lab color space in which the color information is in 2 layers. The 2 color layers were analysed by K-means clustering with K = 5 producing 5 sub-images. For segmenting multiple habitats into sub-images, kernel density curves were constructed from randomly sampled pixels and thresholds between habitats were identified between humps. Habitats were classified by photo-interpretation (color, texture and context) using field observations as validation. Nine habitat classes were compiled: closed black spruce, open black spruce, jack pine, alder, regenerating immature stands, Ericaceae-dominated shrubs, lichen-dominated low vegetation, herbaceous / organic soils, and burned patches. Main differences between the 4 reservoir regions and between each reservoir and adjacent lakes are presented.

496 Powell & Slack

Winter habitat use by the Black-capped Vireo in its winter range in Mexico. ROBERT A. POWELL and R. DOUGLAS SLACK, *Dept. Wildl. & Fish. Sci., Texas A & M Univ., College Station, TX.*

Little is known about the Black-capped Vireo (BCVI) in its non-breeding (winter) range in Mexico. Portions of its winter range have been investigated during 2 previous research expeditions (Graber 1957, **Ph.D diss.**, Univ. Okla; Marshall et al. 1985, **Status report**, Office End. Spec., USFWS), but quantitative habitat data across the winter range is nonexistent. We collected quantitative habitat data at sites in w. Mexico containing BCVI's between Jan and Apr 2003 and between Dec 2003 and Mar 2004. These efforts were conducted at approximately 30 sites throughout the winter range of this species. Data on habitat and vegetation was collected within a series of 0.04 ha plots. Variables were measured at 3 random locations along the survey transect at all sites surveyed. Additionally, for sites at which BCVI's were found, habitat and vegetation variables were measured at the specific site where the BCVI was first seen, and at 3 non-use points. Within each habitat plot, we recorded slope, aspect, elevation, vegetation type, GPS coordinates, distance to

nearest road/trail, the number of tree species within the plot, evidence of disturbance, height of initial bird perch and perch tree, and estimated ground cover, visual obscurity, shrub density, tree density, and canopy cover. We will present results on these surveys and show comparisons of habitat use between BCVI-points and non-BCVI points.

497 Somershoe, Twedt & Reid

Estimating density of migrants from mini-Breeding Bird Survey route in Vicksburg National Military Park. SCOTT G. SOMERSHOE, DANIEL J. TWEDT, *USGS Patuxent Wildl. Res. Center, Vicksburg, MS*, and BRUCE REID, *Audubon Mississippi, Vicksburg, MS*.

Although Vicksburg National Military Park is renowned as a historic commemorative battlefield, its deep wind-blown loess soils on the bluffs of the Mississippi Valley support lush hardwood forests. The loess bluffs within Vicksburg National Military Park represent one of the few tracts of loess bluff hardwood forest on public land in the U.S. We hypothesize that, similar to bottomland hardwood forests, these mesic bluff forests are important stopover habitat for migrant songbirds during spring. To assess avian migration, we surveyed avifauna along a mini-Breeding Bird Survey route within Vicksburg National Military Park between 27 Mar and 2 May. Surveys were conducted on 10 d during 2003 and 14 d during 2004. Using within year Julian date as a covariate, we estimated bird densities using program DISTANCE. We derived bird densities for 20 of the 49 migrant songbird species detected at 20 point counts distributed along the survey route. During 2003, the most abundant migrant birds were Tennessee Warbler, Ruby-crowned Kinglet, Blue-gray Gnatcatcher, Summer Tanager, Indigo Bunting, White-eyed Vireo, and Red-eyed Vireo. We estimated a daily average population of >8500 birds within Vicksburg National Military Park during spring migration

498 Németh & Moore

Differential migration in Ruby-throated Hummingbird during spring passage along the northern coast of Gulf of Mexico. ZOLTÁN NÉMETH and FRANK R. MOORE, *Dept. Biol. Sci., Univ. Southern Mississippi, Hattiesburg, MS*.

Migration biology of the only eastern North American breeding hummingbird species, the Ruby-throated Hummingbird, is poorly understood. We analyzed 7 yr (1998 - 2004) of capture data (n = 598) from a migration banding station in southwest coastal Louisiana in order to describe differential timing of spring migration between sexes. We found significant sex-based difference in mean passage dates where males preceded females by about 3 d. Females carried significantly more fat stores than males, suggesting that females may adopt an energy maximization strategy whereas males are time minimizers. Consistent with this intersexual discrepancy in the migratory strategy, we found that only males display positive correlation between amount of fat stores and passage date, whereas females do not show this pattern.

499 Smith & Moore

Arrival timing and seasonal reproductive performance in a long-distance migratory landbird. ROBERT J. SMITH, *Dept. Biol., Univ. Scranton, Scranton, PA*, and FRANK R. MOORE, *Dept. Biol. Sciences, Univ. Southern Mississippi, Hattiesburg, MS*.

The date when a landbird migrant arrives on its breeding grounds may have reproductive consequences. Generally, early arriving individuals begin breeding earlier and consequently experience greater seasonal reproductive performance. Here we describe relationships between arrival timing and seasonal reproductive performance in the American Redstart, a long-distance passerine migrant, arriving at northerly breeding grounds in Michigan's e. Upper Peninsula. Evidence suggests that both males and females benefitted from early arrival at the breeding grounds. Early males appeared to settle on higher quality territories and hatched nestlings sooner than later arrivals. Early females began their clutches early, produced heavier nestlings and possibly laid more eggs than later arrivals. Larger clutches and heavier offspring increase the likelihood of offspring recruiting into the breeding population. The findings of this study point to fitness consequences arising from when a bird arrives at its breeding grounds. These results also have implications for understanding how events occurring during spring migration influence reproductive performance as migratory delays likely influence arrival timing.

500 Smith, Ewert & Diehl

Use of habitat patches by landbird migrants during spring migration in southwestern Michigan. ROBERT J. SMITH, *Dept. Biol., Univ. Scranton, Scranton, PA*, DAVID N. EWERT, *The Nature Conservancy, Lansing, MI*, and ROBERT H. DIEHL, *Univ. Southern Mississippi, Hattiesburg, MS*.

The ability for a migrant landbird to locate suitable habitat to stop, rest and refuel is critical to ensuring a successful migration. However, our knowledge of how transients use habitat and what habitat elements are important during migration is poor. Traditional methodologies constrain most stopover habitat research to relatively small spatial scales even as migration, and therefore stopover, occurs at large scales. Ideally, large- and small-scale approaches should be coupled to provide a more complete picture of stopover habitat use. Here we take a multi-scale approach in efforts to characterize important stopover habitats in the Great Lakes region by seeking a better understanding of (1) landscape contexts where stopover habitat is in limited supply, (2) patch specific characteristics that identify particular sites within critical landscapes where birds concentrate and (3) the relationship between field-based measures of migrant density and those estimated from weather radar. We combined transect censuses for birds and arthropods with radar data (NEXRAD) describing the nightly exodus of birds during spring migration, 2002 - 2003, Barry Co., sw. Michigan. Our census results suggest that woodlot size and surrounding matrix (agricultural vs. forested) influenced both bird and arthropod density. Further, while we found no landscape scale tendency for landbirds to favor woodlots associated with water, we did find that within woodlots, habitats near water held higher numbers of birds. Finally, radar and transect based bird density estimates were not spatially or temporally correlated, though both measures showed birds occurring in highest abundance in forested landscapes.

501 Evans Ogden & Martin

Physiological insights into body condition at a high elevation migratory stopover site. L. J. EVANS OGDEN and K. MARTIN, *Centre Appl. Cons. Res., For. Sci. Centre, Univ. British Columbia, Vancouver, BC*.

Fuel deposition rate at stopover sites is a crucial factor determining stopover duration, departure fuel load, migration speed, and ultimately survival and reproduction of migratory birds. Few studies have examined high elevation habitats as stopover sites, and increasing human activity threatens these habitats. As sites for refuelling, the body condition of individuals using these sites can be assessed using fattening as an index. I am exploring temporal, interspecific, and age differences in fattening at a sub-alpine site in British Columbia. Fattening is quantified by means of plasma metabolite profiling, which determines a refuelling index of an individual from a single capture. In fall 2003, I captured, aged, measured, and blood sampled 222 individuals of 6 species. Results indicate that this site has a strong age bias toward juveniles, but we found no age differences in fattening rates. We detected no decline in absolute body mass over time, and determined that fat deposition rates increased through to the end of migration. Our data suggest that this site provides high quality stopover habitat even late in the fall. Our study is expanding in 2004 to compare fattening indices between high and low elevation sites. Use of this physiological index provides valuable insights into the importance of subalpine stopover habitats for migratory birds, enabling such sites to be prioritized for conservation.

502 Shawkey & McGraw

Yellow colour production in Budgerigars. MATTHEW D. SHAWKEY, *Dept. Biol. Sci., Auburn University, Auburn, AL*, and KEVIN J. MCGRAW, *School Life Sci., Arizona State Univ., Tempe, AZ*.

It has previously been thought that the green chest feathers of wild-type Budgerigars (*Melopsittacus undulatus*) contain both a blue-producing structural "spongy layer" (i.e., highly organized keratin and air matrix) and a yellow pigment, while chest feathers of yellow budgerigars contain only the yellow pigment. Indeed, yellow Budgerigar chest feathers contain a yellow pigment, but transmission electron microscopy reveals that they also contain a spongy layer. This spongy layer is unusual in 2 ways. First, it lacks the layer of melanin granules that typically lies beneath structural reflectors of this type. Second, it is of the appropriate size and spatial organization to reflect light in the yellow range, peaking at about 600 nm. All previously described spongy layers reflect light with a peak below 550 nm. This peak is close to that measured from the same feathers using spectrophotometry (574 nm), suggesting that the spongy layer may be involved in colour production. These findings underscore the limits of our understanding of the mechanisms of colour production in vertebrates, and the need for caution when assigning mechanisms to different colours.

503 Morissette, Hobson, Butterworth, Mack & Devito

Boreal forest riparian bird communities: effects of local- and landscape-level processes. J. MORISSETTE, *Ducks Unlimited Canada, Edmonton, AB*, KEITH HOBSON, *Univ. Saskatchewan, Saskatoon, SK and Canadian Wildl. Serv.*, ERIC BUTTERWORTH, G. MACK, *Ducks Unlimited Canada, Edmonton, AB*, and K. DEVITO, *Univ. Alberta, Edmonton, AB*.

The boreal riparian bird community, particularly around ponds and wetlands, is not well studied. In the western boreal forest, wetlands comprise over 20% of the landscape and 5% of the terrestrial land-base exists as riparian habitat. Since changes in topography, surficial geology and hydrology have been linked to changes in vegetation patterns on the landscape, and since birds have been shown to be sensitive to changes in relative habitat composition, sampling on a scale determined by surficial geology characteristics could improve planning for forestry and conservation. To examine this hypothesis, we surveyed bird communities along a gradient in surficial geology to sample wetlands in regions dominated by clay till plain, moraine, and outwash. All wetlands were surveyed using a method that combines strip-transects and fixed-radius point-counts. Community analysis to date shows that habitat features determined by these underlying landscape features could be used to predict riparian bird community structure. We anticipate this approach will provide guidance to conservation planning efforts carried out by DUC in collaboration with industry partners.

504 Heiss, Ulion, Clark, McGowan & Caffrey

Mouth color and tail shape as an indicator of age in American Crows. REBECCA HEISS, KELLY ULION, ANNE B. CLARK, *Dept. Biol. Sci., Binghamton Univ., Binghamton, NY*, KEVIN J. MCGOWAN, *Lab. Ornithol., Cornell Univ., Ithaca, NY*, and CAROLEE CAFFREY, *Audubon Science, Ivyland, PA*.

Tail feather shape and mouth coloration are often used to determine age in birds. In American Crows, the changes from a predominantly pink to a completely black mouth, and from pointed to squared-off rectrices have been used to distinguish first year from older birds. In fact, crows show a continuum of mouth color and intermediate rectrix shapes. Crows typically breed at 3+ yr, often after helping at the parental nest. Thus intermediate mouth colors and tail shapes could reflect intermediate ages of life-history significance. We scored tail shape and mouth color, and evaluated whether a) 2nd or 3rd year birds could be reliably identified, or alternatively, b) sex and breeding status affected either or both. Using 2 populations of known-age birds assessed at banding or death, and 3 samples of birds captured or shot during winter, we related tail shape to mouth color and to sex, age, and breeding status where known. Tail shape discriminates first-year from older birds. Intermediate tail shapes are associated with intermediate mouth colors, suggesting real year classes. Mouths darken with age and known breeders have the darkest mouths. Variation in mouth color after 2 yr is, however, great, and intermediate colors incorrectly classified some known-age birds. One 7-yr old helper retained both intermediate mouth color and tail shape, perhaps reflecting its non-breeding status. Studies of behavioral and hormonal status in relation to both mouth color and tail feather shape are needed.

505 Ryder & Durães

Using molt limits to age and sex green-plumage manakins (Aves: Pipridae). THOMAS B. RYDER and RENATA DURÃES, *Dept. Biol., Univ. Missouri-St. Louis, and Internatl. Center Trop. Ecol., St. Louis, MO*.

Aging and sexing individual birds is central to avian ecology and can enhance studies ranging from population demographics to reproductive biology. Birds that breed and migrate through North America are commonly aged and sexed based on molt patterns. Yet to date, a similar approach has not been developed for birds breeding at tropical latitudes. Here we develop a technique for aging and sexing green-plumage manakins in the family Pipridae. Utilizing common techniques for temperate passerines we aged 115 individuals and sexed 39 individuals across 4 species (*Lepidothrix coronata*, *Pipra pipra*, *Pipra erythrocephala* and *Pipra filicauda*). Hatching year birds were distinguishable from after hatching year birds by retention of some juvenile greater coverts and or juvenile primary coverts. Birds which had completed their 2nd prebasic molt and had no signs of male plumage were sexed as female. Individuals with signs of male plumage were not reliably sexed because older females can attain male plumage attributes at older ages. The sexing and aging technique was validated using molecular sex techniques in the laboratory and later capture of known age plumage birds, respectively. Both techniques are highly accurate and, thus, constitute a major addition to understanding variation in survival, population demographics and, reproductive success.

506 Stettenheim

What do feathers do for birds? PETER STETTENHEIM, *Plainfield, NH.*

A survey of modern birds finds that feathers are more versatile than is commonly realized. They serve in at least 24 different ways within the class. Many functions are universal (e.g., thermal insulation, temperature regulation, physical protection, visual signaling), some are widespread (e.g., flight, sound production, water repellency), and others are unusual or restricted to a particular genus or species (e.g., chemical defense in Pitohuis). A table summarizes this survey, giving for each known function the birds in which it occurs, as far as known, the kinds of feathers involved, and what they do. The diversity of these roles supports the idea that birds arose and flourished as the group of dinosaur descendants which most fully exploited the potentialities of feathers.

507 Saranathan & Burt

Variation in plumage microbial communities among Song Sparrows of Arizona, Ohio and Washington. VINODKUMAR SARANATHAN, *Dept. Physics & Astr., Ohio Wesleyan Univ., Delaware, OH,* and EDWARD H. BURTT, Jr., *Dept. Zool., Ohio Wesleyan Univ.*

Populations of Song Sparrows with limited genetic contact occur in geographically and ecologically different regions of North America. We sampled 3 subspecies of Song Sparrows: *Melospiza melodia fallax* in the riparian corridors of se. Arizona, *M. m. melodia* in old field habitat in Ohio and on Kent Island, NB, and *M. m. morphna* in the Olympic rainforests of w. Washington (Arcese et al. 2002, **BNA** 704). We compare the variation in plumage microflora within and among these subspecies of Song Sparrows. We found differences in the occurrence of feather-degrading microbes, especially *Bacillus licheniformis*, *Streptomyces* spp., *Fusarium* spp. and *Acremonium* spp. among the 3 subspecies. We speculate on the causes of differences in the microbial communities of the plumage in these populations. We also call attention for the need to study how such differences in plumage microflora may affect the morphology, behavior or ecology of sparrows in the different populations.

508 Kuntz, Gremillet, Berteaux, Butler, Woakes & le Maho

Collecting data on free-ranging birds: is data-logger implantation a satisfying method? G. KUNTZ, *Chaire de Conservation des Ecosystèmes Nordiques, Univ. Québec à Rimouski, Rimouski, QC,* and *Centre d'Ecologie et Physiologie Energétiques, CNRS, Strasbourg, France,* D. GREMILLET, *Centre d'Ecologie et Physiologie Energétiques, CNRS, D. BERTEAUX, Chaire de Conservation des Ecosystèmes Nordiques, Univ. Québec à Rimouski,* P. J. BUTLER, A. J. WOAKES, *School Biol. Sci., Univ. Birmingham, Birmingham, UK,* and Y. LE MAHO, *Centre d'Ecologie et Physiologie Energétiques, CNRS.*

The use of implantable devices to study free ranging birds is increasing. Surgical developments are usually not published, however, and there are few impact studies on implantation techniques. Negative impacts must be obviously minimized because of both ethical reasons and data validity. To study the ecophysiology of Great Cormorants, *Phalacrocorax carbo*, from Greenland we used implanted data-loggers. During the initial phase of the project we tested the hypothesis that our methods induced no detectable impacts. Implanted birds (n = 5) made shorter foraging trips than birds monitored using automatic nest-balances (n = 5). Implanted birds performed more dives and a higher number of foraging bouts than birds equipped with external recorders (n = 5). The ratio of bout duration to the number of dives was higher to the later group. These differences might nonetheless be due to methodological discrepancies between the systems used to assess the foraging parameters of implanted versus non-implanted cormorants. Further, we found no difference in the reproductive success of implanted birds and that of a control group (n = 70). We neither found a difference in the survival rate of implanted birds and that of a control group 1 yr later (n = 15). These contrasting results are discussed.

509 Coleman, Richmond & Linse

A programmable release device for the recovery of avian telemetry tags. JEREMY T. H. COLEMAN, MILO E. RICHMOND, *New York Coop. Res. Unit, Dept. Nat. Res., Cornell Univ., Ithaca, NY,* and MICHAEL H. LINSE, *Alpha Omega Comp. Sys., Corvallis, OR.*

Technological advances have allowed for greater opportunities to collect physiological, behavioral, and location data on increasingly smaller animals through electronic tagging. Developments in satellite transmitters have made them progressively useful for studies of animal movement, however, that technology is still limited in both the volume of data that can be transmitted

from the tag and by the expense of the units themselves. Long-term studies requiring a high degree of precision are still best served by lower-cost tags that archive data internally. These units, such as time-depth recorders (TDRs) or physiological monitors, must be recovered to retrieve the data. Re-trapping the same individual to remove a tag can be practically impossible, depending on the species. We designed and constructed a backpack-style, 24 g release platform to recover TDRs deployed on Double-crested Cormorants on 3 New York lakes in 2002 and 2003. The device uses a heated element to sever a monofilament segment of the ribbon harness, allowing the tag to simply drop off. The units were preprogrammed to release during the night, while cormorants were roosting on land, and were designed to leave the bird completely unfettered. We tested variations on the design and achieved an 80% recovery rate (8 of 10) with the best model. The programmable design we employed was fairly simple, but more complex features, like remote controlled detonation, could be incorporated. Other applications for this device include deployment of tags on endangered species where a reliable short-term attachment to the animal is desirable.

510 Hazler

Mayfield logistic regression: a practical approach for the analysis of nest survival. KIRSTEN R. HAZLER, *Warnell School For. Res., Univ. Georgia, Athens, GA.*

"Mayfield logistic regression" is a method for analyzing nest survival data which extends the traditional Mayfield estimator by incorporating explanatory variables (e.g., habitat structure, seasonal effects, or experimental treatments) in a logistic regression analysis framework. Although Aebischer (1999, *Bird Study* 46: S22-31) previously showed that logistic regression can be used to fit Mayfield models, few ornithologists have put this finding into practice. The purpose of this paper is to reintroduce an underutilized method of nest survival analysis, to compare its performance to that of a dedicated survival analysis program (MARK), and to provide a practical guide for its use. Like the traditional Mayfield method, Mayfield logistic regression accounts for the number of "exposure days" for each nest and allows for uncertain fates (censoring), thus avoiding the bias introduced by typical applications of logistic regression to date. Mayfield logistic regression should be widely applicable when nests are found at various stages in the nesting cycle and multiple explanatory variables influencing nest survival are of interest.

511 Noel & Chandler

Population dynamics of wintering Piping Plovers in coastal Georgia. BRANDON L. NOEL and C. RAY CHANDLER, *Dept. Biol., Georgia Southern Univ., Statesboro, GA.*

The Piping Plover is a federally listed species with distinct breeding populations in the Great Lakes region, northern Great Plains, and along the northeastern Atlantic coast as far south as North Carolina. Most conservation-related research on this species has focused on the breeding season despite the fact that Piping Plovers spend only 3 - 4 mon of the year on their breeding grounds. We report preliminary data on the abundance and movements of Piping Plovers wintering on Little St. Simons Island (LSSI), an important wintering site for Piping Plovers in the Altamaha River estuary of coastal Georgia. Between Aug 2003 and Apr 2004, an average of 53 plovers were found on LSSI. Based on observations of individually recognizable color-banded birds, we confirmed a minimum of 30 plovers from the Great Lakes population, 10 from the northern Great Plains, and 15 from the Atlantic coast using LSSI during migration or wintering. Median arrival dates for each population were 28 Aug 2003 (Great Lakes), 12 Sep 2003 (northern Great Plains), and 3 Sep 2003 (Atlantic coast), respectively. During the height of migration (Sep and Mar), we observed an average of 75 and 61 plovers with no confirmed birds using both migration months, except one Great Lakes individual (fledgling). Three individuals from the Great Lakes population were confirmed to have spent 9 mon, and 7 individuals spent 8 mon, on LSSI. No individuals from the northern Great Plains or Atlantic coast populations resided >7 mon. Our results suggest that LSSI is a globally important site for Piping Plovers during winter and migration.

512 Jennelle, Sydenstricker & Kollias

Factors influencing disease recovery in captive House Finches infected with *Mycoplasma gallisepticum*. CHRISTOPHER S. JENNELLE, *Dept. Nat. Res., Cornell Univ., Ithaca, NY*, KEILA V. SYDENSTRICKER and GEORGE V. KOLLIAS, *College Vet. Med., Cornell Univ.*

The impacts of both abiotic and biotic factors in avian disease dynamics is appreciated, but has not been demonstrated often in an experimental setting. To address this need, we examined the influence of temperature, gender, and pre-infection mass on infection and recovery probabilities of

House Finches infected with *Mycoplasma gallisepticum* (MG). We captured 22 wild House Finches in Ithaca, NY during the winter of 2001. All birds tested negative for MG infection using PCR and RPA diagnostics, and were quarantined for 3 wk prior to the start of the experiment. 2 groups of 11 finches with approximately equal sex ratios were housed in outdoor aviaries. We took baseline measurements of body mass before the start of the experiment when all individuals were confirmed to be healthy. One index individual was inoculated with MG in each group and we monitored the spread of MG infection weekly from Feb to Aug 2002. We used mark-recapture software MARK to determine if probabilities of infection and/or recovery were related to temperature, gender, and/or pre-infection mass. We found strong evidence that suggests pre-infection mass is positively correlated with recovery probability, with male recovery probability higher than that of females. We found some evidence to suggest that infection probabilities were lower for males than females, but pre-infection mass and temperature were not significant factors. These findings reveal the importance of specific biotic factors that should be evaluated in future field studies of avian disease dynamics.

513 Dionne, Hamilton & Diamond

Relationship between diving ducks and mussel aquaculture in Prince Edward Island. MARK DIONNE, DIANA J. HAMILTON and ANTHONY W. DIAMOND, *Dept. Biol., Univ. New Brunswick, Fredericton, NB and Atlantic Coop. Wildl. Ecol. Res. Network, Univ. New Brunswick.*

Mussel aquaculture on Prince Edward Island started in the 1970s, with rapid expansion occurring in the past decade. In recent years, during migration periods, interactions between diving ducks (mainly Greater Scaup and Long-tailed Duck) and cultivated mussels have increased. Using existing Canadian Wildlife Service duck survey data, I quantified the relationship between ducks and the industry. Diving duck abundance during the fall migration has increased concurrently with mussel landings over the years. Increases in duck numbers took place mainly in areas where mussel aquaculture intensity is high. Greater Scaup did not redistribute, as they were most abundant in those areas prior to the presence of cultivated mussels. On the other hand, historical numbers of Long-tailed Duck were consistent in all areas, suggesting that they redistributed according to the level of mussel aquaculture.

514 Beadell, Gering, Austin, Dumbacher, Peirce, Pratt, Atkinson & Fleischer

Prevalence and differential host-specificity of two avian blood parasite genera in the Australo-Papuan region. JON S. BEADELL, *Smithsonian Inst., Washington, DC*, EBEN GERING, *Pacific Island Ecosys. Res. Center, Hawaii Natl. Park, HI*, JEREMY AUSTIN, *Mus. Victoria, Melbourne, Australia*, JOHN P DUMBACHER, *California Acad. Sci., San Francisco, CA*, MIKE A PEIRCE, *MP International Consultancy, Wokingham, UK*, THANE K PRATT, *CARTER T ATKINSON, Pacific Island Ecosys. Res. Center*, and ROBERT C FLEISCHER, *Smithsonian Inst.*

The degree to which widespread avian blood parasites in the genera *Plasmodium* and *Haemoproteus* pose a threat to novel hosts depends in part on the degree to which they are constrained to a particular host or host family. We examined the host distribution and host-specificity of these parasites in birds from 2 relatively understudied and isolated locations: Australia and Papua New Guinea. Using PCR, we detected infection in 69 of 105 species, representing 44% of individuals surveyed (n = 428). Across host families, prevalence of *Haemoproteus* ranged from 13% (Acanthizidae) to 56% (Petroicidae) while prevalence of *Plasmodium* ranged from 3% (Petroicidae) to 47% (Ptilonorhynchidae). We identified 78 unique parasite mitochondrial lineages out of a total of 165. Related lineages of *Haemoproteus* were more likely to derive from the same host family than predicted by chance within both ecological (avg. LogDet genetic distance = 0, n = 12, P = 0.001) and evolutionary (avg. distance = 0.014, n = 11, P < 0.001) time frames. Within 2 of 3 *Haemoproteus* subclades identified in a maximum likelihood phylogeny, host-specificity was evident up to parasite genetic distances of 0.029 and 0.007 based on logistic regression. We found no significant host relationship among lineages of *Plasmodium* by any method of analysis. These results support previous evidence of strong host-specificity in *Haemoproteus* and suggest that lineages of *Plasmodium* are more likely to form stable associations with novel hosts.

515 Snipes, Nkhoma & Rolf

Ontogenic changes in muscle enzyme activities affect the ontogeny of thermoregulation in neonatal Japanese Quail. KIM V. SNIPES, ELLA T. NKHOMA and ALISON L. ROLF, *Dept. Biol., Austin College, Sherman, TX.*

We used 2 - 14 d Japanese Quail chicks to investigate the ontogenic changes in muscle citrate synthase (CS) and pyruvate kinase (PK) activities. We also measured the ontogenic changes

in maximal oxygen consumption in response to severe cold stress. Pectoral CS activity increased to a peak of 7.1 IU/g on day 10 ($P < 0.05$). By days 8 - 10 the pectoral muscle had surpassed the leg muscles. The activities of CS in the thigh and calf both declined similarly with age ($P > 0.05$). In comparison to PK, CS activity was extremely low and constant. PK activities in both the pectoral and thigh muscles on day 2 were more than twice (26.58 and 34.5 IU/g for pectoral and thigh PK) the maximal CS activity. A sharp rise in PK activity (from 104.1 to 169.3 IU/g) occurred between days 8 and 10 in the pectoral muscles. By day 14 the PK activity was over 210 IU/g. A similar increase happened in the thigh muscle (125.5 IU/g on day 14). Beginning on day 4, maximal mass-specific oxygen consumption increased from 6.1 ml $O_2/g \cdot h$ to a peak of 7.9 ml $O_2/g \cdot h$ on day 8, then stabilized at 6.6 ml $O_2/g \cdot h$ for days 12 - 14. The peak in maximal mass-specific oxygen consumption on day 8 - 10 coincided with an inflection point in thermoregulatory ability. At 10 days of age the quail chicks are beginning to have all the necessary pieces in place for homeothermy: anaerobic capacity for shivering, muscle mass to generate the large amounts of heat, and a body size large enough to retain heat to maintain body temperature.

516 Robinson, Chin, Clark & McGowan

Mouth color correlates in nestling American Crows. DOUGLAS A. ROBINSON, Jr., MIN CHUNG CHIN, ANNE B. CLARK, *Dept. Biol. Sci., Binghamton Univ., Binghamton, NY*, and KEVIN J. MCGOWAN, *Lab. Ornithol., Cornell Univ., Ithaca, NY*.

Variation in the mouth color of nestling birds has been related to hunger state, body temperature, and immunocompetence. We examined mouth color variation with respect to body temperature, ambient temperature, hunger level, and age at banding of pre-fledging nestling American Crows in 2003 and 2004. Tongue and palette color were determined based on a standardized color chart, and examined in relation to cloacal temperature, hunger level (length of time out of nest due to banding procedures) and age (7th primary length). Body temperature was significantly related to nestling age and older nestlings were generally warmer than younger ones at all ambient temperatures. Mouth color saturation was negatively related to nestling age at all ambient temperatures $< 20^\circ C$. Furthermore, there appeared to be no relationship between mouth color and time out of nest. Mouth color of pre-fledging crow nestlings appears to be indicative of nestling age, but not body temperature and hunger state. In late-stage nestlings, other forms of parent-offspring communication (e.g., body posturing), rather than mouth color, might be a better indicator of a nestling's current condition.

517 Wilson & Holberton

Potential consequences of failing to show an adrenocortical response to stress. C. MORGAN WILSON, *Dept. Biol., Hollins Univ., Roanoke, VA*, and REBECCA L. HOLBERTON, *Dept. Biol. Sci., Univ. Maine, Orono, ME*.

An acute increase in plasma corticosterone in response to perturbation may redirect an individual toward immediate, life-sustaining behavioral and physiological responses (e.g., feeding, "escape-like" behaviors, gluconeogenesis, and lipid deposition) until conditions improve. If corticosterone remains chronically elevated, an individual may incur physiological costs (e.g., suppression of immune and reproductive systems, muscle catabolism). However, the benefits and costs of the adrenocortical response have not been extensively documented, and the consequences of not expressing an acute response when challenged have not been explored. To investigate the functional role of the adrenocortical response, we inhibited corticosterone secretion in Dark-eyed Juncos using dexamethasone (DXM) and challenged them to a short-term $20^\circ C$ reduction in temperature. Control birds (saline-injected) showed significantly elevated baseline corticosterone in response to the thermoregulatory challenge, demonstrating that the challenge was sufficient to elicit increased corticosterone secretion. DXM successfully inhibited a similar rise in corticosterone in the experimental birds. Both control and experimental birds showed significant decreases in body mass (% change) and food intake, and significant increases in locomotor activity, as a result of the thermoregulatory challenge. However, corticosterone-inhibited birds showed a significantly greater % decrease in body mass than did control birds, suggesting that the cost of not exhibiting an acute adrenocortical response when faced with an energetic challenge may be the inability to maintain energy reserves, via intermediary metabolism, to the extent that normal birds do.

518 Dufty & Crandall

Corticosterone levels in nestling American Kestrels exposed to adult alarm calls. ALFRED M. DUFTY, Jr., *Dept. Biol., Boise St. Univ., Boise, ID*, and MEREDETH B. CRANDALL, *Dept. Biol., Whitman Coll., Walla Walla, WA*.

Many nestlings respond to alarm calls with anti-predator behaviors, but their physiological responses to such calls are unknown. Alarm calls could stimulate increased secretion of corticosterone, a hormone associated with stress. Many studies use baseline corticosterone levels as an indicator of body condition, and if nestlings respond hormonally when they hear alarm calls rather than when they are first handled by (or catch sight of) an investigator, then determination of baseline hormone levels will be difficult. To investigate this phenomenon we broadcast tapes of either adult conspecific alarm calls or heterospecifics songs to 10 American Kestrel broods (5 experimental, 5 control). Nestlings were 15 - 20 d old and capable of secreting corticosterone. Playbacks were started when adults were absent, but adults returned and produced alarm calls at 2 control nests. Blood was collected from randomly selected nestlings at each nest 10 min after the end of a playback and within 2 min of entry into the nest box, and the plasma was assayed for corticosterone. There was no difference in corticosterone values between nestlings that heard alarm calls and those that heard control vocalizations, nor did hearing natural kestrel alarm calls affect the results. These data indicate that young kestrels do not increase corticosterone secretion in response to adult conspecific alarm calls.

519 Sandercock & Rintoul

Annual survival rates of a migratory population of Grasshopper Sparrows in northeast Kansas. BRETT K. SANDERCOCK and DAVID A. RINTOUL, *Div. Biol., Kansas State Univ., Manhattan, KS*.

Grasshopper Sparrows are a species of conservation concern in many areas of North America for ongoing population declines. Management efforts are hampered by a lack of baseline demographic data for migratory populations in the Great Plains. Few estimates of survival are available, perhaps because Grasshopper Sparrows have low site-fidelity to breeding territories in consecutive years. In this paper, we present mark-recapture data collected over a decade (1994 - 2003) at a MAPS banding station at Ft. Riley military base. In the first 9 yr of the study, we banded a total of 140 juveniles, 88 adult females, 111 adult males and 15 birds of indeterminate age or sex. The proportion of birds that returned was low, only 0.021 of juveniles, 0.034 of adult females and 0.198 of adult males were recaptured in the year after first banding. All of the 3 returning juveniles were recaptured as yearlings. We used mark-recapture statistics and CJS models to analyze adult survival. Apparent survival rates (ϕ) were similar in males (0.413 ± 0.064 SE) and females (0.454 ± 0.160 SE), but the probability of capture (p) was higher in males (0.402 ± 0.101 SE) than females (0.103 ± 0.069 SE). Our estimates of apparent survival are comparable to estimates for other small-bodied birds and also male Grasshopper Sparrows from a sedentary population in Florida (2 sites: 0.482 ± 0.079 SE and 0.533 ± 0.091 SE). Moreover, our estimates of apparent survival > 0.40 demonstrate that migratory Grasshopper Sparrows show greater fidelity to breeding territories than has been previously appreciated.

520 Benson & Metcalf

* Genetic differentiation among Pygmy Nuthatch populations in southern California. THOMAS A. BENSON and ANTHONY E. METCALF, *Dept. Biol., California State Univ., San Bernardino, CA*.

Pygmy Nuthatches (*Sitta pygmaea*) are sedentary songbirds resident in coniferous forest throughout w. North America, and within s. California they generally occur in disjunct populations on mountaintops. In this work we are focusing on broad patterns of genetic differentiation in order to address questions concerning subspecific breaks and the degree of gene flow among populations (i.e., mountain ranges). To that end we are sequencing mitochondrial DNA to characterize the genetic differentiation among subspecies and populations. Initially we are examining an approximately 2700-base pair region of the mitochondrial genome that includes ND6, the tRNAs for threonine, proline, and glutamine, and portions of cytochrome b and the control region. Analysis of 18 individuals from 5 populations has yielded 7 haplotypes. Phylogenetic analyses suggest strong differentiation between Laguna Mountain birds (*S. p. leuconucha*) and San Gabriel and Piute Mountain birds (*S. p. melanotis*), while San Bernardino (*S. p. melanotis*) and San Jacinto Mountain (disputed) birds show intermediate characteristics. Low levels of mean genetic variation across individuals and haplotypes and a high transition to transversion ratio across all individuals suggest that these differences are relatively recent. Future work will include sequencing additional individuals from 12 sampling locations across 8

populations within the study area, followed by population genetic and phylogenetic analysis of sequence data. This research will provide insight into the evolutionary ecology and natural history of the Pygmy Nuthatch, especially regarding the distribution of subspecies and the degree to which gene flow occurs among naturally fragmented populations of a sedentary species.

521 Radomski

Inadequacies of over-wintering population estimates of Double-crested Cormorants from aquaculture production sites and surrounding areas. ANDREW A. RADOMSKI, *USDA, Agri. Res. Serv., Stuttgart, AR.*

Now that the U.S. Fish and Wildlife Service and the Canadian Wildlife Service have national Double-crested Cormorant plans, it is imperative to understand the spatial and temporal population trends. Given that there has been a paucity of rigorous long-term studies on the over wintering numbers of cormorants in the commercial aquaculture producing areas of the se. U.S., understanding these changes will be important to the management strategies, especially at aquaculture facilities. Therefore, within Arkansas, aerial surveys by fixed-wing aircraft will continue to be used to fulfill these needs of monitoring and quantifying the wintering cormorant numbers. Since 1999, cormorant estimates were conducted during the last 3 h of sunlight and encompassed catfish production areas in Arkansas. A minimum of 2 surveys/mon was conducted along a fixed route. Survey flights were usually conducted on consecutive days. Aerial counts were validated with ground observations the following morning at specific roosts for accuracy. A minimum of 16,000 cormorants was observed during each survey, with the exception of early Jan 2000 and 2001. Cormorant numbers peaked (>26,000) in early Feb 2001 and a total of 12 to 15 night roost sites were monitored during 1999 - 2004. Cormorants roosted in bald cypress trees almost exclusively. Some roosts were protected from human disturbances, but some were adjacent to highways or adjacent to high recreational areas.

522 Fleischer, McIntosh & Olson

Systematics of the Hawaiian Thrushes. ROBERT C. FLEISCHER, CARL E. McINTOSH and STORRS L. OLSON, *Natl. Mus. Nat. Hist., Smithsonian Inst., Washington, DC.*

The Hawaiian thrushes include 2 morphologically differentiated lineages that have been allied with the New World genus *Myadestes*. One lineage is represented by taxa (species or subspecies) from 6 of the main islands (Kauai, Oahu, Maui, Molokai, Lanai, and Hawaii) while the second lineage contains a single extant, but endangered, species from Kauai (the Puahiohi, *Myadestes palmeri*). Previous molecular analyses of the extant Omao of Hawaii supported the placement of the Hawaiian thrushes within *Myadestes*. mtDNA analyses of museum specimens of the extinct forms shows that they form a clade with the Omao, but are moderately differentiated from it. Their species level status appears to be supported by the DNA data (in spite of their morphological uniformity). The Puahiohi, while also falling within *Myadestes*, is highly divergent from the Omao lineage, and may represent a separate colonization of the archipelago. We also explore using the Omao lineage for estimating rates of mtDNA sequence divergence.

523 McIntosh, Peer, Olson, Rothstein, Beadell & Fleischer

Genetic differentiation of three Bermuda species of land birds. CARL E. McINTOSH, BRIAN D. PEER, STORRS L. OLSON, STEVEN I. ROTHSTEIN, JON S. BEADELL and ROBERT C. FLEISCHER, *Natl. Mus. Nat. Hist., Smithsonian Inst., Washington, DC.*

Bermudas closest continental landmass is North America with a distance of just over 1,400 km east of North Carolina. The avifauna in Bermuda is depauperate and North American in origin. The species list is composed of indigenous seabirds, an endemic petrel (Cahow, *Pterodroma cahow*), introduced birds (i.e., House Sparrow, Great Kiskadee), migrants from North America and 7 supposedly indigenous land birds (Bangs & Bradlee 1901, *Auk* 18: 249-257). On the basis of morphology, Bangs & Bradlee elevated 4 birds with closely related North American counterparts to full species: Bermuda Ground Dove (*Columbigallina bermudiana*), Bermuda White-eyed Vireo (*Vireo bermudianus*), Bermuda Catbird (*Galeoscoptes bermudianus*) and Bermuda Cardinal (*Cardinalis bermudianus*). We compared levels of genetic differentiation for 3 land birds from Bermuda to their North American counterparts: Northern Cardinal (*Cardinalis cardinalis*), Eastern Bluebird (*Sialia sialis*) and White-eyed Vireo (*Vireo griseus*). For genetic estimates, we sequenced mitochondrial genes. The results of our survey suggest that there is low genetic differentiation between the 3 island taxa and their mainland counterparts. None of the current resident species has yet been found in the abundant Quaternary fossil record of Bermuda. This suggests a very recent colonization with very little

divergence time from their 3 North American founders.

524 Outlaw & Voelker

Systematics and historical biogeography of the *Monticola* Rock-Thrushes (family: Muscicapidae) ROBERT K. OUTLAW and GARY VOELKER, *Dept. Biol., Univ. Memphis, Memphis, TN.*

Monticola is a genus of Old World Thrushes in the avian family Muscicapidae. We reconstructed a molecular phylogeny using approximately 2000 bp of the mitochondrial cytochrome b (cytb) and NADH dehydrogenase subunit 2 (ND2) genes. Preliminary results suggest a Southeastern Palaearctic origin with 2 independent movements into Africa, followed by dispersal to Madagascar. Using a molecular clock based on cyt-b data, we were able to date these movements. *Monticola pretoriae* is currently considered a subspecies of *M. brevipes* (*sensu* Sibley & Monroe 1990, **Distribution & taxonomy**, Yale), yet our reconstructions indicate that it may in fact be a distinct species. *M. pretoriae* and *M. brevipes* occupy different habitats in overlapping ranges suggesting current ecological speciation in the absence of vicariant barriers. *M. explorator* occupies a distinct habitat with its range contiguous with *M. brevipes* and *M. pretoriae* indicating that this ecological mode of speciation may have occurred several different times within the genus. Consistent with previous findings, our results indicate that *Pseudocossyphus* is not a valid genus as it forms a well supported clade within *Monticola*. These findings may call for possible taxonomic revision of the genus *Monticola*.

525 Carson & Spicer

Phylogenetic relationships among emberizids inferred by mitochondrial genomes. REBECCA J. CARSON and GREG S. SPICER, *Dept. Biol., San Francisco State Univ., San Francisco, CA.*

We have sequenced the entire mitochondrial genome of 18 species of emberizids and finches: *Vermivora celata*, *Oporornis tolmiei*, *Dendroica coronata*, *Piranga ludoviciana*, *Thraupis episcopus*, *Pipilo maculatus*, *Spizella atrogularis*, *Melospiza melodia*, *Zonotrichia leucophrys*, *Junco hyemalis*, *Pheucticus melanocephalus*, *Cardinalis cardinalis*, *Passerina amoena*, *Sturnella neglecta*, *Agelaius phoeniceus*, *Icterus bullockii*, *Carpodacus mexicanus*, and *Carduelis tristis*. The purpose of our study is to examine the phylogenetic relationships among the major groups in the family Emberizidae. The relationships among the tanagers, sparrows, warblers, buntings, blackbirds and the finches have not been fully resolved. By examining the entire mitochondrial genome, instead of a few select genes, we hope to obtain a better understanding of their phylogenetic relationships.

526 Vazquez-Miranda

Biogeography of West Indian birds: an approach using Parsimony Analysis of Endemicity. HERNAN VAZQUEZ-MIRANDA, *Mus. Zool Fac. Cienc., Universidad Nacional Autónoma de México, México D.F., México.*

The aim of this study was to obtain biogeographical patterns based on the distribution of land birds of the West Indies and the Caribbean. Records for 695 genera and 2026 species were retrieved from the literature on 56 islands of the Caribbean basin. Galapagos and Bermuda were included as outgroups, also all Central American countries, Venezuela and Yucatan. A Parsimony Analysis of Endemicity (PAE) was performed to find biogeographical patterns. Resulting trees were rerooted with the resultant extant outgroup of the initial analysis (Galapagos Islands). Extant outgroup option for retrieving cladograms was preferred over hypothetical, for better adjustment to cladistic methodologies. Two island groupings were revealed: 1) North America-Bahamas, Florida, Bermuda, Greater and Lesser Antilles, Virgin Islands, Cayman Islands, Saint Andrew, Old Providence, Central America, Yucatan and Cozumel; and 2) South America-Venezuela, Trinidad, Tobago, Dutch Antilles and Margarita Island. Island groupings are congruent with Rosen's geological and biogeographical models, Bond's conclusions and on a very general scale they are also congruent with several phylogenies published to date, meaning West Indian and Caribbean land bird fauna appear to respond to vicariant processes, although particular distribution of some taxa can only be explained through dispersal.

527 Jablonski, Barrowclough & Groth

Genetic population structure and species limits in the Tepui Brush-Finch (*Atlapetes personatus*). BARTEK JABLONSKI, GEORGE F. BARROWCLOUGH and JEFF G. GROTH, *Dept. Ornithology, Am. Mus. Nat. Hist., New York, NY.*

We investigated gene flow, genetic population structure, and species limits in the *Atlapetes personatus* complex of s. Venezuela. DNA sequences of the complete mitochondrial ND3, ND4L, and

ND4 genes confirmed the existence of 3 reciprocally monophyletic lineages that correspond to allopatric regional forms with distinct plumages. There was no evidence for any recent gene flow among these regions, suggesting that the lineages should be treated as species-level taxa. Genetic structure among populations within regions was modest. The recognition of poorly-differentiated subspecies of these birds in the past obscured both species limits and important biogeographic implications.

528 Galloni D'Istria & Cibois

Molecular phylogeny and biogeography of African babblers of the genus *Illadopsis*. CLAIRE GALLONI D'ISTRIA, *Univ. Geneva, Switzerland*, and ALICE CIBOIS, *Nat. Hist. Mus., Geneva, Switzerland*.

Tropical forest ecosystems are credited with containing unparalleled biodiversity but unfortunately are increasingly threatened by human activities. Conservation policies are focussing on maintaining patterns of species richness and endemism, but a broader perspective is capital for understanding the evolution of these ecosystems. In this context, passerine birds of tropical forest, particularly from Africa, have been recently the focus of several phylogeographic studies. Because comparison between independent lineages are warranted to infer general patterns of evolution, it is important to conduct phylogenetic analyses on groups sharing similar geographic distributions. This study focuses on tropical African passerines, the illadopsises (genus *Illadopsis*), which belong to the large babbler family (Timaliidae). These little brown passerines are secretive forest-dwellers that forage generally in the undergrowths or on the ground. The distribution of most taxa is centred on western and central Africa with several widespread species. Previous molecular studies on babblers suggested that illadopsises belong to a clade that includes several Asian babblers (jungle and "wren-like" babblers). We used mitochondrial markers to infer the phylogeny of all species of *Illadopsis* (7 taxa) and of most subspecies. Results support the monophyly of the genus but also suggest that some traditionally defined species do not form monophyletic units. Biogeographic information derived from the analysis of these molecular markers are then compared to results from other African passerines inhabiting tropical forested areas.

529 Feinstein, Yang & Li

Molecular systematics and historical biogeography of the Black-browed Barbet species complex (*Megalaima oorti*, S. Muller 1835). JULIE FEINSTEIN, *Ambrose Monell Collection Molec. & Microbial Res., Am. Mus. Nat. Hist., New York, NY*, XIAOJUN YANG, *Kunming Inst. Zool., China Acad. Sci., Kunming, China*, and SHOU-HSIEN LI, *Dept. Life Sci., Natl. Taiwan Normal Univ., Taipei, Taiwan*.

Five allopatric subspecies of the Black-browed Barbet, *Megalaima oorti*, are recognized. *M. o. oorti* is found on the Malay Peninsula and in Sumatra, *M. o. annamensis* in Indochina, *M. o. faber* on Hainan Island, *M. o. sini* in se. China, and *M. o. nuchalis* on Taiwan Island. Plumage patterns suggest 3 distinct subspecies groups (Goodwin 1964, *Ibis* 106: 198-219; Short & Horne 2001, **Toucans, barbets & honeyguides**, Oxford) the *oorti/annamensis* group including *M. o. oorti* and *M. o. annamensis*, the *faber/sini* group comprised by *M. o. faber* and *M. o. sini*, and the *nuchalis* group for *M. o. nuchalis*. We sequenced entire cytochrome b genes, mostly from DNA extracted from museum study skin specimens ranging in age from 69 to 99 yr old. Genetic distances between the subspecies ranged from 0.7% between *M. o. faber* and *M. o. sini* to 6.8% between *M. o. oorti* and *M. o. nuchalis*. Maximum parsimony, maximum likelihood, and Bayesian analysis were used to infer the phylogenetic relationship of these barbets. We found 4 deeply diverged groups with significant geographic associations, namely *M. o. oorti*, *M. o. annamensis*, *M. o. faber/M. o. sini*, and *M. o. nuchalis*. The deepest split is between the se. Asian taxa, *M. o. oorti* and *M. o. annamensis* (*oorti/annamensis* clade) and the eastern Asian taxa, *M. o. faber*, *M. o. sini* and *M. o. nuchalis*. Moreover, the molecular phylogeny suggests that *M. oorti* is a polyphyletic species. *M. asiatica* was found to be the sister taxon of *M. o. annamensis* within the *oorti/annamensis* clade. This phylogeny was applied to infer how geological events since the Pliocene might have shaped the diversification of this species complex.

530 Feinstein & Corthals

The Ambrose Monell Cryo Collection at the American Museum of Natural History: archiving genetic resources. JULIE FEINSTEIN and ANGELIQUE CORTHALS, *Ambrose Monell Collection Molec. & Microbial Res., Am. Mus. Nat. Hist., New York, NY*.

In a time of massive species loss, natural history museums are poised at the forefront of biodiversity information access, especially concerning biomaterial collections used in modern genetic, genomic and taxonomic studies. The utility of molecular techniques in the resolution of taxonomic

issues has been widely confirmed. A tremendous increase in number and size of frozen tissue collections warrants the establishment of centralized repositories with vigilant quality control, computerized sample tracking, and a commitment to archiving biomaterials in perpetuity. The American Museum of Natural History (AMNH) launched the Ambrose Monell Collection to help meet the demand for properly documented frozen tissue specimens. The Collection maintains specimens in an array of liquid nitrogen cooled vats at temperatures below -150°C. Tissues are archived at the coldest practical temperatures to ensure optimal preservation of macromolecules, as the long-term use of our genetic resources is undefined. The collection provides archiving services and loans of material to researchers free of charge. Scientists using the Monell Collection have access to legally collected, authoritatively identified and properly documented specimens for use in their research complete with AMNH catalogue numbers to reference in publications. The broad scope of the Monell Collection addresses an under-served niche within the cryogenic bio-repository community by attempting to catalog all biodiversity at the molecular genetic level. We are further distinguished from other repositories because we exist within the framework of the AMNH, where tissue samples can be referenced with documented collecting events involving traditional voucher specimens and associated data. Here, modern bioinformatics initiatives will ultimately link collections with taxonomic determinations, bibliographic citations, geospatial referencing information, genetic data, digital images and photographs.

531 Schikler, Marchese, Moyle & Cracraft

Phylogeny of the Furnarii using nuclear DNA sequence data. PETER A. SCHIKLER, DANIEL J. MARCHESE, ROBERT G. MOYLE and JOEL CRACRAFT, *Dept. Ornith., Am. Mus. Nat. Hist., New York, NY.*

We compared DNA sequences from the nuclear RAG-1 and RAG-2 genes to develop a phylogenetic hypothesis for the Furnarii. The data matrix included over 4000 bases/individual and 128 of 139 genera representing all families (Furnariidae, Dendrocolaptidae, Thamnophilidae, Formicariidae, Conopophagidae, and Rhinocryptidae). Parsimony and model-based analytical methods produced highly congruent results, namely strong support for most basal and distal nodes on the tree, but a lack of resolution in some medial regions. We recovered support for the basal position of the typical antbirds (Thamnophilidae) and Crescent-chests (*Melanopareia*), as well as polyphyly of the ground-antbirds (Formicariidae), ovenbirds (Furnariidae), and several proposed subfamily divisions.

532 Humphries, Peters, Omland & Jonsson

Phylogeography and phylogenetics of the white goose complex. ELIZABETH M. HUMPHRIES, JEFFERY L. PETERS, KEVIN E. OMLAND, *Dept. Biol. Sci., Univ. Maryland Baltimore Co., Baltimore, MD*, and JON E. JONSSON, *Louisiana Wildl. & Fish. Coop. Res. Unit, School For., Wildl. & Fish., Louisiana State University, Baton Rouge, LA.*

The white goose complex of North America presents one of the most complicated and intriguing genetic problems in ornithology today. This complex consists of 3 taxa, the Ross's Goose (*Chen rossii*), the Lesser Snow Goose (*C. caerulescens caerulescens*) and the Greater Snow Goose (*C. c. atlantica*). Previous genetic studies of this complex have shown 2 highly divergent lineages in mitochondrial DNA present in all 3 taxa. Two hypotheses have been proposed to account for this lineage sharing - ancestral polymorphism and hybridization. We further examined these hypotheses by sequencing 658 base pairs of the mitochondrial DNA control region from 10 to 40 individuals of the 3 taxa. A widespread common haplotype with a central position in the haplotype network was shared by all 3 taxa. This pattern is consistent with ancestral polymorphism. However, several rare haplotypes were also shared among taxa, perhaps suggesting the influence of hybridization. More sophisticated coalescent-based methods of inference and analysis of nuclear loci are needed to better elucidate the complex phylogenetic and phylogeographic history of the White Geese.

533 Mertz, Barrowclough & Groth

The phylogeny of owls and the position of *Xenoglaux*. LISA A. MERTZ, GEORGE F. BARROWCLOUGH and JEFF G. GROTH, *Dept. Ornithology, Am. Mus. Nat. Hist., New York, NY.*

We used DNA sequences from the nuclear RAG-1 exon to investigate the evolutionary relationships among most of the genera of owls. The traditional Strigidae and Tytonidae were reciprocally monophyletic. Within the Strigidae, we found 3 major clades of owls: 1) a clade consisting solely of members of the Austral-Asian genus *Ninox*, 2) a worldwide clade of small owls including *Aegolius*, *Athene*, and *Glaucidium*, and 3) a very large cosmopolitan clade of all other owls,

e.g., *Asio*, *Bubo*, *Otus*, *Strix*, etc. The enigmatic *Xenoglaux*, known only from a couple of cloud-forest localities in the Peruvian Andes, was found to be sister to the desert-dwelling Elf Owl (*Micrathene*) within the clade of small owls.

534 Calmé

The forgotten Maya idol: update on the Ocellated Turkey. SOPHIE CALMÉ, *División Conservación de la Biodiversidad, El Colegio de la Frontera Sur, Chetumal, Quintana Roo, Mexico.*

Few attention has been paid to the only other turkey, the Ocellated Turkey. It seems paradoxical when, contrary to its cousin, populations are apparently declining over most of its range. During the past 5 yr, I have tried to understand: 1) Where and why populations are changing, 2) How does the species adapt its diet in the context of habitat disturbance, 3) What vegetation type do they prefer, 4) How do they use forest roads and trails. The species' range has been contracting during the past 3 decades, but it mainly disappeared from its periphery, though coastal populations are still found in the state of Yucatán, Mexico. Everywhere except in biosphere or private reserves, the species is heavily hunted. When habitat is disturbed, the Ocellated Turkey switches its diet from fruits of trees typical of mature forest to herbs or cultivated maize. However, when available in the landscape mosaic, it prefers patches of mature medium-height forest where it spends most of the time during the non-reproductive season. On the other hand, while it prefers mature forest, the Ocellated Turkey largely takes advantage of forest roads and trails. These roads and trails are mainly used to walk, display, dry and groom feathers, and gather. Other activities such as bathing, or scratching the forest floor for food are done within the forest. I conclude so far that the main reasons for the waning of the Ocellated Turkey are traditional – non- regulated – hunting and deforestation.

535 Lein

Song variation among individual Buff-breasted Flycatchers: patterns and a comparison of techniques. M. ROSS LEIN, *Dept. Biol. Sci., Univ. Calgary, Calgary, AB.*

We know little about the extent of individual song variation in tyrant flycatchers (Tyrannidae) and other suboscine passerines. Their presumably innate songs tend to be rather simple in structure and demonstrate less variation than the more elaborate songs of many oscine passerines. However, understanding this variation is important for the explanation of the function of songs in suboscines, and for the explanation of the evolution of song learning in the oscines. I examined song variation within and among individual Buff-breasted Flycatchers recorded in the Chiricahua and Huachuca Mountains of Arizona in 1999. I used both discriminant function analysis (DFA) of temporal and frequency measurements and spectral cross correlation (SCC) of entire songs: (1) to determine whether songs were individually-distinctive; (2) to determine whether songs differed between the 2 localities; and (3) to evaluate the effectiveness of the 2 techniques. Both techniques indicated high levels of distinctiveness in songs of individuals. DFA indicated significant differences in songs between the 2 localities. SCC was more effective than DFA in discriminating songs recorded from different individuals. It has the potential to be used to assign unknown recordings to known individuals and, in contrast to DFA, to detect “new” individuals not included in the reference sample.

536 Lovell & Lein

* Geographic variation in the songs of a suboscine, the Alder Flycatcher. SCOTT F. LOVELL and M. ROSS LEIN, *Dept. Biol. Sci., Univ. Calgary, Calgary, AB.*

The well-documented geographic variation in songs of oscine passerines is largely a consequence of the vocal learning which characterizes song development in this group. There is no definitive evidence for song learning in suboscine passerines, and the amount of variation exhibited in their song structure is less than most oscines. Previous attempts to characterize geographic variation in the songs of suboscines has met with little success. However, these studies were hampered by small sample sizes and by a lack of quantitative analyses. To address the question of geographic variation in songs of suboscines at the species level, we examined ‘fee-bee-o’ songs of Alder Flycatchers from 6 geographic regions (Alberta, Alaska, Maine, Michigan, New York, and Ontario). We measured temporal and frequency variables using SIGNAL bioacoustical analysis software and conducted univariate and multivariate statistical analyses to characterize variation among regions. We found sufficient variation among geographic regions to identify them statistically. Discriminant function analysis (DFA) classified 60% of the songs to the correct geographic region. Cluster analysis grouped most individuals from the same geographic region together. However, individuals from Alberta and Maine had similar song characteristics and DFA assigned 50% of the individuals from Maine to

Alberta. This study while exploratory in nature, represents the first quantitative study of geographic variation in a suboscine and demonstrates that geographic variation occurs in the songs of suboscines, although not the extent observed in the songs of oscines.

537 Liu, Gardner & Nottebohm

Multiple vocal learning strategies in male Zebra Finches. WAN-CHUN LIU, TIMOTHY J. GARDNER and FERNANDO NOTTEBOHM, *Field Res. Center, Rockefeller Univ., Millbrook, NY.*

Humans and songbirds imitate the sounds of other individuals of their same kind. In human infants this is an active, problem-solving process that employs a variety of strategies to imitate words. Here we report that juvenile male Zebra Finches too can use an array of strategies to imitate a same song and do so in a manner that is sensitive to social setting. In clutches with several males, the strategy of the sibling that starts to sing first is often different from that of the sibling that starts next. Each juvenile seems to avoid the solutions worked out by its brothers and males reared singly do not prefer a particular strategy. None of the strategies encountered so far is noticeably faster in achieving model imitation. For reasons that may be central to vocal learning, in neither finches nor humans is vocal ontogeny a mere unfolding of a preset plan.

538 Mackin

Variation in vocalizations of Audubon's Shearwaters: possibilities for individual recognition and signals of condition. WILLIAM A. MACKIN, *Biol. Dept., Univ. North Carolina-Chapel Hill, Chapel Hill, NC.*

Many animals can use acoustic signals to recognize conspecifics or to obtain information about the condition of the signaler. I examined whether a single signal can be used both for individual recognition and as a signal of condition. I used ANOVA to partition the variance within and among 15 male Audubon's Shearwaters that were each recorded on at least 2 different nights. The calls consisted of alternating inhaling and exhaling components, the durations of which varied much more among than within individuals. There were significant differences within individuals when calling in different contexts, years, and nights within the same year, and measures of frequency changed more within individuals than measures of timing. The total information for individual recognition in the calls was 1.9 to 2.7 bits (binary discriminations). Each bit provides space for 2 individuals to be distinguished by an ideal receiver with an average error of 38%. These results corroborate the results of Linear Discriminant Analyses, which correctly identified 100% of training calls and only 35% of calls from different nights. The loudest, highest frequency exhaling segments were shorter in duration than those that were lower in amplitude and frequency. Since timing features, particularly the length that an individual inhales, are stable within individuals, receivers could gain information about an individual's condition from his ability to produce loud, high frequency notes with a given amount of inhaled air. More investigations are needed to determine if this trade-off is used to evaluate a signaler's condition.

539 Hannam

House Wren begging calls: are individuals or broods distinct? KRISTINA HANNAM, *Biol. Dept., State Univ. New York-Geneseo, Geneseo, NY.*

Individual differences in species, sex, age and condition can often be recognized through vocal differences in birds. Vocal differences among offspring in a nest or during the post-fledging period could be an important cue used by parent birds to determine how to allocate limited resources. It may be important, for example, for parents to be able to distinguish between related and unrelated nestlings or fledglings when allocating food resources. The begging calls of individual House Wren nestlings on nestling day 10 were recorded and examined for differences. Begging calls were analyzed using the Canary sound analysis program. We measured the duration of each call, range of frequencies, the average intensity, and the peak frequency on sonograms of 6-10 calls from each individual. Preliminary data from 2003 suggest broods may differ in measures of duration, high frequency, and peak frequency by nestling day 10. We will report results from additional data collected in 2004 on individual and brood differences in begging calls in a New York population of House Wrens.

540 McLellan & Shutler

Do Ring-billed Gulls use the marine environment to feed their young? NIC R. McLELLAN and DAVE SHUTLER, *Dept. Biol., Acadia Univ., Wolfville, NS.*

Ring-billed Gulls were historically an inland/fresh water species. Their population boomed in the 1960s and 1970s during which the species expanded its range east into the Maritime Provinces.

Breeding colonies now exist in all of Atlantic Canada except Nova Scotia. Over the last 15 - 20 yr, their numbers in the Maritimes have more than doubled, while populations of other gull species have declined. The feeding ecology of this species, when nesting in a marine environment, is unknown. We studied a colony of Ring-billed Gulls on Prince Edward Island where they nest among both Herring Gulls and Great Black-backed Gulls, species known to capitalize on marine food sources. Regurgitants from Ring-billed Gull chicks were collected and analyzed for content. Blood samples were taken from chicks of the 3 gull species. Stable isotope analysis for carbon and nitrogen was conducted on the regurgitants and blood to determine whether Ring-billed Gulls were using marine food sources to feed their young.

541 Cohen & Lindell

White-throated Robin area and habitat use in a mixed agricultural landscape in Costa Rica. EMILY B COHEN and CATHERINE A LINDELL, *Dept. Zool., Michigan State Univ., East Lansing, MI.*

Most work on the effects of land-cover change on tropical birds has focused on forest-interior birds because these species are assumed to be the most severely affected by forest loss. However, species that use a number of habitat types may also require some threshold level of forest. White-throated Robins (*Turdus assimilis*) frequently nest in coffee and pasture in southern Costa Rica, although several lines of evidence suggest the species could not exist solely in agricultural habitat. We examined the size and composition of adult White-throated Robin home ranges using radio-telemetry in 2000. 29 robins were radio-tagged, and home ranges were constructed for the 10 birds that were located most frequently. We calculated the proportions of different land-cover types within each home range by clipping polygons from a classified image. Mean home range size was $0.26 \text{ km}^2 \pm 0.17 \text{ SD}$ and varied from 0.07 km^2 to 0.58 km^2 ($n = 10$). All home ranges contained forest, pasture, and coffee or regenerating forest. Forest comprised 16 to 68% of each home range. The percentages of habitat types within the home ranges was fairly evenly distributed with means of $30.0\% \pm 14.2 \text{ SD}$ forest, $32.5\% \pm 10.6 \text{ SD}$ pasture, and $37.5\% \pm 14.8 \text{ SD}$ coffee. Our results suggest that even tropical bird species that are able to use a range of habitat types may require some threshold level of forest. Further information is needed about how avian species use and survive in different habitat types.

542 Olson & Lindsay

Evaluation of systematic conservation reserve networks in the face of climate change. LEIF OLSON and KATHRYN LINDSAY, *Dept. Biol., Carleton Univ., Ottawa, ON.*

Using breeding bird survey (BBS) distribution data for 150 bird species in the conterminous U.S. east of the 100th parallel, we design a complementary reserve network using irreplaceability analysis. We evaluate the effectiveness of this reserve design given predicted changes in bird distributions under climate change suggested by the Canadian Climate Centre and Hadley Center for Climate Prediction and Research general circulation models. We find that the reserve network does not provide comprehensive protection to the future species sets, and select additional reserve sites to complement the existing design. The appended reserve set contains some sites in the initial reserve network that are unnecessary for complete protection of the predicted future species sets. This technique allows flexible adaptive management of conservation reserve networks, and highlights the potential impact of climate change on conservation.

543 Lindsay, Tischendorf, Olson, Hansen, Bishop & Prior

Delineating critical habitat under the new Species at Risk Act in Canada. KATHRYN LINDSAY, *Natl. Wildl. Res. Centre, Canadian Wildl. Serv., Ottawa, ON*, LUTZ TISCHENDORF, *Elutis Modelling & Consulting, Ottawa, ON*, DOUG OLSON, *Medina Hansen, Olson+Olson Planning & Design Consultants, Calgary, AB*, CHRISTINE BISHOP, *Canadian Wildl. Serv.-Pacific & Yukon Region, Delta, BC*, and KENT PRIOR, *Endangered Species Conserv., Canadian Wildl. Serv., Gatineau, QC.*

This poster will illustrate a series of pilot studies to produce and promote robust, state-of-the-art methods for delineating critical habitat as required under the new Species At Risk Act (SARA) in Canada. Six endangered or threatened species for which designation and mapping of critical habitat in their breeding range has been identified as a Recovery Strategy priority (Yellow-breasted Chat, Banff springs snail, Whooping Crane, Acadian Flycatcher, Hooded Warbler, Prothonotary Warbler) were selected to represent different taxa (birds, molluscs), habitat types (wetlands, forest, riparian scrub), terrestrial ecoregions (Lake Erie Lowland Mixed-Wood Plains, Slave River Lowland Boreal Plains, Eastern Continental Montane Cordillera, Thompson-Okanagan Plateau Montane Cordillera) and lead federal departments (Environment Canada, Parks Canada). Habitat suitability mapping, spatially-

explicit population viability modeling and socio-economic considerations were developed in consultation with Species Recovery Teams to produce critical habitat maps for the target species. Results for the Yellow-breasted Chat in the south Okanagan region of British Columbia will be used to illustrate the approach.

544 Weir & Schluter

Ice sheets promote speciation in boreal birds. JASON T. WEIR and DOLPH SCHLUTER, *Dept. Zool. Univ. British Columbia, Vancouver, BC.*

The premise that Pleistocene ice ages played an important role in generating present day terrestrial species diversity has been challenged by genetic data indicating that most of the youngest species coalesce long before major glacial advances. However, study has been biased toward faunas distributed at low latitudes that were not directly fragmented by advancing ice sheets. Using mitochondrial sequence divergence and a molecular clock we compared the coalescent times between 15 pairs of species belonging to superspecies complexes from the high latitude boreal forest avifauna with sister-species pairs from subboreal and tropical avifaunas of the New World. Low levels of sequence divergence suggest that all coalescent events in boreal superspecies date to the Pleistocene and provides direct evidence that speciation was commonly initiated and completed during recent glacial periods. A pattern of endemism shared by most boreal superspecies further links timing of divergence to the fragmentation of the boreal forest by ice sheets during the mid- and late Pleistocene. In contrast to the boreal zone, only 56% of sub-boreal and 46% of tropical superspecies members coalesced during the Pleistocene suggesting that avifaunas directly fragmented by ice sheets experienced rapid rates of diversification while those distributed further south were impacted to a lesser extent. The absence of pre-Pleistocene superspecies in boreal avifaunas suggests that strong selection pressures operated in boreal refugia causing superspecies members to achieve ecological differentiation at an accelerated rate.

545 Morissette, Butterworth, Hobson, VanWilgenburg & Bayne

Cumulative effects of human activity on wetland-associated birds in the boreal forest. JULIENNE MORISSETTE, ERIC BUTTERWORTH, *Ducks Unlimited Canada-Western Boreal Prog., Edmonton, AB*, KEITH HOBSON, STEVE VanWILGENBURG, *Canadian Wildl. Serv., Univ. Saskatchewan, Saskatoon, SK*, and ERIN BAYNE *Univ. Alberta, Edmonton, AB.*

Given the potential importance of boreal wetlands to various species, particularly birds, it is important that we understand how the cumulative effects of different human activities on the landscape might be affecting these systems. Although there has been little industrial development directly around most Alberta boreal wetlands, there has been a dramatic increase in forestry and energy sector development in the surrounding landscape. In contrast to industrial development, agricultural conversion has dramatically changed the landscape matrix around many Alberta boreal wetlands. We calculated total area of human disturbance (e.g., roads, harvesting, oil and gas, agriculture) in 5 x 5 km areas using existing spatial data sets. 5 ponds (1 - 25 ha) in each of 32 blocks were randomly selected. The bird community was surveyed using a combination of point counts and playback techniques. Our preliminary results suggest that human disturbance is altering the structure of boreal wetland bird communities by shifting them towards communities more typical of aspen parkland regions. For example, the abundance of the Brown-headed Cowbird, Mallard, and Common Yellowthroat increased with increasing human disturbance. In contrast, the abundance of Common Loon and Ring-necked Duck decreased with higher levels of cumulative effects. Ongoing research will identify whether these changes occur as a slow incremental process or whether there are distinct thresholds in cumulative effects that rapidly shift the natural state of boreal wetlands to a new domain.

546 Morissette, Hobson & VanWilgenburg

What is a riparian bird? JULIENNE MORISSETTE, *Ducks Unlimited Canada, Edmonton, AB*, KEITH HOBSON and STEVE VanWILGENBURG, *Canadian Wildl. Serv., Edmonton, AB.*

The definition of riparian bird is actually more elusive than it would seem. Riparian bird studies have typically involved evaluating the utility of buffer strips in maintaining bird communities along watercourses. Many of these studies have focused the impact of harvesting buffer areas on upland birds particularly interior forest species. Is it enough to use upland forest near water for a species to be considered a riparian bird? Using a survey method that combines playbacks, point counts and transects we surveyed boreal riparian areas in both Manitoba and Alberta. Together these methods allowed us to attribute birds to specific habitat types (e.g., upland deciduous, tall shrub). In

addition, we surveyed mature deciduous forest in upland transects to evaluate whether proximity to water and edge features play a role in structuring the forest bird community. We will present data that examine these specific habitat associations to shed light on the question "what is a riparian bird?"

547 Audet, Gauthier & Lévesque

Feeding ecology of Greater Snow Goose (*Chen caerulescens atlantica*) goslings in upland tundra on Bylot Island, Nunavut. BENOIT AUDET, GILLES GAUTHIER, *Dept. Biol., and Centre d'études nordiques, Univ. Laval, Québec, QC*, and ESTHER LÉVESQUE, *Dept. Chimie-Biol., Univ. du Québec à Trois-Rivières, Trois-Rivières, QC, and Centre d'études nordiques, Univ. Laval.*

Although geese prefer wetland habitats during brood-rearing, a significant amount of feeding also occurs in uplands where their feeding ecology has been little studied. We assessed the diet of Greater Snow Goose goslings in upland tundra using observations on wild goslings (oesophagi contents) and on captive, human-imprinted goslings (feeding trials) on Bylot Island, Nunavut. We examined the oesophagi content of 67 goslings and conducted feeding trials with 16 captive goslings 5 times during the summer (9 Jul to 17 Aug) in 3 types of upland plant communities. A total of 35 vascular plant species were found in the goslings' diet; about 75% of the items were leaves and the rest was mostly flowers. Gramineae were the main food item (48% for captive and 53% for wild goslings) with *Arctagrostis latifolia* being the main species. Captive goslings also consumed many Leguminosae in communities where those plants were abundant (39%). Juncaceae (captive 18%, wild 8%), Polygonaceae (captive 4%, wild 16%), Caryophyllaceae and Cruciferae (<5% each) were also eaten. We also found seasonal variations in the diet; goslings consumed 5 times more Gramineae in late summer compared to early in the season and the number of plant taxa eaten decreased over time, presumably because goslings gained experience.

548 Schieck & Bayne

Information pyramids as a method to describe changes in biodiversity. JIM SCHIECK, *Integrated Res. Manag., Alberta Res. Council, Vegreville, AB*, and ERIN BAYNE, *Dept. Biol., Univ. Alberta, Edmonton, AB.*

During the last 6 yr government, industries, and academia in Alberta have developed the Alberta Biodiversity Monitoring Program (ABMP). This program is based on a systematic grid of approximately 1650 sites. Field protocols for sampling birds, plus many other terrestrial biota (vascular plants, mosses, lichens, fungi, springtails, and mammals), aquatic biota (benthic invertebrates, dragonflies/damselflies, zooplankton, amphibians, and fish), terrestrial and aquatic habitats, and remote sensing to describe landscape patterns and human development have been developed (<http://www.abmp.arc.ab.ca>). As a pilot project, data are being collected at approximately 150 sites during 2003 - 2006. These data will be used to develop a pyramid of biodiversity metrics. The pyramid will provide an overall measure of biodiversity, while also providing information about specific segments of biodiversity. At its base, the pyramid will present information on the relative abundance of each species. At level 2, guilds of species are created within families/orders, and multi-metric indices describing these guilds are compared to indices created within in reference areas. At level 3, multi-metric indices describing guilds are averaged separately for terrestrial and aquatic families/orders. Finally, at level 4, multi-metric indices are averaged between terrestrial and aquatic biota. This pyramid approach to describing biodiversity will facilitate comparison of multiple levels of biodiversity among regions, and detection of broad regional changes in biodiversity over time. Within the ABMP changes in biodiversity will be related to changes in human land use in the region.

549 Johnson, Hicks, Wimmers, Masters, Milkie, Molinaro & Gallagher

Offspring sex vs. position in the laying sequence in clutches of Wyoming House Wrens: a second look. L. S. JOHNSON, B. G. HICKS, L. E. WIMMERS, B. S. MASTERS, R. C. MILKIE, R. L. MOLINARO and B. S. GALLAGHER, *Dept. Biol., Towson Univ., Towson, MD.*

Most reports of adaptive manipulation of offspring sex come from 1 yr studies involving small sample sizes. As such, calls have gone out for a repeat of studies over multiple years to confirm positive results. In a study of a Wyoming population of House Wrens, Albrecht (2000, *Anim. Behav.* 59: 1227-1234) asked whether embryos from last-laid eggs in clutches were typically female. Last-laid eggs hatch 36 - 48 h after most other eggs. This puts offspring from last-laid eggs at a competitive disadvantage. Consequently, such offspring are often undersized and/or in poor condition at fledging. Because of intense competition for nest cavities, being undersized or in poor condition should negatively impact male fitness more than female fitness. As he predicted, Albrecht found a strong

female bias among offspring from last-laid eggs (27 of 34 individuals) during the 1997 breeding season. We repeated Albrecht's study using the same study population in 2002 and 2003. We found no sex bias among offspring from last-laid eggs (30 of 61 individuals were female). We also found no sex bias among offspring from penultimate eggs (which also hatch late) or offspring from first- or second-laid eggs. Why our findings differ from the original study is unclear but we argue that whether Wyoming House Wrens adaptively manipulate the sex of offspring within broods must again be considered an open question.

550 Causey, Edwards & Trimble

The ornithology collections at the Museum of Comparative Zoology, Harvard University. D. CAUSEY, S. V. EDWARDS and J. R. TRIMBLE, *Mus. Comp. Zool., Harvard Univ., Cambridge, MA.*

One of the first acquisitions recorded in the MCZ bird catalog was a series of 25 specimens purchased by Louis Agassiz at the Boston Market in the winter of 1846. From this inauspicious beginning, the early curators including J. A. Allen, William Brewster and Outram Bangs, made extensive collections of birds throughout the continental U.S. (New England in particular), and South America. At the same time, these and most of the subsequent curators actively acquired other existing collections of North and South American birds made in the early 19th century including those by made by Alexander Wilson, Lafresnaye and d'Orbigny, and Greene Smith. The latter collector was one of the first preparators of birds for the newly formed Smithsonian Institution. His large collection of birds include some of the first documented records from New England and Ohio Valley, primarily before the Civil War. The present holdings include about 350,000 skins and specimens (~8,100 species); 40,000 nest and egg sets; and about 2,400 type specimens or about 5% of the world's holdings. We are actively importing data into our online database (<http://www.mcz.harvard.edu/Departments/Ornithology>), primarily of skin specimens, and we plan soon to link images of specimens, labels, and other metadata with record data.

551 Aldabe

Morphological adaptations for terrestrial habits of the Scimitar-billed Woodcreeper (*Drymornis bridgesii*). JOAQUIN ALDABE, *Div. Birds, Smithsonian Inst., Washington, DC, and Facultad de Ciencias de la Universidad de la Republica Oriental del Uruguay, Laboratorio de Evolucion, Montevideo, Uruguay.*

Woodcreepers are arboreal birds that forage almost entirely by gleaning and probing along trunks and branches. However there is one species, the Scimitar-billed Woodcreeper (*Drymornis bridgesii*) of the south-central South America region that forages mainly on the ground where it feeds by probing loose soil with its long bill. Osteological characters, claw morphology, and tail feathers were examined and compared with other species within the woodcreeper clade that have arboreal feeding habits. The results show that *Drymornis* has clear anatomical modifications that support the ground foraging habits which characterize this species. This study also suggests that some of these characters may be used to predict the feeding behavior of fossil birds.

552 Vandergon, Barker & Lanyon

Molecular systematics of the meadowlarks and allies (Icterini). ARION J. VANDERGON, F. KEITH BARKER and SCOTT M. LANYON, *Bell Mus., Univ. Minnesota, St. Paul, MN.*

The meadowlarks and allies are 1 of 5 lineages of the New World Icterini detected using molecular data. However, the monophyly of the meadowlark group has been poorly supported with mtDNA data, and some analyses fail to recover the group at all. This group is of particular interest and some controversy, as it is thought to include not only the "typical" meadowlarks (genera *Sturnella* and *Leistes*), but also the enigmatic Bobolink (*Dolichonyx*), and the Yellow-headed Blackbird (*Xanthocephalus*). We have addressed the monophyly of this group using DNA sequences from 2 mitochondrial genes (cytochrome b and ND2), as well as 4 nuclear genes, including 1 coding (RAG1) and 3 non-coding regions (ACO1-I10, FGB-I5, and MG-I2). Monophyly of the meadowlarks and allies, including the Bobolink and Yellow-headed Blackbird, finds it first strong support in analyses of these combined data. In addition, our data offer into some insight into population relationships within the *Sturnella magna* complex.

553 Mainwaring, Anderson, Szewczyk, Polastre & Culler

Microhabitat monitoring with sensor networks. ALAN MAINWARING, J. ANDERSON, R. SZEWCZYK, J. POLASTRE and D. CULLER, *Intel Res. Lab. Berkeley, Berkeley, CA*.

Recent advancements in very low power microelectronics have enabled the integration of microprocessors, power radios, and diverse assortments of sensors into small, battery powered devices with lifetimes ranging from months to years. Collections of these devices, called motes, self-organize themselves into sensor networks capable of capturing continuous high resolution environmental and habitat data, and relaying this information to the outside world via the Internet. Sensor networks represent a powerful new tool for biologists with the ability to measure at high spatial and temporal scales, to minimize and largely eliminate observer effects and habitat intrusions, to provide continuous real-time data access via the Internet, and to improve data quality while anticipating reductions in costs of long-term data collection possible with large scale manufacturing. We have deployed several generations of sensor networks on Great Duck Island, Maine, to advance this technology while providing novel data to biologists. During the 2003 field season, 162 motes were deployed that operated continuously for >4 mon and provided >500,000 sensor readings on microhabitat conditions across a remote Leach's Storm Petrel colony.

554 Niven, Sauer, Link & Butcher

Population trends of boreal songbirds over-wintering in the U.S. and Canada: a hierarchical analysis of Christmas Bird Count data. DANIEL K. NIVEN, *Audubon, Patuxent Wildl. Res Center, Laurel, MD*, JOHN R. SAUER, WILLIAM A. LINK, *USGS, Patuxent Wildl. Res Center*, and GREGORY S. BUTCHER, *Audubon, Washington, DC*.

Canada's boreal forest provides breeding habitat for up to a third of the continent's landbirds. Evidence of declines for at least 40 species of boreal-breeding landbirds from North American Breeding Bird Survey (BBS) data, along with increasing threats to habitat in the region, have created concern about the population status of these species. Unfortunately, the BBS provides very limited information for this critical area. We used Audubon Christmas Bird Count (CBC) data to assess the population trends for 13 landbird species that breed primarily in Canada's boreal forest and winter in the U.S. and s. Canada. A hierarchical log-linear model was used to model change in counts as a function of effort, stratum (Bird Conservation Regions), circle, and year effects. In the model, shape of the effort adjustment could vary by species and region. Of the 13 species, 4 (Rusty Blackbird, Northern Shrike, Bohemian Waxwing and Harris's Sparrow) significantly decreased in population between 1966 - 2003, with Rusty Blackbird showing the steepest decline (4.98%/yr), and 4 (Merlin, Ruby-crowned Kinglet, Hermit Thrush and Palm Warbler) were increasing. We compare CBC results to BBS results and provide summaries of regional patterns of population change. CBC data provide a useful source of information for the conservation of boreal species.

555 Johnson

South American Migration Moon-watching Project. JENNIFER E. JOHNSON, Biol. Dept., *Swarthmore Coll., Swarthmore, PA*.

There are 2 major long-distance migration systems in the Western Hemisphere: Nearctic-Neotropical (movements between North America and Latin America) and austral (movements between temperate and tropical South America). Although these systems are roughly comparable in number of species and volume of birds, the Nearctic-Neotropical system has received intense research attention while the austral system is almost completely unknown. In order to provide the first data on flight patterns of austral and Nearctic-Neotropical migrants in South America, a network of volunteers in Argentina, Bolivia, Brazil, Colombia, and Uruguay participated in a coordinated moon-watching study during Mar, Apr, and May 2004. Data were collected each month during one-week periods centered on the full moon, compiled via the internet, and analyzed with circular statistics. Here I will present preliminary data on the flight directions, timing, and migration traffic rates of nocturnal migrants crossing South America.

556 Burger, Mayer, Greenberg, Powers, Volz & Gochfeld

Ecological risk, Conceptual Site Models, and long-term stewardship where critical risk is off-site: the case of the Department of Energy's Amchitka Island nuclear test site. JOANNA BURGER, *Div. Life Sci, Rutgers Univ., Piscataway, NJ, and Consortium for Risk Evaluation with Stakeholder Participation, Piscataway, NJ*, HENRY J. MAYER, MICHAEL GREENBERG, CHARLES W. POWERS, CONRAD D. VOLZ and MICHAEL GOCHFELD, *Consortium for Risk Evaluation with Stakeholder Participation, Piscataway, NJ*.

Managers of contaminated sites are faced with options ranging from monitoring natural attenuation to complete removal of contaminants to meet residential standards. Conceptual Site Models (CSM) is one tool used by the Department of Energy (DOE) and other environmental managers to understand, track, and communicate with the public about contamination risks. CSMs graphically depicts the sources, releases, transport and exposure pathways, and receptors, along with possible barriers to interdict pathways and reduce exposure. In this paper we explore CSMs using Amchitka Island, where contamination remaining from underground nuclear test shot cavities contain large quantities of various radionuclides in various forms. The surrounding waters have high avian species diversity. We propose that the CSMs on Amchitka Island focus the pathways of exposure to critical avian receptors. Further, CSMs should be incorporated within a larger ecosystem model because of the potentially rapid transport within ocean ecosystems, the large number of migratory bird species that pass by Amchitka, and the potential for a direct pathway to Aleut food chains and commercial fisheries, remote from the island itself.

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Dickinson, J L	294	Feinstein, J	529 ⁺	Giocomo, J J	210 ⁺	Hart, P J	428
Diefenbach, D R	221 ⁺	Feinstein, J	530 ⁺	Gipson, P S	214	Hartman, P J	486 ⁺
Diehl, R H	31 ⁺	Ferron, J	417	Giroux, J-F	27	Hasegawa, T	410
Diehl, R H	313	Fettig, S M	144	Giroux, J-F	472	Haskell, D G	454 ⁺
Diehl, R H	500	Fetz, T	107	Gissing, G	295	Haskell, D G	430
Dieni, J S	438	Fisher, R J	206 ⁺	Glasse, B	s40 ⁺	Hathcock, C	436
Dietsch, T V	439 ⁺	Fitzgerald, T M	32 ⁺	Gochfeld, M	556	Havens, L E	84
Dillon, M	175	Fleischer, R	s43	Goetz, J E	s23	Hawley, D M	s47 ⁺
DiMiceli, J K	452 ⁺	Fleischer, R C	407	Golightly, R T	117	Hayward, J L	197
DiMiceli, J K	467	Fleischer, R C	522 ⁺	Golightly, R T	295	Hazler, K R	159 ⁺
Dingle, C E	130 ⁺	Fleischer, R C	s42 ⁺	Gonzalez Voyer, A	262 ⁺	Hazler, K R	510 ⁺
Dion, J-P	495	Fleischer, R C	217	Gonzalez, E	409	Heath, T A	11
Dionne, M	513 ⁺	Fleischer, R C	409	Goodman, S M	s45	Hebert, P D N	185
Djojo, F	253	Fleischer, R C	514	Gorman, K B	319 ⁺	Hebert, P N	117 ⁺
Doherty, P F, Jr	300 ⁺	Fleischer, R C	523	Gould, W R	107	Heiss, R	504 ⁺
Doherty, P F, Jr	s51	Flint, B	300	Gouse, P J	438	Henneman, C	315
Dolby, A S	84 ⁺	Flint, P L	319	Graham, C	55	Henson, S M	197
Donovan, T M	183	Flint, P L	443 ⁺	Granados, J A	318	Herzog, M P	115
Dor, R	s39 ⁺	Fonseca, D	s42	Gratto-Trevor, C L	431 ⁺	Hess, S C	437
Doucet, G J	491 ⁺	Foote, J F	57 ⁺	Graves, G	s43	Hicks, B G	549
Doucet, S M	36 ⁺	Foote, J F	416 ⁺	Green, D J	242 ⁺	Hill, G E	174 ⁺
Doucet, S M	108	Forbes, G J	167	Greenberg, M	556	Hill, G E	36
Drapeau, P	195 ⁺	Forbes, G J	188	Greenberg, R	89	Hill, G E	178
Drapeau, P	69	Forbes, S	s40	Greenberg, R	151	Hobson, K A	74
Drapeau, P	445	Forsman, J T	196	Greenberg, R	152	Hobson, K A	265 ⁺
Driscoll, M J L	120	Francis, C M	68 ⁺	Greenberg, R	288	Hobson, K A	267
Driscoll, M J L	121 ⁺	Francis, C M	185 ⁺	Greenberg, R	423	Hobson, K A	288
Driskell, A C	129 ⁺	Francis, C M	s27	Gremillet, D	218	Hobson, K A	444
Drummond, H	262	Franzreb, K E	80	Gremillet, D	508	Hobson, K A	503
Duckworth, R A	170 ⁺	Fraser, G S	118 ⁺	Grenier, J L	152 ⁺	Hobson, K A	545
Duffy, A M, Jr	518 ⁺	Fraser, R	s11 ⁺	Griffin, A	291	Hobson, K A	546
Dumbacher, J P	514	Fraser, R	s15	Griffing, S M	75 ⁺	Hobson, K A	P02 ⁺
Dupuis, A P, II	s49 ⁺	Frey, S	s21	Groth, J G	14	Hobson, K A	s25 ⁺
Durães, R	35	Friesen, V L	176 ⁺	Groth, J G	527	Hobson, K A	113
Durães, R	475 ⁺	Friesen, V L	295 ⁺	Groth, J G	533	Hobson, K A	225
Durães, R	505	Friesen, V L	s11	Grove, K	405	Hochachka, W M	153
Dusek, R J	s48	Friesen, V L	10	Grubb, T C, Jr	177 ⁺	Hochachka, W M	250 ⁺
DuVal, E D	38 ⁺	Friesen, V L	272	Grubb, T C, Jr	303	Hochachka, W M	121
Earnshaw, S M	85	Friesen, V L	412	Grubb, T C, Jr	s51	Hofmann, C M	110 ⁺
Easton, W E	434 ⁺	Friesen, V L	479	Gryczynska-S., A	49	Hohman, E	405

Holberton, R L	26 ⁺	Kesler, D C	4 ⁺	Li, S-H	282 ⁺	Martin, K	45
Holberton, R L	288	Ketterson, E D	447	Li, S-H	241	Martin, K	501
Holberton, R L	124	Kim, D H	80	Li, S-H	283	Marzluff, J M	298 ⁺
Holberton, R L	204	Kimball, R T	41	Li, S-H	529	Marzluff, J M	281
Holberton, R L	248	Kimball, S A	s51	Libsch, M	285	Master, T L	461
Holberton, R L	425	King, R S	65	Lin, Y S	241	Master, T L	487
Holberton, R L	517	Kingsford, R T	136	Lindell, C A	541	Master, T L	489
Holloran, M J	205 ⁺	Kirkpatrick, C	95	Linder, E T	80	Masters, B S	549
Holmes, R T	20	Klatt, P H	258	Lindo, A J	437 ⁺	Mather, D D	201 ⁺
Holmes, R T	77	Klicka, J	12	Lindsay, K	543 ⁺	Matsuoka, S	s32
Holmes, S	449	Klicka, J	40 ⁺	Lindsay, K E	542	Mattice, J A	221
Horn, A G	s41	Klicka, J	98	Lindsay, R	252	Mattsson, B J	234 ⁺
Horton, B M	26	Klicka, J	193	Link, W A	554	Mayer, H J	556
Horton, B M	248 ⁺	Knoche, M	73 ⁺	Linse, M H	509	Mays, H L Jr	108
Host, G	192	Koivula, K	186	Liu, L	123	McCartney, M A	194
Houston, C S	275 ⁺	Kollias, G V	512	Liu, M	178 ⁺	McClure, K	315
Houston, C S	424 ⁺	Kondo, B	482 ⁺	Liu, W-c	81 ⁺	McCracken, K G	11
Hovey, A	176	Kosciuch, K L	61 ⁺	Liu, W-c	537 ⁺	McDonald, D B	316 ⁺
Hsu, Y-C	241 ⁺	Krakauer, A H	62 ⁺	Loiselle, B A	35 ⁺	McEachen, T	s16 ⁺
Hsu, Y-C	283	Kramer, L D	s49	Loiselle, B A	55 ⁺	McEachen, T	s17
Huddleston, C J	41	Kramer, L	s48	Loiselle, B A	475	McFarland, K P	s17
Hughes, J M	104 ⁺	Krohn, W B	317	Lombardo, B C	405 ⁺	McFarland, K P	s18
Hughes, K M	492 ⁺	Kubel, J E	s10 ⁺	Lombardo, M P	179 ⁺	McFarland, K P	s21 ⁺
Hughes, M E	140 ⁺	Kuehn, M K	171 ⁺	Long, J A	7 ⁺	McFarland, K P	s22
Humphries, D G	270	Kuenzli, J J	s51	Long, J A	26	McFarland, K P	s23
Humphries, E	481	Kuntz, G	218 ⁺	Longland, W S	115	McGaha, H R	403
Humphries, E M	532 ⁺	Kuntz, G	508 ⁺	Lopes, I F	473 ⁺	McGowan, K J	504
Hunter, M L, Jr	21	Kushneriuk, R S	s26	Lotem, A	s37	McGowan, K J	s50 ⁺
Hussell, D J T	267	Kyser, T K	63	Lotem, A	s39	McGowan, K J	516
Huyvaert, K P	64 ⁺	Kyser, T K	116	Lougheed, S C	412	McGrath, L J	226 ⁺
Ibarguchi, G	176	Kyser, T K	411	Lougheed, S C	29	McGraw, K J	110
Ibarguchi, G	412 ⁺	LaHaye, W S	191	Lougheed, S C	413	McGraw, K J	174
Ibarguchi, G	413 ⁺	Laing, D K	270 ⁺	Lovell, S F	536 ⁺	McGraw, K J	502
Imbeau, L	417	Lambert, J D	s22 ⁺	Lovette, I J	130	McIntosh, C E	522
Imbeau, L	195	Lamothe, P	s30	Lovette, I J	12	McIntosh, C E	523 ⁺
Ishtiaq, F	s42	Lamothe, P	471	Lowy, E	131	McKnight, J	456 ⁺
Islam, K	420	Lamothe, P	495	Lowy, E	477	McLean, R	s52
Jablonski, B	527 ⁺	Lampila, P	189 ⁺	Lucas, J R	238	McLean, R G	s48 ⁺
James, D A	249 ⁺	Lampila, S	186 ⁺	MacDonnell, L	456	McLellan, N R	540 ⁺
James, H F	11	Langin, K M	116 ⁺	Mack, G	503	McLennan, D S	457
Janes, S W	82 ⁺	Lanyon, S M	12	Mackenzie, S A	414 ⁺	Meadows, M G	194 ⁺
Januchowski, S	405	Lanyon, S M	299	Mackin, W A	33 ⁺	Mee, A	156 ⁺
Jarvis, D	405	Lanyon, S M	476	Mackin, W A	538 ⁺	Mejeur, J	474
Jarvi, S	437	Lanyon, S M	552	Maddox, J D	273 ⁺	Mennill, D J	88 ⁺
Jarvi, S	s42	Larivée, J	s31	Maehr, D S	486	Mertz, L A	533 ⁺
Jennelle, C S	512 ⁺	Larivière, S	74	Maehr, D S	s13	Mertz, L A	14
Jennings, W B	105 ⁺	Larkin, J L	486	Mainwaring, A	320	Metcalfe, A E	520
Jobin, B	22	Larkin, J L	s13	Mainwaring, A	553 ⁺	Meyer, K D	301 ⁺
Johansson, U S	132 ⁺	Larkin, R P	313 ⁺	Male, S K	142 ⁺	Meyer, K M	266 ⁺
Johnson, D J	463	Larsen, J K	215 ⁺	Mallory, M L	446	Mickelson, N	253
Johnson, E I	452	Le Maho, Y	218	Manfredi, L	427	Middleton, H A	242
Johnson, E I	467 ⁺	Le Maho, Y	508	Manville, A M	47	Miglia, K J	41
Johnson, J E	555 ⁺	Leary, P	147	Marchese, D J	531	Mika, M	164 ⁺
Johnson, J M	158 ⁺	Leboeuf, M	195	Marks, B D	41	Milkie, R L	549
Johnson, K P	11	LeBrun, J J	315	Marra, P P	20	Miller, J K	84
Johnson, L S	155 ⁺	LeBrun, J J	428	Marra, P P	53	Miller, M J	99 ⁺
Johnson, L S	549 ⁺	LeClair, S C	5 ⁺	Marra, P P	63	Mills, A M	25 ⁺
Johnston, J C	26	Leclerc, J	495 ⁺	Marra, P P	65	Mills, J	490
Johnston, J C	124 ⁺	Leclerc, J	s30 ⁺	Marra, P P	75	Milot, E	133 ⁺
Jones, A W	43 ⁺	Lecomte, N	472 ⁺	Marra, P P	77	Milton, G R	167
Jones, A W	109	LeCroy, M	s03 ⁺	Marra, P P	116	Mlodinow, M	470
Jones, S L	438 ⁺	Lee, T-Y	453 ⁺	Marra, P P	288 ⁺	Mock, D E	232 ⁺
Jonsson, J E	532	Lefebvre, L	180	Marra, P P	411	Molina, K C	216
Joos, R	243 ⁺	Lefebvre, L	291	Marra, P P	458	Molinari, R L	549
Junker, S	156	Lein, M R	535 ⁺	Marra, P P	s49	Mong, T W	150 ⁺
Kapoor, J	455 ⁺	Lein, M R	536	Marra, P P	168	Mönkkönen, M	189
Kearns, L J	127 ⁺	Lein, M R	s01 ⁺	Marra, P P	245	Mönkkönen, M	196
Kedar, H	s39	Leisler, B	402	Marra, P P	280	Montgomerie, R	108 ⁺
Kellam, J S	238 ⁺	Leonard, M L	s19	Marshall, J S	s51 ⁺	Moore, C T	190
Keller, D	436	Leonard, M L	s41 ⁺	Marshall, M R	221	Moore, F R	30
Keller, D C	144	Leonard, M L	435	Marshall, M R	251	Moore, F R	498
Kendall, W L	300	Lévesque, E	547	Marshall, S R	437	Moore, F R	499
Kennedy, R S	43	Lewis, T	8 ⁺	Marshall-Rosen, L C	3 ⁺	Moore, W A	41
Kerlinger, P	47	Lewis, T	406 ⁺	Martin, K	289 ⁺	Morand-Ferron, J	180 ⁺

Morgan, T.....	434	Omland, K E	481	Quinn, T W	39 ⁺	Robinson, W D	478
Morrisette, J.....	503 ⁺	Omland, K E	482	Radomski, A A.....	146 ⁺	Rock, J C	435 ⁺
Morrisette, J.....	545 ⁺	Omland, K E	532	Radomski, A A	521 ⁺	Rockwell, R F	52
Morrisette, J.....	546 ⁺	O'Neill, J.....	405	Ramirez, A	318	Rodewald, A D.....	46 ⁺
Morneau, F.....	464	Orell, M.....	186	Ramsay, S	162	Rodewald, P G	28 ⁺
Morneau, F.....	466 ⁺	Oring, L W	158	Ratcliffe, L M	63	Rodriguez-Contr., V	485 ⁺
Morneau, F	491	Ortiz-Pulido, R.....	318 ⁺	Ratcliffe, L M	116	Rohwer, S	16
Morrison, E B	404 ⁺	Outlaw, D C.....	102 ⁺	Ratcliffe, L M	154	Röhwer, S	202
Morrissey, C A	242	Outlaw, D C	419 ⁺	Ratcliffe, L M	411	Rojas, A E.....	318
Morse, J A.....	418 ⁺	Outlaw, R K.....	524 ⁺	Rathburn, M K	108	Rolf, A L	515
Morton, E S	235	Overington, S	291 ⁺	Rathburn, M K	154	Rompré, G	274 ⁺
Morton, E S	236	Padura, M	427	Rauch, R L	155	Rose, M	147 ⁺
Moscoso, J.....	131	Papes, M	137 ⁺	Ravaoarimalala, A...	s45	Rosenberg, K V	161
Moscoso, J.....	477	Parker, G A	232	Reader, S M	180	Rosenberg, K V	s12 ⁺
Moseley, D	83 ⁺	Parker, P G	231	Reed, E	s29	Ross, K	s29
Mosley, E	449 ⁺	Parker, P G	P03 ⁺	Reid, B	497	Roth, A.....	s06 ⁺
Moss, D.....	210	Parker, P G	64	Reid, K	181	Roth, K.....	420 ⁺
Mousseau, P	465 ⁺	Parker, P G	237	Reimchen, T E	79	Rothstein, S I.....	171
Moyle, R G	531	Parker, T H.....	214 ⁺	Reineke, R.....	415 ⁺	Rothstein, S I.....	523
Mullins, T D	101	Patrican, L A.....	s50	Reitsma, L R	53	Rothstein, S I	87
Murphy, M T	93 ⁺	Patterson, C J	249	Rejt, L.....	49 ⁺	Roulin, A.....	s36 ⁺
Murphy, M T	230	Patterson, W	134	Rempel, R S	s26 ⁺	Roux, K E	280 ⁺
Murphy, T G	184 ⁺	Patton, L L.....	s13 ⁺	Renaud, C	309 ⁺	Rowell-Garvon, S R	148 ⁺
Murray, B G, Jr	480 ⁺	Paulios, A T.....	s14	Renfrew, R B	463 ⁺	Rowell-Garvon, S R	483 ⁺
Murray, T C.....	437	Paxton, E H.....	114	Renfrew, R B	s21	Ruché, D.....	417 ⁺
Naughton, M	300	Peacock, M	115	Restifo, R A	s51	Ruiz-del-Valle, V.....	131
Navarro-Sigüe., A G.	97	Pedersen, A B.....	447	Reuink, M W.....	246 ⁺	Ruiz-del-Valle, V.....	477
Negro, J J.....	165	Peer, B D.....	523	Revels, M R	422 ⁺	Runge, M C	443
Németh, Z	498 ⁺	Peer, B D	171	Reynolds, S	209	Runge, M C	219
Neubig, J P	s51	Peery, Z.....	295	Rhymer, J M	136 ⁺	Russell, J	118
Neuman, C R	229	Peirce, M A.....	514	Rich, T D	212 ⁺	Rutkowski, R.....	49
Neville, K	s15 ⁺	Peirce, M A.....	s42	Richkus, K D.....	443	Ryan, P C	433
Nevitt, G A.....	181	Pelkey, N W	454	Richmond, M E	509	Ryan, P G.....	13
Newman, S.....	295	Peluc, S I	2 ⁺	Ricklefs, R E.....	99	Ryder, R A	223
Nguyen, L P	493 ⁺	Peplinski, P	162 ⁺	Ricklefs, R E.....	s43	Ryder, T B.....	35
Nichols, J D	216	Perkins, D.....	26	Riddle, B.....	193	Ryder, T B.....	505 ⁺
Nielsen, C R.....	231 ⁺	Perkins, D E.....	204 ⁺	Rimmer, C C.....	s17	Ryker, L	82
Nishida, C A	469	Perkins, J C.....	292 ⁺	Rimmer, C C.....	s18 ⁺	Safran, R J.....	229 ⁺
Niven, D K.....	554 ⁺	Perlut, N G	23	Rimmer, C C.....	s21	Sales, J.....	107
Nkhoma, E T.....	515	Perlut, N P.....	183 ⁺	Rimmer, C C.....	s23	Salgado-Ortiz, J.....	245 ⁺
Nocera, J J.....	167 ⁺	Peters, J L.....	481 ⁺	Rintoul, D A	519	Sánchez-Gonz., L A	97 ⁺
Noel, B L	511 ⁺	Peters, J P.....	532	Rios-Munoz, C A ..	450 ⁺	Sandercock, B K....	519 ⁺
Nol, E	68	Peterson, A T	15	Risch, T S.....	90 ⁺	Sandercock, B K	34
Nol, E	147	Peterson, A T	97	Risch, T S	91	Sandercock, B K	61
Nol, E	198	Peterson, A T	306	Rising, J D	52	Sandercock, B K	150
Nol, E	267	Phillips, K W.....	197 ⁺	Rivers, J W.....	409 ⁺	Sanders, T A	223
Nol, E	449	Phillips, L.....	24 ⁺	Rivers, J W.....	s34 ⁺	Saranathan, V.....	507 ⁺
Nol, E	493	Piatt, J F.....	176	Robbins, C S	300	Sarasola, J H	165
Nol, E	142	Piatt, J F.....	295	Robert, M.....	22 ⁺	Sauer, J R.....	554
Nolan, V, Jr	447	Piersma, T.....	P04 ⁺	Robert, V	s45	Sauter, A.....	56 ⁺
Nooker, J K.....	34 ⁺	Poland, V F	176	Roberts, D L	96 ⁺	Savard, J-F.....	220 ⁺
Norris, A R	45 ⁺	Polastre, J	320	Roberts, P K	77 ⁺	Savard, J-P L	220
Norris, D R	20	Polastre, J	553	Robertson, G J	433	Schaalje, G B	164
Norris, D R	63 ⁺	Pollock, K H.....	71	Robertson, G J	441 ⁺	Scheffers, B R	430 ⁺
Norris, D R	116	Pollock, K H.....	72	Robertson, G J	442 ⁺	Scheigg, K	56
Norris, D R	411 ⁺	Potvin, C.....	268	Robertson, G J	446	Schenk, G A	51
Nottebohm, F	81	Poulin, M	445 ⁺	Robertson, R J	245	Schieck, J	548 ⁺
Nottebohm, F	537	Powell, A F L A	139 ⁺	Robertson, R J	s11	Schieck, J	s33 ⁺
Nowak, H.....	405	Powell, A N.....	24	Robertson, R J	244	Schikler, P A.....	531 ⁺
Nowicki, S	59	Powell, A N.....	73	Robertson, R J	s15	Schluter, D	544
Nur, N.....	123	Powell, A N.....	418	Robertson, R J	s15	Schmiegelow, FKA ..	19 ⁺
O'Brien, E L.....	112 ⁺	Powell, K G	213 ⁺	Robichaud, I	293	Schmiegelow, FKA	s24 ⁺
O'Connor, R J	317	Powell, R A.....	496 ⁺	Robillard, K A	230 ⁺	Schmiegelow, FKA	312
Oesterle, P	s52	Powers, C W	556	Robillard, L.....	22	Schnell, G D	126
Oh, K P	297 ⁺	Powers, C W	514	Robinson, D A, Jr ..	516 ⁺	Schnodde, R.....	s04 ⁺
Oli, M K	173	Pratt, T K.....	514	Robinson, D A, Jr ..	s50	Schoede, R.....	56
O'Loughlen, A	87 ⁺	Price, J J	85 ⁺	Robinson, S K	285	Schoech, S J	209 ⁺
Olsen, B	89 ⁺	Prior, K	543	Robinson, T J.....	91 ⁺	Schoech, S J	5
Olson, D	543	Prizzia, A M.....	163	Robinson, T J	90	Scholes, E	240 ⁺
Olson, L.....	542 ⁺	Pruett-Jones, S	129	Robinson, T R	478 ⁺	Schreiber, E A	51 ⁺
Olson, S L	522	Pruett-Jones, S	239	Robinson, W D	285	Schwagmeyer, P L..	232
Olson, S L	523	Prum, R O	129	Robinson, W D	66	Sealy, S G	403
Omland, K E.....	100 ⁺	Prum, R O	135 ⁺	Robinson, W D	274	Searcy, W A.....	59 ⁺
Omland, K E	110	Puryear, K A	23	Robinson, W D	451 ⁺	Sedinger, J S.....	115
		Pyle, P	300				

Self, J	470	Spitzer, P R	122 ⁺	Thomson, S J	146	Whitfield, M J	469 ⁺
Sénéchal, E	495	St John, J	39	Tischendorf, L	543	Whittam, B	s20 ⁺
Serrano-Vela, I	131	Stahl, J T	173 ⁺	Tittler, R	468 ⁺	Wiebe, K L	206
Serrano-Vela, I	477	Staicer, C A	457	Tori, W	35	Wieczorek, J R	15
Serrell, R	s09	Staicer, C A	86 ⁺	Trimble, J R	550	Wikelski, M	227
Serrell, R	s50	Staicer, C A	484	Tubaro, P L	413	Wilder, S	26
Servello, F A	292	Stansberry, B M	214	Turcotte, Y	304 ⁺	Wilder, S A	425 ⁺
Seutin, G	10	Stapleton, M K	244 ⁺	Twedt, D J	286 ⁺	Wiley, R H	83
Seutin, G	s16	Steadman, D	41	Twedt, D J	497	Wilhelm, S I	433 ⁺
Seutin, G	s17	Stechler, K M	84	Twedt, D J	159	Wilhelm, S I	441
Seutin, G	287	Stenhouse, I J	446 ⁺	Tweed, E	315	Will, T	s14 ⁺
Severinghaus, L L	241	Stettenheim, P R	506 ⁺	Tweed, E J	428	Willard, D E	31
Shaffer, F	22	Stewart, I	253 ⁺	Ubico, S R	s48	Williams, A B	251
Shaffer, F	268	Stodola, K W	80 ⁺	Ulion, K	504	Williams, M J	136
Shaffer, F	456	Stoeckle, M Y	185	Urban, J	462	Williams, T D	111
Shawkey, M D	108	Storey, A E	441	Uy, J A C	37 ⁺	Williams, T D	319
Shawkey, M D	502 ⁺	Stouffer, P C	50 ⁺	van Coeverden		Willson, S K	259 ⁺
Sheehan, J	489 ⁺	Stouffer, P C	467	de Groot, P J	10	Wilson, C M	517 ⁺
Sheldon, F H	41	Stouffer, P C	7	van-den-Elzen, R	131	Wilson, E	405
Sherry, T W	20 ⁺	Stouffer, P C	138	van Riper, C, III	224	Wilson, P	s16
Sherry, T W	263	Stouffer, P C	452	van Riper, C, III	226	Wilson, P	s17 ⁺
Shirley, S	125 ⁺	Stratford, J A	66 ⁺	van Wilgenburg, S L	545	Wimmers, L E	549
Shustack, D P	23	Strong, A M	23 ⁺	van Wilgenburg, S L	546	Wingfield, J C	166
Shutler, D	540	Strong, A M	183	van Wilgenburg, S L	s25	Wingfield, J C	238
Sillett, S	300	Strong, C	50	Vandergon, A J	552 ⁺	Winkler, D W	s39
Sillett, S	s21	Studds, C E	168 ⁺	Varela, P	477	Winkler, H	402 ⁺
Sillett, T S	151	Sturdy, C B	60	Vazquez-Miranda, H	526 ⁺	Winn, B	147
Sillett, T S	219 ⁺	Sturdy, C B	453	Veillette, M	180	Witham, J W	21
Silverman, E D	181 ⁺	Sturge, R J	52 ⁺	Vézina, A	495	Withers, K	148
Silverman, E D	127	Stutchbury, B J M	29	Vézina, F	111 ⁺	Withers, K	483
Simons, T R	71	Stutchbury, B J M	236	Vilella, F J	18 ⁺	Withey, J C	281 ⁺
Simons, T R	72	Stutchbury, B J M	258 ⁺	Villard, M-A	293 ⁺	Woakes, A J	218
Skypala, A C	s38 ⁺	Stutchbury, B J M	160	Villard, M-A	67	Woakes, A J	508
Slack, R D	496	Stutchbury, B J M	235	Villard, M-A	468	Woltmann, S	30
Slater, S J	149 ⁺	Styring, A R	474 ⁺	Vitz, A C	46	Woodcock, E A	154 ⁺
Smith, A L	272 ⁺	Styrsky, J N	285	Voelker, G	16 ⁺	Woodworth, B L	217
Smith, J	53 ⁺	Sullivan, K A	1 ⁺	Voelker, G	102	Woodworth, B L	315
Smith, J	405	Surai, P F	113	Voelker, G	524	Woodworth, B L	428
Smith, J N M	166	Sutherland, J M	276 ⁺	Volz, C D	556	Woodworth, B L	428
Smith, K G	470 ⁺	Swarthout, E C H	120 ⁺	Vondrasek, J R	58 ⁺	Woodworth, B L	428
Smith, K G	3	Swartzentruber, B A	487 ⁺	Vuilleumier, F	s02 ⁺	Woodworth, B L	428
Smith, L A	198 ⁺	Swift, T L	290 ⁺	Walters, J	89	Woodworth, B L	428
Smith, M D	157 ⁺	Sydenstricker, K V	512	Walters, J R	222 ⁺	Woodworth, B L	428
Smith, R J	499 ⁺	Sykes, P W	426 ⁺	Walters, J R	78	Woodworth, B L	428
Smith, R J	500 ⁺	Sykes, P W, Jr	427 ⁺	Wang, J-P	283	Woodworth, B L	428
Smith, R J	20	Szewczyk, R	320	Ward, D W	201	Woodworth, B L	428
Smith, T	156	Szewczyk, R	553	Warnock, N	310	Woodworth, B L	428
Smith, T B	130	Takekawa, J Y	310 ⁺	Wassenaar, L I	265	Woodworth, B L	428
Snajdr, E A	447	Tanner, G W	163	Wassenaar, L I	267	Woodworth, B L	428
Snipes, K V	515 ⁺	Tardif, J	311 ⁺	Wassenaar, L I	444	Woodworth, B L	428
Sol, D	180	Taylor, E J	24	Weatherhead, P J	273	Woodworth, B L	428
Sol, D	291	Taylor, P D	32	Weatherhead, P J	401	Woodworth, B L	428
Soma, M	410 ⁺	Taylor, P D	213	Webster, M S	239 ⁺	Woodworth, B L	428
Somershoe, S G	497 ⁺	Taylor, R J	s18	Webster, M S	85	Woodworth, B L	428
Somershoe, S G	286	Tellkamp, M P	305 ⁺	Weimerskirch, H	133	Woodworth, B L	428
Sorenson, M D	11 ⁺	ten Have, J	103	Weir, J T	544 ⁺	Woodworth, B L	428
Spautz, H	123 ⁺	Terry, B	424	Welch, C M	228	Woodworth, B L	428
Speakman, J R	111	Terwilliger, L A	217	Weseloh, D V C	243	Woodworth, B L	428
Speidel, M	202	Tetreau, M	418	Westneat, D F	253	Woodworth, B L	428
Spellman, G M	193 ⁺	Thatcher, B S	421 ⁺	Westneat, D F	404	Woodworth, B L	428
Spellman, G M	40	Theimer, T C	114	Whiskeychan, S	464	Woodworth, B L	428
Spicer, G S	525	Therien, J	474	White, C M	164	Woodworth, B L	428
Spiegel, C	315	Thogmartin, W E	s14	White, J D	460 ⁺	Woodworth, B L	428
Spiegel, C S	428 ⁺	Thomas, P	456	White, J D	54 ⁺	Woodworth, B L	428
Spithill, T W	252	Thomson, R L	196 ⁺	White, M	192	Woodworth, B L	428