BIRDS AS BRIDGES

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Abstract Booklet

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Symposia

Incorporating point counts and breeding behavior in a joint spatial density framework for bird atlases

E. Adams, G. Mittelhauser, A. Leppold
Presenting author: **Evan Adams**, Biodiversity Research Institute, evan.adams@briwildlife.org

Breeding bird atlases in North America have become increasingly complex over the past decade with more volunteers and streamlined data collection and management tools. These changes give atlases flexibility in their methods and allow increased coverage over space, time, and species. In practice, these increases are often related to conducting concurrent surveys with different methodologies that each contribute information to understanding breeding distributions. By linking density estimates from point count surveys with breeding behavior information from atlasing efforts in a joint spatial density modeling framework, we can combine the relative strengths of different atlas surveys for integrated estimates of breeding density. We designed a multivariate correlated autoregressive (MCAR) modeling framework incorporating data from the Maine Bird Atlas to estimate spatially explicit breeding densities. Two ecological submodels inform the joint spatial pattern: a distance-sampling, time-removal density model from point counts, and a multi-state occupancy model estimating the probability of breeding from atlas data. Using Northern Cardinal, Black-throated Green Warblers, and other example species, we will describe the model, compare the results to non-joint model products, and contrast the relative contributions of each data set. Joint model results showed broader breeding ranges for some species and had evidence of improved overall fit, with submodel correlations across species ranging from 0.4-0.7. Many potential applications exist for such a flexible joint modeling framework, particularly for bird atlases with multiple conservation goals and spatiotemporally aligned monitoring efforts.

Breeding bird survey results at a 16 year restoration site in Norfolk County, Ontario.

D. Agro
Presenting author: **David Agro**, International Conservation Fund of Canada, david@icfcanada.org

Breeding bird surveys during a 16 year restoration of a former tobacco farm to tallgrass prairie/oak savanna were used to assess whether most species and some rare species would return quickly when using a species-rich ecosystem approach to restoration. The site was highly modified by past human use, was relatively isolated from other natural areas by intensive agriculture, and had no recent records of rare species. Sixty-three acres of cleared field were planted with over 117 locally-collected native plant species between the fall of 2006 to 2011. Changes in vegetation were monitored by an annual general survey and 47 meter square plots and in breeding birds using the Breeding Bird Census methods. By the end of 2011, 130 native species of plants were well established in the restored grassland areas and by 2022 over 200 were (80% of total) well established. Over 16 years, the total breeding bird species increased from 49 to 79, close to 70% of the local species recorded during the two Ontario Breeding Atlases. By 2018, the density of breeding pairs (all species) increased from 1.9 to 8.5 pairs/ha. The majority of bird species (90 %) returned within 5 years of the start of restoration with higher densities of pairs occurring after 7 growing seasons. Rarer species like whip-poor-will and henslow's sparrow occurred after the 11th growing season as did a number of other Ontario species at risk. We attribute the rapidity of these increases to the large variety of plants/ecosystem based approach to restoration.

Research needs and employment opportunities relating to restoration management for conservation

D. Agro
Presenting author: **David Agro**, International Conservation Fund of Canada, david@icfcanada.org

Meeting COP 15 targets to conserve 30% of the planet will require improved knowledge of ecological systems and how to repair them. The field of conservation has expanded substantially in the last 20 years

and more investment from the public and private sectors will be directed to address the biodiversity and climate crises. Restoration will play a key role managing landscapes. Examples of successes and problems with restoration will be provided as well as a discussion of how research can help to develop appropriate methodologies. Restoration is an ideal activity for engaging individuals and communities in conservation by reestablishing or managing habitats in collaboration with restorationists and researchers. Opportunities for employment and research in conservation will be discussed. Birds are a popular and relatively well known fauna. They form an ideal link between different sectors of science, management and with the public at large. Restoration that focuses on high profile bird species can bring different communities together for a common cause – often with broad environmental benefit.

Building connections: Birds Canada's role in volunteer-based monitoring in Canada

J. Allair

Presenting author: **Jody Allair**

For decades, Birds Canada has played a significant role in the development and implementation of bird monitoring programs across Canada. We currently administer or collaborate on 44 volunteer-based monitoring programs that engage over 74,000 volunteers and that number continues to climb annually. These programs help researchers collect vast amounts of high quality data to help understand and conserve birds. If designed properly they can also give people a glimpse into the scientific process and make it accessible. Beyond just the data, engaging volunteer-based monitoring programs can help build connections to the subject matter, bridging the disconnect from nature, and create a community of engaged volunteers. This session will provide an overview of the bird-focused volunteer-based monitoring landscape in Canada and highlight several different categories of programs that we employ at Birds Canada including: 1) entry-level programs (Project FeederWatch), 2) targeted species monitoring (Canadian Lakes Loon Survey) 3) stewardship-focused monitoring (Swiftwatch) 4) collaborative initiatives (Christmas Bird Count) and 5) multi-species monitoring (Marsh Monitoring Program). We will also introduce the challenges and successes that we've encountered over the years, highlight the volunteer experience, and demonstrate how we, and our partners, are leveraging these data to generate conservation impact for birds.

Advocating for bird-friendly buildings in post-secondary settings

K. Anton

Presenting author: **Krystal Anton**, Johnson County Community College, kanton@jccc.edu

Raising awareness of bird strike issues on a college campus can be challenging as it requires collaboration from different groups across the campus community. One of the key challenges in raising awareness is that the issue does not fall under anyone's specific job responsibility; additionally, most people are unaware of bird strike issues. Clusters of low-rise buildings set within curated landscaping that bridges natural areas creates an often-lethal setting for migrating birds.â€¯ A five-year study at Johnson County Community College (JCCC) documented over one thousand birds and ninety species as window strikes, even with mitigation in place after year one.â€¯ The issues are lessening but ongoing as modifications are made to buildings, trees are cut down and replaced, and landscaping changes occur. Continued monitoring of the issue shows how these changes affect bird movements through campus and how even window remediation itself can change how birds move through an environment and create or solve issues at other locations. The JCCC bird study demonstrates that collecting data through grass roots movements, student volunteerism, and citizen science can raise awareness and create a compelling call for action. Notably, getting buy-in with upper administrators who have aesthetic appearance concerns is necessary for both approval and potential funding sources.

Christmas Bird Count: 123 years of international collaborative monitoring

Y. Attia

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Many migratory boreal and arctic species occur over vast, often inaccessible areas during the breeding

season, making detection through other monitoring programs a challenge. Additionally, many Canadian breeding species winter mostly in the United States or further south, so monitoring on the wintering grounds provides a more complete estimate of abundance. Christmas Bird Count (CBC) is one of the longest-running volunteer-based bird monitoring programs in the western hemisphere. The program was international from the outset, with original censuses in the year 1900 at locations both in the United States and Canada. Birds Canada entered a partnership with National Audubon Society in 2001 to deliver the program in Canada, resulting in increased growth and uptake across the country. The CBC is now one of the most collaborative, accessible, standardized, volunteer science surveys, as well as a cherished social tradition, contributing to its success. International CBC data are sourced to support several conservation outcomes including to inform the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent advisory panel determining recommendations for the federal Species at Risk Act (SARA). Designation of species by COSEWIC and SARA sets off a chain-reaction of implications for conservation that would not be possible without international data sharing. In an ever-changing landscape, the CBC has been monitoring bird distribution and abundance for 123 years, and will continue to be a crucial program that relies on multi-level collaboration and volunteer interest.

Golden-winged Warbler conservation, habitat implementation, and community outreach with land trusts in the Northeast

S. Barker, M. LaBarr

Presenting author: **Sara Barker**, Cornell Lab of Ornithology, sb65@cornell.edu

Research published in Science in 2019 states eastern forest birds have declined by 17% while grassland birds have experienced a staggering 53% decline. In New England, 80% of lands are privately held, necessitating innovative partnerships between conservationists and private landowners to curb declines and conserve biodiversity. Land trusts protect 61 million acres of private land, engage 230,000 volunteers, and connect with 6.3 million members, providing an ideal mechanism for protecting and stewarding privately-owned ecosystems. To address bird declines and build partnerships, the Cornell Lab of Ornithology established the Land Trust Bird Conservation Initiative (CLTBCI) to provide bird resources, decision-support tools, capacity-building, and funding opportunities that accelerate and amplify private land bird conservation. The Champlain Valley in Vermont hosts the largest breeding population of Golden-winged Warblers in New England and Audubon Vermont has been working with area landowners to improve habitat for this species. In 2015, together with the CLTBCI, they formed the Western Vermont Collaborative to unite the region's land trusts and partners, increasing connectivity between protected lands critical to Golden-winged Warblers, lending access to new grant funds, and creating opportunities to work with landowners open to protecting birds. We will showcase how land trusts have used the Golden-winged Warbler to develop beneficial partnerships with the bird conservation community to further conservation efforts for this rapidly declining species, and how partnerships with groups who are experienced with private land protection can help bring efforts for declining species to scale in landscapes such as Vermont.

Maximizing automated telemetry data: assessing multiple ecological questions through tag deployments in the Neotropics

N. Bayly, C. Gomez

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The Motus automated telemetry array has revolutionized our ability to track small animals at large spatial scales, making it possible to address many questions in the field of migration ecology that were previously out of our reach. The effects of non-breeding habitats, especially at stopover sites, on subsequent migratory journeys or how survival rates vary across different legs of a migration route, are examples of such questions. In this presentation, we describe a number of studies showing how the deployment of radio-transmitters at non-breeding sites in the Neotropics can be used to answer multiple questions including: How long do birds stay at stopover sites?; What contribution does a given stopover or wintering site make to the overall migratory journey?; How do conditions at stopover or wintering sites influence departure dates and the subsequent speed of migration?; and how does survival vary between different

legs of the migratory journey? We use examples of Gray-cheeked Thrushes, Blackpoll Warblers, Cerulean Warblers and Golden-winged Warblers tracked through the Motus network to illustrate how we can answer multiple questions through a single deployment of radio-transmitters, highlighting the critical role of Neotropical wintering and stopover sites in shaping subsequent migratory journeys.

The mid-elevation forest Conservation Investment Strategy: a spatial prioritization for wintering Golden-winged Warblers

N. Bayly, A. Gonzalez-Prieto, C. Gomez, J. Sandino, B. Stewart, R. Dettmers
Presenting author: **Nicholas Bayly**, SELVA: Investigacion para la Conservacion en el Neotropico, nick.bayly@selva.org.co

The mid-elevation forest conservation investment strategy was developed to unify and target actions for the conservation of Golden-winged Warblers, Canada Warblers and Cerulean Warblers on their non-breeding grounds in Central and South America. Through a Conservation Standards approach, 217 individuals representing 79 organizations from 12 countries developed a set of interconnected results chains, complete with goals, indicators and associated actions in early 2021. The resulting strategies provide a framework for conservation action aimed at protecting and enhancing habitat for wintering Golden-winged Warblers, through the establishment of conservation areas, best agricultural practices, ecological restoration, averting the loss of shade coffee plantations and strengthening indigenous reserves. The first step in the implementation of the conservation investment strategy involves creating a spatially explicit prioritization of regions for action. In this presentation we describe how a team of biologists from Central and South America combined eBird Status and Trends models with a protocol for identifying forest fragments and tree-rich landscapes, to subsequently select priority areas for establishing conservation areas, enhancing agricultural landscapes and working with indigenous groups. The results highlight the critical need for the establishment of protected areas in Honduras, the maintenance of shade coffee in Honduras and Nicaragua, and ecological restoration in Costa Rica for the future of the Golden-winged Warbler.

Insights from 9 years of tag deployments on passerines in the province of Québec

J. Tremblay, C. Bégin-Marchand, V. Lamarre, Y. Aubry, A. Desrochers, P. Cí´té, J. Therrien
Presenting author: **Camille Bégin-Marchand**

Migration is the least-studied phase of the life cycle for many songbird species, yet it is of high importance to the full understanding of their life history traits. Between 2014 and 2022, we deployed over 900 nanotags and used the Motus Wildlife Tracking System to investigate migration patterns of a variety of landbirds breeding in the boreal forest of eastern Canada, several of which are of special conservation concern in the United States and Canada. During these years, we deployed tags at various breeding sites in the province of Québec and during fall migration at the Observatoire d'Oiseaux de Tadoussac (OOT), located an important site of southward migration corridor during the autumn. We will present the results from various deployments at the different tagging sites, and discuss the main results coming out of this large program, with a special focus on migration routes and phenology for some focal species.

Golden-winged Warbler overwintering ecology: A synthesis to guide conservation planning and investment

R. Bennett
Presenting author: **Ruth Bennett**, Smithsonian Institution, bennettr@si.edu

Knowledge of Golden-winged Warbler overwintering ecology has increased dramatically over the past twenty years through field studies of nonbreeding distribution, habitat use, vital rates, migratory connectivity, and behavior. Most Golden-winged Warblers overwinter at intermediate elevations in Central American broadleaf forests or riparian corridors with vine tangles and epiphytes. Overwintering individuals maintain large home ranges (~4-9 ha), defend territories against conspecifics, join mixed species flocks, and forage for arthropods primarily by probing dead leaves. The Central American overwintering population was linked to the Great Lakes breeding population through stable isotopes and light-level

geolocators, while the Appalachian breeding population, which declined by 96% since 1966, overwinters in northern South America. Overwinter survival is lower for juveniles than adults and appears to be de-coupled from habitat selection at one anthropogenically-disturbed site in Costa Rica. Females overwinter at lower and drier elevations than males and in habitats subject to greater anthropogenic disturbance and conversion. While males display poor body condition in female-dominated sites, the impact of sexual segregation on female vital rates is unknown. Collectively, these studies facilitated the development of nonbreeding conservation focal areas and a conservation strategy to protect existing habitat and to rebuild habitat in deforested areas. Originally published in 2016, the conservation strategy is now part of a multi-species conservation business plan for the highlands of Central and South America. Evaluating the success and population-level impacts of habitat conservation and restoration is a future priority.

Adapting hidden Markov models to data from small GPS transmitters

L. Berigan, S. Clements, R. Darling, A. Fish, C. Slezak, S. McWilliams, A. Roth, E. Blomberg

Presenting author: **Liam Berigan**

Recent innovations in animal tracking have led to advances in autonomous tools that can identify animal behaviors using GPS data. Hidden Markov models (HMMs) are a class of tools typically applied to classify behavioral states using high spatial and temporal resolution data collected by large tracking devices (10–1500 g). HMMs perform less reliably on smaller devices, which have decreased temporal resolution and frequently only last a few months. Small devices have fewer locations, more frequently contain data gaps, lack additional information from ancillary sensors (e.g., accelerometers) and produce incomplete movement paths, each of which complicate HMM state assignment. We devised methods for overcoming these obstacles during a study of >500 American Woodcock (Scolopax minor) in eastern North America. Woodcock were equipped with 4–6.5 g GPS devices collecting 70–150 locations each. We classified locations during spring and fall as pre-migratory, migratory, and post-migratory using a series of HMMs. We used a correlated random walk model to fill in missing data and addressed issues with low temporal resolution of movement tracks using additional data streams (e.g., recursiveness, residence time, ordinal day) to improve classification accuracy. We addressed issues with incomplete movement tracks using HMMs to estimate unknown starting or ending states and assessed accuracy of those designations. We found that HMMs can be used to accurately classify pre-migratory, migratory, and post-migratory GPS locations for complete and incomplete migratory tracks. HMMs provide a data-driven approach to reconciling uncertainty in movement behaviors and our methods improve their effectiveness for data from small tracking devices.

Conserving Western Migratory Hummingbirds Throughout Their Lifecycles

S. Bonfield

Presenting author: **Susan Bonfield**, Environment for the Americas, sbonfield@environmentamericas.org

The Western Hummingbird Partnership was created to bring together biologists, researchers, land managers, educators, and others to address gaps in knowledge about 7 species of NA western migratory hummingbirds and to develop solutions to troubling population declines in some of these species. As a nectarivore and insectivore, hummingbirds face unique conservation challenges among bird orders in NA. During this presentation, we will share our work identifying threats and challenges to migratory hummingbirds in the United States, Canada, and Mexico and the strategies we have developed to help protect their populations. You will also have the opportunity to contribute to our discussions and findings with your expertise. This is the first conservation plan dedicated to migratory hummingbirds and represents years of collaborative work across three countries and with over 140 participants and 50 organizations.

Working group on bird collisions and modernized Migratory Bird Regulations: some tools to address window collisions

J. Bourque, C. Roy

Presenting author: **Julie Bourque**

In Canada, window collisions kill 16 to 42 million birds a year. It is one of the top sources of human-caused bird mortality, despite being easily preventable. Migratory birds are a federal responsibility and there is therefore a vested interest for the Government of Canada (GoC) to address bird collisions. Recently, the GoC has worked on and implemented several tools in its efforts to eliminate bird collisions. I will discuss two: the creation of an Interdepartmental Working Group on Bird Collisions (IWGBC) and the modernization of the Migratory Birds Regulations (MBR 2022). The IWGBC is a forum for government to work collaboratively towards the reduction of bird collisions with federally owned or managed structures. This is achieved through facilitating the collecting, sharing and analysis of data, the dissemination of information on bird collisions to the general public, and the implementation of agreed-upon actions to mitigate, minimize or eliminate bird collisions. The modernized MBR 2022 have clarified that the prohibition to kill migratory birds applies outside of the hunting context. Homeowners and building managers can now be given clear directives regarding their responsibilities towards the protection of migratory birds, and law enforcement can more easily enforce the prohibition when birds are killed from window collisions.

Assessing the impact of feather mites using an experiment involving hosts that harbor specialist and generalist mites

T. Boves, A. Matthews
Presenting author: **Than Boves**

Most bird-symbiont research has focused on putative 'parasitic' symbioses, but this presumption often lacks experimental evidence and overlooks potential context dependency of the relationship. For example, almost all studies on the symbiosis between feather mites and avian hosts have been correlational and focused at one location or on one host-symbiont partnership. This has led to conflicting classifications of the nature of the relationship (parasitic, mutualistic, or commensal). In addition, gaps in our understanding of the co-evolutionary history between mites and their hosts, expressed as current host specificity (host specialists to generalists), and thus our inability to account for this factor, may also contribute to these varying conclusions. To begin to fill these knowledge gaps, we conducted a field experiment using two species of warblers to assess the impact of mites on host body condition and survival under two host specificity scenarios. We captured and color-banded Cerulean Warblers (Setophaga cerulea; host of an ultra-generalist mite, Amerodectes ischyros) and Prothonotary Warblers (Protonotaria citrea; host of a specialist mite, A. protonotaria). We removed all mites from half of the individuals captured (treatments) and released the other half with their full mite load (controls). The following year, we attempted to resight all birds and recapture returnees. Upon recapture, we re-estimated body condition and mite abundance, and then compared results for treatment and control groups. This study provides some of the only experimental data on this perplexing symbiosis as well as a preliminary assessment of the importance of host specificity on the functional nature of this symbiotic relationship.

Winter ecology of Loggerhead Shrikes in the Lower Mississippi Alluvial Valley of Arkansas, USA

E. Donahue, L. Bryant, J. Wessels, J. Youtz, K. Krajcir, A. Worm, W. Guy, B. Dunnahoo, J. Miranda, A. Matthews, T. Boves
Presenting author: **Than Boves**

As intensive agriculture has transformed much of the landscape across central North America, many grassland birds have either disappeared from or declined in these new, highly homogeneous habitats. Despite this conversion, some species, like the Loggerhead Shrike (Lanius ludovicianus), still persist in agricultural landscapes. The Lower Mississippi Alluvial Valley (LMAV) is dominated by intensive agriculture but still provides non-breeding habitat for the species. However, we lack information on the sustainability of these populations, and Loggerhead Shrike non-breeding ecology is understudied range-wide. To fill these gaps, we banded and monitored >200 Loggerhead Shrikes in the LMAV of Arkansas (across 3,800 km2) during the winters of 2016–2023. We assessed apparent within-season and annual survival, movements between seasons and years, space use, and habitat selection patterns (with

a focus on agricultural features). Our results will assist in the development of improved management and conservation strategies at both local and global scales.

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*Population genomics among mainland and island chewing lice (Physconelloides eurysema) from Columbina passerina

Presenting author: **Paige Brewer**, Arkansas State University, paige.brewer@smail.astate.edu

Despite the importance of parasites for ecosystems and diseases, relatively little is known about the dispersal patterns of parasite between fragmented habitats, such as oceanic islands. Physconelloides eurysema, a body-specific feather louse from Common ground doves (Columbina passerina), are a model system to compare the influence of oceanic islands on parasite evolutionary and ecological patterns. The overarching goal of this study is to highlight P. eurysema phylogeography and population genetics among several island and mainland populations. We sampled feather lice from mainland and island populations, including from the U.S. (Texas), Ecuador, Brazil, Mexico, Bahamas, Jamaica, and Cayman Islands. This data was acquired through existing specimens and samples accessible on the National Center for Biotechnology Information (NCBI) SRA database. We extracted DNA from available samples using a Qiagen QIAamp DNA Micro kit and sequenced whole genomes using paired-end Illumina reads. We aligned these reads to an existing reference genome to obtain single nucleotide polymorphisms (SNPs) for population genetic analysis. We then used these SNPs to test for population genetic structure among the samples of lice. We also used a partial Mantel test to test for isolation by distance. We expect to find strong genetic structure between mainland and island populations with an isolated by distance pattern. This is because of the limited parasite dispersal among hosts from populations separated by large oceanic distances. We also expect island populations to have reduced genetic diversity due to the founder's effect on islands.

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*Golden-winged Warbler winter distribution under current and future climate and land use change scenarios

R. Brodie, A. Roth, J. Hightower, B. Stewart, N. Bayly, S. Wilson, A. Gonzalez-Prieto
Presenting author: **Ryan Brodie**, The University of Maine, ryan.brodie@maine.edu

During the overwintering period, Golden-winged Warbler (GWWA) occupies a variety of habitat types in low- and mid-elevation humid forests in Central America and northern South America. Threats faced by GWWA in these habitats include rapid deforestation and declines in food availability due to climate change. Recent projections of future breeding ground distributions highlight the need to understand the effects of climate and land use on this species and to expand projection modeling to the Neotropics. Selected environmental variables and a multi-source species occurrence dataset were used in a Biomod2 modeling framework to map recent (i.e., 2012-2021) and future (i.e., 2050) wintering ground distributions. Recent distributions were projected based on historical climate conditions (i.e., 1970-2000 averages), because these conditions contain useful ecological patterns that strengthen model results. Future distributions were projected under two climate scenarios (SSP 245 – 'Middle of the Road' and SSP 585 – 'Fossil-fueled Development') and three global coupled climate models (CMCC-ESM2, FIO-ESM-2-0, and MIROC-ES2L). Preliminary results show consistent and substantial range contraction in future climate scenarios, with the SSP 585 FIO-ESM-2-0 scenario being the most severe. High occurrence probabilities in Costa Rica for both current and future distributions suggest this is a critical area for targeted conservation efforts. A decision support tool will be developed to inform full-annual cycle conservation planning and direct limited resources to areas where they can be most effective. In addition, this research provides a framework to model non-breeding distributions of other Nearctic-Neotropical migrant species.

Post-breeding survival of adult and hatch-year Bank Swallow (Riparia riparia) in the Great Lakes ecoregion

C. Buchanan-Fraser, Y. Morbey, G. Mitchell
Presenting author: **Christian Buchanan-Fraser**

The post-breeding period poses significant threats to newly fledged birds due to predation, starvation,

exposure to inclement weather, and collision risk prior to their first southward migration. To address the gap in knowledge about this important time period, I used automated radio telemetry to track 100 adult and 100 hatch-year Bank Swallow (Riparia riparia) in the Great Lakes ecoregion during the 2021 post-breeding period. Additionally, 74 hatch-years tracked in 2018 were included in this study. I estimated and compared the daily apparent survival probability and daily recapture probability of Bank Swallow radio tagged during the 2018 and 2021 post-breeding periods. Daily apparent survival probability was higher for adults compared to hatch-years and we estimate that 20% of hatch-years die within two weeks post-fledging. Daily recapture probability was higher for birds radio tagged at lakeshore colonies compared to birds radio tagged at aggregate pit colonies. We suggest that large declines in detections during the post-breeding period may have been caused by premature tag loss or tag failure. Results suggest that hatch-year Bank Swallow experience differential mortality compared to adult Bank Swallow during the post-breeding period and that colony type may affect survival during the post-breeding period. Future studies should analyse Bank Swallow post-breeding tag retention and habitat use.

Lessons learned from long-term monitoring of Vermivora populations in the Southern Appalachians

L. Bulluck, C. Kelly, C. Smalling, D. Buehler

Presenting author: **Lesley Bulluck**, Virginia Commonwealth University, lpbulluck@vcu.edu

Golden-winged Warblers breeding in the Appalachian Mountains have experienced significantly greater population declines (96% loss since 1966) than those breeding in the Upper Great Lakes (41% loss) with some of the most extreme declines in the Southern Appalachians. Although similarities in habitat use and population demographics exist across the breeding range, there are differences that suggest regional conservation approaches should also differ. We present lessons learned from 20 yrs of data collected in Tennessee, North Carolina and Virginia. We have found that some sites/regions have remained remarkably stable over time while others have steeply declined. Poor post-fledging survival, range contraction by elevation, plant succession, and hybridization are all contributing to declines. Low-intensity grazing, timber harvests, and reclaimed mine lands are the mechanisms of habitat maintenance and creation in this region. In contrast to other regions, timber harvests are suitable for fewer years with persistent occupancy typically restricted to log landings and roads with ample herbaceous cover. Most GWWAs occur on private lands in this region, and therefore programs that provide sufficient financial incentives for old field management alongside timber management are necessary to sustain Southern Appalachian GWWA populations. Some remaining challenges are (1) teasing apart mechanisms of decline when they are multifaceted, (2) implementing long term monitoring across dynamic landscapes with low densities of GWWAs, and (3) supporting conservation of 'unpopular' habitats on private lands. We recommend focusing management in long term legacy areas where populations have been most stable, and expanding efforts out from there.

Novel opportunities to benefit Kirtland's Warbler and other Great Lakes fire-based bird communities in Ontario

P. Burke

Presenting author: **Peter Burke**, GEI Consultants, pburke@geiconsultants.com

The Kirtland's Warbler was rescued from extinction due to management in Michigan beginning in the 1960s. Searches from 2013-2016 in Jack Pine dominated areas north of Lake Huron revealed no occupancy. We asked if creation of habitat using structural requirements will attract the species to a mixed forest community of the Great Lakes. We predicted that restoration techniques replicating a central Ontario pine-oak assemblage will create suitable conditions. Spatial and temporal elements of the habitat are also required based on occupancy in Michigan. Since fire is a driver of Great Lakes communities, we predicted that habitat could be created at isolated sites. An GIS analysis of central Ontario used soils and land cover. Simcoe County which had the highest rank in our analysis, piloted a project to create habitat. Plans were developed to remove vegetation, use prescribed burns, replant, and broadcast native seeds in 2017 (Museum Tract) and 2019 (Packard Tract). Due to previous replanting, Packard was closer to the target seral stage. In 2022, six male Kirtland's Warblers occupied the Red Pine-dominated site. An average of 85 species of native vegetation of Simcoe County were used. The seral stage on which

Kirtland's Warbler is reliant upon, likely was sporadic on the central Ontario landscape and has been eliminated. Many other companion species will benefit from incorporating results we achieved in this study. Warbler occupancy at Packard indicates that habitat restoration can attract the species. Incorporating our results will support the recovery of this species and innumerable others. Adjustments in Red Pine management may assist forest modelling practices in sustainability and conservation objectives.

Avian grooming rates vary in time and space and predict survival.

S. Bush, M. Waller, D. Clayton
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Birds have evolved a variety of behavioral adaptations to care for their plumage, such as preening and scratching. These grooming behaviors keep the plumage clean, parasite-free, and properly arranged. Despite extensive research on the grooming of in animals, including birds, mammals and arthropods, the degree to which grooming responds to geographic and seasonal variation remains largely unexplored. We investigated geographic variation in the grooming behavior of American kestrels (Falco sparverius) in the sub-tropical Bahamas and temperate Utah in both summer and winter. Bahama kestrels groomed significantly more than Utah kestrels and had significantly greater parasite pressure from feather lice (Insecta: Phthiraptera). Within each region, however, birds with more lice did not groom more. This pattern is consistent with geographic differences in programmed grooming over evolutionary time, rather than stimulus-driven grooming in ecological time. We also investigated the fitness consequences of variation in grooming time using a population of marked kestrels on San Salvador Island, Bahamas, where resighting probability is high. We found a strong quadratic relationship between grooming time and long-term survival, consistent with stabilizing natural selection on grooming time.

The Aesthetics of Bird-Friendly Design

J. Carley, M. Carreño
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The Aesthetics of Bird-Friendly Design Too often, the architectural profession perceives bird-friendly design measures as a design negative. We see it as a positive opportunity for architectural expression. This presentation will briefly review some of the architectural myths pertaining to glass, and then will delve into the subject of the aesthetics of bird-friendly design, from the perspective of the designer who must achieve a bird-friendly design, while managing their clients' expectations. The presentation will look at particular issues of retail space and the showcasing of goods, will look at residential applications and the implications on sales, and in general, look at various architectural treatments and techniques beyond those of simply 'the dots'. The presentation will discuss how building glazing budgets may be affected by incorporating bird friendly design, as well as the complexities of procuring products that meet the aesthetics, performance, and cost criteria while reducing bird collisions. The presentation will be accompanied by images of actual bird-friendly applications.

Measures of individual and collective breeding ecology: grassland birds' response to restoration with bison.

A. Chavez Trevino, S. Lerman, M. Byrne, L. Sullivan, K. Gutknecht
Presenting author: **Alejandro Chávez Treviño**, School of Natural Resources - University of Missouri, acxgd@umsystem.edu

Native grazer reintroduction and land management may play a role in reversing the catastrophic decline of grassland birds. This is especially relevant in the Tallgrass Prairie where grasslands are scarce, and management critical. At Midewin National Tallgrass Prairie, efforts to manage grasslands includes cattle grazing, ungrazed tallgrass prairie restorations and bison grazing. An experimental restoration is comparing the interaction between bison with different land management strategies (fire, herbicide, mowing). Here, we present the multiple approaches used to monitor breeding birds' response to this experiment and historical management, and preliminary results of movement patterns of Eastern Meadowlark. Our objective was to determine bird response to different management strategies using collective and individual measures of breeding ecology. We investigated bird community distances and

density differences between grazing with bison, cattle and ungrazed plots. Then, we collected high-resolution GPS data on tagged Eastern Meadowlarks to compare measures of telemetry between the different management strategies. We found significant differences in the bird communities between grazing systems. Density of Eastern Meadowlarks and Grasshopper Sparrow was higher in grazed sites than in ungrazed sites. Dickcissel and Bobolinks were more abundant in bison pastures. Savannah Sparrow was more abundant in cattle grazed pastures. We expect to see differences movement patterns of Eastern Meadowlarks with territories under different management. This multi-approach monitoring may reveal potential ecological traps, and spotlight important considerations for grassland birds' conservation and grasslands restoration.

Quantifying shorebird energy expenditure reveals different drivers of behavior at two sites within a management unit

S. Clements, B. Ballard, J. Loghry, M. Weegman
Presenting author: **Sarah Clements**, University of Maine, sjclements9@gmail.com

There is often substantial variation in habitat and environments within species ranges and management units. We explored drivers of American avocet (Recurvirostra americana) energy expenditure to evaluate patterns of non-breeding habitat use at Mustang Island in Texas, USA and Rockefeller Wildlife Refuge in Louisiana, USA, in the Gulf Coastal Prairie Bird Conservation Region (BCR). Presently, habitat requirements for avocets and many other shorebirds are uniformly defined across the BCR. However, habitat composition and configuration are variable within the BCR and practitioners have noted regional differences in habitat use and behavior. Using GPS-acceleration data from tracking devices on 31 avocets, we parameterized a Bayesian linear mixed model with overall dynamic body acceleration (a proxy for energy expenditure) as a response variable, and tide, time of day, day of year, and landcover as hypothesized drivers. We found that landcover, tide amplitude, and time of day explained substantial variation in energy expenditure, but that patterns in these effects differed between sites. For example, the interaction of landcover and tide was more influential at Rockefeller than Mustang Island, and Mustang Island birds showed a substantial dichotomy in energy expenditure between day and night, while Rockefeller birds did not. Our study uses a unique approach to demonstrate that for American avocets and similar shorebirds, the utility of habitat for foraging, roosting, or other activities may change with temporal factors. Variation in both spatial and temporal factors influencing wildlife-habitat relationships should be considered for conservation planning.

Conserving Migratory Hummingbirds on Non-Breeding Sites in Western Mexico

S. Contreras
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Twenty-four species of hummingbirds are found in Western Mexico, including seven long-distance migratory species, five endemic species, and twelve others with diverse and unique needs. To conserve populations representing different species, we have studied their biology, phenology, use of habitats, and floral preferences. During this presentation, we will share the results of some of our work identifying key threats to hummingbirds, with a focus on migratory hummingbirds, This work has been comprehensive and focused largely at the Sierra de Manantlán Biosphere Reserve in Jalisco, Mexico. There, we explored the use of fire as a habitat management tool. We also offer our study as an example of how working with community members can benefit bird conservation and will describe our collaborations with the Biosphere Reserve, ejidos, and other governmental and non-governmental organizations. The results of our work will help to inform the first Hummingbird Conservation Plan and, we hope, will serve as a model for future efforts.

Songbirds initiate migratory flights synchronously relative to civil dusk

N. Cooper, B. Dossman, L. Berrigan, J. Brown, A. Brunner, H. Chmura, D. Cormier, C. Bégin-Marchand
Presenting author: **Nathan Cooper**, Smithsonian Migratory Bird Center, nathanwands@gmail.com

Each spring and fall billions of songbirds depart on nocturnal migrations across the globe. Theory suggests that songbirds should depart on migration shortly after sunset to maximize their potential for nightly flight duration or to time departure with the emergence of celestial cues. However, observational studies have found that wild birds depart later and more asynchronously relative to sunset than predicted. We used coded radio tags and automated radio-telemetry to estimate the time that nearly 400 individuals from nine songbird species departed their breeding or wintering grounds across North America. We then explored variation in nocturnal departure time by post-departure movement type, species, age, sex, and season. We found that 90% of individuals from species that were likely initiating long-distance migratory flights departed within 69 minutes of civil dusk, regardless of species, season, age, or sex. By contrast, species that likely first made non-migratory regional movements departed later and more asynchronously throughout the night. Regardless of post-departure movement type, 98% of individuals departed after civil dusk but otherwise showed no preference in relation to twilight phase. Although the presence of celestial orientation cues at civil dusk may set a starting point for departure each night, the fact that species likely beginning long-distance migration departed earlier and more synchronously relative to civil dusk than those first making non-migratory regional movements is consistent with the hypothesis that departing promptly after civil dusk functions to maximize the potential for nightly flight distance, and may be one aspect of a time-minimizing migration strategy.

Investigating spring migration timing and stopover duration of Sora and Virginia Rail using automated telemetry

Presenting author: **Chad Cremer**, Forbes Biological Station INHS UIUC, ccremer@illinois.edu

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Build it and they will come: Wetland restoration on Pelee Island, Ontario Canada

J. Crosthwaite
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Habitat loss is one of the biggest threats to biodiversity in southern Ontario. In Essex County, over 90% of wetlands have been lost. Pelee Island, in Lake Erie, is a biodiversity and species at risk hotspot and major stopover point for migrating birds. The Nature Conservancy of Canada has developed a Natural Areas Conservation Plan for the Western Lake Erie Islands, focusing on Pelee Island. NCC owns and manages over 420 ha (10% of the island), including former agricultural fields. One of the goals of our conservation plan for the area is to increase wetland cover to replace habitat that has been lost. We identified areas that had been wetland prior to draining for agriculture and worked with qualified contractors and researchers to recreate almost 30 ha of wetland habitat for birds and species at risk. In 2020-21, we created a 25 ha wetland by breaking agricultural drains, excavating low-lying areas and constructing a 1.6 km berm to create the wetland basin. Native plant species were collected as seed from on-island sources and planted in and around the wetland using a combination of direct seeding and plug planting. An eBird hotspot has been established for the property and 164 species have been observed since spring 2021, including marsh species like bitterns and rails. Two endangered species, Scarlet Ammannia and Small-mouthed Salamander have also been documented reproducing at the site. This project is already being successfully used by wildlife and ongoing monitoring will inform our management into the future.

Quantifying shorebird migration pathways through Atlantic Canada using automated telemetry: a community perspective

D. de Zwaan, H. Mann, A. Hjort Toms, R. Linhart, E. Geldart, S. Davis, J. Arsenault, P. Doiron, J. Paquet, D. Hamilton
Presenting author: **Devin de Zwaan**

Atlantic Canada is a critical staging ground for Arctic-breeding shorebirds during post-breeding migration, representing the last stop before overseas flights to Central and South America. Understanding how

shorebirds move through this landscape prior to departure is imperative to identifying habitat requirements & guiding conservation actions. Automated telemetry revolutionized tracking of large numbers of volant animals, like shorebirds. However, the full potential of Motus data has yet to be realized, particularly when integrating across multiple data sources & moving beyond single species to community-level patterns. Using 8 years of Motus data from 7 shorebird species, we identified the location, timing, & intensity of migration pathways through Atlantic Canada during southbound migration. Specifically, we integrated Motus data with citizen science surveys to estimate the strength of connectivity among key arrival and departure locations, as well as variation among species with different traits. We identified major pathways connecting to key departure locations on the east and southeastern coast of Nova Scotia, as well as multiple secondary pathways. The shorebird community stratified across these pathways based on whether species were long or short-distance migrants & through time, as species with different phenology moved through the region. Given variable movement patterns, certain species may be more at-risk from spatially explicit habitat degradation & infrastructure that disrupts the aerosphere. We highlight the implications of integrating broadscale abundance patterns with fine-scale location data for regional conservation planning, siting decisions for windfarms & other energy development.

The influence of sex ratio on the spring migration traits of male Yellow-rumped Warblers

J. Deakin, C. Guglielmo, Y. Morbey
Presenting author: **Jessica Deakin**

Migratory birds are under selective pressure to accurately time their arrival at the breeding grounds. They may use cues from the social environment to schedule their annual events to achieve an appropriate arrival time. For instance, a population-level social environment that is male-biased is predicted to advance spring migration because of increased male-male competition for access to females and/or breeding territories. We investigated the consequences of a slightly male-biased sex ratio on the progression of spring migration traits in male Yellow-rumped Warblers (Setophaga coronata coronata). Birds were captured during fall migration and housed in either male-biased or female-biased treatment flocks in captivity overwinter. In the spring, we monitored mass gain and moult progression, which were similar between the treatment groups. We used digitally coded radio-transmitters to quantify locomotory activity, including the onset of migratory restlessness, a proxy for migration onset and propensity. Following release at their capture site, we used the Motus Wildlife Tracking System to examine post-departure movements. Interestingly, we found that birds in the male-biased treatment displayed less locomotory activity and were less likely to initiate migratory restlessness. However, departure timing and post-departure movements were similar between treatments. Our findings suggest that the social environment can influence behaviour of songbirds, but do not support the hypothesis that a male-biased sex ratio accelerates migration.

Climate change impacts on aerial insectivores roosting phenology at the Great Lakes

Y. Deng, M. Belotti, B. Haest, W. Zhao, G. Perez, E. Tielens, J. Kelly, S. Maji, D. Sheldon, K. Horton
Presenting author: **Yuting Deng**, Colorado State University, hermione.deng@colostate.edu

Given the threats presented by climate change, conserving migratory birds requires knowledge of the factors driving changes in migratory behavior. Post-breeding roosting phenology of aerial insectivores has advanced over the past two decades in the Great Lakes region, though its interannual variability and long-term trend have not been fully explained. It remains a challenge to assess the influence of weather on migratory bird phenology with temporal and spatial uncertainties. For instance, are phenophases paced by local conditions or more distant conditions? Remote sensing platforms offer a unique opportunity to monitor migratory movements and collect long-term and large spatial-scale environmental data. We conducted a location-specific time-window analysis to examine the effects of 20 gridded weather and vegetation variables on swallow roosting phenology in the Great Lakes region. The analysis covered a 21-year (2000-2020) long time series and covers areas across Canada and the northern United States. This work will contribute great knowledge on migration ecology and migratory birds' response to

ongoing climate change.

Communities on the move: testing the strength and persistence of songbird species associations at stopover

J. DeSimone, E. Cohen
Presenting author: **Joely DeSimone**, University of Maryland Center for Environmental Science, joely.desimone@umces.edu

Migrations often converge in space and time such that songbirds arrive at stopover sites en masse. Spatial and temporal co-occurrence of species provides opportunities for meaningful social interactions, including competition or the acquisition of social information, that could influence stopover refueling and duration and ultimately migratory success. However, we know very little about the community ecology of stopover sites. Not only may social interactions be important at a given stopover site, but they may be recapitulated at each stop as communities of songbirds migrate together. Alternatively, each stopover may represent a complete re-shuffling of community composition and species interactions over the course of migration. We use almost one million banding records collected over ~20 years from bird observatories throughout northeastern North America, inferring species associations from individuals captured in the same net (12 m) during the same net run (30-45 min). First, we quantify the strength of species associations, identifying species pairs that are encountered together more often than expected based solely on similarities in migration timing and habitat use. Second, we test the persistence of species associations, finding meaningful similarities among social networks of songbird communities across multiple stopover sites. This work supports a community ecology perspective of animal migration, considering the mass movements of communities traversing continents together.

Comparing nestling diet, condition, and post-fledging survival of Barn and Tree Swallows across an agricultural gradient

A. Diaz, C. Morrissey, K. Hobson
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Diet quality and other environmental conditions experienced while breeding can have immediate and long-term effects on phenotypic quality of offspring. Notably, there is growing interest in carry-over effects from the nest to influence the post-fledging period. We investigated if the intensity of agriculture (crop and wetland cover) influenced parental selection of prey and nestling body condition of Tree Swallows (Tachycineta bicolor) and Barn Swallows (Hirundo rustica) in the Saskatchewan agricultural landscapes. Using the Motus Wildlife Tracking System, we determined the early post-fledging apparent survival and movements of both species. Stable isotope (Î´2H) data showed that Tree Swallows strongly relied on aquatic-emergent prey, regardless of the availability of wetlands in the immediate area (<500 m) whereas Barn Swallows used this prey when wetlands were locally abundant. Although wetland cover (1700 m) and row-crop cover (500 m), showed weak but negative effects on nestling body condition of Tree and Barn Swallows, respectively, nestling quality was strongly influenced by local site and brood conditions. Apparent post-fledging survival was similar between species, declining to ~ 28% after two weeks, but was not related to developmental traits (body condition, wing) measured while in the nest. Tree Swallow fledglings left their natal areas sooner than Barn Swallows and, after fledging, were found congregating at wetlands and marshes (> 5 km). Our work highlights the importance of the conservation of wetlands within agricultural landscapes for breeding aerial insectivores and contributes to filling in gaps in our knowledge of the post-fledging period, an important demographic driver of annual population growth.

Introgression dynamics in bird feather lice

J. Doña, K. Johnson
Presenting author: **Jorge Doña**

The highly specialized relationship between bird feather lice and their hosts has made it an iconic system for understanding coevolutionary dynamics. Recent studies have found evidence that opportunities for interspecific gene flow in host-symbiont systems may be higher than previously thought. On the other hand, genomic studies on plant and animal patterns of introgression have found that introgression can

increase effective population size (Ne) and can be particularly useful in changing or novel conditions, allowing populations to cross fitness valleys and evolve and persist along new avenues. This presentation will explore the extent to which introgression is a common phenomenon in feather lice, based on whole-genome data for over 700 louse species. The investigation will show whether introgression occurs among closely related species and provide information on how the amount of introgression relates to the date when hybridization may have occurred. Additionally, the presentation will discuss how introgression relates to macroevolutionary events, such as host switching. Integrating hybridization into the study of coevolutionary dynamics opens many avenues for understanding the complex processes that shape the diversity of host-symbiont systems.

Hidden Space Use Behavior of a Nonbreeding Migratory bird: The Role of Environment and Social Context.

B. Dossman, A. Rodewald, P. Marra

Presenting author: **Bryant Dossman**, Georgetown University, bd618@georgetown.edu

Movement is a fundamental component of the ecology of all organisms and governs how they interact with other species and the environment - ultimately underlying fitness. Yet, our understanding of space use has remained constrained by our inability to track organisms at fine spatiotemporal resolutions, resulting in biases towards larger organisms and easily observed movement behaviors. Here, using a novel automated telemetry array coupled with manual hand-tracking, we examined the distribution of space use behaviors of a wintering population of migratory songbirds; the American redstart Setophaga ruticilla. We identified several distinct space-use behaviors including territoriality, floating, and transience, as well as quantified the variability in space-use behaviors that often blur the lines between distinct strategies. In resource-poor years, birds exhibited less constrained space use behaviors such as floating and transience. Likewise, within a season, declines in weekly resources increased the prevalence of forays and the area of space utilized. Lastly, we determined that dominance status (i.e., age and sex) significantly influenced the space use behavior and plasticity in space use, with more dominant classes (i.e., adult males) more likely to occupy territories and respond more strongly to changing seasonal resource availability. Taken together, we demonstrate the importance of the interplay between environmental conditions and individual behavior in ultimately driving the distribution of space use behaviors at the individual and population-level. Our study highlights the rich variability in space use behaviors that are typically not captured in most conventional population studies and have gone largely overlooked

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Urban Bird Diversity in Colombia: Insights from Long-Term Studies and Trends for Neotropical megadiverse cities

M. Echeverry-Galvis, P. Lozano, J. Amaya-E.

Presenting author: **Maria Echeverry-Galvis**, Pontificia Universidad Javeriana, mayayito@gmail.com

The significance of biodiversity in urban areas is often overlooked, and there need to be long-term studies to understand how different species respond to these environments. Most information on urban birds comes from short-term studies conducted in the northern hemisphere that can provide insights into the diversity and distribution of communities but may only focus on more visible and abundant species, which can bias them. One of the few global multi-temporal datasets available on urban birds in tropical regions is the Christmas Bird Counts (CBC), conducted in Colombia since 2001. Using CBC data from 21 urban and peri-urban sites in Bogotá, Cali, and MedellÃn between 2001 and 2018, we analyzed the diversity and distribution of bird communities, their response to urbanization and dietary guilds, abundance, similarity, and complementarity. Our results showed that cities and sites with higher levels of urbanization had lower richness, particularly among species that avoid urban areas (called avoiders) and those that rely on a diet of fruits and insects. Peri-urban sites were important in maintaining sensitive species, promoting higher dissimilarity and complementarity. Wetlands and urban parks were crucial for maintaining the highest richness and abundance of avoiders and utilizers in MedellÃn and Bogotá. Long-term studies are necessary to understand bird diversity and distribution patterns in urban areas fully. Our findings provide baseline information to inform decision-making and recommendations for reconciling urban development with preserving native avifauna in megadiverse Neotropical countries like Colombia.

*NA-POPS: Point count offsets for estimating population sizes of North American landbirds

B. Edwards, A. Smith, T. Docherty, M. Gahbauer, C. Gillespie, A. Grinde, T. Harmer, D. Iles, S. Matsuoka, N. Michel, A. Murray, G. Niemi, J. Pasher, D. Pavlacky Jr
Presenting author: **Brandon Edwards**

Bird monitoring in North America over several decades has created many open databases, housing millions of structured and semi-structured bird observations. These can be used as the basis for generating population estimates, but require accounting for variation in factors such as underlying field methods, timing, land cover, proximity to roads, and uneven spatial coverage. The QPAD approach considers probability of availability (p) and detection (q) of birds in relation to area (a) and density (d), allowing counts of birds from any stationary point-count survey to be translated into estimates of true density, facilitating integration of data from across disparate survey methods. Here, we describe NA-POPS: Point Count Offsets for Estimating Population Sizes of North American Landbirds, a large-scale, multi-agency project aimed at generating an open-source database of detectability functions for all North American landbirds. To date, NA-POPS has collected over 7 million data points spanning 292 projects from across North America. This has allowed for the generation of detectability functions for over 300 species of landbirds so far. We describe how we curate these data while respecting data-ownership, the methods to generate the detectability functions, the open-access nature of the resulting database of offsets, and highlight some key spatial gaps that we are working to fill. We also describe our vision for use cases of the open-source detectability functions to improve estimates of abundances in various bird monitoring programs such as atlas projects.

Why does detectability matter? From density estimation to conservation decisions

B. Edwards, J. Bennett, A. Smith
Presenting author: **Brandon Edwards**

Detection probability, or detectability, is an important metric to consider across a suite of conservation purposes. In many cases, estimates of detectability are no more than educated guesses based on experiences in the field. While these guesses are often backed by the experience of hundreds of surveys and can provide reasonable ballpark estimates toward a species' true detectability rate, they may lack information about heterogeneity in detection probability, such as variance based on survey timing or vegetation structure, and almost certainly lack in information about precision around the guesses. Over the last few decades, several modelling techniques have been developed to produce data-driven estimates of detectability. These model-based approaches allow us to explicitly estimate precision around these empirical estimates of detectability, and may even provide more precise estimates. Given sets of covariates such as vegetation structure or survey time, these models can also allow researchers to account for these covariates that may affect detectability. This talk introduces some of the latest methods in estimating detection probabilities in birds, and highlights the importance of estimating precise and accurate measures of detection probability. Not only are these detection probabilities used to estimate occupancy and abundance of birds, but they can also be used in important conservation decisions surrounding species at risk. When conservation decisions are made around species based on the presence or absence of the species, or based on population trends of the species, proper accounting for detectability and uncertainty around it can mean the difference between protecting or not protecting a declining species.

Restoring migratory bird habitat in working landscapes in Latin America & the Caribbean

M. Eggers
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More than 340 migratory bird species - totaling nearly 5 billion birds - travel from the United States and

Canada each year to Latin America and the Caribbean. This represents one of the world's largest and most awe-inspiring animal migrations. When managed sustainably, working lands - such as farms and ranches - provide good habitat for migratory birds that are stopping over or wintering in Latin America and the Caribbean during their annual migration cycle. While maintaining existing pristine forest habitat for migratory birds in parks and reserves remains critically important, creating buffer zones of bird-friendly working lands around these protected areas is also beneficial for migrant species. Their benefit stems from the fact that many migrant birds, especially forest species, live as habitat generalists on their wintering grounds, which enables them to find food and shelter in a variety of landscapes. American Bird Conservancy (ABC) is working with producers, such as growers of cacao, coffee, and cardamom, as well as cattle ranchers, to promote the adoption of sustainable practices and habitat restoration initiatives that benefit birds while increasing producers' yields and incomes.

Tracking fall migration of Bank Swallows (Riparia riparia) from across Canada – insights from automated radio telemetry

S. Endenburg
Presenting author: **Sarah Endenburg**

Migratory birds use a variety of habitats across large geographic areas throughout their annual cycle and encounter different threats as they move from one area to another. Bank Swallow (Riparia riparia) abundance in North America has declined by 98% since 1970, but regional population trends vary across the breeding range. The drivers of these varying declines have not yet been identified, but may reflect exposure to different threats in different locations during breeding, migration, and over-wintering. We used the Motus wildlife tracking system to quantify departure times and migration routes for R. riparia. We tagged 302 birds in 2022 at 12 breeding sites across nine provinces and territories, and 183 were detected by the Motus network. Riparia riparia in Nova Scotia departed earliest, and birds in Yukon departed the latest, but there was substantial overlap in departure dates among most sites. Birds departing from Atlantic Canada flew south along the east coast of North America and were last detected in Florida. Birds tagged in Yukon crossed through Alberta and Saskatchewan, then travelled to Florida. Birds tagged in B.C. followed the Rocky Mountains into Montana and Idaho, then moved south-west. The southernmost detections were in Mexico, Costa Rica and Paraguay in mid-August and late September. These results illustrate differences in the migration ecologies of R. riparia from breeding regions across Canada, which may expose them to different threats during the breeding and non-breeding seasons. Understanding movements of R. riparia across the full annual cycle can inform spatially explicit conservation prioritization, and may reveal drivers of the varied population trends on their breeding grounds.

Anthropogenic and mechanistic drivers of contrasting demographic changes in hummingbirds

C. Bishop, A. Gonzalez, J. Elliott, A. Moran, F. Maisonneuve, S. English
Presenting author: **Simon English**, University of British Columbia, sgeng@mail.ubc.ca

Conserving species requires knowledge of vital rates that govern population dynamics including adult and juvenile survival, and recruitment. Practitioners may then direct limited resources to the most vulnerable stages of target species' life-cycles. Additionally, quantifying drivers of change in vital rates allows conservationists to enact specific remediation strategies. However, knowledge gaps about how drivers of demographic change affect population dynamics persist. We developed an integrated population model using 25 years of mark-recapture data alongside survey data for four species with contrasting population trends: Anna's, black-chinned, calliope, and rufous hummingbirds. We integrated a suite of land cover and climate data to test hypotheses concerning the major drivers of demographic change in relation to species' life histories. We found that adult survival contributed most strongly to population growth, followed by juvenile survival, and then recruitment. For rufous hummingbirds, we found that declines in juvenile survival and to a lesser extent, adult survival, are the most likely cause underlying their decline. Moreover, rufous hummingbird adult and juvenile survival rates were negatively impacted by human population density. Wetland cover contributed significantly and positively to juvenile survival of calliopes. Adult calliope and rufous hummingbird survival was positively associated with crop cover and negatively

associated with wetland cover respectively. Factors including flowering-crops and emigration likely contribute to these counter-intuitive results. Overall, our model provides insight into how anthropogenic changes to landscapes affect the population dynamics of species of conservation concern.

Identifying and stewarding Key Biodiversity Areas: the critical role of volunteer-gathered data

D. Evans, A. Couturier, A. Bichel
Presenting author: **Dean Evans**, Birds Canada, devans@birdscanada.org

In 2016, the International Union for the Conservation of Nature (IUCN) released a global standard for identifying Key Biodiversity Areas (KBAs). KBAs are sites that are essential for the persistence of biodiversity and can be important for several reasons: they support threatened or geographically restricted biodiversity; they have high ecological integrity; they support biological processes; and/or they are irreplaceable. Canada was one of the first countries to develop a national standard for identifying KBAs, a process that is currently underway. Important Bird and Biodiversity Areas (IBAs) are foundational for identifying KBAs due to the similarity of IBA and KBA criteria and the considerable conservation work done in IBAs over the last 30 years. Focusing on at-risk species and aggregations of birds, we have undertaken an analysis to transition IBAs to KBAs with the goal of identifying sites to be nominated as KBAs. This was done by applying the global and national KBA criteria to over 18 million records, across all 581 IBAs in Canada, collected from the NatureCounts database of bird monitoring and citizen science-based programs such as eBird, Christmas Bird Count, and Maritimes Piping Plover Survey data, to name a few. We found 437 of these IBAs to be presumptive KBAs, of which 183 contain quality data allowing for nomination as a KBA and the remaining 254 are a priority for expert review and additional data harvesting before nomination. To date 23 IBAs have formally been accepted as KBAs of global significance. By engaging local stewards and experts we hope to continue to nominate qualifying IBAs as KBAs to ultimately communicate and recognize the importance of these sites for biodiversity.

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*Identifying key roost sites and their connectivity for swallows

S. Fensore, J. Nocera
Presenting author: **Sarah Fensore**, University of New Brunswick, sarah.fensore@unb.ca

Aerial insectivores, a guild of bird species defined by their common method of foraging for insects while in flight, are showing significant population declines in North America, though the causes remain hypothetical and are likely to be multi-faceted. We explored some of those facets, roost ecology and movement patterns, to fill in key knowledge gaps about two species of aerial insectivore: Barn Swallow (Hirundo rustica), and Bank Swallow (Riparia riparia). Roost sites act as important refugia and refueling sites for these communally roosting species, but little is known about roost site use patterns. Using automated radio telemetry, we gathered movement data during the breeding and post-breeding seasons for these species in New Brunswick and Nova Scotia to 1) identify roost sites and roost site use within the study area and 2) characterize movement patterns related to breeding timing and landscape use. This presentation will highlight findings in the identification of roost sites, differences in roosting behavior between biologically significant time periods (breeding and pre-migratory), as well as change points in movement patterns across the season.

An introduction to statistical effect sizes for assessing collision prevention

E. Fernandez-Juricic
Presenting author: **Esteban Fernandez-Juricic**, Purdue University, efernan@purdue.edu

Selection of appropriate statistics for assessing performance of collision prevention technologies has important implications for conservation management. Focusing the inference of statistical analyses on P-values (i.e., 'significant differences') to make a pass/fail decision about the effectiveness of a tested technology carries a risk that some of those analyses may be underpowered, and increases the uncertainty of significant as well as non-significant results. The magnitude or biological importance of the difference (i.e., effect size) is rarely considered to place the test results in a broader applied context. The goal of this presentation is to review the concept of effect size and its different types. I will discuss the

relevance of effect sizes to design future collision prevention tests, estimate the necessary sample sizes to make strong inferences, and most importantly interpret the results of such tests. Stakeholders will be encouraged to define the minimum effect sizes of interest (i.e., the minimum improvement in collision prevention technology relative to a baseline that is worth the increase in bird survival and/or implementation costs) to guide future decision making in the adoption of standards for new technologies that can minimize bird-window collisions.

Estimating Golden-winged Warbler adult apparent survival based on range-wide capture-recapture data

E. Filiberti, A. Roth, E. Royal, W. Thogmartin, D. Crawford
Presenting author: **Emily Filiberti**, University of Maine, emily.filiberti@maine.edu

The Golden-winged Warbler (Vermivora chrysoptera) is a precipitously declining Nearctic-Neotropical migratory songbird in urgent need of population recovery. To assess potential protection under the US Endangered Species Act, more information is needed on population demographics. A current gap in knowledge is understanding primary drivers that result in steeper decline in the allopatric Appalachian region, in comparison to the shallower decline of the Great Lakes population. While multiple studies have estimated localized apparent survival rates for male Golden-winged Warblers, literature is lacking a range-wide analysis that incorporates estimates between regions, sexes, and ages. To better understand overall annual apparent survival, we collected 23 temporal mark/recapture datasets collected by collaborators throughout the species' breeding and wintering range. Survival estimates for the Great Lakes and Appalachian populations were compared using a multilevel model that incorporated 16 and 7 datasets, respectively. Preliminary results suggest similar survival estimates between the two regions. Additional steps will investigate potential differences between ages and sexes. These data will contribute to development of a full annual cycle integrated population model used to identify demographic factors driving population changes. Awareness of intra-population variability will inform management strategies to target particularly vulnerable subpopulations, individuals, or cohorts.

Fall stopover length and movements of migratory birds in urban greenspaces

B. Frei, A. Morales
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Urban greenspaces serve an important role in supporting biodiversity in the landscape, and may be disproportionally important to birds during certain times of the year (e.g., migration stopovers). During fall migration many birds use inland forest as stopover habitats, and show broad-scale attraction to artificial light while airborne, leading to increased stopover density near urban areas. While stopover length is generally quantified from banding data, there remains little known of individual-level stopover duration and movements for a majority of migratory birds. Using VHF radio nanotags from the Motus network, we tagged 78 individuals of our three focal species: Song Sparrow (Melospiza melodia), Hermit Thrush (Catharus guttatus), and Yellow-rumped Warblers (Setophaga coronate) in the fall of 2022, captured in a large urban greenspace in Montreal, Quebec. We identified movements, habitat associations, departure decisions, and stopover length via daily tracking, and quantified fall migration patterns via the Motus network. Our findings highlight that stopover duration from banding data may underestimate stopover length, with all three species having significantly longer true stopover periods when comparing results from daily tracking to 18 years of banding data. For Hermit Thrush and Yellow-rumped Warbler, mean length of stay from tracking was almost 3 times longer than banding estimates. Our findings highlight that even species that are not considered 'urban birds', such as boreal-breeding neotropical migrants, may spend a significant part of their annual cycle at stopover sites within an urban landscape.

Common Loons are in trouble: citizen science and international collaboration to the rescue?

M. Fuirst, K. Bianchini, M. Mallory, W. Piper, D. Tozer
Presenting author: **Matthew Fuirst**

Population size, productivity, and survivorship of Common Loons (Gavia immer) have declined over the

past several decades in some, but not all, regions of the species' North American breeding range. These regional declines are shown by ongoing intensive monitoring of a uniquely colour-marked study population in a single county in northern Wisconsin since the early-1990s, and by broad-scale citizen science monitoring data from the Canadian Lakes Loon Survey and a dozen other long-term loon monitoring programs. Leading hypotheses explaining the declines include multifaceted interactions and pathways among past damage from acid rain, mercury pollution, decreasing water clarity due to runoff and algal blooms, and climate change. These hypotheses fail, however, to fully explain patterns in population dynamics across all regions. Here, we describe the efforts of a growing international collaboration, the Loon Research Working Group, which brings together loon scientists from across the continent to jointly analyze all available Common Loon data to help generate additional hypotheses explaining regional declines. Analyses are being conducted according to the conservation unit framework developed for the Common Loon across North America, making our results directly relevant for on-the-ground conservation efforts. Our ultimate goal is to uncover the drivers of Common Loon population dynamics issues throughout North America, and to identify and implement actions to mitigate or hopefully eliminate the issues.

NRCS Working Lands for Wildlife: delivering conservation science on private land in the Appalachian Conservation Region

J. Larkin

Presenting author: **Kristin Fuoco**

Habitat management is an important conservation strategy for species like the Golden-winged Warbler that are limited by habitat quantity or quality. While efforts to create or enhance Golden-winged Warbler habitat on public lands play a valuable role in the species recovery, the importance of private lands cannot be overstated. In 2012, NRCS and its partners initiated the Working Lands for Wildlife (WLFW) program to restore Golden-winged Warbler breeding season habitat in the Appalachian Mountains portion of the species range. To date, several hundred private landowners representing ten states have received technical and financial assistance to create habitat for the Golden-winged Warbler through WLFW. A multi-year outcome assessment was also completed. Assessment results provided: a) improved information about the distribution of Golden-winged Warbler; b) better understanding about the response of Golden-winged Warbler and other species to habitat management; and c) greater insight into ecological criteria associated with GWWA occurrence. Managed habitat required several growing seasons (â‰¥ 3) post-treatment to become occupied by Golden-winged Warblers. Future habitat management efforts for this species should avoid landscapes with >10% mixed forest, and efforts in the Appalachians should target areas within 13 km of known breeding populations. Monitoring results were used to create Priority Areas for Conservation which are used to guide placement of new habitat projects in areas with maximum potential for species occupancy. Evidence suggests that carefully implemented programs like Working Lands for Wildlife, and similar efforts on public lands have the potential for success, even where a focal species may be rare.

Ecological Restoration of Critical Habitat for Grassland and Migrant Birds

M. Gartshore

Presenting author: **Mary Gartshore**, Long Point Basin Land Trust, gartcar@kwic.com

We worked with the Nature Conservancy of Canada and other conservation land owners to establish new habitat areas using seed-based ecological restoration. Could we re-create a self-driven, successional oak savanna - woodland habitat using a diverse mix of local flora? If so, would rare or declining birds and other fauna respond positively to a restoration based on a successional trajectory of vegetation? Restoration occurred on a glacial outwash sand plain near Long Point, Norfolk County, Ontario. We used knowledge of floristics, reference sites and plant life history traits to select seed of around 100 species to sow agricultural fields. Restored sites were weedy in the first year and occupied by Vesper Sparrows. From second year onward sites were mostly vegetated by native plants supporting Grasshopper and other sparrows. Tree saplings began to appear above the herbaceous layer by the fourth growing season and by the fifth growing season Indigo Bunting, Eastern Towhee, Eastern Whip-poor-will and other shrubland species occurred. By the 10th growing season forest and edge birds included restored fields in

their territories alongside grassland and shrubland birds. In addition, rare mammals, herpetofauna and insects also occupied the restoration sites. Our results were in keeping with initial expectations. A surprise was that forest-dwelling species also utilized the restoration fields even when trees were 2 - 3 m saplings, and grassland birds inhabited smaller patches later than their successional stage. Restoring fields reduced forest fragmentation effects, increased habitats and reduced ecological degradation in a high biodiversity landscape dominated by agriculture.

American policy landscape for bird friendly buildings and federal collisions initiatives

J. Gehring, P. Toschik, E. Kershner
Presenting author: **Joelle Gehring**, US Fish and Wildlife Service, joelle_gehring@fws.gov

Every year in the United States nearly one billion birds collide with building glass, mainly at low-rise buildings and homes (Loss et al 2014). Most birds that collide with glass in the U.S. are protected by the Migratory Bird Treaty Act, a law implemented by the U.S. Fish and Wildlife Service (FWS). The FWS promotes glass retrofits and light minimization by providing resources, outreach, educational signs, tools, and materials for diverse audiences. To educate FWS staff and the public, set a federal agency standard, and reduce collisions at FWS facilities, we distributed an online survey of FWS facility collision risk. The survey allows ranking and prioritization of facility retrofits, thereby supporting collision reduction. FWS efforts are consistent with current Department of the Interior appropriations language regarding the reduction in the number of bird collisions with buildings and towers. General Services Administration, the agency managing federal buildings, also facilitates bird safe glass in their P100 Building Standards for federal facilities. Using Memoranda of Agreements, working groups, and outreach campaigns the FWS encourages other federal agencies to reduce bird collisions via light reduction and glass retrofits. The U.S. federal agencies are using diverse approaches and working together to reduce bird collisions at government facilities and beyond. Bird collisions with glass contributed to the loss of nearly three billion birds since 1970, but these collisions are preventable and the FWS is working with partners to implement proven solutions and inspire others to take action.

The gift that keeps on giving: Motus reveals overwinter space use and survival of Canada Warbler (Cardellina canadensis)

A. Gonzalez, N. Espejo, A. Caguazango, C. Gonzalez Prieto, N. Bayly, K. Hobson, P. Marra, S. Wilson
Presenting author: **Ana Gonzalez**

Steep declines in long-distance migrants have been linked to habitat loss on the wintering grounds. Yet, information about survival and patterns of space use during the wintering period and underlying mechanisms remain largely unknown. We estimated the effect of precipitation on seasonal survival of Canada Warblers (Cardellina canadensis) overwintering in three study sites in the Colombian Andes through detection histories recorded by automated telemetry stations (Motus). We also used manual tracking to estimate the size of the home range used by individuals at the three sites and assessed the effect of habitat quality and heterogeneity on home range size. Survival was lower mid-season and varied by the total precipitation in January and February in each year at each site. Specifically, daily survival was lower at the site when January and February precipitation was higher. The size of the home ranges varied by site and home ranges with high quality habitat were smaller. We found strong support for the effect of habitat heterogeneity on home range size with high variation in vegetation density within the home range results in larger home ranges. Assessing the amount of habitat needed by the Canada Warbler during the winter and overwinter survival will allow to set habitat conservation targets that would ultimately benefit a realistic number of individuals.

Systemic insecticides neonicotinoids and their replacements: occurrence in hummingbirds and their floral food resources

C. BISHOP, A. Gonzalez, J. Elliott, A. Moran, F. Maisonneuve, S. English
Presenting author: **Ana Gonzalez**

Globally over 300 species of hummingbirds contribute substantially to both the biodiversity and ecosystem services as pollinators. Recently however studies determined for the first time that hummingbirds are exposed to pesticides and they are detectable in their urine, feces, whole body carcasses and feather rinsates in Canada and in California. In our study in British Columbia, Canada, imidacloprid is most commonly detected in urine but also detected other neonicotinoies. In 2018, we also detected the new systemic chemical which is a butenolide compound known as flupyradifurone in hummingbird urine. This compound continues to be present through to 2022 at concentrations at an order of magnitude above imidacloprid. Furthermore, pesticide synergists used to enhance pyrethroid toxicity are also detected in hummingbird feces. Systemic chemicals in hummingbirds and the flowers they feed on were mostly associated with sites near agricultural areas, primarily blueberry growing areas, but also detected in birds living at sites up to 22 km from the nearest agriculture.

Movement of non-breeding birds in Metro Vancouver

E. Gow, T. Hohn, T. Imlay, S. Bliss, A. Gonzalez-Prieto, K. De Groot

Presenting author: **Elizabeth Gow**, Environment and Climate Change Canada, elizabeth.gow2@ec.gc.ca

Birds use urban areas throughout the year as they provide a diversity of habitats, abundant resources, and protection from predators. The lower mainland region of BC, including Metro Vancouver, has some of the highest abundances and biodiversity of non-breeding birds in Canada. However, little is known about bird ecology during the non-breeding season including how birds use and move through urban habitats such as yards and parks, and their relative survival. Over the past three non-breeding seasons we coloured banded over 300 individuals and attached Motus tags to a subset of individuals from several songbird species in parks and residential backyards in Metro Vancouver to assess movements and survival of individuals. We engaged members of the public to report band combinations and conducted several colour band re-sighting surveys. We will discuss preliminary findings on movements of birds in urban areas during the non-breeding period and the effectiveness of engaging members of the public in reporting re-sightings of colour banded birds.

Golden-winged Warbler productivity in Minnesota

A. Grinde, B. Howland, S. Nelson

Presenting author: **Brett Howland**

Golden-winged warblers (Vermivora chrysoptera) is one of the most critically threatened birds in North America with a global population estimated at only 400,000 individuals of which 50% nest in Minnesota. Densities of Golden-winged Warbler are highest in young forests and shrubby wetlands, however it is unknown if there are differences in quality provided by these two distinct habitats. To understand the differences in habitat-specific measures of demography, we documented differences in nest success and post-fledgling survival across two study areas over a four year period in Minnesota. We analyzed daily nest success (n= 49) and post-fledgling survival (n= 74 individuals) using a multistate competing risks design to quantify differences in breeding season productivity between habitats. For both analyses, we compared the performance of covariates associated with landscape, stand and nest site characteristics. Preliminary results indicate probability of nest success varies between habitats, and edge density and shrub density were associated with predation rates. Final model results will be presented. The results from this study will help identify characteristics associated with high quality breeding habitats that can be used to guide forest management and restoration actions that maximize breeding season productivity for this imperiled species.

Aerial Insectivore responses to insecticides in agricultural working landscapes

B. Han, C. Morrissey

Presenting author: **Biyao Han**, University of Saskatchewan, biyao.han@usask.ca

The population of aerial insectivores has steeply declined worldwide. One of the primary drivers of this decline is agricultural intensification, which results in increased use of agrochemicals and loss of wetlands. The rising use of insecticides in modern agriculture not only decreases non-target insect populations, limiting the food availability for insectivores but also poses risks to these birds due to toxicity.

Neonicotinoids are the largest group of insecticides sold globally for decades. We have detected neonicotinoids in plasma from 100% of wild-captured tree swallows (Tachycineta bicolor) breeding in agricultural landscapes of Saskatchewan. We hypothesize that concurrent wetland loss may exasperate the toxicity of neonicotinoids on some aerial insectivores, as wetlands are critical habitats providing nutritious aquatic insect prey enriched with polyunsaturated fatty acids (PUFAs). Previous studies suggest higher wetland coverage and PUFAs can improve the growth of swallow nestlings. In 2022 and 2023, we conducted dosing experiments in the field to examine the toxicity of imidacloprid and clothianidin on the development and post-fledging survival of nestling tree swallows, and the potential mitigating effects of supplementary PUFAs or higher wetland availability. Our results show that both insecticides significantly impaired the growth and conditions of nestlings. However, the beneficial effects of co-exposure to PUFAs for reducing toxicity appear limited when wetland availability is high. Together these findings, provide the first evidence of neonicotinoids' toxic effects on swallows and we provide recommendations for management and conservation in agricultural landscapes to reduce risks to aerial insectivores.

Ecosystem recovery in the Beni Savana, Boliva by restoring functioning grasslands and engaging stakeholders

B. Hennessey

Presenting author: **Bennett Hennessey**, Asociacion Armonia, bennett_hennessey@hotmail.com

The Llanos de Moxos in Bolivia is home to the Critically Endangered Blue-throated Macaw. The Motacu Palm forest islands, gallery forest, cerrado influenced habitats, and wetlands cover an area the size of Spain. It is poorly managed due to overgrazing and burning. Without proper management, the savanna will lose 90% of its forest that the macaw depends on. Asociación ArmonÃa purchased the 25,000-acre Barba Azul Nature Reserve in 2009 after a century of human occupation and degradation. The natural steady-state ecology of this community is unknown. We wanted to demonstrate ecosystem recovery through management using mechanisms of functioning grasslands and engaging stakeholders. Flooding, fire, and grazing pressures are all hindered by current land uses. We predicted that recovery would lead to greater biodiversity. Twelve staff have been hired to execute reserve objectives since 2015, using species management, patch burn, grazing rotation, and exclusion zones. We are experimenting with Motacu forest islands regeneration and afforestation. We quickly began to see ecological dynamics change on the reserve. There is an increase in fauna, including threatened species. Stakeholder participation has improved with these results. Our understanding of the grasslands has improved along with stakeholder views on shared objectives. This supports our predictions that greater system functioning can maintain ranch productivity while conserving the Beni. Native species are showing dramatic increases. This project urgently addresses the disappearance of a global ecosystem that is at risk from multinational agricultural practices. The flora, fauna and people of the Beni will benefit from this work to better manage this landscape.

The value of atlasing in the era of big data

W. Hochachka, T. Auer, C. Crowley, D. Fink, S. Ligocki, L. Oldham Jaromczyk, O. Robinson, A. Rodewald, M. Strimas-Mackey, C. Wood

Presenting author: **Wesley Hochachka**, Cornell University, wmh6@cornell.edu

The sophistication of bird atlases has grown through time, both in the types of data collected and in the outputs produced from these data. Nevertheless, describing the distributions of bird species at relatively fine spatial resolution continues to be the fundamental goal of bird atlasing. Today, large volumes of volunteer-collected data from projects like eBird, appropriately modeled, can produce the same insights that were once only available from atlasing. We will discuss two questions: (1) what current analytical challenges can atlas data uniquely meet, and (2) what analytical challenges remain for using atlas data? Other presentations in this symposium will discuss the use of highly structured atlas data, like point counts, for the estimation of population densities. We will focus on the less structured data that are typical of all atlases. In our opinion the largest analytical challenge overcome by atlasing is the variability in observer effort across space and habitat types that is typical when bird watchers are entirely responsible for choosing the locations. We will show examples of how atlas projects lead to the collection of observations that are more representative of the atlas region, and of the habitats within the atlas region.

We suggest that an important remaining challenge for analysis of atlas data is the interpretation of breeding-code information, which is not consistently collected when it is optional, for example when eBird is used as the data-collection platform. Inconsistent reporting of breeding code information produces a type of presence-only data, with lack of reporting of breeding codes not indicative of lack of nesting.

Protecting Chimney Swift habitat through municipal engagement and landowner stewardship in working landscapes

R. Hoeg, G. Sorenson, A. Manthorne

Presenting author: **Rielle Hoeg**, Birds Canada, riellehoeg@acadiau.ca

Chimney Swifts are Threatened in Canada due to declines of flying insect prey, climate change, and loss of habitat used for roosting and nesting. Chimney Swifts have been a part of human landscapes for hundreds of years, and although we know the locations of 32 active roost chimneys in the Maritimes, their numbers and suitability to swifts are diminishing. The recently published Recovery Strategy outlines the actions needed to halt or reverse population declines and protect existing habitat in urban areas while forest habitats regenerate. Birds Canada is implementing many of these actions, including encouraging stewardship by landowners, volunteers, and municipalities; collaborating with national partners on the Chimney Swift Chimney Restoration Fund to support repair of active roost sites; and supporting ongoing population monitoring efforts. In the Maritimes, Birds Canada has formed working relationships with five municipalities. We will share examples of how these projects conserve Chimney Swifts and their habitats and how we are increasing our stewardship reach by working directly with municipalities and landowners. Local government involvement is key to on-the-ground stewardship, and we welcome advice from those who have worked directly with regional governments to increase our project's reach and potential. Our project will improve awareness of these birds within communities and help Birds Canada build partnerships, locate new nest and roost sites, and protect existing sites to support these declining aerial insectivores.

Collaborating with partners, citizen scientists and private landowners to help conserve Chimney Swifts and Bank Swallows

H. Polowyk

Presenting author: **Rielle Hoeg**

In Canada, Chimney Swift and Bank Swallow populations have declined by 90% and 98% since 1970. To help alleviate these declines, Birds Canada created the Maritimes SwiftWatch program in 2011 and the Atlantic Canada Bank Swallow monitoring project in 2021. These programs bring together conservation organizations, citizen scientists, and private landowners to increase our capacity to locate and protect priority critical habitats across large geographic areas. For example, using 10 years of data collected by citizen scientists participating in the SwiftWatch program, Birds Canada and our partners identified and restored five critical chimneys for Chimney Swifts through the 2022 pilot year of the Chimney Swift Fund. Further, we anticipate using Atlantic Canada Bank Swallow monitoring project data to guide on-the-ground conservation efforts. Implementing successful citizen-science monitoring programs and promoting private landowner stewardship comes with challenges. In this talk, we will explore the challenges we face with effective landowner outreach, the lack of easy, affordable alternatives to shoreline hardening, and the creation of a program dependent on the public for success. Despite these challenges, our projects will allow us to locate and protect more priority critical habitats faster than we could do without these collaborative partnerships. With such steeply declining populations, we are in a race against time to locate and develop methods to restore important habitats for Chimney Swifts and Bank Swallows.

Improving estimates of breeding bird distributions through integrated analysis of checklists and point counts

D. Iles, S. Van Wilgenburg, A. Couturier, D. Evans, C. Francis, A. Smith

Presenting author: **David Iles**, Environment and Climate Change Canada, david.thomas.iles@gmail.com

Breeding bird atlases use multiple protocols to document the distribution and abundance of avian species

within a defined jurisdiction. Point counts are one of the primary survey methods used in breeding bird atlases because they are highly standardized with well-defined analytical approaches for population density estimation, but are less suitable for surveying non-songbirds. Atlases typically augment point count methods with checklists, which are less standardized and potentially more difficult to incorporate into population density models, but have greater survey effort than point counts and likely detect a broader group of species. Here, we describe a statistical approach to formally integrate atlas data collected through point counts and checklists, with the goal of improving maps of species density across the province of Saskatchewan. We demonstrate that data integration improves the precision and accuracy of species density estimates, particularly for species that are not well-surveyed by traditional point counts. Checklists provide a useful complement to point counts in breeding bird atlases.

Bridging the data gap: How the NatureCounts platform drives avian conservation action

C. Jardine, D. Lepage
Presenting author: **Catherine Jardine**

Birds are widely recognized as important indicators of the state of our environment - they are sensitive to habitat change, relatively easy and cost-effective to monitor, and changes in their populations are often a first indication of larger ecosystem issues. The NatureCounts platform (www.naturecounts.ca), seeks to leverage vast amounts of data on bird populations from a large network of citizen science monitoring initiatives to identify and address conservation issues. NatureCounts operates across the full spectrum of conservation from data collection through data housing, sharing, interpretation, and direct conservation action. The NatureCounts platform provides the technological tools needed to nurture a large network of motivated and engaged volunteers, maintain reliable data, transform that data into interactive summaries and make raw data and interpreted knowledge widely available for conservation partners and communities of action to address environmental issues. NatureCounts is one of the largest biodiversity data repositories in the world (190 million records) and holds over a century of accumulated collective knowledge on populations of all bird species in Canada, all of which are made freely available to thousands of users. This talk will explore the features that make NatureCounts successful, the challenges the program has faced, and how citizen science data are being leveraged to have direct conservation impacts for birds in Canada, and beyond.

Validating and extending bird migration forecasts with a portable radar

M. Jimenez, A. Khalighifar, K. Horton
Presenting author: **Mikko Jimenez**, Colorado State University, Migfjimenez@gmail.com

Given their steep decline, understanding the spatial and temporal patterns of migrating birds is critical to developing strategies to protect them. The Next Generation Weather Radar (NEXRAD) system is a powerful tool for quantifying bird movement and forecasting nocturnal migration intensity. However, the surveillance system on which this tool relies is limited by gaps in spatial coverage and challenges with sampling areas with variable topography. We aimed to address these limitations by comparing ground truthing measures of migration traffic rates to NEXRAD-driven migration estimates at varying distances and elevations from a stationary weather radar station. Throughout the spring migration seasons of 2022 and 2023, we quantified the migration traffic rates across northern Colorado and southern Wyoming using a mobile, vertical-facing radar. We collected these data at 10 sites along two transects that ranged in distance and elevational variance from the NEXRAD station in Cheyenne, WY. For our 2022 field campaign, we found a strong positive relationship ($r=0.78$, $p<0.05$) between mobile radar observations and measures extracted from NEXRAD in the neighboring area. However, we found that this relationship diminishes with both distance and elevational variance. By quantifying these relationships in region that is prone to bias, we can partially overcome the challenges associated NEXRAD-driven migration estimates to both validate and extend current forecasting practices at the continental scale.

The influence of neighbor on reproductive success of mountain bluebirds and tree swallows

S. Joly, A. McKellar, N. Flood, R. Moller, S. Mahoney, M. Reudink
Presenting author: **Stephen Joly**

During the breeding season, secondary cavity nesting birds are limited by the abundance and distribution of nest sites on the landscape, which can result in aggressive interactions among nesting neighbors. Once nests are established, however, interactions with neighbors can be positive (e.g., through shared nest defence) or negative (e.g., through reproductive interference). The nature of these interactions are likely to be determined by both neighbor identity (heterospecifc/conspecific) and the stage of reproduction. We investigated the influence of conspecific and heterospecific neighbors on the reproductive success of mountain bluebirds (Sialia currucoides) and tree swallows (Tachycineta bicolor) within agricultural working landscapes near Kamloops, BC, over eight breeding seasons. The abundance of mountain bluebird neighbors was positively associated with reproductive success at both conspecific and heterospecific nests-a finding that could be explained by either positive behavioral interactions (e.g., shared defence) or by habitat quality, with birds settling at higher densities in high-quality habitat. In contrast, the proximity and abundance of tree swallows was negatively associated with the reproductive success of both conspecific and heterospecific neighbors early in the breeding cycle (i.e., reduced hatching success), but was positively associated with reproductive success later on (i.e., increased fledging success). Together, these results indicate that the effects of neighbors on reproduction is likely to be species-specific, dependent on neighbor identity (conspecific/heterospecific), and differs across breeding stages.

Survivorship Rates from Bird-Building Collisions and Related Rehabilitation Efforts

A. Jones, T. Jasinski, C. Brennan, H. Webster, M. Shumar
Presenting author: **Andrew Jones**, Spring Island Trust, ajones@springislandtrust.org

The total number of bird-building collisions are highest along major water obstacles that concentrate large numbers of migratory birds during their stopovers. The Great Lakes are of particular concern because of the size of the lakes as well as the large number of migratory passerines in this area during spring and fall migration. The city of Cleveland, Ohio, USA is situated along the southern shore of Lake Erie, and has been the site of many collisions of a great diversity of species. Lights Out Cleveland, a citizen science effort that is now six years old, was established to transport injured, live birds to a rehabilitation facility as well as to preserve specimens from the collision fatalities in a natural history museum collection. This grouped effort, focusing on rehabilitation and release of live birds, and data preservation from both a banding effort as well as research specimens, is uncommon among Lights Out programs. The survival of several species were very low in the early days of the program due to little available information on methods, but the access to large numbers of infrequently rehabilitated species like American Woodcock has led to significant improvements in their survivorship. We examined an array of data (including age, sex, wing length, weight) on several species that were abundant as collision species. By pairing specimen data with banding data we were able to tease apart the relative impacts of these characteristics, and we find that hatch year individuals are more likely to die in collisions. Overall weight also has a significant impact on odds of survival in collisions.

Emerging forest megadisturbances and the conservation of spotted owls

G. Jones, M. Peery
Presenting author: **Gavin Jones**, USDA Forest Service, gavin.jones@usda.gov

In the seasonally dry forests of the western United States, we find a conundrum. A century of fire suppression and climate change have combined to produce transformative megafires and drought-induced tree mortality, threatening forest persistence. On the one hand, we have tools to combat such transformations: mechanical fuels reduction, thinning of tree densities, and prescribed fire can all move the needle on increasing forest resilience to disturbance. On the other hand, such actions could cause collateral damage to already-vulnerable wildlife populations that inhabit and depend on fire-prone forests, including the threatened spotted owl. Can we restore forest resilience while conserving spotted owls? In this talk, I review recent innovative science that sheds light on this question and provides a path forward for conserving spotted owls and other sensitive old-forest species in the age of

megadisturbances.

Habitat associations and molt strategy mediate drought and monsoon rain timing effects on Southwestern bird densities

H. Jones, C. Ray, M. Johnson, R. Siegel
Presenting author: **Harrison Jones**, The Institute for Bird Populations, hjones@birdpop.org

Climate change is considered a major driver of recent avian population declines, particularly in the drought-stricken southwestern United States. Predicting how bird populations will respond requires an understanding of the climatic drivers influencing population density across the diverse habitats of the region. In this study, we model breeding-season densities of 50 bird species in relation to spring and summer drought and the timing of North American monsoon rainfall over a twelve-year period (2007-2018) and across four habitat types comprising a ~1500 m elevational gradient. We estimated breeding-season population density in relation to climate in the previous year by fitting a Bayesian hierarchical N-mixture model to point count data from each of six national parks on the Colorado Plateau. Specifically, we asked whether (1) population trends in this region were stable, increasing, or decreasing on protected lands and (2) breeding densities were affected by drought or the timing of monsoon rains. Species of high-elevation mixed-conifer forest declined over the study period, matching regional Breeding Bird Survey trends, likely in response to climate-related habitat loss and disturbance. By contrast, pinyon-juniper and grassland species density generally increased. Effects of drought varied by habitat with elevation: mixed-conifer bird species responded positively to drought the previous year, likely due to earlier snowmelt and breeding phenology, while pinyon-juniper species were unaffected, and grassland species responded negatively. Later arrival of monsoon rains had a negative effect on species that migrate to the Mexican monsoon region to molt. Late monsoon rains may therefore result in a phenological mismatch.

Key strategies for successfully managing volunteer citizen scientists

K. Jones
Presenting author: **Kathy Jones**, Birds Canada, volunteer@birdscanada.org

Birds Canada has implemented citizen science bird monitoring programs for over 50 years, currently delivering 44 programs that engage over 74,000 volunteers throughout Canada each year. As such, Birds Canada is globally-recognized as a leader in volunteer citizen science management. Here, I outline key lessons learned for successfully managing volunteer citizen scientists based on a quarter-century of personal experience delivering Birds Canada programs. I begin with the most important lesson, which is to always fully and genuinely respect each volunteer. Other key lessons include remaining aware of, and acting on, the differences between volunteers and paid staff; remembering that the science comes first; building flexibility without comprising quality; designing programs to both suit volunteers and produce high quality data; and that the best reward for volunteers is seeing their data contribute to on-the-ground conservation. For each lesson learned, I outline the strategy in general and then illustrate it, where possible, with examples from Birds Canada programs. Other concepts covered include the volunteer management cycle; the power of honesty; diversity, equity, and inclusion; and the importance of dedicating adequate resources to volunteer management. The strategies and concepts overviewed should be useful and relevant to anyone delivering, or considering delivering, a bird citizen science monitoring program.

Shifting seasons: Migratory bird responses to changing seasonal events tells us about the resilience of our forests

S. Kaiser, M. Hallworth, M. Webster, S. Sillett
Presenting author: **Sara Kaiser**, Cornell Lab of Ornithology, sak275@cornell.edu

Climate change is shifting seasons in the Northeast – winters are shorter, springs are arriving earlier, summers are longer, and autumns are arriving later. These changes can affect the timing of annual life cycle events of migratory birds, such as reproduction and migration. Shifts in the timing of these seasonal events could have population consequences. We examined these potential shifts in a 40-yr demographic

study of the migratory Black-throated Blue Warbler (Setophaga caerulescens) at the Hubbard Brook Experimental Forest (HBEF), New Hampshire. Over four decades, leaf emergence dates have advanced 8 days in response to increasing spring temperatures and autumn leaf senescence has occurred 11 days later, resulting in a 19-day extension of the growing season at the HBEF. Black-throated blue warblers have exhibited flexibility in their timing of arrival and breeding in response to earlier spring leaf emergence and an increased propensity to double brood later in the breeding season, suggesting an extension of their breeding window both early and late in the season. This could lead to potential trade-offs between extended breeding and the time and energy available for costly but critical late season, life-history events such as post-fledging care, molt, and autumn migration. We discuss our recent work examining the effects of phenological change in autumn – a neglected season in climate change research – on the timing of these late season events. Tracking shifts in annual life cycle events of migratory birds provide insights into the mechanisms driving population responses to environmental change in forest ecosystems.

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*Importance of green unburned forest for fire-associated birds in the megafire era

M. Kerstens, J. Rivers

Presenting author: **Mark Kerstens**, Oregon State University, mark.kerstens@oregonstate.edu

Woodpeckers serve as keystone species within forest ecosystems, and both they and the secondary cavity-nesting species they support are often associated with recently burned areas. These birds typically require mature forest characteristics for successful nesting, such as complex structure, snags, and mature trees. Recently burned forests create ephemeral resource pulses for cavity nesters and other fire-associated bird species. However, burned areas can become unsuitable for breeding over relatively short timescales post-fire as succession progresses, and key habitat features are lost. In addition, adequate nesting structure can take more than a century to regenerate in some systems, and conversion to non-forest is occurring at increased rates due to reburns, increased size/severity of modern fires, and climate change. Forests that are unable to undergo conifer recruitment post-fire-due to fire-limited seed availability and climate-limited seedling establishment-may cease to be part of the available habitat pool for cavity nesting species and forest-associated birds in general. This decrease in suitable habitat would likely exacerbate current population declines in many species. Recent studies have highlighted that fire associated species may be less likely to nest in the interior of high severity megafires, and that green forest is important for supporting fledgling survival. In addition, some of these fire-associated species have similar vital rates in green vs. recently burned forests. These findings raise important conservation implications for unburned areas given that green forest may provide refugia and more temporally stable resources than the ephemeral habitat created by recent wildfire in the megafire era.

Bird communities reveal the homogenization of eastern North American forests

D. King, M. Akresh, J. Larkin, A. D'Amato

Presenting author: **David King**, US Forest Service, david.king2@usda.gov

Reports that forests in eastern North America lack tree age-class and species diversity concern conservationists, since this could reduce their carrying capacity for bird species, which evolved with forests more diverse than contemporary forests. Forest birds have declined, and diminished forest structure is one likely contributor. Given that 1. silviculture can increase tree age-class and species diversity, and 2. forest birds are arguably at risk in proportion to the degree to which their forest habitat is degraded, we reasoned that managed eastern forests would have healthier bird communities than unmanaged forests. Accordingly, we conducted a meta-analysis of forest bird communities along a gradient of silvicultural intensity in eastern North America to establish the impact of basal area retention on birds. We weighted density estimates of bird species by their Partners in Flight Conservation Scores, which reflect each species' imperilment. When summed across all bird species in a stand, this yields an aggregate Avian Community Conservation Score, which can be used as a unitary measure of the influence of silvicultural treatments on bird community health. Overall, clearcuts and shelterwoods had the highest conservation values, and unharvested and lightly thinned stands (70%–100% tree retention) had the lowest conservation scores. We believe the low structural diversity of most unmanaged forests in eastern North America, due to historical patterns of land use and tree harvesting, limits nesting and foraging opportunities, which are reflected in their degraded bird communities. Thus, we conclude that

bird communities reveal the homogenization of eastern North American forests.

Historical perspective of window collisions

D. Klem

Presenting author: **Daniel Klem**, Muhlenberg College, klem@muhlenberg.edu

The first scientifically documented avian window strike fatality occurred in 1832, followed by scattered accounts in the late 19th and early to mid-20th Centuries. The first comprehensive study was conducted from 1974 to 1979, and, since then over 200 popular and peer-reviewed scientific publications have been added to the bird-window literature. Authors of these works represent a diverse multidisciplinary combination that include behavior, conservation, ecological, physiological, rehabilitation and veterinary scientists and citizen scientists, architects, landscape architects, developers, material engineers, glass and film manufacturers in the building industry professions, and environmental law, law enforcement, and legislative authorities. Fundamentally, birds behave as if clear and reflective sheet glass and plastic in the form of windows are invisible to them. They kill themselves flying to or into reflective illusions of habitat and sky. Birds have been recorded colliding with windows of any size installed in any human structure, at all times of day, in every season of the year, and under all types of weather conditions wherever they coexist. Each of these diverse constituent investigators seek to use their current and developing knowledge and products to transform these invisible killers into barriers that birds will see and avoid. There are a growing number of solutions to save more bird lives from windows. They are inspiring, uplifting, and overall offer realistic hope that this specific human-associated lethal threat can be eliminated worldwide, and thereby meaningfully contribute to a healthy and sustainable global bird population.

An integrated modeling framework for broad-scale spatial prediction and population estimation from varying survey protoc

E. Knight, A. Drake, P. Solymos, D. Stralberg, T. Docherty, A. Crosby, E. Bayne, S. Song, S. Cumming, F. Schmiegelow

Presenting author: **Elly Knight**, Smithsonian Institution, ecknight@ualberta.ca

Spatially explicit estimates of species abundance are needed to inform conservation planning and management decisions at a range of spatial scales. We present a generalized framework that bridges the gap between local studies and large-scale management needs by harmonizing data from varying sources to predict avian abundance at a fine resolution and broad extent. We first applied detectability offsets to standardize avian point-count data from an ad-hoc compilation of research and monitoring projects across northern North America. We then subsampled the data by time period and sixteen geographic regions; and developed boosted regression trees to model the density of 143 boreal landbird species as a function of temporally matched environmental covariates. Finally, bootstrapped model predictions for each region were combined to generate predictive density maps, habitat- and subregion-specific density estimates, and rolled-up population estimates for Canada. Our models estimated a total of ~8.8 billion breeding birds across subarctic Canada, with the largest portion of this represented by boreal and hemi-boreal regions. Forest generalist species made up the largest part of this estimate, followed by boreal forest specialist species. An analysis of variable importance showed that, across species, the variable set that explained most of the variation in bird abundance was landscape-scale vegetation composition, suggesting that the effect of climate on bird abundance is mostly indirect, via vegetation, but that landscape-scale variables are needed to capture this variation. In developing these models we created a standardized, updatable, and reproducible workflow and provided a template for similar efforts in other regions.

Accounting for observer heterogeneity in the data collection process using an updated Checklist Calibration Index (CCI)

E. Knight, D. Iles, B. Edwards, E. Bayne

Presenting author: **Elly Knight**

Passive acoustic monitoring (PAM), or the use of autonomous recording units (ARUs) is an increasingly common tool in avian research and monitoring. Similar to human point count surveys, PAM is subject to imperfect detection, whereby the true occupancy state of an individual is not necessarily observed due to

the probability an animal produces a cue and the perceptibility of those produced cues. The detection process of PAM can differ from human point counts, and in some cases be more complex; however, the majority of existing knowledge and methods about imperfection detection are based on human point count surveys. In particular, the detection process of using an automated recognizer, or computer algorithm, to extract species detections from ARU recordings is different from the detection process of species detection by a human observer. There is great potential to use statistical integration of ARU and human point count data to understand avian ecology across large scales; however, that potential is limited without a comprehensive framework to account for detectability across the data types. We synthesized the existing literature to summarize the various endogenous and exogenous processes that affect probability of detection for human point counts, ARU recordings processed by human listeners, and ARU recordings processed by recognizers. We combined that synthesis with analyses from a large (> 10M detections) database of human point counts and ARU surveys to identify when processes differ across the three survey methods. We propose a potential path forward to account for detectability when integrating human point count and PAM data that builds on the existing QPAD method developed by the Boreal Avian Modelling Project.

Lake-crossing behavior of migratory songbirds: Assessing potential collision riskÂ with offshore wind on Lake Erie

Z. Korpi, S. Matthews, R. Jacob, M. McDermott, D. Russell, M. Shieldcastle, M. Shumar, C. Tonra

Presenting author: **Zoe Korpi**

With the growing need for renewable energy sources, there is an interest in the development of offshore wind within the Great Lakes, which is a highly used corridor for migratory birds. Wind turbines present a substantial obstacle to birds causing casualties directly through collision or through other indirect effects. The potential impact of these offshore wind projects on migratory birds cannot be fully determined without first understanding the lake-crossing behaviors of birds traveling through the region. We aim to determine the prevalence of lake-crossing behavior, to identify key pre-crossing sites and crossing routes, and to evaluate the landcover of critical areas along the shore of Lake Erie. Using automated radio telemetry and the Motus Wildlife Tracking System, digitally coded nanotags will be deployed at three sites across central Ohio on White-throated Sparrows (Zonotrichia albicollis), Swainson's Thrush (Catharus ustulatus), Tennessee Warblers (Leiothlypis peregrina), and Magnolia Warblers (Setophaga magnolia). Detection data collected over two field seasons (Spring 2022 and Spring 2023) will be used to estimate the prevalence of lake-crossing behavior of spring migrants and to identify critical stopover habitats and lake-crossing routes. The overarching goals being to inform management decisions and the development of a spatial tool for collision risk analysis when siting future offshore wind projects within the Great Lakes.

Exposure to risk factors experienced during migration is not associated with recent Vermivora warbler population trends

G. Kramer, D. Andersen, D. Buehler, P. Wood, S. Peterson, J. Lehman, K. Aldinger

Presenting author: **Gunnar Kramer**

Determining which factors limit populations of migratory species can be especially challenging because of their reliance on multiple, geographically distant regions during their annual cycles. We investigated the association between distribution-wide variation in recent breeding population trends and exposure to risk factors experienced during migration or factors associated with breeding and nonbreeding areas in golden-winged warblers (Vermivora chrysoptera) and blue-winged warblers (V. cyanoptera). We used geolocator data from 85 Vermivora warblers (n = 90 geolocator tracks) collected from 2013–2017 to quantify variation in space use among populations. We assessed whether differences in space use among populations of Vermivora warblers during migration were associated with exposure to migration risk-factors and whether increased relative exposure to migration risk factors was associated with population declines at regional and subregional scales. Regional and subregional populations of Vermivora warblers exhibited variation in space use and exposure to anthropogenic and natural risk-factors. However, we found no evidence that recent variation in population trends of Vermivora warblers was associated with risk-factors experienced by different populations during migration. Instead,

factors associated with land cover-types in breeding and nonbreeding areas were more strongly associated with recent population trends. Consequently, our results suggest that efforts to reverse ongoing population declines of Vermivora warblers may be more effective if directed toward conservation actions targeting limiting factors within the breeding and nonbreeding periods versus those directed at conditions encountered during migration.

Single visit variable effort survey design for robust analysis of point count and ARU data with detection error

S. Lele, P. Solymos
Presenting author: **Subhash Lele**, University of Alberta, slele@ualberta.ca

Bird population monitoring is often conducted using point count surveys. Last decade has also seen an exponential rise in the use of Autonomous Recording Units (ARU) to monitor bird populations. Presence of detection error is a major challenge to analyzing these data. Detection error can be corrected by using distance sampling and removal sampling. It can also be corrected by using multiple visits to the same location and using the N-mixture models. These approaches depend on accurate estimation of distance for distance sampling, identification of individuals for removal sampling and the close population assumption for N-mixture approach. We show that these assumptions can be circumvented by using single visit methodology with variable effort survey design. We propose, somewhat unintuitively, that researchers conduct point count surveys for varying amount of time at each station. This simple change in the protocol leads to identifiability of bird density parameters without any need to estimate distances, identify individuals, or assume close population. We show that single visit variable effort survey method leads to robust inferences as compared to distance sampling, removal sampling and N-mixture approaches. Our methodology is also applicable to data obtained from the ARUs. We illustrate our methodology with field data collected by human observers and ARUs simultaneously.

American Bird Conservancy's approach to bird-friendly building design ordinances

B. Lenz
Presenting author: **Bryan Lenz**

Collisions with glass are a conservation crisis, killing up to 1 billion birds each year in the United States and countless more around the world. One pathway to address this crisis at scale is the adoption of local ordinances that require architects to follow bird-friendly building design principles that prevent birds from dying on the façades of their buildings. Over the past 15 years, conservationists have used this strategy to prevent window collisions in communities across North America, many with assistance from American Bird Conservancy (ABC). This presentation will explore ABC's approach to creating and advocating for bird-friendly building design ordinances, an approach that focuses on providing motivated individuals with the tools that they need to effect change in their communities.

Lessons learned from a decade of research evaluating bird-window collision risk factors and management approaches

S. Loss, J. Elmore, S. Lao, R. Lawson, T. O'Connell, C. Riding, G. Riggs
Presenting author: **Scott Loss**, Oklahoma State University, scott.loss@okstate.edu

Collisions with building windows are a top bird mortality source threatening avian populations worldwide. Reducing bird-window collisions has been identified as an important action to stem the decline of the North American avifauna. Over the past decade, we have conducted bird-window collision surveys in Oklahoma and Minnesota, as well as national quantitative analyses synthesizing existing data, to assess spatiotemporal variation and correlates of collisions and to inform approaches to reduce collisions. This research has found that: (1) bird-window collisions vary predictably in time, both seasonally and throughout the day and night, and also in association with bird migration phenology and weather; (2) collisions vary spatially in association with factors (e.g., amount of glass, nighttime lighting, and vegetation) operating at multiple scales, from individual building façades, to entire buildings, to landscapes around buildings; and (3) collision risk varies among species and in association with life

history. We have used these findings to recommend collision mitigation practices, and we have also conducted studies directly assessing approaches to reduce collisions, including using weather radar to predict collisions, installing markers on windows to reduce transparency and reflection effects, and evaluating stakeholder perceptions about bird-window collisions and approaches to manage them. We will discuss past findings, highlight ongoing research and research needs, and describe potential approaches to further mainstream bird-friendly building practices, such as supporting citizen science activities and increasing funding to conduct research and implement approaches that reduce collisions.

Mobilizing Motus: A decade of crowdsourcing conservation science.

S. Mackenzie, L. Berrigan, P. Davidson, E. Geldart, J. Hussell, C. Jardine, A. MacDonald, J. Sayers, A. Smith, D. Lepage

Presenting author: **Stuart Mackenzie**, Birds Canada, smackenzie@birdscanada.org

This year marks the 10-year anniversary of the Motus Wildlife Tracking System (Motus); a collaborative global network using automated radio telemetry to collect and share information about the behaviour and movements of small flying organisms (birds, bats, and insects) at multiple spatio-temporal scales. This pioneering system provides a framework for global collaboration, integration of multiple technologies, and a coordinated approach to solving some of the most complex problems in the ecology and conservation of migratory animals. Motus is thus a science, technology and outreach program of Birds Canada in collaboration with a large, vibrant, highly committed community of organizations, businesses and individuals. The growth and trajectory of Motus has been impressive. Since 2013 more than 1,750 collaborators have built and maintained tracking and outreach infrastructure comprised of more than 1,450 automated telemetry stations across in 34 countries. Researchers have tracked more than 37,400 individuals of 314 species, and results have contributed to more than 170 peer-reviewed published works. Here we will present the Motus Strategic Plan to 2030 which outlines a path for the development of the system across four main areas: Enabling Conservation, Pioneering Science, Building Community, and Innovating Technology Integration. We will summarize our collective results, milestones, impact across these themes and present a road map for future work that aims to maximize efficacy of the system for conservation science. Toward this end, the proceeding symposium will feature further examples of how Motus is helping to advance avian ecology and conservation across numerous disciplines, habitats, landscapes and species.

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*Loss of social partners weakens winter site fidelity in Golden-crowned Sparrows (Zonotrichia atricapilla)

A. Madsen, B. Lyon, A. Chaine, T. Block, D. Shizuka

Presenting author: **Anastasia Madsen**

Many animal social interactions have an intrinsic spatial basis-individuals must intersect in space to interact, whether directly (e.g., co-occurrence, allo-grooming) or indirectly (e.g., interact with latrines or with parasites at communal nests). This presents a dilemma when determining causality: do individuals interact socially because they happen to share space, or do they share space because they are socially linked? We present a method that uses demographic turnover events as a natural experiment to investigate the links between social associations and space use in the context of inter-annual winter site fidelity in a migratory bird. We previously found that golden-crowned sparrows show consistent flocking relationships across years, and that familiarity between individuals influences the dynamics of social competition over resources. Using long-term data on winter social and spatial behavior across 10 years, we show that 1) sparrows exhibit inter-annual fidelity to winter home ranges on the scale of tens of meters and 2) the precision of inter-annual spatial fidelity increases with age, but 3) this fidelity is weakened when sparrows lose social partners from the previous year. Furthermore, the effect of social partner loss on spatial fidelity was stronger for older birds, suggesting that social fidelity may play an increasingly important role on spatial behavior across the lifetime of this migratory bird. Our study provides evidence that social relationships can influence spatial fidelity and shows the potential of long-term studies for disentangling the relationship between social and spatial behavior.

Priority Threats to Hummingbirds Lead to Strategic Actions for Conservation

M. Matta

Presenting author: **Miguel Matta Pereira**, Environment for the Americas, mmatta@environmentamericas.org

Through a series of extensive planning sessions with partners from Canada to Mexico, we evaluated the threats to western migratory hummingbirds. Agriculture, pesticides, fire, and climate change rose to the top of our list of prioritized concerns, In this session, we will delve into the impacts of agriculture and the increasingly intensive methods that are used to enhance crop production. Our aim is to not only draw attention to the negative effects, but also to highlight the positive actions being taken to mitigate them. For example, studies show that farmers who provide natural habitat near their fields benefit both the birds and the crop. Furthermore, we will share a range of strategies that may support the protection and/or restoration of habitats that hummingbirds need during nesting, migration, and overwintering.

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*Evaluating feather mite diet to classify the nature of their symbiosis with avian hosts: are mites picky eaters?

A. Matthews, B. Trevelline, A. Wijeratne, T. Boves

Presenting author: **Alix Matthews**

Symbionts have numerous effects on the life of birds and provide critical links between species in ecological communities. Feather mites are one of the most ubiquitous avian ectosymbionts, yet the functional nature of their symbiotic relationship with hosts is still unclear (i.e., Are they parasites, mutualists, commensals?). In particular, it is known that mites consume microbes and oils found on feathers, but it is not clear whether they prefer or avoid certain microbes, or whether their preferences are density dependent. To address these knowledge gaps and better classify this symbiosis, we characterized and compared the microbial communities of feather mite guts (used resources) to those of feathers on which they live (available resources). We collected one tail feather harboring mites from 30 Prothonotary Warblers (Protonotaria citrea) breeding in Arkansas, USA. From each paired feather and mite sample, we conducted high-throughput DNA metabarcoding to amplify bacteria (16S V4 region) and fungi (ITS1) and compared the microbial communities. Overall, our results indicate that the microbial communities between used and available resources differed significantly. Feather communities (i.e., available resources) were more diverse than what mites consumed across all diversity metrics, suggesting that mites preferred certain microbes. Furthermore, mite densities did not appear to alter this pattern. Next, predictive metagenomics of differentially abundant microbes will give us insight into the functional nature of this symbiotic relationship and whether mites are defensive mutualists or parasites. Such studies will greatly expand our understanding of symbioses at multiple levels (e.g., birds-mites and mites-microbes).

Understanding movement and dispersal of seabird ticks and their eco-evolutionary consequences

K. McCoy

Presenting author: **Karen McCoy**, CNRS, karen.mccoy@cnrs.fr

Due to their particular way of life, parasitic organisms have adopted various strategies to reach their hosts in order to complete their life cycle. In ectoparasites, such as ticks, a common tactic to ensure easy access to the host is to remain permanently in the host's nesting/resting environment. While this nidicolous strategy increases the probability of encountering the host - and thus helps to ensure the necessary bloodmeal - it may also limit the dispersal potential of the species and thus its genetic diversity and (co)evolutionary potential. As ticks can have a major impact on host demography when feeding in large numbers and/or through their role as disease vectors, understanding tick dispersal is also of key importance for predicting infestation and epidemiological dynamics. Colonial seabirds harbour a surprisingly large number of tick species, almost all of which have adopted nidicolous lifestyles, living within the substrate of the breeding colonies, except for the short period of time when they feed on the host bird. While dispersal patterns can be easily understood and measured in seabirds, this is not the case for their ticks. Here, I will present work on two marine tick systems, where my colleagues and I have combined field observations and genetic data on host and parasite population structure to better

understand the frequency and mechanisms of tick dispersal and to infer its eco-evolutionary consequences. I will show that dispersal mechanisms differ strongly across host types and spatial scales, consistent with the characteristics and constraints of the biological system.

A rocky road: socioeconomic barriers to Breeding Bird Atlas participation in Newfoundland

J. McDermott, C. Dale
Presenting author: **Jenna McDermott**

The Newfoundland Atlas, like all current Breeding Bird Atlases, is at its core a citizen science, volunteer-driven project. Its primary intention is to map the distribution and abundance of the bird species that breed on the island of Newfoundland. A secondary, but no less important goal, is to develop and strengthen a community of birders who will become stewards of the natural world. However, volunteer recruitment in Newfoundland has proven challenging, particularly in the more rural areas of the island. Interactions with volunteers have identified several barriers to participation, including both lack of knowledge and the rising cost of living and travel. This latter factor may be particularly important given (1) NL's history of economic woes; and (2) the launch of the Newfoundland Atlas in 2020 at the height of pandemic-based job loss. Other barriers to participation in our Atlas and other citizen science projects may include lack of access to nature and the impacts of systemic racism. All these barriers raise the question of how inclusive the community of birders developed by breeding bird atlases is. Using demographic and economic information from Statistics Canada, registration records for Canadian atlases, and surveys of Breeding Bird Atlas volunteers, we investigate overarching trends and barriers to participation in breeding bird atlases, using Newfoundland as a case study. We also advance ideas for overcoming or reducing some of these barriers to participation in citizen science.

Effects of climate and agricultural intensity on swallow fitness in Saskatchewan's working landscapes

A. McKellar, L. Berzins, C. Morrissey, R. Clark
Presenting author: **Ann McKellar**

The Canadian Prairies are both rich in biodiversity and severely impacted by human land use, primarily for agriculture. This intersection between wildlife and working landscapes has resulted in the region being a hotspot of declining migratory birds and Species at Risk. Given the importance of both food production and healthy ecosystems for wildlife and human well-being, it is imperative to understand how to enhance species persistence in working landscapes. Recent research suggests that Tree Swallows may be able to tolerate intensive croplands where sufficient wetlands are maintained on the landscape. However, critical gaps remain about the mechanisms behind the value of wetlands in working landscapes, and how climate change will interact with agricultural land use to influence aerial insectivore populations. Using data collected over 9 years from 7 sites representing a gradient of agricultural intensity in Saskatchewan's working landscapes, we analyzed the effects temperature, wetland area, crop intensity, and their interactions on metrics of Tree Swallow reproductive success and body condition (n = 1905 boxes, 8454 nestlings, and 1550 adult females). Nestlings were in better body condition when daily temperature during development was warmer and at sites with more wetland area in the surrounding landscape, with this effect being especially prominent at sites under higher crop intensity. Similarly, interactions between wetland area and crop intensity influenced reproductive success. Overall, our results suggest that retaining and restoring wetlands is especially important in areas of high agricultural intensity, and further highlight the value of wetlands to buffer against future climate changes.

Using Aerial LiDAR to Assess Regional Availability of Potential Habitat for a Conservation Dependent Forest Bird

D. McNeil, G. Fisher, C. Fiss, A. Elmore, M. Fitzpatrick, J. Atkins, J. Cohen, J. Larkin
Presenting author: **Darin McNeil**, University of Kentucky, darin.j.mcneil@gmail.com

The fusion of LiDAR data with field-based species surveys can advance our understanding of species-habitat relationships and improve the effectiveness of conservation programs to recover

habitat-limited species. As with many early-successional forest obligates, the Golden-winged Warbler (Vermivora chrysoptera) has been declining for decades due, in part, to the steady loss of young forest/shrubland nesting habitat. Although conservation programs have begun restoring Golden-winged Warbler habitat, these efforts are currently limited by the inability to identify existing habitat across large spatial extents and diverse ownership patterns. Recent availability of state-wide LiDAR data for Pennsylvania provides an opportunity to overcome this limitation. From 2019-20, we surveyed for Golden-winged Warblers and structural vegetation at 837 sites across six forest blocks in eastern Pennsylvania. We combined these data with LiDAR derived forest structural metrics to develop statistical models to predict patterns of occupancy. Golden-winged Warbler occupancy probability was explained by models containing several LiDAR-derived structural metrics (e.g., percentage of first returns between 1-5m in height, rugosity, etc.). Moreover, models fit with LiDAR-derived covariates predicted occupancy much better than those using only field-measured vegetation covariates (Î”AICc = 53.27). Mapped predictions of Golden-winged Warbler occupancy revealed potential habitat both private and public lands. These results demonstrate the efficacy of LiDAR for modeling forest bird habitat associations, and how such data sources can provide a valuable tool for conservation planning.

How we detect wildlife - does ignoring visual detections affect our estimates?

S. Merker, C. Elphick, M. Tingley

Presenting author: **Samuel Merker**, University of Connecticut, sam.merker@gmail.com

Successful conservation of wildlife populations requires detailed knowledge of population parameters. Collecting data to inform parameters requires detailed understanding of how species are detected. The detection process is an important component of wildlife surveys and there have been advances in how surveys are conducted to account for imperfect detection. However, this is still much to be understood about how detection varies and how this variation affects parameter estimates. In particular, little is known about how detection type differs between species and if detection type matters for parameter estimation. Many species can be detected in multiple ways. For example, during human based point counts, birds are detected through both auditory and visual cues. Conducting point counts at relevant scales can be prohibitively expensive, resulting in increased use of automated recording units (ARUs). ARUs generate similar data to point counts but cannot make visual detections which may have consequences for population parameter estimates. We used the R package 'unmarked' to fit occupancy models that account for imperfect detection to avian point count data collected during the Connecticut Bird Atlas to assess if and how a lack of visual detections affects occupancy and detection estimates of 71 bird species. We found little variation in occupancy estimates derived from datasets including visual detections and where visual detections were removed for all but two species. Detection estimates differed between datasets for some species and not others. Our results support previous findings that ARUs generate suitable data to inform population parameter estimates despite a lack of visual detections.

Revisiting the CSA A460:19 Bird-friendly building design standard

M. Mesure

Presenting author: **Michael Mesure**, FLAP Canada, mesuremichael@gmail.com

Bird-window collisions can be significantly reduced by incorporating bird-friendly design elements into the construction of new buildings, such as glass with visual markers, dark-sky compliant lighting and landscaping. In recent years, bird-friendly building design has increasingly become established in policy, such as municipal green building standards, and in architectural practice. The Fatal Light Awareness Program (FLAP) Canada has advocated for the adoption of a standardized framework of technical specifications. Since its publication in 2019, the Canadian Standards Association CSA A460:19 Bird-friendly building design standard has provided leading technical specifications for designing buildings to be safe for birds. FLAP Canada played an integral role in the establishment of the standard as part of the original CSA technical committee. After several years of implementing the standard, and as scientific knowledge of bird-window collision prevention has continued to improve, now it is time to consider recommendations for updates to the standard. This presentation will provide an overview of the context for the existing CSA standard, review select aspects of the standard and its implementation that may reflect gaps in need of further consideration and explain how the community can provide feedback

towards a proposed future update to the standard.

Overview of the North American Loggerhead Shrike Working Group's efforts to conserve the eastern Loggerhead Shrike

A. Chabot, J. Steiner, H. Wheeler, A. Samuelson, J. Spero, J. Giocomo, A. Lymburner
Presenting author: **Philip Miller**

Loggerhead Shrike (Lanius ludovicianus) populations have suffered significant, sizable declines across the continent. According to North American Breeding Bird Survey (BBS) (Sauer et al. 2020) results, the species has experienced an annual decline of 2.6% survey wide (1966-2019). Declines are greater in the eastern Canada and the United States. Loggerhead Shrike is a species of conservation concern on ~7% of State Wildlife Action Plans in the United States and a priority species for in several Joint Ventures. In Canada, the eastern Loggerhead Shrike is listed as an endangered species federally and provincially. The Loggerhead Shrike Working Group was established in 2013 and includes members from universities, state and federal governments, non-government organizations and private citizens. The Working Group seeks to develop, support and implement coordinated, multi-jurisdictional research and conservation efforts for Loggerhead Shrike and their habitat through collaborative initiatives. The Working Group has been gathering demographic and connectivity data using a coordinated colour-banding and monitoring program. This and other information has been used to develop a Full Annual Cycle model for the eastern subspecies. This presentation will provide an overview of the Working Groups efforts for conservation of the Loggerhead Shrike in Northeastern North America.

Simulation models of stochastic metapopulation dynamics in the Loggerhead Shrike of eastern Canada and the United States

P. Miller, A. Chabot, H. Wheeler, A. Samuelson, J. Giocomo, J. Spero, J. Steiner, A. Lymburner
Presenting author: **Amy Chabot**, IUCN SSC Conservation Planning Specialist Group, pmiller@cpsg.org

Loggerhead Shrike in eastern North America, including Lanius ludovicianus migrans, have experienced recent significant declines, with annual breeding and wintering bird surveys indicating reductions >85%-90% since the mid-1960s. Habitat loss due to agricultural conversion, degradation of both breeding and wintering areas from incompatible livestock management practices, and motor vehicle collisions are among potential threats to population stability. Declines resulting from these threats further destabilize demographic rates in small populations, leading to increased risk of extinction. To better understand how these factors interact to threaten population viability and to clarify the extent of our knowledge of Loggerhead Shrike population dynamics, we have constructed a detailed, individual-based simulation model using the software package Vortex. We account for demographic dynamics among both obligate migratory populations in Ontario and northern Illinois, and migratory and non-migratory populations in Midwestern and Eastern regions of the United States, by developing a two-sex, age-specific full annual cycle metapopulation model with complex rules for seasonal migration and dispersal. These rules interact with local reproduction and survival rates to create regional source-sink metapopulation dynamics that can impact larger-scale population stability. Our primary focus was to determine conditions under which breeding populations in Ontario can demonstrate long-term demographic and genetic viability through management of in situ threats and the potential release of captive-bred birds. Essential components of the model will be presented, and results of a host of sensitivity and management scenarios will be summarized.

The interacting effects of temperature and row-cropping on the breeding productivity of a threatened aerial insectivore

D. Garrett, G. Mitchell, M. Cadman, J. Kusack, D. Evans, K. Bumelis, B. Garcia-Perez, A. Salvadori, S. Wilson, K. Hobson
Presenting author: **Greg Mitchell**, ENVIRONMENT AND CLIMATE CHANGE CANADA, gregory.mitchell@ec.gc.ca

Land use and climate change are considered two major drivers of population declines in migratory songbirds. However, studies examining their potential interactive effects are relatively rare. In Canada, it is hypothesized that barn swallow populations have been negatively impacted by increasing amounts of row-cropping and associated pesticide use through a reduction in insect prey availability. Here, we used a 10-year dataset of barn swallow reproductive success from 20 barns in southern Ontario surrounded by varying amounts of row-cropping to test for interacting effects of row-crop amount and maximum daily temperature on the timing of breeding, clutch size, hatching success, and fledging success. We hypothesized that warmer temperatures should result in increased insect prey availability, offsetting any negative effects of row-crop amount. We used a scale-of-effect analysis to determine the best temporal and spatial scales for assessing temperature and row-cropping effects, respectively. We found that warmer temperatures delayed breeding independent of row-crop amount and that clutch size increased with warmer temperatures and decreased with cooler temperatures as row-crop amount increased for 1st broods. However, the opposite effects were observed for 2nd broods. Hatching success followed a similar pattern. Last, fledging success decreased for both 1st and 2nd broods at warmer temperatures as row-crop amount increased and the opposite pattern was observed for cooler temperatures. Overall, our results suggest that a warming climate has and will continue to result in reduced reproductive success in barn swallows and that this effect is exacerbated in landscapes with higher amounts of row-cropping.

Post-breeding movement and habitat associations of adult and juvenile bank swallows (Riparia riparia)

G. Mitchell, M. Falconer, D. Evans, Y. Morbey
Presenting author: **Greg Mitchell**, ENVIRONMENT AND CLIMATE CHANGE CANADA, gregory.mitchell@ec.gc.ca

In conservation biology, understanding where and when animals move, as well as habitat associations, is critical for understanding threats and drivers of decline. For songbirds, the post-breeding period is one of the least studied periods of the annual cycle, likely because of the challenge of tracking small birds once family groups dissolve. We used the Motus Wildlife Tracking System to study the post-breeding movements and habitat associations of adult and juvenile bank swallows in southern Ontario, Canada. Birds were tagged along or near the shoreline of Lake Erie. Using tower detections, we found that both age groups moved extensively as the crisscrossed southern Ontario prior to leaving Canada and that minimum cumulative distance moved by juveniles was more than twice that observed for adults (1416 Â± 821 (mean Â± SD) km versus 507 Â± 309 km, respectively). For adults, but not juveniles, distance moved was positively correlated with body condition at the time of tagging. Using discrete-choice analyses, we found adults and juveniles were more likely to be detected in landscapes with higher amounts of wetland, that adult females and juveniles were more likely to be detected in landscapes with more grassland land cover and water, and that juveniles were less likely to be detected along the shoreline of Lake Erie. Most birds departed Ontario at Long Point or Point Pelee via a lake crossing and adults departed Ontario approximately two weeks earlier than juveniles (July 15 Â± 8 versus July 29 Â± 15 days, respectively). Together, our results suggest that bank swallows are likely to encounter numerous threats during the post-breeding period and that wetland habitats are particularly important.

Site and landscape investments for safeguarding habitat for Golden-winged Warbler and other migratory land birds

E. Montenegro, S. Morales, B. Stewart, I. Davidson
Presenting author: **Eliana Montenegro**, Birdlife International, elimontenegrop@yahoo.com

The Golden-winged Warbler and other forest-related migratory land birds are facing a decline among their populations. Forest habitat loss over their non-breeding habitat in Central America, the Caribbean and northern South America is one of the main threats. Conservation Investment Strategies are needed across non-breeding ranges to identify the main strategies for conserving these habitats in the long term and identify where, when and with whom to invest in conservation for more effective and lasting results. The Conservation Investment Strategy (CIS) for the Caribbean Slope of Mexico, Central America, and Colombia is the product of a collective effort of multiple local and national stakeholders from Mexico to Colombia. It aims to tackle various economic, social, and environmental factors that affect the biodiversity

and well-being of this region. The CIS identified eight strategies to address the main threats across non-breeding habitats on the Caribbean Slope. These strategies include law enforcement, community-based conservation (indigenous and non-indigenous), habitat restoration, capacity building, conservation incentives, circular economy, and sustainable tourism development. This document, along with other related initiatives such as the CIS for the Ecuadorian Chocó, Andean Highlands and the Southern Cone Grasslands, provide a road map for prioritizing conservation strategies, ensuring the use of adaptive management tools, and identifying fundraising opportunities, as part of a broader full-lifecycle/flyway approach to the conservation of Neotropical migratory birds.

Hierarchical Bayesian models for the estimation of migratory flight duration in passerines

Y. Morbey, S. Bonner
Presenting author: **Yolanda Morbey**, Western University, ymorbey@uwo.ca

Little data currently exist on individual-level nocturnal flight duration in short-hop migratory songbirds, and although recent advances in automated radiotelemetry are providing data to fill this gap, such data are often incomplete. Bayesian models provide a powerful way to integrate process, sampling, and observation models and estimate parameters of biological interest. We have developed hierarchical Bayesian models to estimate the duration of nocturnal migratory flight following departure from a coastal stopover site in southern Ontario. We will summarize the model structure, a simulation study to validate the methods, and our results for Black-throated Blue Warblers and Magnolia Warblers. Our results show that flight duration declines with departure time post sunset in both species, but individual-level covariates such as sex and age appear to have little influence on flight duration.

Afforestation efforts for golden-winged warblers and other forest-associated species in Honduras

D. Murillo, D. King, R. Bennett, F. Rodriguez Vasquez, J. Larkin
Presenting author: **David King**, U.S. Forest Service, david.king2@usda.gov

Since 2011, our team has been monitoring migratory birds in Honduras, and during this period, we have developed and implemented (at a pilot level) strategies such as Integrated Open Canopy (IOC) to conserve and restore ecosystems and protect biodiversity. Our research has shown that bird species are distributed across a gradient of agricultural intensity from sun coffee to intact forest. Among these species, our team has recognized that Golden-winged Warbler (Vermivora chrysoptera) is highly dependent on forested habitats, where males used evergreen forest more than semi-deciduous forest compared to females which used semi-deciduous forest more than evergreen forest. In coffee agricultural regions, Golden-winged Warblers occur in landscapes dominated by humid forest/coffee at higher elevations. Their survival exhibited a negative relationship with canopy height, quadratic effects with vine tangles and dead hanging leaves. Through the implementation of the IOC system, we have been able to conserve and restore native forests, which has proven to be beneficial for the Golden-winged Warbler and other migratory birds. Overall, our efforts to monitor migratory birds and implement the IOC system in coffee plantations has shown great promise in restoring ecosystems and conserving biodiversity. In addition to implementing IOC, efforts are underway to restore watersheds to enhance water supplies to local municipalities, providing opportunities to further protect habitat for GWWA and other forest associated species. We will continue to monitor the Golden-winged Warbler and other migratory birds in the region and work towards further conservation efforts to protect these important species.

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*Comparing the diets of eastern swallows and flycatchers breeding in agricultural and wetland habitats

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Aerial insectivores in North America are experiencing steep population declines, with large variation between species. To investigate the effects of phenological mismatch and agricultural intensification on aerial insectivore populations, we compared the dietary richness and resource use of six species

breeding in the Tantramar region of New Brunswick, Canada. We hypothesize that species in lesser decline have a greater dietary breadth and live in landscapes with a greater abundance of aquatic emergent insects, allowing them to evade the effects of mismatch by switching to more abundant insect prey. We collected fecal samples from Bank swallows (Riparia riparia), Barn swallows (Hirundo rustica), Cliff swallows (Petrochelidon pyrrhonota), Tree swallows (Tachycineta bicolor), Alder flycatchers (Empidonax alnorum), and Least flycatchers (Empidonax minimus). We sampled invertebrates periodically at breeding and foraging sites using vane traps. We used DNA metabarcoding to identify the taxonomic composition of invertebrates in fecal and environmental samples. Bank swallows, the species in greatest decline, consumed a lower richness of insects than other species. Partitioning of insect resources was evident between species, particularly between flycatchers and swallows. By comparing diets between many species living in sympatry and in landscapes varying in agricultural intensity, we hope to improve our understanding of the disproportionate declines observed between insectivore species and how these declines relate to phenological mismatch and breeding habitat.

Feast or famine: do urban forests provide adequate refueling for migratory birds?

D. Narango, S. Lerman, E. Rogers, A. Gerson

Presenting author: **Desiree Narango**, Vermont Center for Ecostudies, dnarango@gmail.com

Several urban-associated mechanisms can influence the availability and quality of arthropod prey for migratory birds, including altered phenology, habitat fragmentation, and novel plant communities. Yet, even though insectivorous migratory birds occur in high densities in cities, little research has assessed the degree to which urbanization affects prey availability and refueling. In spring and fall, we captured migratory birds in forest fragments within Springfield, Massachusetts, USA, that varied in both surrounding urbanization and the dominance of Oak trees (Quercus)-a disproportionately important host plant for caterpillars. We compared arthropod biomass, the nutritional composition of arthropods, migratory bird diets, and plasma metabolites to assess whether urban forests supply comparable stopover habitat quality to rural sites. Our results show that both urbanization and low oak dominance reduce prey abundance and the availability of high-protein prey (e.g., spiders). In addition, we found that some, but not all, bird species stopping over in urban forests had reduced body condition and refueling rates. Effects of urbanization on refueling rates appear to be life-history dependent, such that tree arthropods and small, foliage-gleaning insectivores were more strongly negatively impacted than leaf-litter arthropods and larger, ground-foraging omnivores. Our continued work investigates causal links between altered urban habitat conditions, diet shifts, and stopover performance.

Twenty-five years of habitat restoration to conserve endemic and endangered birds in Ecuador

D. Parra-Puente

Presenting author: **David Parra-Puente**, Jocotoco Conservation Foundation, david.parra@jocotoco.org.ec

Ecuador is known for its strikingly high concentration of species. With only 0.17% of Earth's surface, it is home to 1 out of 5 butterfly species, 1 out of 10 vascular plants, and 1 out of 7 bird species worldwide. These numbers are constantly increasing while our knowledge of biodiversity continues improving as well. Even in well-studied groups such as birds, new species have been discovered in recent years. One of them is the Jocotoco Antpitta, discovered in 1998, which catalyzed the formation of the Jocotoco Conservation Foundation. It quickly became a leading organization in endangered and endemic bird conservation thanks to the strategic establishment of private reserves and science-based management. This includes additional measures for increasing their populations or restoring their habitats. Case studies are presented with lessons learned from successful and unsuccessful strategies in habitat restoration for avian conservation in hyperdiverse highly threatened ecosystems.

Geographical variation in ectosymbiont assemblages of birds: influences of climate and history

H. Proctor

Presenting author: **Heather Proctor**, University of Alberta, hproctor@ualberta.ca

Birds host a great diversity of both internal and external symbionts. Because birds are homeothermic, internal symbionts have a consistent environment irrespective of the climate outside the body of the host. In contrast, external symbionts are potentially exposed to great variation in temperature and humidity. This is particularly true for ectosymbionts of non-migratory birds in regions with cold, dry winters. I and my students tested whether ectosymbiont assemblages (mites and lice) of non-migratory House Sparrows (Passer domesticus) and Rock Pigeons (Columba livia) vary geographically. Rock Doves and House Sparrows were first introduced to eastern North America and both species are now found in almost every urban centre across the continent. We predicted that ectosymbiont richness and prevalence should be lower in host populations from harsher climates. We also hypothesized that richness might decline with distance from sites of initial introduction (i.e., highest on the east coast and declining towards the west). We collected 71 P. domesticus from two sites 650 km apart in Alberta, Canada and compared symbiont richness and prevalence between them and between Alberta and two U.S. states with milder climates. We sampled 162 C. livia from seven locations across Canada from the east to west coasts (a distance of 4000 km). Our results suggest that vane-dwelling feather mites (Acariformes: Analgoidea) are particularly sensitive to harsh climates. Richness and prevalence of other mites and lice showed strong but idiosyncratic variation among sites. Lack of a consistent westward decline in ectosymbiont richness suggests numerous (unrecorded) introductions of these birds to different regions of North America.

Tapping into USDA programs to amplify grassland bird conservation across the state of Virginia

J. Proctor, B. Rigley, J. Gilley, A. Johnson

Presenting author: **Justin Proctor**, Smithsonian's Virginia Working Landscapes, c.justin.proctor@gmail.com

As grassland ecosystems across North America struggle against relentless pressure from development, intensive agriculture, and a changing climate, the avifauna that depend on healthy, functional grasslands for nesting, foraging, and refugia are struggling to survive. With grassland bird declines surmounting those of any other guild of birds, research-guided conservation efforts that can make on-the-ground change are critical if we are going to stem the decline of these birds before time runs out. Smithsonian's Virginia Working Landscapes (VWL), a program focused on building back biodiversity on private working lands in Virginia, is generating research results that can directly inform a suite of best management practices (BMPs) that can work for both grassland birds and farmers. In collaboration with The Piedmont Environmental Council, American Farmland Trust, and Quail Forever, VWL launched the Virginia Grassland Bird Initiative (VGBI) to find ways to effectively-and quickly-launch these BMPs into action. This presentation will focus on how VGBI has been able to partner with the USDA's Natural Resources Conservation Service (NRCS) to use its research and conservation goals to modify state-wide cost-share programs to better marry the needs of both grassland birds and local farmers. VGBI is currently helping train NRCS staff on the conservation value and implementation of the BMPs newly integrated into these cost-share programs, with the goal of increasing the adoption of these programs by farmers and therefore significantly amplifying grassland bird conservation across the entire state of Virginia.

Estimating Sprague's pipit (Anthus spragueii) breeding season survival and movement

N. Raginski, A. Boyce, C. Rushing

Presenting author: **Nancy Raginski**, University of Georgia, nraginski@gmail.com

North American grassland bird populations have experienced steep declines in the past 50 years. Sprague's pipit (Anthus spragueii), a migratory obligate grassland songbird, have experienced particularly severe declines, with an estimated population loss of ~80% since 1970. Demographic data required to assess and conserve this species are nonexistent, which is in part due to their nomadic behavior during the breeding season. We used detection data from a network of Motus towers to estimate Sprague's pipit demographic parameters and movement rates of pipits tagged at two study sites in Montana and Canada. We used a multi-state Cormack-Jolly-Seber model to estimate survival, transition, and detection probabilities of pipits at our study sites. In 2022, weekly apparent survival estimates were similar at

Montana (0.89, 95% CI: 0.86 – 0.92), and Canada study sites (0.78, 95% CI: 0.68 – 0.86) and detection estimates were significantly greater at our Canada study site (0.98, 95% CI: 0.87 – 0.99) compared to Montana (0.79, 95% CI: 0.75 – 0.84). Transition probabilities between study sites were low and only weakly influenced by local precipitation. With the addition of our 2023 data, we will also fit additional weather, habitat, and demographic covariates and incorporate individual variability in detection rate to identify factors influencing parameter estimates. To our knowledge, our study is the first to estimate demographic rates for Sprague's pipit and provides much-needed demographic information for this declining songbird.

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*Pressure points: Barometric geolocators reveal unprecedented details of migration ecology in Swainson's Warblers

G. Rhyne, P. Stouffer, A. Peele, L. Bulluck, D. Buehler, D. Rader, T. Boves, J. Tyrrell, M. Johnson

Presenting author: **Garrett Rhyne**, Louisiana State University, grhyne1@lsu.edu

Understanding the migration ecology, nonbreeding distribution, and migratory connectivity of threatened Neotropical migrants is crucial for implementing effective conservation strategies. Recent developments in multi-sensor geolocators, including barometric units, now allow researchers to uncover migration and location details on small passerines (<25g) at higher resolutions than traditional light-level geolocators. Conservation planning for skulky, understudied migrants such as Swainson's Warblers (Limnothlypis swainsonii) would greatly benefit from full annual cycle tracking. In 2021 we captured breeding territorial male Swainson's Warblers and deployed 86 barometric and light-level geolocators across six states. In 2022 we recovered 31 geolocators (36%) and generated wintering distribution maps from 26 birds. Using the GeoPressureR package, barometric recordings (n=14) revealed novel migration data including stopover sites and migration routes, stopover duration, flight departure and arrival, flight altitude, nonbreeding site elevation, and more precise wintering location estimates. We found high levels of migratory connectivity across longitudinal divides: Mississippi Alluvial Valley breeders crossed the Gulf of Mexico to winter in the Yucatán Peninsula, while Appalachian and Coastal Plains breeders used stopover sites throughout Florida in both spring and fall to overwinter in Cuba and the central Caribbean. Results from this project contribute valuable ecological, phenological, and behavioral information for Swainson's Warblers. More broadly, multi-sensor geolocators show high promise for revealing new details of migration and greatly improving location data for small birds.

Influence of a warming ocean on the breeding activity of a most unusual – and threatened – forest-nesting bird

J. Rivers, L. Adrean, J. Bailey Guerrero, J. Dachenhaus, J. Fisher, C. Frisinger, M. Garcia-Heras, B. Gerber, C. Meyer, K. Nelson, J. Northrup, D. Roby, J. Valente, C. Wolf, E. Woodis

Presenting author: **James Rivers**

Anthropogenic-driven environmental change has led to widespread alterations of our planet, impacting biodiversity across the biological spectrum. Forest-associated species that rely on a split-habitat strategy are of heightened concern in light of these changes because their persistence requires conservation of two distinct habitat types. The ESA-listed Marbled Murrelet (Brachyramphus marmoratus) is unique among North American birds because it requires nearshore marine habitat for foraging yet nests up to 80 km inland in older forests along the Pacific Coast. During 2017-2022 we assessed murrelet breeding activity by fitting individuals captured at sea with VHF-radio telemetry tags and tracking them inland to their nest sites. Across 5 years we captured and radio-tagged 300 murrelets, yet only a small fraction of those individuals ended up breeding (13%). Nesting propensity of tagged birds ranged from 0–37 % per year, with only 30% of the nests we located (n=37) producing offspring. We found lower inland occupancy, lower breeding propensity, and greater long-distance movements in years when low-productivity ocean conditions negatively affected the food resources murrelets require for successful nesting. Projected increases in ocean warming, coupled with long-term reduction and fragmentation of murrelet nesting habitat, suggest that recovery of murrelet populations remains a formidable challenge that will require targeted conservation efforts in both its marine and terrestrial habitats.

Restoring Habitat Across the Annual Cycle for Kirtland's Warbler

S. Roels, D. Ewert
Presenting author: **Steven Roels**

The recovery of the Kirtland's Warbler from the brink of extinction and its removal from the U.S. Endangered Species List is a conservation success story. However, threats to the species persist, including on the wintering grounds in The Bahamas. Relying on early successional vegetation during both the breeding and wintering periods of the annual cycle, the Kirtland's Warbler benefits from the restoration of natural disturbance regimes and land management activities that simulate the effects of natural disturbances. A successful, but intensive, breeding habitat restoration strategy in the U.S. has been driven by public land management agencies. In contrast, limited resources for conservation management in The Bahamas necessitate innovative approaches to create and maintain winter habitat. Developing capacity for Kirtland's Warbler habitat restoration and management in The Bahamas is an essential bulwark against anticipated habitat loss and redistribution driven by human development and climate change.

Twenty years of achievements by the Golden-winged Warbler Working Group

A. Roth, R. Bennett
Presenting author: **Amber Roth**, University of Maine, amber.roth@maine.edu

The Golden-winged Warbler (Vermivora chrysoptera) is a rapidly declining migratory forest bird that breeds in the US and Canada and winters in Central and South America. To better address its conservation, the Golden-winged Warbler Working Group was established in August 2003. In 2005, the group held a workshop where the first full-annual cycle collaborative research and conservation initiative for the species was launched. Collaborative research produced the first rangewide assessments of breeding habitat, nest success, hybridization with the Blue-winged Warbler (Vermivora cyanoptera), and is currently assessing adult survival. A full-annual-cycle conservation plan published in 2012, amended in 2016 to add the nonbreeding chapter, and revised in 2019 provides a comprehensive assessment and strategy to recover the species. Outreach materials in both English and Spanish, including 19,200 educational posters and brochures, were distributed to schools, bird festivals, and landowner workshops. Best management practice publications were developed for land managers and owners to increase and improve breeding habitat in eastern North America. As a result, investment increased from Working Lands for Wildlife and other habitat programs to greatly increase breeding habitat across the range. The recent completion of two conservation investment strategies provides guidance for protecting and managing winter habitats with direct involvement from many Latin American organizations. The working group is a model for other single-species working groups and a focus of Road to Recovery. This symposium celebrates the 20th anniversary of the working group by highlighting achievements and lessons learned from across the full-annual range.

Golden-winged Warbler Habitat Management on Public and Private Lands in the Great Lakes Region

L. Rowse, P. Dieser
Presenting author: **Linnea Rowse**, American Bird Conservancy, lmrowse@gmail.com

As a part of a range-wide conservation initiative, ABC has worked collaboratively with public, private, tribal, and NGO partners throughout Minnesota, Wisconsin, and Michigan to implement science-based best management practices (BMPs) for Golden-winged Warbler, American Woodcock, and associated early successional habitat species. Within defined focal regions, 15,470 acres of habitat projects to restore and enhance young forest breeding habitat have been completed since 2013. ABC provides financial, technical, and project management assistance for all phases of project implementation. Since 2013, the Minnesota GWWA Public Lands Program has spanned three phases of grant funding via the Minnesota Outdoor Heritage Fund (OHF), completing 8,496 acres of habitat management with public and tribal partners (additional 204 acres also completed in MN and WI with other funding sources). Since 2016, the ABC Great Lakes Private Lands Program has completed 6,770 acres on private lands across

MN, WI, and MI with funding from the USDA Natural Resources Conservation Service - Regional Conservation Partnership Program (RCPP). With our current RCPP and MN OHF funding, an additional 8,000+ acres are planned for completion on public and private lands through 2026. Additionally, ABC's coordinated outreach, BMP training efforts, and collaborative work with partner organizations has resulted in a far greater impact across public and private lands than outcomes completed solely by the Great Lakes Team. ABC's conservation goals are to benefit a suite of forest birds and associated wildlife species, and to promote a dynamic mosaic of ages and cover types across the Great Lakes' forested landscape.

Integrating spatially explicit trends and demographic data to assess drivers of Golden-winged warbler population change

E. Royal, A. Smith, D. Crawford, W. Thogmartin, A. Roth
Presenting author: **Ethan Royal**, University of Maine, ethroyal@gmail.com

Golden-winged Warblers (GWWA) have experienced severe population declines throughout their breeding range, although the rates of decline appear to differ between the geographically distinct Appalachian and Great Lakes regional populations. We used an integrated, spatially explicit trend model to leverage both long-term data from the BBS and a more recent targeted GWWA survey, and thus generated range-wide site-level trend estimates, including for areas where BBS surveys no longer detect GWWA. We integrated data from the two surveys by sharing information on annual differences in relative abundance across the species range, using an intrinsic conditional autoregressive model. We then incorporated these spatially explicit trend estimates into an integrated population model (IPM) with demographic data on survival and productivity contributed by collaborators from the across the full species range. This range-wide IPM will allow us to identify demographic drivers of trends at population, regional, and full-range scales. Additionally, we will investigate the influence of spatially and temporally explicit covariates on specific demographic parameters and broader population trends, thus improving our understanding of the roles of management-related, climatological, and ecological drivers of demographic rates and population trends. The demographic parameters and trend estimates derived from this effort will inform conservation efforts by elucidating drivers of population declines and provide insight to management efforts aimed at mitigating declines.

Using Motus to inform movement models of migratory birds: Approaches and considerations for array design

C. Rushing
Presenting author: **Clark Rushing**, Univeristy of Georgia, clark.rushing@uga.edu

The emerging field of movement ecology provides a cohesive framework for understanding the behavioral, energetic, and demographic processes that govern the migratory movements of birds. To date, however, the primary modeling frameworks used by movement ecologists have been developed for high-resolution telemetry data, limiting the applicability of these methods to all but the largest migratory birds. The continued growth of the Motus network provides new opportunities to place the study of bird migration within the field of movement ecology, but the ability to fit movement models to Motus data will require continued development of both modeling frameworks and sampling designs that maximize the utility of detection data. In this talk, I outline approaches to making inferences about migratory movements and behavior from Motus data, with an emphasis on the data structure and quality needed to fit movement models. These considerations have direct applicability to design and deployment of tower infrastructure and I will also discuss issues related to sampling design.

Testing bird window collision prevention technologies

B. Samuels
Presenting author: **Brendon Samuels**

Bird-window collisions can be prevented using deterrent technologies (e.g., bird-friendly films, patterned glass) that alert birds approaching windows to the presence of an obstacle to avoid. Various experimental and passive observational methods are used to evaluate performance of these technologies. The data

produced by 'field tests' and 'tunnel tests' form the empirical basis of standards indicating whether technologies are considered safe for birds in window retrofitting and new building construction. Methods used in these tests have certain strengths that could be synergistic, yielding information about performance of deterrents in various contexts. However, differences between methods are not well described or documented, making it difficult to understand how they complement one another, and communicate nuances to end users who want to generalize from test results to predict performance of deterrents in real-world conditions. This presentation reviews different testing methods currently practiced, addressing some of their strengths as well as assumptions about the birds and interactions with tested materials. I suggest possible ways for existing, ongoing tests to account for sources of uncertainty and to improve ecological validity. I further propose ways to translate descriptions of test methods and results into language that is more interpretable by and ultimately useful for scientists, architects, and the public.

Investigating the home ranges of hummingbirds in Colombia using two automated radio telemetry approaches

A. Sargent, M. Ward, A. Fernandes, Y. Talwekar, M. Muñoz-Amaya, N. Téllez-Colmenares, A. Rico-Guevara

Presenting author: **Alyssa Sargent**

Animals have complex cognitive maps, which can determine individual fitness and thus shape the structure and dynamics of ecological hierarchies. Home ranges (spatially bounded patterns of space-use) indicate areas that animals use to fulfill life history requirements, and are of great importance to characterize. Hummingbirds, the most specialized vertebrate pollinators, are an excellent case study for movement variation research. Not only is there extreme inter- and intraspecific variation across the scale of hummingbird movement-territories can differ almost 200 times in area, and different species can cover daily distances that vary fivefold-but also intraindividual variation. Hummingbirds respond to competition in highly flexible ways, from drastically expanding their territories, to abandoning them altogether. To evaluate behaviorally plastic movements, we radio-tracked 20 Black-throated Mangos (Anthracothorax nigricollis)-a species that employs conditional territoriality, depending on the energetic and competitive landscapes-across a forested-agricultural matrix and hummingbird hotspot in Colombia. Given the wealth of wildlife tracking devices available, and the resulting difficulty for newcoming and experienced researchers to select an approach, we used grid- (Cellular Tracking Technologies) and tower-based (JDJC Corp) receivers, two forms of automated telemetry, to (a) compare how multiple systems perform relative to one another, and (b) explore inter- and intraindividual hummingbird home range variation.

Using GPS-acceleration devices to quantify breeding propensity of birds nesting in remote locations

A. Schindler, A. Fox, C. Wikle, B. Ballard, A. Walsh, S. Kelly, M. Weegman

Presenting author: **Alexander Schindler**, University of Saskatchewan, alecschindler@gmail.com

Understanding how natural and anthropogenic changes to the environment affect breeding outcomes in avian species is a crucial component of avian conservation, but these processes are difficult to study in species with breeding areas in locations inaccessible to researchers. Modern tracking devices that record Global Positioning System (GPS) location and acceleration (ACC) data at frequent intervals provide new opportunities to monitor avian movement and behavior during the breeding season even when direct observation is impossible. However, high-accuracy methods to identify breeding events from tracking data are still needed. We developed a machine-learning approach to remotely estimate annual breeding propensity (i.e., whether an individual was successful in breeding, attempted to breed but failed, or did not attempt to breed) for birds fitted with GPS-ACC devices. Using a training data set of GPS-ACC data collected from Greenland white-fronted geese (Anser albifrons flavirostris) with known breeding outcomes, we used within-day movement, among-day movement, and daily energy expenditure metrics in a random forest model to classify days spent incubating a nest with >95% accuracy. We then defined breeding propensity based on the number of consecutive days spent incubating a nest. Our method for remotely classifying breeding outcomes provides a framework for estimating breeding propensity in any avian species where similar GPS-ACC data is available. These advances will help researchers study a

variety of breeding-related questions even when direct observation of individuals during the breeding season is impossible.

The ecological role of native-plant landscaping in residential yards to birds during the nonbreeding period

N. Smallwood, E. Wood
Presenting author: **Noriko Smallwood**

Residential yards provide habitat for wildlife, especially when landscaped with native plants. But, most native yard and wildlife research has been conducted during the breeding period, leaving a gap in our understanding of the importance of native yards as habitats for animals during the nonbreeding period. We quantified the ecological role of native yards to avifauna throughout Greater Los Angeles, California (L.A.) during the winter nonbreeding period, which is a time of year when the region hosts a high abundance and diversity of migratory and resident birds. We surveyed birds and habitat features from Oct-Mar of 2020 and 2021 at 22 pairs of native and nonnative yards plus ten additional native yards. We compared bird communities, including feeding and nonfeeding behaviors, and habitat features between native and nonnative yards. We also quantified relationships between habitat features and bird richness, abundance, and feeding and nonfeeding behaviors, focusing on species affiliated with urban or natural terrestrial ecosystems of the region. Lastly, we documented feeding and nonfeeding behaviors by birds with native and nonnative plants. Native yards had greater cover of native trees, shrubs, herbaceous plants, and natural habitat elements. Bird richness and abundance, especially bird species affiliated with natural ecosystems, were greater in native than nonnative yards. Yards with a higher cover of native plants supported greater numbers of feeding birds, with individuals focusing their foraging behaviors on distinct native trees and shrubs. We show that native yards provide important habitat for birds during the nonbreeding period and are a viable approach for residents and cities to improve conditions for birds.

Context is everything: How visual environments & lighting influence glass appearance & collision deterrent efficacy

A. Sobolev
Presenting author: **Alexander Sobolev**, Guardian Glass, asobolev@guardian.com

Visual contrast is believed to be an important aspect of collision deterrent effectiveness, yet this relationship is vaguely defined. Understanding how lighting and other environmental variables impact visual contrast of a deterrent technology can lead to better deployment of deterrents on buildings and better interpretation of deterrent test results in research. Glass façade elements, from residential windows to commercial curtainwalls, exist in visual contexts that are constantly changing: brightness, diffusion, lighting directionality, color and texture of the background scene, as well as the observer's position all impact how glass looks on a building. These factors may also impact the appearance of bird collision deterrent elements (e.g., films, etched, frit, etc.) and to what extent they contrast with the background. This presentation will review how contextual factors, such as lighting and background, can affect the appearance of glass, and consider implications for real-world collision deterrent performance as well as sources of bias or confounds in experimental testing environments. It is hypothesized that qualities of ambient lighting differentially affect the range of visual contrast and collision deterrent effectiveness of various 'bird-friendly' technologies, independent of whatever patterning is applied (i.e., the shape, size, or spacing of the visual element like dots, lines, etc.). This research analyzes photographs of buildings and glass deterrent products under varying lighting conditions to quantify the amount of visual contrast between the deterrent elements and untreated glass.

Effects of nest microclimate and ectoparasite abundance on altricial nestling growth and development

K. Stansberry, R. Stephens, E. Forman, M. Kimball, T. Kelly, C. Lattin
Presenting author: **Keegan Stansberry**

Infestations of ectoparasites, such as the Northern Fowl Mite (Ornithonyssus sylviarum) in the nest environment can have strong negative effects on growth and development during the nestling period.

Altricial birds, like the European Starling (Sturnus vulgaris), may be particularly susceptible to the effects of ectoparasites in the nest because nestlings are unable to escape the nest environment until fledging. The abundance of Northern Fowl Mites in a nest and the adverse effects inflicted by them on developing nestling hosts can be affected by abiotic factors, such as relative humidity. Our aims in this study were to determine 1) the effect of humidity on abundance of Northern Fowl Mites in the nest and 2) examine the effects of mite abundance on growth and development in free-living European Starling nestlings. To address these aims, we manipulated humidity and initial mite abundance in nests. We predicted that nests with reduced humidity would have fewer Northern Fowl Mites present by the end of the experiment. We also predicted that fewer mites in a nest would result in nestlings of greater size and improved body condition over the course of two weeks post-hatch. Preliminary results suggest that the reduced humidity treatment increased the abundance of mites in the nest and nestlings in the mite inoculation treatment had reduced mass, wing length, and tarsus length compared to nestlings in control groups. These results suggest that even subtle changes in the nest microclimate can affect ectoparasite abundance and nestling development, with clear conservation implications considering current and future climate unpredictability brought on by global warming trends.

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*Prey selection by breeding and non-breeding Common Nighthawks (Chordeiles minor) across fire management regimes

E. Stein, K. Cockle, N. Fariña, O. Villalba, G. Zubarán, J. Cox, D. Baldo, S. Taylor
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Common Nighthawks (Chordeiles minor) belong to the aerial insectivore guild, which is rapidly declining in part because of changes in insect prey bases. To understand the ability of nighthawks to accommodate fluctuating prey communities, it is necessary to understand their degree of diet specialization, how specialization changes throughout the annual cycle, and the effects of land management practices on prey availability. We examined prey selection by breeding and non-breeding nighthawks by collecting fecal samples during two breeding seasons in Florida, USA, and two non-breeding seasons in Corrientes Province, Argentina. We used DNA metabarcoding to identify insect prey in nighthawk fecal samples, and we coupled fecal sampling with aerial insect sampling to assess prey selection. In Florida, we sampled birds and insects across an array of forest plots with different fire return intervals to assess how fire frequency affects prey availability. We predicted that nighthawks would exhibit more specialized foraging behavior on their breeding grounds compared to non-breeding grounds because of higher energy demands during breeding. We also predicted that forest stands burned every 2-5 years would support higher numbers of prey than stands burned less frequently because of the area's historically frequent natural fire regime. We will present results on nighthawk prey selection in both breeding and non-breeding habitats, and whether season and prescribed fire frequency affected prey availability. Differences in prey selection will reveal the times of year when this declining aerial insectivore is most vulnerable to changes in prey availability, and how fire management can support prey communities during the breeding season.

Incorporating pyrodiversity into woodpecker habitat assessments after fire

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Spatial and temporal variation in fire characteristics (i.e., pyrodiversity) are increasingly recognized as important factors that structure forest bird communities, yet there have been few attempts to incorporate pyrodiversity or post-fire habitat dynamics into predictive models of animal distributions and abundance to support post-fire management. We use the black-backed woodpecker – a species associated with burned forests in the western U.S. – as an adaptive management case study to demonstrate a pathway for incorporating pyrodiversity into wildlife habitat assessments during a time of rapid change to fire regimes in California. Employing 11 years of monitoring data from post-fire forests, we developed three competing occupancy models describing different hypotheses for habitat associations: (1) a static model representing an existing management tool, (2) a temporal model accounting for years since fire, and (3) a temporal-landscape model which additionally incorporates emerging evidence from field studies about the influence of pyrodiversity. We found superior support for the temporal-landscape model, which showed a positive relationship between occupancy and pyrodiversity and interactions between habitat associations

and years since fire. We incorporated this new temporal-landscape model into a predictive management tool to support rapid decision-making after fire and created an RShiny application to run the tool with a point-and-click interface: https://birdpop.org/pages/bbwoPredPostFireDist.php.

Diversification and biogeography of a globetrotting group of parasitic lice from doves

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Parasites are very diverse, yet we know relatively little about the evolutionary history of most groups of parasites. Here, we focus on a globally distributed group of ectoparasitic body lice from doves. These insects are closely associated with their hosts, but do have some ability to disperse between different host species. Our primary questions are 1) did body lice originate once or multiple times on doves, and 2) how have the lice diversified with doves over evolutionary time and space? We used whole genome sequence data of lice to reconstruct the phylogeny of 58 species of body lice from 51 species of doves, including representatives from every continent except Antarctica. From these data, we estimated a well-resolved and highly supported phylogenetic tree of the body lice, with evidence for a single origin on dove hosts. Cophylogenetic comparisons with an existing host phylogeny indicated high amounts of codiversification between doves and their lice, but also some instances of host switching, in some cases between distantly related host species. These patterns suggest that dove diversification played a significant role in the diversification of lice, but was not the only factor driving parasite diversity. Biogeographic history also seemed to play a major role in this host-parasite system. This group of lice likely originated on a group of Australasian birds, and then dispersed across the globe with their hosts. This pattern is consistent with the biogeographic history of doves and other dove parasites. Our study highlights that parasite evolution is often driven by complex interactions among different factors that can have varying effects over long periods of time.

The influence of ALAN on the flight paths of a nocturnal migrant, Eastern Whip-poor-will (Antrostomus vociferus)

S. Thompson, A. Korpach, C. Davy, K. Fraser
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Artificial light at night (ALAN) has been identified as a driver of behavioural change in many avian migratory species, influencing timing, pathways, and stopover habitat use. Nocturnal birds may be most sensitive to ALAN during their migrations owing to their adaptations for moving and foraging in darkness. We predicted that the flight paths of Eastern Whippoorwill (Antrostomus vociferous) would be influenced by ALAN encountered during their fall migrations. We installed archival GPS tracking tags on whip-poor-wills at their breeding grounds in Manitoba and Ontario. We programmed the tags to collect points every 2 hours for the duration of each bird's fall migration to overwintering sites in Central America. We retrieved 18 tags with useable data and measured flight path tortuosity (straightness) in relation to artificial light levels encountered over full routes and on nightly flights between stopover locations. We found that at the route-long scale, more eastern breeding (ON) birds had longer fall routes but similar tortuosity as compared to more western breeding (MB) birds. Preliminary results indicate that ALAN levels encountered by whip-poor-wills on nightly flights did not differ from (simulated) direct paths, suggesting birds did not select routes that reduced ALAN exposure on a nightly scale. However, there may be a difference between the overall quantities of artificial light experienced by birds experienced by birds from different populations (eastern vs western).

Nesting habitat characteristics of a northern population of chimney swifts (Chaetura pelagica) in a forested landscape

J. Tixier, A. Desrochers, P. Paré, V. Lamarre, J. Perrier, C. Bégin-Marchand, J. Tremblay
Presenting author: **Jeremie Tixier**

Chimney swift (Chaetura pelagica) populations have declined drastically in the past decades and the species status is Threatened in Canada. Loss of roosting and breeding habitats in urban regions and

forest ecosystems have been identified as one of the main threats to the species. While little information is known on the nesting habitats in forests, the potential of breeding in natural habitats remains a pending concern and could be an important component for the long-term viability of the species. Our main objectives were to find and characterize active swift nesting trees. Random Transects were then used to determine tree and natural cavities availability. We captured and equipped swifts with nanotags, and tracked them to their nests using seven Motus receiving stations distributed throughout the study area as well as mobile telemetry done by car, boat, ORV and foot. A total of 55 swifts were tracked from which five led us to their nesting trees, located at up to 30 km of the roosting site. Four of the 5 nests were found in yellow birches (Betula alleghaniensis; two live and two dead trees) and one was in a dead sugar maple (Acer saccharum), with a mean diameter (Â±SD) of 77.7 Â± 9.9 cm and were all over four meters tall. Our results suggest that Chimney swifts' nests were more likely to be found in large, live or dead yellow birches located in old growth mixedwood forests. Globally, these findings show promise regarding the identification and protection of suitable nesting trees, a better understanding of swifts' natural nesting habitats and acts as a key factor in the species recovery.

Emerging genomic patterns of Vermivora warblers

D. Toews

Presenting author: **David Toews**

Understanding the barriers to reproduction in closely related species is a central goal of evolutionary biology. Hybrid zones are particularly important in this vein as, by definition, they only occur between taxa that are not completely reproductively isolated. Determining the extent of isolation can, in part, be measured by evidence of gene flow obtained from genome-wide markers. We have applied such genomic tools to study hybridizing Golden-winged (Vermivora chrysoptera) and Glue-winged (V. cyanoptera) warblers, as well as their congener Bachman's Warbler (V. bachmanii). Here I synthesize the last decade of research on this system, which has eluded straightforward characterization for over a century. I also highlight the key knowledge gaps moving forward and how these data may inform conservation management of Vermivora warblers.

Decades of coastal waterbird and beached bird surveys help inform conservations initiatives in British Columbia

R. Torrenta, D. Bradley, D. Ethier

Presenting author: **Remi Torrenta**

The Coastal Waterbird Survey and Beached Bird Survey are citizen science programs collecting live waterbird counts and mortality data from carcasses, respectively, at coastal sites in British Columbia. These volunteer-based data have enabled us to derive temporal trends and distribution patterns of coastal waterbird populations and seabird mortality events. Specifically, with these 20+ year datasets, we have (1) identify sites with ongoing declines in bird abundances, which helps focus conservation attention to important species and sites; (2) resolved which factors and/or biological mechanisms are driving observed declines, including shifts in habitat use or mass mortality events; and finally (3) established and informed waterbird conservation initiatives across British Columbia, particularly in the Salish Sea. Among them, collaborative efforts including research projects, Indigenous-led monitoring, and area-based working groups which focus on the conservation of target shorebirds, sea ducks or alcids, help us guide management decisions and planning process at various jurisdictional scales.

Marshbird monitoring in remote areas: the atlas marshbird survey concept

D. Tozer

Presenting author: **Douglas Tozer**, Birds Canada, dtozer@birdscanada.org

Marshbird monitoring requires specialized methods that can be challenging to implement. The Marsh Monitoring Program (MMP), a citizen science program delivered by Birds Canada, overcomes these challenges and has successfully tracked populations of secretive marshbirds annually for decades across various settled regions of southern Canada. The MMP falters, however, in remote areas where there are few citizen scientists. Here, I first describe the success of the MMP in settled regions, and then I outline

the atlas marshbird survey (AMS), a practical, cost-effective approach that periodically conducts MMP-style surveys in remote areas every 20 years as part of recurring breeding bird atlases. If combined together in a continuous, integrated network, the MMP and the AMS have potential to provide robust marshbird data for wetland conservation across all of southern Canada. Like the MMP, the AMS prioritizes collection of high-quality marshbird monitoring data, but also has the flexibility to maximize volunteer participation. The AMS includes a statistically robust experimental design and a dedicated field protocol to maximize detections of secretive species, all of which are consistent with the Standardized North American Marsh Bird Monitoring Protocol. The AMS is currently being piloted as part of the 3rd Ontario Breeding Bird Atlas (2021–2025), and if successful, will likely become a key delivery mechanism of Birds Canada's Marshbird Monitoring National Strategic Plan for Canada. The AMS may also be useful for monitoring marshbirds in other remote regions of North America and elsewhere.

Cumulative impact of climate change and forest management on bird communities in mixed and boreal forests in Québec

J. Tremblay, G. Labadie, P. Cadieux, í‰ Thiffault, D. Cyr, D. Stralberg, Y. Boulanger
Presenting author: **Junior A. Tremblay**

The combination of climate change and anthropogenic disturbance has the potential to cause major changes in forest bird communities. In this study, we projected changes on forest landscapes and bird communities according to various forest management strategies under a changing climate using the spatially explicit forest landscape simulation model LANDIS-II for two case study areas of Quebec (Canada), i.e., a hemiboreal (Hereford Forest) and a boreal (Montmorency Forest) area. We also evaluated effects on sensitive and at-risk bird species. Forest management and climate change were projected to lead to significant changes in bird communities in both types of forest through changes in forest stand composition. Bird communities associated with mixed and deciduous stands were predicted to be favored by the increase in deciduous vegetation, to the detriment of communities associated with old-growth coniferous stands. The magnitude of the changes was generally projected to be greater in (hemiboreal) Hereford Forest than in (boreal) Montmorency Forest. In addition, bird communities in Hereford Forest were mainly affected by climate change, while those in Montmorency Forest were projected to be more greatly impacted by forest management. We estimated that 25% of the species studied in Hereford and 6% in Montmorency Forests will be sensitive to climate change.

Ongoing forest fragmentation negatively affects the distribution of an endangered forest-breeding bird

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Presenting author: **Jonathon Valente**, U.S. Geological Survey, jonathon.j.valente@gmail.com

Habitat fragmentation can negatively affect biodiversity but understanding how it affects any particular species is complicated by idiosyncratic habitat requirements and spatial variability in fragmentation effects within a species' range. We aggregated 29 years of Marbled Murrelet (Brachyramphus marmoratus) breeding surveys from >42,000 forest sites throughout the Pacific Northwest, USA. We built species distribution models linking occupied sites with Landsat imagery to quantify murrelet-specific habitat, then used occupancy models to test the hypotheses that (1) fragmentation negatively affects murrelet breeding distribution, and (2) these effects are amplified with distance from the marine foraging habitat towards the edge of the species' nesting range. Murrelet habitat declined in the Pacific Northwest by 20% since 1988 while the proportion of habitat comprising edges increased by 17%, indicating increased fragmentation. Furthermore, fragmentation of murrelet habitat at landscape scales (within 2 km of survey stations) negatively affected occupancy of potential breeding sites, and these effects were amplified near the range edge. On the coast, the odds of occupancy decreased by 37% (95% CI: -54% to 12%) for each 10% increase in edge habitat (i.e., fragmentation), but at the range edge (88 km inland) these odds decreased by 99% (95% CI: 98% to 99%). Conversely, odds of murrelet occupancy increased by 31% (95% CI: 14% to 52%) for each 10% increase in local edge habitat (within 100 m of survey stations). Avoidance of increasingly fragmented landscapes and attraction to locally fragmented sites with reduced quality may help explain the lack of murrelet population recovery.

Listening in on social interactions during nocturnal migration

B. Van Doren, G. Van Horn, A. Farnsworth
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Bird migration is one of nature's most spectacular phenomena, but migratory birds and their journeys are imperiled across the globe. Songbirds, especially those that migrate at night, are often thought to undertake migration alone. However, social interactions during nocturnal migration may play a larger role in mediating migratory decision-making than currently understood. Because many species vocalize during migratory flight, passive acoustic monitoring shows great promise for facilitating widespread monitoring of bird migration at the species and individual levels. Here, we present Nighthawk, a deep learning model designed to detect and identify the vocalizations of nocturnally migrating birds, and we use it to characterize in-flight interaction networks among migrant species. We trained Nighthawk on in-flight vocalizations from >70 migratory bird taxa, drawing on a diverse dataset of >500,000 audio clips collected across the Americas. We then applied Nighthawk to thousands of hours of passively recorded audio to identify which taxa are more likely to travel together during migration and how these relationships vary across space and time. Nighthawk is freely available software that will empower diverse stakeholders to efficiently monitor migrating birds and collect data to aid science and conservation efforts.

Can post-hoc correction produce unbiased estimates of effective detection radius given distance estimation error?

S. Van Wilgenburg, D. Iles
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Surveys of passerine birds in North America are primarily conducted using point-count sampling in which all birds seen and heard within a defined temporal window are recorded by the observer. Counts from point-count surveys represent an index of abundance unless additional sampling protocols are employed to estimate the probability that a bird is present and not observed. A major source of detection error in point-count surveys derive from a decay in detections with distance from the observer. Distance sampling has therefore become a commonplace approach to removing biases in point-count data. In forested environments where birds are rarely observed visually, observers can only estimate the distances at which they heard individual birds. Previous experiments have shown that observers have substantial error in their estimates of distances for acoustic detections. Here, we use simulations to explore whether collection of additional known-distance data and applying post-hoc corrections can result in unbiased estimates of the area sampled within a survey. Based on our simulations, we followed up with field experiments in the boreal forest during the summer of 2023 to apply our approach in field conditions. Based on our analyses, we provide recommendations for field protocols to reduce biases from distance estimation error.

Social cues influence the vernal migratory behavior of a nomadic songbird, the pine siskin.

B. Vernasco, J. Cornelius, H. Watts
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Animals often migrate between spatially distinct habitats to exploit ephemeral resources. The decisions related to when to initiate and terminate such movements are critical to tracking favorable environmental conditions. Social cues are thought to be important for making these types of migratory decisions, yet relatively few studies have experimentally tested how social cues influence migratory decision-making. Here, we use an experimental approach to understand how social cues influence the termination of vernal migratory behavior in a captive population of pine siskins (Pinus spinus), a nomadic songbird. Specifically, during the vernal migratory period, we measured the nocturnal activity levels (i.e., zugunruhe), body condition, and reproductive development of pine siskins experiencing two different social environments. Individuals were either visually paired with two same-sex individuals in a neighboring cage or visually paired with two photo-advanced, same-sex individuals in a neighboring cage. Photo-advanced birds experienced 18-hour day lengths for 1 month prior to pairing while all other birds in the experiment

experienced naturally changing vernal photoperiods. We found that birds presented with photo-advanced neighbors ceased nocturnal migratory behavior more rapidly than birds paired with control neighbors. Using an experimental approach, this study provides new evidence for the role of social cues in migratory decisions.

Climatic influences on avian food supply in a temperate forest mediated by snow and soil moisture

B. Walters, E. Nol

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Disruption of the link between nesting songbirds and arthropod prey is an obvious and significant potential risk caused by climate change. Understanding how avian consumer prey is influenced by climate will be important in estimating that potential risk. During the breeding season, altered prey communities and availability could negatively affect fecundity through declining parental condition, reduced nest attentiveness, lower nestling growth rates and longer nestling exposure periods. Changing temperature envelopes has been a central focus of climate change research for ectotherms and results have shown a mixture of positive and negative effects for the geographic ranges and survivorship of invertebrates. In temperate forests, ecosystem dynamics are also strongly mediated by other climatic variables including snow and rain. Using measured snowpack and soil moisture gradients we modeled the response of arthropod relative biomass and relative abundance in deciduous forest and coniferous plantations patches within a large forest on the Oak Ridges Moraine in Ontario. We found significant positive influences of higher snowpack for most arthropod groups and weaker significant influences of soil moisture. Predictions for this region suggest that rainfall will form a greater proportion of winter precipitation reducing snow deposition and residency and increased summer temperatures and drying will coincide with more intense rainfall events that contribute less to soil moisture. Therefore, we suggest that there will be at least short-term negative influences, if not long-term effects of climate change on forest breeding songbirds.

Activity patterns of birds as determined by automated radio telemetry: when, where and why birds become active.

M. Ward, I. Souza-Cole, M. Avara, C. Cremer, A. Fournier, N. Suckow, F. Vega-Reyes, L. Chapa-Vargas, A. Celis-Murillo, S. Stewart, G. Witynski

Presenting author: **Mike Ward**, University of Illinois, mpward@illinois.edu

Abstract: The activity patterns of birds can provide information on many aspects of a species' ecology. Automated radio telemetry is a great tool to collect data on activity because simple data such as signal strength and bearing from the unit can be used to estimate activity of individuals. Automated approaches also provide the opportunity to study activity at night, a period when behavioral observations are difficult. We used both pulse-coded (MOTUS approach) and non-pulse coded transmitters in the context of both single automated units as well as telemetry arrays to collect activity data on Eastern Whip-poor-wills (Antrostomus vociferus), Northern Saw-whet Owls (Aegolius acadicus), Virginia Rails (Rallus limicola), Sora (Porzana carolina), LeConte's Sparrows (Ammospiza leconteii), Henslow's Sparrow (Centronyx henslowii), and Clay-colored Sparrows (Spizella pallida). We focused on daily activity patterns (night, dawn, day, dusk) with particular attention on how the lunar cycle influences the activity of nocturnal (e.g., Northern Saw-whet Owl), crepuscular (e.g., Eastern Whip-poor-will) and diurnal birds (e.g., LeConte's Sparrow). We will highlight the variation among species in how closely tied their activity patterns are to the lunar cycle, and discuss hypotheses about why this variation exists among species. Automated radio telemetry data provides rare insights into the activity patterns of birds and coupling these data with demographic and environmental data can advance our understanding of their ecology and behavior.

Does the avian pectinate claw control ectoparasites?

H. Warr, M. Waller, S. Bush, D. Clayton

Presenting author: **Hannah Warr**

Grooming is the main behavioral defense of birds against ectoparasites. Grooming consists of preening

the body with the beak, and scratching the head and neck with the claws of the feet. Preening and scratching are both very effective in combatting ectoparasites, such as feather lice (Insecta: Phthiraptera). Birds in 17 families have a pectinate claw, which is a serrated comb-like structure. This claw is strikingly similar to louse-combs that are used to remove lice from humans and other mammals, yet the effectiveness of the avian pectinate claw for ectoparasite removal has never been tested. Other hypothesized functions of the pectinate claw include general feather maintenance and removal of stale powder down. We conducted an experiment using wild-caught cattle egrets (Bubulcus ibis) to test whether the pectinate claw contributes to ectoparasite control. The egrets in our study were naturally infested with two species of feather lice: Ardeicola expallidus and Ciconiphilus decimfasciatus. The claw was harmlessly removed with a Dremel tool from half the egrets, chosen at random. The claws of birds in the other half of the experiment (controls) were sham dremeled. During the course of the experiment, which lasted four months, we quantified the time birds spent grooming, as well as the quality and general condition of feathers on the head. At the end of the experiment, we quantified the abundance of both species of lice. Although birds scratched frequently, the parasite loads of birds with and without pectinate claws did not differ at the end of the experiment, indicating that the claw does not play an important role in ectoparasite control.

Full annual cycle modelling to improve Endangered Loggerhead Shrike population management in Ontario

H. Wheeler, A. Chabot, J. Steiner, A. Samuelson
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Eastern Loggerhead Shrikes (Lanius ludovicianus migrans) have been federally Endangered in Canada since 1991. National recovery efforts, coordinated by Wildlife Preservation Canada, focus on managing the local populations in Ontario during the breeding season. These efforts include intensive monitoring to determine annual population size and demographic rates, working with landholders in managing and enhancing habitat, and augmenting the wild population annually with captive-bred juveniles. While these strategies are essential for conservation and supporting population growth during the breeding season, there is still a gap in our understanding that complicates our conservation efforts. This subspecies is fully migratory, and as of yet, there are no clear links to specific wintering grounds for Ontario-breeding birds. It is likely that migration of this subspecies is somewhat diffuse throughout eastern North America, rather than discretely connected to a specific wintering location. Considering the vast array of possible wintering areas as well as the myriad threats that the birds may encounter during the winter months, a broad-reaching range-wide conservation plan is essential. In this presentation, we will begin by summarizing the existing Canadian recovery efforts, highlighting the gaps that we were addressed through a population viability analysis (PVA). The data provided by the PVA helped elucidate and emphasize conservation efforts that will be required to improve management strategies during both the breeding and non-breeding seasons. We will close with a discussion on the prioritized actionable steps that can be taken to improve Loggerhead Shrike conservation in eastern Canada.

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*Boreal bird irruptions as indicators of altered climate variability

I. Widick, M. Young, J. LaMontagne, C. Strong, B. Zuckerberg
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Many bird species demonstrate dynamic range boundaries, reflecting strong seasonal and annual variability in migratory behavior. As a form of facultative migration, irruptions involve the movement of many individuals outside of their resident range in response to climate variability, resource availability, and demographic processes. Many species have experienced range shifts and altered phenology in response to modern climate change, but spatiotemporal changes in irruption dynamics are less well known. We quantified changes in the geography and periodicity of boreal bird irruptions across eastern North America from 1960-2021. Using data from Audubon's Christmas Bird Count for nine finch species, including several exhibiting recent population declines, we evaluated latitudinal trends in southern range and irruption boundaries and characterized irruption periodicity using spectral wavelet analysis. Six boreal birds exhibited significant northward shifts in their southern range boundaries and three species displayed shifts in their southern irruption boundaries. Irruption periodicity across multiple species was consistent

across the 1960s and 1970s, culminating in frequent and synchronized irruptions of multiple species (superflights) during earlier decades. Coherence between species dampened beginning in the early 1980s as superflight periodicity became increasingly unstructured, finally reforming in recent decades, after 2000. Boreal birds are considered important sentinels of the boreal forests, and northward shifts and altered periodicity of irruptions may indicate broad-scale changes in climate- and resource-associated drivers operating across the boreal forests.

Invasive species removal halts long-term population declines of the northern spotted owl

D. Wiens, K. Dugger, M. Higley, D. Lesmeister, A. Franklin, K. Hamm
Presenting author: **David Wiens**, US Geological Survey, jwiens@usgs.gov

The conservation and management of northern spotted owls (Strix occidentalis caurina) is one of the most visible, long-standing wildlife conservation issues in United States history. Despite over 30 years of Federal protection, spotted owl populations have continued to decline at an accelerating rate throughout the subspecies' geographic range. Rapid population increases of a competitively dominant invasive species, the barred owl (S. varia), has been identified as a primary and immediate cause of spotted owl population declines. We replicated a before-after-control-impact removal experiment in five long-term (2002 – 2019) northern spotted owl demographic study areas to determine if barred owl removal can benefit threatened populations of spotted owls. Removal of barred owls had a strong, positive effect on survival of spotted owls across all study areas, and a weaker but consistently positive effect on spotted owl recruitment. After 3 – 6 years of barred owl removal, the mean annual rate of population change for spotted owls stabilized in areas with removals (<0.2% decline per year) but continued to decline sharply in areas without removals (12.1% decline per year). Our results clearly show that the persistence of spotted owls will depend heavily on reducing the negative impacts of invading barred owls while simultaneously addressing other key threats, such as habitat loss.

Lessons learned from 35 Years of Project FeederWatch

K. Wilcox
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Watching birds at your feeder is an enjoyable pastime. In Canada alone, statistics suggest that in 2021 more than 3.7million households purchased seed or shelter for birds. This bird watching pastime has become a successful 35 year long, continent-wide program of winter bird abundance counts, known as Project FeederWatch. This citizen-science program is co-administered by Birds Canada and Cornell Lab of Ornithology, which manages > 25,000 participants across Canada and the US, collating âˆ¼180,000 checklists annually with submissions increasing every year. These data provide a unique view into how winter birds are changing over time and have resulted in dozens of peer reviewed publications. FeederWatch has been very successful in collecting standardized long-term data, which is partially facilitated by high volunteer retention, consistent funding through its participant funding model, and ongoing volunteer and database management. However, there is still great potential to fill ornithological and conservation knowledge gaps by increasing the diversity and numbers of participants that share bird observations with Project FeederWatch. Specifically, FeederWatch volunteers are biased towards a more educated, older audience, with moderate-high socio-economic status. Breaking these barriers are not easy but are necessarily to ensure that long-term data are collected from broad audiences across the continent. Further, engaging diverse audiences will help inspire a deeper understanding and appreciated of birds, and other local environmental challenges.

Broad-scale benefits of hedge rows for bird populations in agricultural landscapes

D. de Zwaan, K. Hannah, N. Alavi, G. Mitchell, D. Lapen, J. Duffe, S. Wilson
Presenting author: **Scott Wilson**, Environment and Climate Change Canada, scottd.wilson@ec.gc.ca

Linear woody features (LWFs), like hedgerows along field edges, are a promising strategy to promote habitat heterogeneity in agroecosystems and support biodiversity. The benefits of LWFs often focus on

community-level indices, such as species richness. However, effective conservation actions must balance the contrasting habitat preferences of different species within the bird community, necessitating focus on population-level effects in working landscapes. We examined the associations between LWFs and abundance for 38 common species within an intensive agroecosystem in eastern Ontario, Canada. Specifically, we used distance and removal sampling methods across three years (2016-2019) to estimate local abundance in habitats representing a range of LWF density, and also predicted population size across the landscape with and without LWFs present to understand regional scale impacts. Associations between local abundance and LWFs varied among species, but overall community effects were clearly positive, particularly for forest and shrubland species. The positive effects of LWFs were most pronounced in areas with the highest agricultural intensity, suggesting LWFs may provide crucial habitat resources in highly degraded landscapes, but may have limited value in areas with greater habitat heterogeneity and retention. With rapidly declining songbird populations and a societal push towards food security, conservation strategies that promote biodiversity and agricultural productivity are of utmost importance. We demonstrate the benefits of habitat heterogeneity in agroecosystems and highlight the need to integrate both local and landscape-level perspectives in conservation planning.

LiDAR predicts habitat for birds during the nonbreeding period across a California megacity

E. Wood, M. Beland, C. Benitez

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Urban development is among the most widespread forms of land use globally. While there has been a plethora of work detailing the ecology of biodiversity within urban ecosystems, most land within cities is private, presenting an obstacle to robust biological surveys. Therefore, there is a need to use methodologies that allow for characterizing habitat on lands where a ground-based biological survey is problematic. One such approach that holds promise is using data from remote sensing. Remote sensing, the acquisition of information via remote sources (e.g., aerial photographs), has been extensively used to describe wildlife habitat within natural settings. However, using data from remote sensing to distinguish habitat features for wildlife in urban areas has mostly been unexplored, which presents a gap in our knowledge of biodiversity monitoring within cities. We tested the utility of using remote sensing methods coupled with ground-based measures to characterize habitat for nonbreeding avifauna across Los Angeles, California. Data from light detection and ranging (LiDAR), which is a fine-resolution remote sensing technique useful in depicting vertical vegetation structure was the strongest predictor of the wintering avian community throughout L.A. - outperforming ground-based measures and other remote sensing data, e.g., the normalized difference vegetation index (NDVI). Given our results, we recommend that urban ecologists prioritize using LiDAR and other fine-resolution remote sensing data in quantifying wildlife habitat across public and private lands within cities, which will aid our understanding of the distribution of urban biodiversity.

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*Population genetics of ectoparasitic feather lice (Insecta: Philopteridae) from hybridizing songbirds (genus Tyrannnus)

A. Worm, E. Donahue, T. Boves, A. Sweet

Presenting author: **Alexander Worm**, Arkansas State University, alexanderj.worm@gmail.com

Hybridization can be used as a powerful tool for understanding the processes of speciation. Although parasites make up a large portion of biodiversity, our understanding of hybridization in parasites is still limited. By studying populations of parasites on host species that hybridize, we can assess if hybridization is also occurring in these parasites. Ectoparasitic feather lice (Order Psocodea) are wingless obligate ectoparasites of birds and are typically host-specific with limited dispersal, which can lead to co-divergence with their hosts. The feather lice species Picicola foedus is found on multiple species of the songbird genus Tyrannus including two hybridizing sister species, the Scissor-tailed Flycatcher (Tyrannus forficatus) and the Western Kingbird (T. verticalis). Although P. foedus is found on both host species, the buildup of genetic differences resulting in distinct populations could have occurred. Alternatively, it is unclear if hybridizing hosts facilitate gene flow in lice, thus counteracting divergence due to host-specificity. Here, we aimed to (i) assess population structure of P. foedus and determine if

hybridization occurs in populations of P. foedus from both T. forficatus and T. verticalis. In 2021 and 2022, we collected P. foedus from across the range of both host species, as well as from hybrid individuals. We generated high-coverage whole-genome sequences of 19 P. foedus extracted from T. forficatus (n = 7), T. verticalis (n = 7), and T. forficatus X T. verticalis hybrid (n = 2) and assessed genetic structure in the lice. These results will help inform our understanding of how host-specific parasites with limited dispersal move among hosts with ongoing gene flow.

Survival debt: Kirtland's Warblers pay the costs of winter conditions during migration and breeding.

S. Yanco, N. Cooper, P. Marra

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Given rapid declines in avian abundance at continental scales, identifying the drivers of avian mortality is a key challenge for ornithologists. Migrants, in particular, present a challenge because demographic outcomes in a given season may be disconnected in both space and time from the causative environment-organism interactions. Despite recent advances in tracking technology, identifying the location, timing and source of mortality in migrant songbirds remains particularly challenging. Here, we leveraged spatially-explicit mark-recapture data for Kirtland's Warblers (Setophaga kirtlandii, n = 137), derived from the MOTUS automated telemetry network, to quantify season-specific survival rates and identify environmental drivers of mortality dynamics. We found that weekly apparent survival during spring (0.90, CI = 0.85-0.94) was considerably lower than either winter (0.97, CI = 0.95-0.99) or summer (0.96, CI = 0.94-0.98). Additionally, environmental productivity on winter home-ranges (measured as Enhanced Vegetation Index; EVI) was positively associated with apparent survival during winter (beta=0.65, CI = 0.37-0.86), spring (beta=0.62, CI = 0.34-0.84), and summer (beta=0.62, CI = 0.34-0.83). These findings highlight the complex environment-organism interactions which link environmental conditions and demographic outcomes across disparate geographies over the full annual cycle. Specifically, we show that individual survival outcomes may arise from sub-lethal carryover 'debts' incurred during previous seasons. Finally, our novel formulation of a multi-state survival model provides a potential framework for other studies focussed on small-bodied migrants which are best tracked by automated telemetry systems.

Contributed Oral Presentations

*Inbound arrivals: Using weather surveillance radar to quantify the timing of spring trans-Gulf bird migration

A. Abbott, Y. Deng, K. Badwey, A. Farnsworth, K. Horton
Presenting author: **Annika Abbott**

Each spring, more than two billion birds migrate through the Gulf of Mexico region en route to breeding grounds in the US and Canada. The northern Gulf coast is critical for migratory birds as it provides the first possible stopover habitat for migrants making nonstop trans-Gulf crossings. However, anthropogenic activity in this region makes migrants vulnerable to a multitude of obstacles and is increasingly fragmenting these habitats. Understanding the timing of migrants' overwater arrivals has value for expanding our understanding of migration ecology and is imperative for advancing conservation of this critical region through the identification of key times in which to direct conservation actions (e.g., temporary halting of wind turbines, reduction of light pollution). We explored 10 years of weather surveillance radar data from five sites along the northern Gulf of Mexico coast to quantify the daily timing and intensity of arriving trans-Gulf migrants. On a daily scale, we found that migrant intensity peaked an average of nine hours after local sunrise, occurring earliest at easternmost sites. On a seasonal level, the greatest number of arrivals occurred between late April and early May, with peak intensity occurring latest at westernmost sites. Overall intensity of migration across all 10 years of data was greatest at the westernmost sites and decreased moving farther to the east. These findings emphasize the differing spatial and temporal patterns of use of the Gulf region by migrating birds, information that is essential for improving our understanding of trans-Gulf migration ecology and for supporting data-driven approaches to conservation actions for the migratory birds passing through this critical region.

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*Variation in Ovenbird (Seiurus aurocapilla) flight song composition is related to breeding stage

C. Acorn, J. Foote
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The nocturnal songs of some diurnal passerine species are thought to function to attract females for extra-pair copulations. In some species, song complexity relates to the stages of the breeding cycle. Female songbirds have been shown to prefer males that perform compositionally complex songs. The nocturnal flight songs of male Ovenbirds (Seiurus aurocapilla) often vary in composition between renditions performed by a single individual, however, it is not known why this occurs. A relationship between the composition of Ovenbird flight songs and their breeding stages would provide evidence for the hypothesis that nocturnal flight songs are used to attract females for within or extra-pair copulation. We hypothesized that the composition of Ovenbird flight songs was related to the breeding stage they were performed in. We tested this by autonomously recording Ovenbird flight songs (n = 641) from paired males over the course of their breeding season from May-August 2022. We analyzed several compositional variables of flight songs to test for a relationship with breeding stage. We found that breeding stage was a significant predictor of flight song composition. Flight songs were longer when mates were fertile or incubating, the periods of highest population fertility. We also found that the period of day (dusk or night) was significantly related to flight song composition. Our results show a relationship between Ovenbird flight songs and the breeding cycle and suggest that paired males could use flight songs to attract females for extra-pair copulation, varying the length and content of songs with female fertility.

Colorful Feathers and Colorful Skin: Correlated Trait Evolution Between Feathered and Non-feathered Regions in Tanagers

J. Alderson, A. Shultz, G. Brown III, K. Burns

Presenting author: **Jonah Alderson**

Non-feathered regions, such as the bill, legs, and iris can play an important role in visual signaling and species recognition in birds. In tanagers (Aves: Thraupidae), these regions display a wide range of colors, and have been suggested to be involved in mate choice and speciation. However, the patterns of color evolution in these regions and their relationships to other traits, such as feather color and morphology, have not been well studied and have only recently garnered scientific attention. Here, we investigate the evolution of color in non-feathered regions of tanagers, using a comprehensive dataset color data for over 300 species. We use phylogenetic comparative methods to test for correlated evolution between different traits, including feather coloration, non-feathered color, and habitat preference. Analyses suggest that there are strong patterns of correlated evolution between non-feathered skin color and feather color, as well as habitat. More specifically, we find that non-feathered regions that are topologically close to each other (e.g. legs and feet, upper bill and lower bill) tend to evolve towards similar colors, and carotenoid-based feather coloration is strongly correlated with the evolution of similar colors in non-feathered regions. Our results have important implications for understanding the evolution of visual signaling and speciation in birds. By shedding light on the patterns and processes that drive the evolution of color in non-feathered regions, we can gain a better understanding of the ecological and evolutionary factors that shape the diversity of life on our planet.

Unraveling the migration of Red-tailed Hawks in the Great Lakes Region

N. Alioto, B. Robinson, J. Owen

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Identifying migratory routes and high use areas for birds during migration is critical, especially if a large concentration of individuals occur in a geographically constrained area, because alterations to these locations can cause implications at the population level. The Mackinac Straits of northern Michigan separate Lake Michigan and Lake Huron creating an important migratory bottleneck used by tens of thousands of raptors during spring and fall migration, including the Red-tailed Hawk (Buteo jamaicensis), one of the most widely distributed raptors in North America. During spring migration, this species moves through the Mackinac Straits in the largest documented concentrations observed for the species. Despite our knowledge of this concentration and in turn the importance of this location as a migratory corridor for the Red-tailed Hawk, little is known about how this area is used or its importance in the full migratory cycle. To resolve this knowledge gap, we deployed 37 GPS/GSM transmitters during the springs of 2021-2023 on adult hawks to document their migrations. We then used dynamic Brownian bridge movement models to quantify space use and highlight important high-use areas used during migration. Results show that Red-tailed Hawks show high route fidelity as we identified that the Straits as an important high-use area during fall migration. Additionally, we observed that this population breeds in Northern Ontario and Quebec and winters throughout Michigan, Ohio, Indiana and Kentucky. Understanding how high concentration areas are used during migration are beneficial not only for Red-tailed Hawks, but for species with similar flight strategies.

Environmental and individual components of variation in breeding data in an insular Song Sparrow population

P. Arcese, R. Germain, K. Carbeck, M. Duchesne

Presenting author: **Peter Arcese**, University of British Columbia, peter.arcese@ubc.ca

Annual variation in climate can profoundly affect breeding phenology in vertebrates, but its influence on populations is likely to interact with local ecological conditions, population density, and the genotype or phenotype of the individuals that comprise them. However, potential complexities that might arise in the event that climatic factors, local ecological conditions, and individual differences interact to affect phenology point to the value of empirical studies capable of investigating such links and quantifying their influence in detail. We used data on the initiation of breeding by ~1000 female Song Sparrows that resided on Mandarte Island over the 63 year period 1960-2023 to document a hierarchy of geophysical, climatic, population and individual factors affecting breeding phenology in this completely enumerated population. Population density, age, inbreeding, and heritage were all informative of breeding date, given climate, but their influence varied temporally. Although much variation in breeding date could be attributed

to variation in local climate, these relationships largely reflected processes acting at hemispheric scales. We discuss our results in the context of making predictions about the influence of climate on breeding phenology and the capacity of populations to adapt to temporal change in them.

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*The occurrence and preference of anthropogenic materials in European Starling (Sturnus vulgaris) nests

G. Armstrong, C. Barber
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Avian nests provide critical shelter for offspring. Nests typically consist of natural and sometimes, anthropogenic materials. Natural materials include plant materials and feathers while anthropogenic materials consist of various types of plastics, string/ribbon and fishing gear. Even cigarette butts have been found in various avian nests and are thought to decrease ectoparasite abundance, potentially increasing nestling success. The increase in anthropogenic materials observed in nests demonstrate that worldwide improper garbage disposal is on the rise. Although there are many studies documenting anthropogenic materials in nests of aquatic/marine avian species, there is surprisingly little research focusing on terrestrial species, although occurrence of anthropogenic materials is more prevalent in terrestrial environments. European Starlings (Sturnus vulgaris) are an urban-thriving double-brooded passerine that incorporates anthropogenic materials within their nests from the nearby landscape. Our first objective was to document the frequency of nests having anthropogenic materials incorporated into them, with results showing that 97.37% (37/38) contained materials. Secondly, we examined whether the amount of anthropogenic materials present in a nest had adverse effects on nestlings. We predicted that nests with a higher amount of anthropogenic materials would have nestlings in poorer condition than nests with less materials. The results indicated that brood condition tended to be negatively correlated with the total mass of anthropogenic materials in the nest ($P = 0.057$). These findings may help to gain insight into why certain passerine species incorporate potentially adverse materials into their nests.

Estimating annual survival from sparse data: a case study using wood warblers breeding in North America

T. Arnold
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Age-specific survival probabilities are critical components of population models, but too few data are available for most species, or data provide analytical challenges such as: 1) mixtures of live and dead encounters, 2) re-encounters that occur at the original marking sites, where survival and encounter probabilities are confounded by site fidelity, or 3) individuals that were not aged or sexed at time of marking. I addressed these issues in a combined analysis of mark-recapture-recovery data for 45 species of North American wood warblers (Aves: Parulidae). I estimated true survival (S), fidelity to marking site (F), dead recovery (r) and live encounter (p) probabilities for juvenile and adult males and females for 45 species in a combined analysis using species identity as a random effect. Analyses based on live encounter data have historically underestimated female and juvenile survival, due to greater probability of breeding and natal dispersal, respectively, but inclusion of dead-encounter data allowed me to estimate true survival. Mixture models provided an effective means of utilizing data from birds of unknown age or sex at time of marking, which was especially important for historical data, when aging and sexing methods were less refined. If marking occurs during multiple time intervals per year (e.g. spring and fall), the model can be readily adapted to estimate seasonal survival and encounter probabilities (i.e., breeding and nonbreeding survival), and the modelling approach can also accommodate factors thought to affect species specific survival and/or encounter probabilities, such as body mass or migration distance.

Exploring population-level song signatures in a bird endemic to the sky islands of the Western Ghats of India

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Behavioural traits are often culturally transmitted, and cultural evolution of traits can be faster than genetic

inheritance. Isolation may result in local cultures forming signatures within populations - like regional dialects in human languages. We examine birdsong dialects in the White-bellied Sholakili (Sholakili albiventris), a bird endemic to the Shola Sky Islands (SSI) - isolated mountain tops 1400m above sea level in the Western Ghats of India. We also look at landscape and climatic factors that may facilitate or impede species movement, thus affecting the transmission of local cultures. We explored how birdsongs differ between populations along a transect within a mountaintop. We sampled songs across populations of the White-bellied Sholakili and examined the acoustic data for variation in spectral properties. To understand the transmission of syntactical song properties, we also compared the presence of Complex Vocal Mechanisms in songs across populations. We then look at climatic variables -rainfall and temperature and landscape variables like habitat type- native shola forests and modified landscapes such as timber plantations to assess if species movement might be affected and, in turn, affect the transmission of behavioural traits. We find distinct signatures in spectral properties that are population specific. We further uncover more significant differences between the extreme ends of the populations and lesser variation between two closer populations, despite being several kilometres apart. We also associate spatial variation of climatic variables (rainfall seasonality and temperature) and indicate a potential role in impeding species movement, thus resulting in isolation between populations.

Modularity and rates of morphological evolution in an adaptive radiation of birds (Vangidae)

A. Auerbach, S. Reddy
Presenting author: **Anya Auerbach**

Adaptive radiations are clades that have undergone exceptional diversification in both ecology and morphology. Among classic adaptive radiations the Malagasy vangas remain particularly poorly known, despite displaying spectacular diversity in ecological niche, shape, and size. In this study we used a dataset of microCT scans of Vangidae to investigate how ecologically significant morphological traits evolve in adaptive radiations. Bill shape has been the traditional focus of ecomorphological study in birds, but microCT scanning of museum specimens provides access to almost the entire skull, allowing for high-density, three-dimensional landmarks and characterization of many important details of shape that linear measurements do not capture. Scanning traditional round skins has allowed us to include more of the bill and skull in our analysis while achieving nearly complete species-level taxonomic sampling of both Malagasy vangas and their widespread but less diverse relatives. Examining rates of morphological evolution across the phylogeny of Vangidae, we find higher rates of evolution in Malagasy versus non-Malagasy vangas. We also examined integration and modularity, or how different anatomical regions evolve relative to one another, which may play a key role in the adaptive potential of a clade. We find that the bill and skull of Malagasy vangas are more tightly integrated than those of non-Malagasy vangas. Together these results suggest that morphological integration has enabled the rapid evolution of diverse forms in the vanga adaptive radiation.

Post-breeding migration departure timing in Whimbrels breeding in the Hudson Bay Lowlands

A. Ausems, G. Brown, H. Mackellar, E. Nol
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Understanding the movement ecology of long-distance migrants is essential to identifying their conservation needs. Relatively little is known about the migration habits of several declining shorebird populations, including the population of Whimbrels (Numenius phaeopus) breeding in the Hudson Bay Lowlands. Using radio telemetry, we monitored fall migration timing of Whimbrels breeding in the Hudson Bay Lowlands in two distinct breeding populations located close to the Churchill Northern Studies Centre in northern Manitoba, and the Burntpoint Creek Research Station in the Polar Bear Provincial Park, 400 km south in northern Ontario. We used permutational multivariate analysis of variance tests to compare departure dates between breeding sites, sexes, and nest success (failed or successful). We found that birds from Churchill departed on average 16 days later than birds from Burntpoint (July 31st Â± 3.10 days SE, n = 19; July 14th Â± 1.86 days SE, n = 12, Churchill and Burntpoint, respectively). Within the Churchill population, successful males departed on average 22 days later than females and failed males

(August 19th Â± 5.69 days SE, n = 3; July 27th Â± 2.75 days SE, n = 16, successful males and others, respectively), but we did not find significant differences in departure date within the Burntpoint population. Post-breeding departure is constrained by the timing of the breeding season, which is determined predominantly by local weather conditions. Breeding further north may thus impose a cost in terms of arrival times on the non-breeding and stopover areas, as the start of the breeding season is often delayed compared to southern populations.

Gut microbiome variation across the Vermivora warbler hybrid zone

M. Baiz, A. Wood, D. Toews
Presenting author: **Marcella Baiz**

Birds host complex microbial communities. In the vertebrate gut, microbes play an important role in development and immune function. Previously, we found that in wood-warblers, host evolutionary history plays a role in structuring the gut microbiome. This may suggest that as host populations diverge, so do their gut microbiota, either as a result of tight coevolutionary dynamics with their hosts, or reflecting differential environmental influences in allopatry, or both. Hybridization is common in warblers, but the effects of evolutionary divergence on host-microbiome dynamics during secondary contact are unclear. Further, the fitness consequences of potential host-microbiome mismatches for admixed individuals are not known. Here, we present an analysis of gut microbiome variation across two geographically disjunct hybrid zones between Blue-winged and Golden-winged Warblers. We performed 16S amplicon sequencing of fecal samples from 146 individuals collected during the breeding season to test the hypothesis that admixture is associated with gut microbiome disruption. We found that hybrids and parental individuals harbored similar microbiome diversities, and microbiomes varied between contact zones. We identified several bacterial taxa associated with host admixture phenotype, suggesting hybrids may carry incompatible combinations of bacteria. Bacteria in some of these genera encode pathways for carotenoid biosynthesis. Because warblers derive their colorful plumage from carotenoid pigments, this may suggest avian hosts take advantage of bacteria-derived carotenoids. However, the functional significance of species-specific bacteria and whether they impose selection on their hosts remain targets for future study.

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*Is the answer blowin' in the wind? Differences in migration strategies of Alaska-breeding Short-billed Dowitchers

R. Bathrick, D. Ruthrauff, J. Johnson, R. Snyder, N. Senner
Presenting author: **Rosalyn Bathrick**

Separate breeding populations of the same species can exhibit different migratory strategies, including variation in route choice, staging duration, and flight distance. Ecological barriers, where migratory birds are unable to rest, can create migratory divides – in which geographically adjacent groups of a single species use differing routes to migrate to nonbreeding grounds. Here, we explore the role wind plays in shaping southbound migratory strategy between populations positioned along a migratory divide, with differing wind access on their breeding grounds. We tracked two populations of Short-billed Dowitchers (Limnodromus griseus caurinus) that breed on an east-west gradient along the Gulf of Alaska coast, to inform the previously unknown migration ecology of the species and investigate the role of wind in southward migration timing and route. We compared the wind conditions individuals experienced both as they departed breeding grounds and as they conducted their first flight, and the resulting levels of migratory connectivity between the populations. Arrival to wintering sites was the biggest difference between birds from different populations: individuals departing from more westerly sites left at the same time as those further east, but arrived along the Pacific coast of Mexico an average of 19 days earlier than their counterparts. This distinction demonstrates how differences in wind availability at breeding sites may form the basis for variation in post-breeding migratory strategy and resulting levels of connectivity, elucidating conservation implications in the face globally changing weather and climatic conditions.

Now I've heard everything!: An overview of recent advances in avian monitoring and research using ARUs

E. Bayne
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The use of ARUs (autonomous recording units) as a tool in avian ecology has grown exponentially in the past decade. The most common application has been to use the technology to replace unlimited distance human point counts with a focus on presence/ absence of species. Numerous pros and cons exist when using ARUs in this way to mean we have to use a 'relative' approach to assessing abundance, habitat selection, and trend. However, advances in data processing, recording technology, computation, and analytical methods is now allowing us to estimate other parameters like density, pairing success, and local intensity of use. I will discuss a generalized framework for estimating absolute metrics through the online platform WildTrax will be introduced. The value of ARU data grows when it is made broadly available to everyone. A proposal for an open-access Canadian Soundscape Archive will be presented.

Avifauna Distribution, richness and relative abundance of salt pond habitats on St. John, US Virgin Islands

V. Beasley, N. Angeli
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Located in the Lesser Antilles of the Caribbean, the United States Virgin Islands (USVI) are comprised of three main islands and numerous minor islands and cays. The island of St. John is the smallest of the three main islands, with a land area of 50.8km2. Its total area being slightly smaller than the Orlando International Airport, St. John contains over 20 salt ponds and is home to dozens of native and migratory bird species. Understanding avian distribution, abundance and richness at salt ponds in the USVI is crucial to ensuring bird populations and their salt pond habitats are properly managed and protected. A study of territory wide use of salt ponds, by birds and other wildlife, was completed by Knowles and Amrani (1991), more than 30 years ago. Our study aimed to describe present-day relative avian abundance, distribution and species richness in and surrounding salt pond habitats on St. John. Surveys consisted of point counts and traveling counts, as described in the Caribbean Waterbird Census. From January 2021-March 2023 over 300 surveys were completed across eight salt ponds. Over 70 species were counted, and individual bird observations exceeded 10,000. Results from this study are compared to an eBird data set with an identical timestamp to determine if the citizen science website is as effective at capturing avian distribution, abundance and richness on such a small island.

Sex-specific song use across breeding stages in a non-duetting Australian passerine

K. White, C. Beckmann
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Peaks in birdsong during breeding compared to non-breeding are well-established, but variation in avian singing behaviour also occurs within breeding stages. Ecologically distinct stages of nesting often require differential investment by the female and male of a cooperating pair, and therefore, communicatory needs may be sex-specific and change across a nesting attempt. Comparisons of these changes may help to elucidate when song is important for female and male birds, which can facilitate future hypotheses for song functions. We examined song rates across a nesting attempt in grey fantails (Rhipidura albiscapa), breaking the breeding season into nine stages of breeding. We found that females and males showed different patterns of song use across stages of breeding, indicating that song may serve different functions for females and males. Female song peaked during fledging, while male song peaked during nest building, but both sexes showed their lowest song outputs during early hatchling rearing. In addition to effects of breeding stage, we found that grey fantail song decreased with advancing date for females, but not males, and that song rates were not affected by time of day. We found little evidence that grey fantails had stage-specific song types, though some song types appeared to become more or less common based on breeding stage. By comparing the timing of song rate peaks, we highlight similarities and differences in the behavioural patterns of female and male song use, and contribute to our understanding of the function of female song.

Habitat use and characteristics of Connecticut Warbler during the nesting and post-fledging period

J. Bednar, A. Grinde, S. Kolbe, K. Snow, B. Howland, R. Slezak, M. Windmuller-Campione
Presenting author: **Josh Bednar**

Widespread declines in breeding bird populations have been documented across North America since the 1970s and concerns for loss of avian biodiversity are growing. Species with narrow habitat preferences which are at the southern edge of their breeding range are of particular conservation concern. Connecticut Warblers (Oporornis agilis) breed in forests in central Canada and around the western Great Lakes; throughout much of its breeding range, this species is associated with lowland black spruce (Picea mariana) and tamarack (Larix laricina) forests. Population trends of Connecticut Warblers indicate they are one of the most rapidly declining bird species in North America. To better understand the breeding ecology of Connecticut Warblers, we studied their nesting and post-fledging habitat use and survival in northern Minnesota, USA at two study sites in 2019 and 2020. We mapped territories of 49 singing males, located and monitored 11 nests, and tracked the post-fledging movements of individuals from 5 broods. Nest sites were located in tamarack-dominated stands with a semi-open canopy and dense understory. The average fledging age was 7.5 days post-hatch and the individuals (n= 14) tracked during 0-7 days post-fledging had a mean daily distance from nests of 35.5 m and a maximum distance from nest of 104 m during that time period. Our findings indicate that micro-site areas with high stem density were important features for post-fledgling birds and that the same habitats were used for breeding and the post-fledging time period. Results from this study can be used by managers to develop conservation strategies that will provide critical habitat to support this species.

Cooperative breeding in Harris's Hawks revisited: delayed dispersal and multiple paternity documented in south Texas

A. Gibbons, J. Bednarz, S. Hagler, W. Clark, J. Johnson
Presenting author: **James Bednarz**

Harris's Hawk (Parabuteo unicinctus) populations in Arizona and New Mexico have been documented to be cooperative breeders and form groups of up to seven hawks. However, some Texas populations were reported to be mostly monogamous. We captured and color marked territorial hawks and their nestlings and monitored their presence in territories between 2018 and 2020 in south Texas. In addition, we collected blood samples from all hawks and nestlings captured and analyzed 8 polymorphic microsatellite loci to assess the incidence of multiple paternity. Of 65 marked nestlings that we censused for 1 yr or longer, 58% were documented with their natal group at least 6 mo post-fledging. The mean length of delayed dispersal was 4.6 mo and the median length of time to dispersal (disappearance) was 6 mo. Five (8%) males resided in their natal territory for at least 12 mo. Of the 37 broods sampled for paternity analysis, we confirmed mixed parentage in three broods (8%). We also identified four additional broods where cooperative polygamy was suspected but could not be confirmed (mean pairwise estimate of r = 0.35). Although previously suspected based on observed multiple male copulations with a breeding female, this study provides the first genetic confirmation of multiple paternity within Harris's Hawk broods. We suggest that ecological constraints in the form of a limitation of available females drives delayed dispersal of juvenile males. Further, non-kin group membership may be favored by both resource-defense and collective action benefits in terms of securing resources both for group members and their offspring, especially in the highly variable and unpredictable environment of south Texas.

Deploying regional wetland bird monitoring to assess management impacts for the NFWF SOGL Restoration program

S. Beilke, S. Saunders, N. Miller
Presenting author: **Stephanie Beilke**, Audubon Great Lakes, stephanie.beilke@gmail.com

Audubon Great Lakes (AGL), in partnership with WSP, is assessing the impact of National Fish & Wildlife Foundation (NFWF) restoration efforts on wetland birds through NFWF's Sustain Our Great Lakes (SOGL) Program. In 2021-23 AGL and WSP implemented migratory waterfowl, migratory shorebird, and breeding marsh bird surveys at NFWF-funded wetland restoration sites and control sites across the U.S.

Great Lakes watershed. Monitoring data were collected using a Before After Control Impact (BACI) design to measure how migratory and breeding wetland birds respond to restoration. The results of this project will guide how NFWF applies future funding to maximize restoration impact and benefits to priority bird groups. Future analyses will allow us to achieve the following objectives: 1) determine whether breeding marsh bird abundances or occurrences are increasing in response to restoration efforts, 2) identify which restoration activities have the greatest impact across these three species groups, 3) evaluate how indicator species are responding to restoration interventions across species groups, and 4) assess whether expected gains in bird use days are occurring for shorebirds and waterfowl. Initial data discovery revealed a lack of consistent data collection across bird species groups at restoration sites, which pinpointed the need to focus on pre-implementation data collection. Early monitoring results indicated widespread use of breeding marsh birds and migratory waterfowl at both restoration and control wetland sites and more limited use by migratory shorebirds. We recommend consistent long-term, regional monitoring across the Great Lakes to further establish best management practices.

Temporal niche conservatism of a forest-obligate bird at the edge of its range

P. Belamaric, B. Zuckerberg, J. Pauli

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Niche conservatism – the tendency of a species' niche to remain constant over space and time – is a critical assumption of predictive distribution modeling. Failing to account for potential niche shifts in the face of changing climatic and environmental conditions, however, reduces the accuracy of predictive models and may result in poorly informed habitat management decisions. Ruffed grouse (Bonasa umbellus; hereafter 'grouse') are a forest-dependent, winter-adapted bird whose southern range limit terminates in the Upper Midwest. Within Wisconsin, grouse populations have been routinely monitored through annual spring drumming surveys since 1994. Over the past 15 years, many populations in Southern and Central Wisconsin have drastically reduced in size or become functionally extinct, while northern populations have maintained predictable trends. We hypothesize that grouse demonstrate niche conservatism and predict that shifts in their range boundary can be explained by changes in climate, mediated by forest habitat availability. We modeled the 'past' and 'present' distribution of grouse in Wisconsin using drumming survey detections. Results of this study highlight the drivers of grouse distribution and compare n-dimensional niche space of each model to evaluate shifts across time. We also present maps of 'past' and 'present' distributions that are forecasted and hindcasted, respectively, to visually compare areas of predicted habitat suitability between models within each time period. Implications of these results will be discussed in the context of grouse management, with suggestions for future modeling efforts to predict grouse distribution under climate change in the Midwest.

Forest cover drives occupancy of all bird guilds in a Colombian coffee-growing landscape

R. Bennett, E. Botero-Delgadillo

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Coffee is grown across the tropics in regions with exceptionally high bird diversity. Biodiversity-friendly coffee initiatives have historically focused on farm-level practices that maximize bird diversity, although many species respond to habitat at broader spatial scales. To better understand the impact of landscape composition on birds in coffee landscapes, we recorded birds and habitat characteristics at 150 point-count sites in coffee and forest within 9 municipalities of Cundinamarca, Colombia. Sites were stratified across gradients of forest cover and coffee management intensity and were visited 8 times in December-January and July-August 2021. Using community occupancy models, we found that all birds guilds, even open-area specialists, responded positively to the amount of forest in a 2km radius. This remarkable finding highlights the critical importance of highly forested landscapes to the birds of the tropical Andes, regardless of their foraging strategy or life history traits. Forest specialists were essentially absent in coffee agriculture, regardless of management intensity, but habitat generalists, Nearctic migrants, frugivores, insectivores, and nectarivores responded positively to the complexity of tree density and diversity on coffee farms. This finding generally validates the farm-level approach of the Bird Friendly coffee certification, which promotes a dense and diverse shade tree canopy on coffee farms. Granivores

and omnivores responded negatively to vegetation complexity both in coffee farms and forest patches but still responded positively to the amount of forest on the landscape. These findings highlight the urgency of integrating forest conservation with farm-level practices that conserve birds

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*Evolution and plumage color introgression in island manakins

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Islands have been vital in the study of diversification. Isolation of populations on islands has generated copious new biodiversity on Earth, including well-studied adaptive radiations and unique features like gigantism. Nearshore islands can also be powerful tools for studying the evolution of mainland populations. In Bocas del Toro, Panama, lekking golden-collared and white-collared manakins (Manacus vitellinus and candei, respectively) interbreed in a narrow hybrid zone. Several male plumage and behavioral traits have introgressed from vitellinus into candei, most notably yellow collars. Manakins on islands just offshore of the plumage introgression region have yellow collars and were hypothesized to derive from introgressed mainland candei populations that were subsequently isolated. In this study, we used morphological and genetic data to test this idea, including for the oldest island Escudo de Veraguas, where manakins have evolved much larger body sizes. We measured plumage color variation among island and mainland populations to understand how coloration has changed since the islands were isolated. Finally, we used motion-sensor cameras to record male courtship display behavior and characterize island vs. mainland display phenotypes. Our results shed light on past introgression dynamics, uncover unique patterns of island evolution, and resolve a century-old taxonomic mystery.

Survival of Eastern Whip-poor-will (Antrostomus vociferus) young from incubation to independence

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Reproductive success is often estimated by the number of young that fledge from a nest. However, mortality after nest departure is common, leaving fledgling survival as a critical and potentially limiting parameter. The Eastern Whip-Poor-Will (Antrostomus vociferus) is a crepuscular, aerial insectivore experiencing precipitous population declines, and whose post-fledging ecology is limited to incidental observations. Whip-poor-wills are ground nesters and invest considerably in brood-rearing even after chicks are of fledging age. It is not known if whip-poor-wills experience a sharp decrease in survival during the post-fledging period or how this compares to pre-fledging survival. To better understand how the breeding behavior of whip-poor-wills may contribute to population their population status, we sought to identify the stage when broods are most vulnerable. From 2021 to 2022, we investigated pre- and post-fledging survival in two populations in Illinois by monitoring nests (n=64) and VHF-tagging fledglings (n=17). We found that egg and chick survival was low compared to estimates from other parts of their range, with mortality rates peaking during the incubation stage of the nesting cycle. Fledgling survival was relatively high and we only observed four instances of predation of fledglings, which occurred primarily after independent foraging began. These results suggest that whip-poor-wills do not undergo a survival bottleneck after fledging, instead experiencing heightened levels of mortality earlier in the nesting cycle. Thus, whip-poor-will conservation efforts on breeding grounds focused on increasing pre-fledging survival may help to address population declines in the region.

Sweating the small stuff: Does nest-site selection affect microclimate exposure in grassland birds?

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Nest-site selection is an important form of habitat selection with strong fitness consequences, and there is likely selective pressure to balance predation risk, food availability, and nest climate. In declining grassland songbirds, which nest in an open and poorly buffered environment, selecting a nest site with favorable microclimate may mediate exposure to heat and desiccation processes that affect reproductive

success. We assessed drivers of nest-site selection in four grassland obligate species including Eastern Meadowlark (n = 37), Dickcissel (n = 33), Henslow's Sparrow (n = 17), and Bobolink (n = 16), as well as two facultative species-Red-winged Blackbird (n = 47) and Common Yellowthroat (n = 21). We leveraged UAS collected imagery and observations of temperature and vapor pressure anomalies collected by iButtons to characterize vegetation productivity and structure, topography and elevation, and microclimate at 60-cm resolution. We tested the relative importance of these environmental drivers on nest-site selection and compared exposure of nest sites to microclimate anomalies among species. Vegetation models outperformed microclimate and topography as important predictors of nest-site selection. However, we found significant differences in microclimate exposure among species resulting from differing vegetation conditions where shrub associated and facultative species selected nest sites that experienced cooler anomalies. We conclude that although nest-site selection most strongly reflects species vegetation structure requirements, there are microclimatic consequences of this selection with potential implications for grassland birds in a changing climate.

Space use and home range size of wintering Swamp Sparrows in relation to habitat type, life-history parameters and SLR.

A. Best, J. Walters, R. Danner
Presenting author: **Allie Best**

Marsh birds are of great conservation concern due to ongoing loss of wetlands due to sea level rise (SLR). Habitat availability and quality in the winter limit the population sizes of some species, however, knowledge regarding specific habitat needs during winter is lacking. Habitat-use patterns are important to understand the habitat needs of species prone to SLR-induced habitat loss to develop the proper conservation plans. We conducted a telemetry study to understand the wintering movements and habitat needs of Swamp Sparrows (Melospiza georgiana). We attached radio transmitters to 54 Swamp Sparrows in coastal North Carolina during non-migratory wintering months (January–March) of 2008–2010 and tracked their movements across marshes and adjacent croplands. We estimated home range sizes as 50% and 95% kernel densities. Individuals maintained tight home ranges throughout the winter (average core home range size was approximately 0.925 ha) and commuted between distinct roosting and foraging locations (average commute was approximately 159.82 m and ranged from 0.73 – 1648.69 m). We quantified home range overlap and describe both home range size and overlap in relation to habitat type (high marsh, roadside grasslands, and agricultural lands), age, sex, and subspecies. An individual's home range on average overlapped with 2 other home ranges. We also describe the predicted effect of SLR on home ranges using sea level affecting marsh models (SLAMM). We used imagery from 2009 and 2021 to assess the degree of SLR and how this may affect space-use patterns in the future. These results will help prepare conservation goals and management strategies.

Status and conservation challenges of globally threatened species of vultures in Pokhara, Nepal.

H. Dhakal
Presenting author: **Dinesh Bhusal**

Nepal's rich biodiversity with a record of 892 species of birds (DNPWC 2022). Among them, 133 nationally threatened species, of which 4 species are vultures. Vultures play an important ecological role through rapid consumption of animal carcasses and also of human dead bodies in the form of sky burials within Nepal and Tibet (Dhakal et al. 2022). Nine species of vultures have been recorded in South Asia, of which eight are resident and one migratory. Nepal supports 6 resident vulture species viz. White-rumped Vulture (WRV) Gyps bengalensis, Slender-billed Vulture (SBV) Gyps tenuirostris, Egyptian Vulture Neophron percnopterus, Red-headed Vulture (RHV) Sarcogyps calvus, Himalayan Griffon Vulture Gyps himalayensis, and Lammergeier Gypaetus barbatus, one winter visitor i.e., Cinereous Vulture Aegypius monachus, one passage migrant i.e., Eurasian Griffon Vulture Gyps fulvus and one vagrant i.e., Long-billed Vulture Gyps indicus. (DNPWC, 2015-2019). IUCN has categorized WRV, SBV, and RHV as Critically Endangered and EV as Endangered. All these nine species were recorded in Pokhara valley in the years 2016 to 2022. We used the direct observation method to monitor vulture status;12 different vantage points were selected and the same spots were repeated every year. To avoid the repetition of the

same individual count, we monitored and record the sighted individuals (soaring, roasting, nesting, and feeding) in all 12 different sites on the same day& time i.e. 8:00 am to 11: 00 am. The nearest and the farthest sites were at approx..2 km and 12 km respectively. The data clearly reflects the increase in the number of vulture individuals from 2016 to 2019 from 383 to 485 and the number goes down from 2019 to 2022 i.e from 485 to 387.

Insights into the breeding distribution and chronology of North American scoters from satellite telemetry data

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North America's scoter species are poorly monitored relative to other waterfowl. Black (Melanitta americana), surf (M. perspicillata), and white-winged (M. deglandi) scoter abundance and trend estimates are thus uncertain in many parts of these species' ranges. Our goal was to refine our understanding of the spatial and temporal distributions of scoters to inform the timing and location of breeding surveys. In this study, we integrated satellite telemetry tracking data from black, surf, and white-winged scoters marked at multiple molting, staging, breeding, and wintering areas along the Atlantic and Pacific coasts to quantify scoter breeding chronology and distribution across North America. We also examined possible drivers of variation in timing of arrival, length of stay, and departure at nesting locations. We documented a northwest to southeast distribution of estimated breeding sites across Alaska and Canada. On average, scoters arrived at nest sites on June 1. Surf scoters and Pacific black scoters arrived earliest and departed earliest. Pacific-wintering black and white-winged scoters began breeding earlier than Atlantic-wintering birds. Additionally, birds arrived at nesting locations earlier in years with earlier snowmelt, and later snowmelt reduced lengths of stay for males. Breeding chronology also varied by age group, with adults arriving earlier than subadults. Our study is the first to comprehensively describe spatial variation in timing of breeding of both Atlantic and Pacific populations of all three scoter species across North America. Our results provide insight into how current surveys enumerate scoters and can inform possible supplemental efforts to improve continental scoter monitoring.

Threats and conservation opportunities for migrating Whooping Cranes (Grus americana) in the Oil Sands Region of Alberta

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The Aransas-Wood Buffalo population of endangered Whooping Cranes (Grus americana) contains approximately 550 individuals, and migrates twice annually through the Oil Sands Region (OSR) of Alberta, Canada. The OSR contains a great deal of industrial disturbance, particularly in the mineable area, and thus migratory stopover sites are likely to be in areas with high amounts of anthropogenic activity. This poses many direct potential hazards to migrating cranes. Moreover, cranes may avoid areas with high levels of development, thus functionally reducing the availability of stopover habitat. There are currently no estimates of migratory habitat selection within the OSR. Thus, our objectives were to model and map habitat selection by migrating whooping cranes within the OSR, estimate reductions in available stopover habitat caused by oil sands development, and delineate areas of highest conservation value for cranes. We developed a scale-integrated resource selection function (SRSF) including selection of stopover sites and habitat selection within sites. We found that cranes avoid anthropogenic disturbance at all scales, but avoidance decreases as total amount of disturbance within stopover sites increases. Our models suggested significant reductions in available habitat caused directly by industrial development, and indirectly by proximity to anthropogenic activity. Our maps showed areas of high potential risk within the minable area, and adjacent areas with high conservation value due to good quality habitat and reduced risk. Our work provides a scientifically defensible tool for land-use planners to delineate threats and help mitigate risks to migrating whooping cranes in the OSR.

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*Cardueline finches vary in innate immunity against a deadly strain of avian Salmonella

L. Biehler, T. Van Laar, J. Slade
Presenting author: **Lindsey Biehler**

A recent outbreak of Salmonella enterica serovar Typhimurium in 2020-21 resulted in a large die-off of wild Cardueline finch species in the Pacific Northwest and California. Studies predominantly focus on the presence of Salmonella in humans and agricultural animals, but studies on the relationship between this pathogen and wild songbirds are lacking. Cardueline finches occupy bird feeders, however Pine Siskins (Spinus pinus) seem to die during Salmonella outbreaks whereas other finch species, such as Lesser Goldfinches (Spinus psaltria), American Goldfinches (Spinus tristis), and House Finches (Haemorhous mexicanus) appear resistant. The aims of our research is to (1) quantify constitutive innate immune function by measuring bactericidal activity in the four wild finches against a locally cultured avian Salmonella strain in vitro, and (2) analyze genetic variation at Toll-like receptor 4 (TLR4), which is involved in immunity against this bacterium. We found that there was significant variation in their constitutive innate immunity against Salmonella, with Spinus spp. having low bactericidal ability in comparison to the Haemorhous sp. (House Finch). TLR4 analysis is underway. By comparing the results of both the BKAs and TLR4 variation, we will get a better understanding as to why certain Cardueline finches may be more susceptible to Salmonella infections. Overall, this research will provide data that helps with the conservation of local bird populations that are susceptible to bacterial infections and help with mitigating avian diseases.

Two might really be better than one: paired wintering American Kestrels have greater foraging success than singles

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Pairing and associated behaviors during the winter season are rarely documented across most temperate bird species. The fact that several North American migratory raptor species establish pairs during the winter is essentially unrecognized in the literature. We studied a mostly migratory population of wintering American Kestrels (Falco sparverius) in north Texas in which pairing behaviors were pervasive throughout the non-breeding season. We banded American Kestrels with coded anodized bands and then resighted these birds across several years to document behavior, estimate survival, and determine which were migrants. Annual survival was calculated using Program MARK's robust design model. Foraging success was derived from behavioral observations over 30-min sampling periods that documented foraging attempts, successes, and pairing behaviors. We found that forming pairs during the non-breeding season is common in our study population, as 47 of 230 banded migratory kestrels (20.4%) were paired across the winter. There was a significant difference in average foraging success between individuals in pairs (59.2%, n = 53) and single kestrels (43.2%, n = 85, p = 0.015). Paired kestrels were also significantly more often adult birds, had less fault barring on their rectrices, and were more often found in urban environments than singles. There was no difference in the annual survival of paired and single kestrels (72% vs 83%, p = 0.073). Although kestrels are mostly reported to establish individual winter territories, pairing during this period in north Texas may represent an alternative strategy in which some migrants gain at least a short-term energetic advantage by enabling them to occupy higher-quality foraging territories.

The American woodcock singing ground survey largely conforms to the phenology of male woodcock migration

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Presenting author: **Erik Blomberg**

To avoid bias, surveys of breeding birds should be timed to avoid periods of migration, and the spatial distribution of survey points should coincide with breeding distributions. American Woodcock (Scolopax minor; hereafter woodcock) are monitored, in part, by the American Woodcock Singing Ground Survey (SGS), which suggests persistent, range-wide population declines. We marked 133 male woodcock

captured throughout eastern North America with GPS transmitters during 2019–2022, and compared the timing of their migration with the spatiotemporal stratification of the SGS. Most woodcock (74 %) completed migration prior to the onset of the SGS. In the northern-most SGS zone a greater number of males, 34 %, continued migration during the survey window, however the influence of this is offset because SGS routes were run more frequently during the second half of the window. Delayed migration during a survey window was more likely for young woodcock completing their first spring migration, which took 8.6 days longer on average compared to adult birds, and we found little evidence for substantial annual variation in migration phenology. We found existing SGS routes appear to cover 90% of male woodcock post-migratory breeding distribution. Our results confirm the SGS detects some migrant males, with the proportion relative to resident breeding males increasing in more northern survey strata, but these errors are unlikely to bias trend estimates at large scales (e.g., within woodcock management regions).

Does density dependence regulate populations of tropical birds?

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Basic questions about the biology of tropical birds remain unresolved. Of particular importance is the issue of how conspecific density may affect the behavior of individuals and dynamics of populations. We used a long-term capture-mark-recapture dataset to explore associations between annual variation in population growth rate (Î») and population size (N) as a proxy for local density. We estimated population size for eight focal species using a finite mixture Jolly-Seber model to account for the presence of transients. We tested for density dependence using Bayesian Gompertz state-space models that provided discrete time estimates of N, Î», and strength of density dependence. Our approach also allowed for uncertainty in estimates of population size. We found strong indication of density dependence on rates of population growth across all eight focal species. Whereas the generality of our results merits study, these analyses provide unique evidence that local density is an important influence on the evolutionary ecology of tropical birds.

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*Latitudinal gradient in climatic stress of the Northern Cardinal, a species undergoing northerly range expansion

J. Brewer, K. Brzeski, D. Baldassarre, E. Johnson, D. Mooney, J. Wolfe
Presenting author: **Jenna Brewer**

In the face of climate change and urbanization, the Northern Cardinal (Cardinalis cardinalis) has expanded its range across North America. Determining the drivers of this ongoing range expansion may provide insight into drivers of resilience in an era of global change. Given the earlier onset of cold temperatures and the subsequent decreased abundance of food resources experienced by pioneering cardinals in the northernmost extent of their expansion front, we predicted that northern birds would exhibit greater fitness consequences than their southern counterparts. We evaluated nutritional and environmental drivers of fitness costs by examining stable isotope composition and feather growth rates in cardinals captured in Louisiana, New York and northern Michigan, encompassing the latitudinal gradient of the species easterly range. We found that isotopic fractionation values of 13C and 15N did not differ significantly across locations signifying similar nutritional regimes; however, feather growth rate decreased along a northerly latitudinal gradient. Given that feather growth rate has been implicated to be a function of surplus resource allocation within birds, decreased growth rates across latitudes suggests that northerly cardinals have less available energy to allocate to feather growth likely due to increased metabolic burdens associated with colder temperatures in northern Michigan. Specifically, cardinals in the north likely expend greater amounts of energy maintaining homeostatic metabolic body temperatures and thus have less resources available for feather growth. This implies that climatic stress may be a greater driver of range determination within Northern Cardinals than nutritional stress.

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*Using Bayesian occupancy modeling to identify the roles of climate and landscape in black vulture range expansion

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Land use alterations and shifting climatic conditions are contributing to novel wildlife-human interactions due to species range contractions, shifts, or expansions. Black vultures (Coragyps atratus) have expanded the northern margin of their range significantly in recent decades. Black vulture-human conflicts have risen concomitantly with this range expansion, driving a need to better understand current and future occupancy of black vultures across the landscape. Although the exact drivers of this range expansion are unknown, climate change and anthropogenic food subsidies have been hypothesized to play a role. Thus, our objective was to model black vulture range expansion over time as a function of climatic and landscape variables using continent-wide Christmas Bird Count (CBC) data. Using CBC data from 1984-2021, we formulated a Bayesian single-visit occupancy model. Site occupancy was estimated as a function of relevant climatic (e.g., minimum annual temperature, thermal uplift) and landscape (e.g. distance to landfills, density of roads) and included a spatial general additive model (GAM) to account for spatial and temporal autocorrelation. We then compared this to estimates from Breeding Bird Survey data to better understand climatic effects on vulture occupancy across seasons. We found that the northernmost occupied latitude has increased over time (~11 km annually) partly due to anthropogenic food subsidies. This approach also allows prediction of future vulture-human conflict locations to prioritize damage mitigation. Given the large-scale collection of CBC data, this approach can be readily applied to other species to model range dynamics in a rapidly changing world.

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*Evaluating the effects of investigator disturbance on the activity level of wintering Ammospiza sparrows

M. Buddy, M. West, R. Danner
Presenting author: **Miles Buddy**

Studies of the impacts of investigator disturbance have been largely limited to breeding waterbird colonies. However, various sources of environmental stress compel us consider these effects in studies of endangered, marsh-dwelling passerines. In coastal North Carolina, we study the nonbreeding populations of Seaside (Ammospiza maritima), Saltmarsh (A. caudacuta), and Nelson's Sparrows (A. nelsoni) that spend the winter in syntopy in tidal saltmarshes. Our team regularly passes through these areas to capture and study these birds in the supratidal marshes where they congregate to roost at high tide. We monitored the birds' activity over two winter seasons at four sites, using a form of automated radiotelemetry system (ARTS), a type of wildlife tracking technology sensitive to fine-scale movements. We measured activity level using the variance of RSS (received signal strength) on the premise that a more active bird exhibits more variation in its distance from a given receiver, and therefore more variation in RSS, during a given time interval. We evaluated the relationship between activity level during consecutive 10-minute intervals and researcher presence, as well as tidal water level, time of day, age, and species identity, using linear mixed effects models. We predicted that activity level would be higher during high tides where investigators were present. Results were variable between sites, with some top-ranked models implicating the variable of researcher presence. The effects of temperature and spatial sources of variation remain to be investigated. This study has the potential to inform best practices to minimize human disturbance in marshes and other systems.

Evolutionary history of the Southern Lapwing (Vanellus chilensis) and the role of glaciations in its diversification

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The evolutionary patterns of temperate South America, particularly in open habitats, have been less studied than in other areas of the Neotropics. We analyzed the evolutionary history of the Southern Lapwing (Vanellus chilensis), a widespread species characteristic of open habitats, as a case study to evaluate the continental-scale patterns and processes of diversification in the Neotropics, with a focus on Patagonia. We used two mitochondrial genes (COI and cyt b) and ddRADseq data from 58 individuals of

the four subspecies of V. chilensis to perform a phylogenetic/phylogeographic analysis, and also studied their vocalizations. The initial diversification event within V. chilensis separated two lineages approximately 600,000 years ago, one of which is restricted to Patagonia. Genomic analyses indicated considerable gene flow between these two main lineages, supported a contact zone in northern Patagonia, and showed that genomic admixture extends to northwestern Argentina. A shallower divergence was detected between the two non-Patagonian subspecies, which are separated by the Amazon River. Vocalizations were significantly different between the two main lineages and were intermediate in the contact zone. Our results indicate that Patagonian populations of V. chilensis are clearly differentiated from the rest of the species, likely due to their isolation in refugia during the Pleistocene glaciations. The post-glacial, northward expansion of the Patagonian populations generated a secondary contact zone in northern Patagonia with extensive gene flow among lineages. Future analyses focused on the dynamics of the contact zone will allow us to establish whether the species continues to diverge or if its genome is homogenizing.

Using a lidar-derived land cover classification to model site occupancy for shrubland habitat conservation

L. Bulluck, B. Lin

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Understanding landscape-level habitat selection is important for guiding broad-scale conservation. This is difficult for species that occupy early-successional habitats (ESH) due to a lack of accurate representation of shrub/saplings in land cover data. We used a novel, LIDAR-derived land cover classification that accurately identifies shrub/saplings to investigate how habitat composition and configuration influence site occupancy for two declining songbird species: Golden-winged Warblers (Vermivora chrysoptera), a flagship for ESH conservation, and the closely related Blue-winged Warbler (V. cyanoptera). We developed occupancy models using 1m and 30m resolution land cover data that accurately represents shrub/saplings and 30m resolution National Land cover Data (NLCD) which does not. To account for potential spatial autocorrelation, we ran spatial occupancy versions of the top performing models, which performed better than non-spatial models. We confirm that forest and shrub/sapling cover are important habitat features for Vermivora and demonstrate specific extents and optimum amounts that these cover types should be maintained. Aggregating land cover to 30m resolution and using NLCD identified the same cover types and extents as important; however, NLCD model predictions were unrealistic for shrub/sapling cover because it does not accurately represent this cover type. Our results demonstrate that habitat models for shrubland-dependent species would be improved by using land cover maps that accurately represent shrub/sapling cover, specifically those that use LIDAR data. For species that require a complex mosaic of cover types, such models would lead to improved communication and implementation of conservation.

A joint species distribution model with imperfect detection and species traits

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Joint species distribution models (JSDMs) have become ubiquitous in ecological literature due to their ability to estimate not only species' responses to the environment but also their correlations with each other. Some JSDMs additionally model species' niches as a function of their traits, thus improving niche estimates for rare species and giving insight into the community assembly process. Yet most commonly used JSDMs do not account for imperfect detection, an important component of much avian community data. Tobler et al. (2019) developed a JSDM that includes both species correlations and imperfect detections, but this model as published did not implement a framework for including detection covariates, species traits, or study design-related random effects. We expand the model of Tobler et al. (2019) using NIMBLE in R to facilitate inclusion of detection covariates, species traits, and hierarchical random effects. We demonstrate the design and features of this model using both simulated and real-world data.

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*Spatial synchrony in primary productivity and its effect on bird occurrence and

abundance at continental scales

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Ecological synchrony, which is correlated fluctuations in time and space from abiotic or biotic components of the ecosystem, is ubiquitous across the globe. For example, reproduction of many taxa coincides with peak greenness. Also, synchrony is not always spatially consistent, with some regions more synchronized than others. Both primary productivity and some avian taxa have displayed synchrony, but the questions are: (1) How are the spatial variations of primary productivity synchronized over broad scales? (2) Does primary productivity synchronize bird populations? To assess synchrony across large scales, remotely sensed data and Breeding Bird Survey (BBS) data offer unparalleled spatial coverage. We quantified patterns of spatial synchrony in abundance of more than a dozen landbirds and Dynamic Habitat Indices (DHIs), which characterize primary productivity on an annual basis, at multiple grains and extents across North America. To do so, we computed correlograms to estimate the magnitude and scale of spatial autocorrelation within the bird counts and the DHIs. We used multiple regression on distances matrices to determine the relative importance of DHIs in explaining spatial synchrony for each avian taxa. By leveraging bird data from BBS, we were able to assess the nature and strength of synchrony of abundance with primary productivity, among species. Results highlight species that have abundances fluctuating with primary productivity and that will likely be more vulnerable to changes to vegetation in light of climate change. Assessing synchrony across multiple spatial scales also yields insight into the influence of local or regional processes at play for specific species.

The relationship between tree and bird diversity and mental health in Canadian cities

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For over half of the human population that live in cities, urban birds and trees are among the most common ways people experience nature. Urban environments can reduce people's engagement with nature, which is problematic because exposure to nature is associated with a broad array of health and well-being benefits. Yet, the dominant factors linking biodiversity and mental health in cities remain unclear. Here we combine bird and tree species diversity estimates from eBird community science datasets and national forest inventories with individual self-reported mental health metrics from the Canadian Community Health Survey (CCHS) from 2007-2022. We use health behaviours and demographic variables collected during the CCHS to control for other factors affecting mental health. Our cross-sectional analysis captured over 420,000 participant responses across 36 Canadian cities and tree and bird species diversity from 180,000 postal codes. We found that tree and bird species diversity metrics were more predictive of self-reported mental health and psychological distress than vegetation cover alone. Intermediate tree and bird biodiversity was related to higher self-reported mental health even after controlling for other factors. Our results indicate a previously unaccounted link between bird and tree diversity and human well-being, suggesting that policies supporting healthy urban ecosystems and bolster bird diversity may also benefit human mental health.

Few genomic regions resist gene flow and underlie phenotypic differences in a pair of Neotropical seedeaters

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Recent speciation events or hybridizing species can be leveraged to associate their phenotypes with causal genotypes, thus providing insights into the traits relevant to reproductive isolation and the process of speciation. Here we investigate the genetic underpinnings of the phenotypic differences between a pair of species from the genus Sporophila, S. plumbea and S. beltoni. The Tropeiro seedeater (S. beltoni) has only recently (2013) been described based, most notably, on the yellow bills which distinguish males from those of S. plumbea, that have black bills. Both species share mtDNA haplotypes, and whole-genome

sequences revealed low levels of genetic differentiation (average FST = 0.0015). Demographic reconstructions attribute this genetic homogeneity to high levels of gene flow, despite divergence in the order of millions of years. These results are consistent with a hybrid zone in southern Brazil where admixed individuals are prevalent. Although genome-wide genetic differentiation is low in this species pair, we found 40 SNPs of high divergence contained in just three narrow peaks (average length of 60 kb) along the genome. We used the ancestral recombination graph (ARG) to explore the processes which have shaped divergence in these outlier regions, finding signatures of resistance to gene flow. These three differentiated regions harbor seven genes, one of which is a well-known pigmentation gene (EDN3 which encodes the protein Endothelin-3), that controls skin coloration in chickens. This study contributes to the growing body of literature indicating that genes potentially involved in traits related to coloration and prezygotic isolation are important to maintain species boundaries.

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*Selection for genes underlying Bergmann's Rule

K. Carbeck, P. Arcese, I. Lovette, C. Pruett, K. Winker, J. Walsh
Presenting author: **Katherine Carbeck**

Ecogeographic rules denote spatial patterns in phenotype and environment that may reflect local adaptation as well as a species' capacity to adapt to change. We compared 79 genomes from 9 song sparrow (Melospiza melodia) subspecies that vary ~300% in body mass (17 - 50 g) to identify genes underlying Bergmann's Rule, which posits that spatial correlations of body mass and temperature reflect historic selection and local adaptation in endotherms. Comparing large- and smaller-bodied northern subspecies revealed nine candidate genes in three genomic regions associated with body mass. Further comparisons to the five smallest subspecies endemic to California revealed nine SNPs in candidate regions of four genes associated with body mass and varying as predicted by Bergmann's Rule. Our results strongly support the hypothesis that co-variation in environment, body mass and genotype reflect historical selection, local adaptation, and a capacity for contemporary evolution in this highly diverse species.

Examining changes in prairie shorebird populations in relation to climate and lake habitat characteristics

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Many shorebird populations are in steep decline, threatened by climate change, human disturbance, and habitat alteration. Shorebirds migrate thousands of kilometres from their wintering grounds to breeding grounds and often rely on a restricted set of high-quality staging sites to rest and refuel. Shorebirds migrating through the interior of North America rely on saline wetlands and lakes opportunistically as stopovers, but the prairie region has historically received less study than coastal stopover sites. Wet-dry cycles in the interior prairie pothole region (PPR) can drastically affect the availability of wetland habitats and the characteristics of saline lakes. We aim to assess spatial and temporal changes in shorebird populations by revisiting lakes in Saskatchewan with historically high shorebird numbers that have not been surveyed since the 1990s. The specific objectives of this project are to 1) understand changes in shorebird populations by comparing current and historic counts; 2) evaluate changes in populations in relation to lake characteristics and surrounding land use to understand effects on shorebird habitat suitability. Across the four study lakes, current shorebird counts are lower than historic counts, declining 86% from 1990s numbers. While each study lake experienced changes in habitat covariates, these changes do not explain observed changes in shorebird counts. This indicates that overall shorebird declines may be masking the impact of local habitat changes. With shorebird populations declining globally, this project provides critical information about how climate and land use change in the prairies alters lake habitats that are crucial staging areas for migrating shorebirds.

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*Investigating the role of testosterone in regulating the post-fledging behaviours of juvenile migrant songbirds

G. Casbourn, C. Posliff, C. Henry, B. MacDougall-Shackleton, S. MacDougall-Shackleton

Presenting author: **Garth Casbourn**, University of Western Ontario, gcasbour@uwo.ca

The post-fledging period is a critical stage in the life of juvenile migrant songbirds. Movement across the landscape may be critical to developing flight, navigation, and orientation skills, and in prospecting future breeding territories. Testosterone is related to individual differences in migration distance in adult sparrows, but it has not been studied in the context of juvenile movement behaviours. We used juvenile Song Sparrows (Melospiza melodia) to investigate the relationships among movement propensity in a novel environment, juvenile prospecting movements, and testosterone profile -- the maximal level of circulating testosterone produced in response to an injection of GnRH. We video recorded 10 minutes of activity of recently fledged, wild sparrows in an artificial chamber (2.4 x 2.4 x 1.8 m) containing 5 artificial trees, as an index of exploration behaviour. Following this, we injected birds with GnRH to trigger a surge in testosterone and collected blood samples 30 minutes later. Finally, we radiotagged birds for two to four weeks to assess prospecting movements. GPS fixes taken every other day were used to calculate a minimum polygon of landscape visited, and a radius of gyration for each bird. Detections from three radio towers in fixed locations at the field site were used to measure daily activity levels. Preliminary results do not give strong support for a relationship between testosterone regulation and movement/exploration propensity at the juvenile stage. Thus, the relationship between testosterone and migration in adults does not appear to function in prepubertal birds.

Replicate Flame-rumped Tanager hybrid zones and the role of selection in gene flow and reproductive isolation

M. Castano, C. Cadena, J. Uy
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The recently diverged Ramphocelus flammigerus subspecies complex comprises two subspecies that exhibit subtle morphological differences, but dramatic variation in carotenoid-based plumage color of the rump along an altitudinal gradient: the smaller, Lemon-rumped Tanager (R. f. icteronotus) occurs at low elevations along the Pacific coast, whereas the larger, Flame-rumped Tanager (R. f. flammigerus) is found at mid-elevations in the Cauca River Valley of Colombia. We obtained genome-wide sequence data from three parallel transects through low mountain passes that form independent contact zones between the two subspecies. At each contact zone, hybridization produces a gradient of intermediate-sized, orange birds. We calculated the extent of genomic divergence between subspecies, characterized population structure within and between transects, and performed geographic cline analyses to test for similarities in morphologic and genetic patterns of introgression across the three transects. Despite overall low genomic divergence between subspecies, we found genetic structure along transects and narrow genetic clines, suggesting some form of selection against hybrids. Our ongoing analyses are exploring the concordance in geographic cline shape and position for specific genomic regions across the three transects to infer the role of selection in mediating introgression and creating reproductive barriers.

Spatial Use of Breeding Female Painted Buntings (Passerina ciris): Documentation of the Use of Multiple Male Territories

K. Ceynar, J. Bednarz, A. Gregory
Presenting author: **Katherine Ceynar**

Passerine spatial ecology studies have focused almost exclusively on conspicuous displaying males-this is also true for Painted Buntings (Passerina ciris). Most quantitative data that are available on the movements of breeding passerines are biased toward males. This is potentially problematic, as female P. ciris are the sole providers of parental care until nestlings fledge; therefore, it is likely that the locations of nests and female movements would be more informative in understanding their mating system and the social-ecological factors influencing fitness and reproductive success than data on male spatial use. The literature suggests that Painted Buntings are mostly monogamous implying that most female movements should be confined to a single male territory. We used leg loop harnesses to attach NTQB2-5-1 nanotags to 30 female P. ciris to test the hypothesis that female buntings primarily restrict their movements in one male territory. We documented male territories with 8 spot-map surveys in two study grids in north Texas. We ground-tracked females by homing. In 2021, average female MCP home ranges were 2.39 Â± 1.46 (SD) ha and in 2022 they nearly doubled 4.17 Â± 2.73 ha, likely due to extreme drought conditions.

Female home ranges overlapped with a mean of 3.63 Â± 0.92 male territories in 2021, and 3.25 Â± 1.54 territories in 2022. Our data indicated that female buntings move through multiple male territories throughout the breeding season, suggesting that they potentially have interactions with multiple males and their breeding system may be polygynandrous.

A social network analysis of Brown-headed Cowbird (Molothrus ater) movements utilizing an automated telemetry system.

M. Chamberlain, S. Lawson, H. Scharf, W. Schelsky, M. Ward, M. Hauber
Presenting author: **Mac Chamberlain**, University of Illinois, Urbana-Champaign, macleechamberlain@gmail.com

Brood parasitic bird species, including the Brown-headed Cowbird (Molothrus ater), develop in the absence of conspecifics yet they engage in complex social behaviors upon independence and in adulthood. However, due to these birds' elusiveness during the breeding season, there is still much about their sociality that remains unknown. To better understand cowbird social behaviors, we conducted a radio telemetry study which utilized a six-tower automated radio telemetry system to continuously track the locations of 24 radio-tagged cowbirds throughout a 1,200-hectare county park located in Central Illinois, USA. We then performed a social network analysis to examine the daily patterns of association among individuals, to identify potential subgroups within our sample population, and to identify any potential factors which could be influencing the strength of these relationships. We found that, during daylight hours, our radio-tagged cowbirds formed a highly clustered, non-random social network with distinct groups of individuals who were more likely to interact with each other. We conducted a pair-wise genetic analysis to determine relatedness scores using nine separate microsatellite loci. Relatedness, however, was not significantly correlated with association strength. Come nightfall, these social groups were repeatably observed fusing with other heterospecific flocks to form one large communal roost consisting of cowbirds, European Starlings (Sturnus vulgaris), Red-winged Blackbirds (Agelaius phoeniceus), and Common Grackles (Quiscalus quiscula). Our study provides the first detailed analysis on the social structure of Brown-headed Cowbirds while also providing novel insights into their mixed-species roosting behavior.

Indirect genetic effects across life cycle stages in a cooperatively breeding bird

G. Spitz, E. Cosgrove, R. Bowman, J. Fitzpatrick, A. Clark, N. Chen
Presenting author: **Nancy Chen**, University of Rochester, nancy.chen@rochester.edu

Indirect genetic effects, which occur when an individual's phenotype is influenced by the genotype of another conspecific individual, are an often-overlooked yet potentially important factor impacting phenotypic variation in natural populations. Most indirect genetic effects studies to date have focused on estimating maternal effects, even though males also care for offspring in many species. Here, we estimated maternal and paternal effects on offspring survival and body condition at different life stages in an intensively-studied population of Florida Scrub-Jays (Aphelocoma coerulescens). We found paternal effects are higher than maternal effects for early nestling survival, which is consistent with variation in provisioning behavior. We also estimate the effects of non-transmitted parental alleles and incorporate parental genotypes in genome-wide association studies of different fitness components. Our study highlights the importance of broadening the consideration of indirect genetic effects beyond maternal effects when studying the evolution of offspring traits and performing genotype-phenotype associations.

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*Nest structure and climate resilience in birds: A global analysis

S. Chia, M. Tuanmu, W. Fagan
Presenting author: **Stephanie Chia**

Nest structure is crucial for the reproductive success of birds, as it affects their ability to cope with adverse environments. Despite previous studies suggesting that enclosed nests (i.e., dome-shaped nests and cavities) might provide better protection against predators and resistance against extreme temperatures and temperature fluctuations, those findings were inconsistent across species or regions. In this study, we aimed to identify the factors driving the use of enclosed nests from a global perspective by

analyzing data from over 8,000 bird species. We compiled information on nest structure and environmental factors associated with each species' breeding range, and built phylogenetic regression models to test the effect of predation risk and temperature variables on the use of enclosed nests. The results indicate that species using enclosed nests can breed across a broader temperature range, and this pattern is consistent across both passerine and non-passerine species. Our findings suggest that enclosed nests might allow birds to adapt to larger climate niches, potentially making them more resilient to climate change. This study sheds new light on the significance of nest structure in birds' adaptation to changing environments, providing important insights into how bird species may respond to future environmental challenges.

Assessing breeding to nonbreeding carry-over effects in the American Redstart through feather quality

I. Ciaburri, B. Dossman, P. Marra, M. Reudink, C. Tonra
Presenting author: **Ivy Ciaburri**

American Redstarts (Setophaga ruticilla) have provided invaluable insights into the importance of studying full-annual cycle biology of migratory birds. That said, almost all this research has examined the influence of nonbreeding on breeding season events and we know little about how breeding-ground environmental conditions affect subsequent phases of the annual cycle despite expected climatic change on temperate breeding habitats. Here, we explore relationships between environmental conditions on the breeding grounds and feather quality, an indicator of an individual's health at the time of molt. We then evaluate potential breeding to nonbreeding carry-over effects by relating individual feather quality to the type of habitat occupied on the wintering grounds which is known to influence subsequent migration departure and breeding success. Using the 27-year collection of tail feathers (3rd rectrix) sampled from a population of redstarts wintering in southwest Jamaica, I measured each feather's carotenoid content via spectrometry, feather density, and growth rate to evaluate feather color and structural quality. We leveraged the fact that our study population breeds in the Upper Midwest to derive annual estimates of environmental conditions (NDVI and precipitation) on the breeding grounds via remote sensing. We then investigated the relationships between environmental conditions on the breeding grounds to individual feather quality and relate that to winter habitat. This expands upon previous research by incorporating more direct indicators of food availability, structural feather quality, a dataset that includes a greater variation in climatic conditions, and the known breeding area of Jamaican redstarts.

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*Genomic architecture of local adaptation in a coastal Song Sparrow subspecies

J. Clark, H. Lim, B. Olsen, A. Kovach
Presenting author: **Jonathan Clark**

Interbreeding populations that maintain divergent adaptations provide an opportunity to examine the genetic basis of local adaptation. The song sparrow (Melospiza melodia) is a ubiquitous North American songbird with several subspecies adapted to diverse environments. In eastern North America, there are two song sparrow subspecies, the generalist Eastern Song Sparrow (M. m. melodia) and the Atlantic Song Sparrow (M. m. atlantica), which is adapted to coastal sand dunes and salt marshes. Despite gene flow in their contact zone, these subspecies maintain divergent adaptations to their respective environments. Namely, the bill of the Atlantic Song Sparrow is roughly 30% larger than the Eastern Song Sparrow, allowing for more efficient heat diffusion and water conservation. We used whole-genome sequencing (15X depth) of 60 individuals (inland = 20, coastal contact zone = 18, barrier islands = 22) to discern population structure, characterize highly divergent portions of the genome between these subspecies, and identify the genes associated with coastal adaptation in the Atlantic Song Sparrow. Our results provide insights into the genomic architecture of adaptation with gene flow and the genetic basis of coastal adaptation in songbirds.

From presence/absence to reliable prey proportions: A field test of fecal metabarcoding for characterizing seabird diets

G. Clucas, A. Stillman, J. Seavey, A. Kovach, E. Craig

Presenting author: **Gemma Clucas**, Cornell Lab of Ornithology, Gemma.Clucas@cornell.edu

Fecal metabarcoding is an increasingly popular method for studying the diets of birds and other taxa. While this approach can detect a wider range of prey than traditional methods, estimating prey proportions continues to be challenging. To test this in seabirds, we recorded the ID and length of fish provisioned to Common Tern chicks on the Isles of Shoals, NH, in 2017 – 2019 while also collecting fecal samples from chicks in the same colony for fecal metabarcoding. We used the popular MiFish primers to sequence a portion of the 12S gene from fecal samples and compared fish visual counts and biomass estimates to two common metabarcoding metrics: the frequency of occurrence (FOO) of prey species, which uses presence/absence, and the relative read abundance (RRA) of those species, which accounts for the relative number of sequences recovered. We found the lowest mean absolute error (MAE=0.06) and root mean squared error (RMSE=0.07) between the relative biomass consumed and RRA, showing that RRA is a surprisingly good metric for estimating prey proportions. RRA also outperformed FOO in detecting interannual changes in fish prey. Thus, RRA appears to be a suitable metric for estimating fish proportions in tern diets (and likely other seabirds) using fecal metabarcoding. To investigate the effect of fecal samples size on error rates, we simulated an annual monitoring protocol ranging from 10 – 40 samples per year and show that error rates reached a lower asymptote around 30-40 samples each year. Therefore, future studies of seabirds with similar levels of diet diversity should sequence 30 – 40 samples per colony/life stage and use RRA to estimate the proportions of prey consumed.

Incubation regime does not explain significant variation in metabolic plasticity among embryos

A. Cones, E. Schneider, D. Westneat
Presenting author: **Alexandra Cones**

Although birds are ectothermic as embryos, recent evidence suggests that their metabolic sensitivity to temperature can vary, even within populations. However, the causes and consequences of this variation are not known. One possibility is that embryos acclimate their metabolism in response to the early incubation environment and do so to optimize their growth rate. This hypothesis has been supported in fully ectothermic taxa, but not tested in birds, which are only ectothermic during development. To test this hypothesis, I artificially incubated the embryos of Pekin ducks (Anas platyrhynchos domesticus) and measured their metabolic sensitivity and growth. Contrary to expectations, incubation regime did not influence embryonic metabolism. Nevertheless, individual embryos did indeed vary in their metabolic sensitivity, but the cause of this variance remains unexplained. I also found that these differences had growth consequences: embryos with higher heart rates took longer to hatch, hatched smaller, but grew faster post-hatching. These results highlight the importance of considering differences in phenotype in the embryonic stage. Further, unlike fully ectothermic taxa, bird embryos do not seem to acclimate to early incubation temperatures, suggesting unique eco-physiological pressures may be present in this taxon.

The Bird-Friendliness Index, an outcome-based indicator of conservation impact

I. Cook, K. Hawkshaw, K. Drake, J. McManus, S. Jenniskens, B. Robinson, R. Fisher
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There is an urgent need to halt biodiversity loss such as declining grassland birds. Economically, biodiversity remains an externality in agricultural systems. A barrier to incentivizing biodiversity outcomes is the lack of robust, trustworthy, and actionable biodiversity indicators. Birds Canada is working to adapt the Bird-friendliness Index (BFI) to the agricultural working landscape and grasslands of the Canadian Prairies. This is an outcome-based indicator that represents impacts of land management on birds by providing a single metric that is standardized to the bird community in the surrounding (background) landscape. The BFI may be applied to guide management and enable market and policy tools to compel positive outcomes for grassland birds. Expressed as a simplified equation: BFI = the Summed Weighted Density of Birds x Functional Diversity. The 'raw' BFI score(s) is then scaled to background data to produce a scaled metric that ranges from 0 to 1. During 2021 and 2022, we piloted the BFI collecting ~3,300 surveys (point count and bioacoustic) achieving representative sampling at 78 sites (farms, ranches, protected areas) and ~340,000 acres of grassland habitat in Manitoba and Saskatchewan. We used the North American Breeding Bird Survey (BBS) data to represent the background bird community

in the surrounding landscape and the initial BFI results indicate that the BFI is representing impacts of land management and that BBS can provide a foundation to build upon. Work remains to assess the consistency and spatial continuity of coverage afforded by the BBS. These results represent an important milestone in work to adapt the BFI to the Canadian Prairies.

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*Advancing methods of diet analysis: a case study using degraded Merlin (Falco columbarius) prey remains

T. Coon, V. Dreitz, S. Lewis, S. Painter
Presenting author: **Taylor Coon**, University of Montana, teakettlebookshelf@gmail.com

Prey remains have long been used as a mechanism to approach diet analyses. As understanding diet is key to a comprehension of ecosystem dynamics, prey remain identification requires a unique methodological approach to determine diversity within a sample. With the advancement of technology, molecular protocols designed for species-specific identification have improved to incredible accuracy and precision. Yet, the visual identification method has remained a predominant technique within diet studies. With entry-level technicians, we matched visual identifications with molecular-based methods to quantify the accuracy of the visual method. This study determined what fraction of visually identified prey remains could be correctly identified to an high degree of certainty. Using the mitochondrial DNA of > 40-year-old Merlin (Falco columbarius) feather samples, we found that the correct identification of visually identified 'high' certainty samples was 41.7%. Furthermore, visually identified samples with a 'medium to low' certainty plummeted to 19%. This study reveals that correct identification of visually identified samples is significantly lower than previously considered, but that certainty level has a significant role in correct identification. Similarly, visual identification can provide rapid determination of separate taxa and the number of species in a sample. It is critical to assess prey remains using multiple techniques in order to procure definitive identification of individual prey items. Additionally, the primers AWF2-R4 and AWF4-R6 targeting regions within the cytochrome c oxidase subunit-1 gene are effective for degraded (i.e. > 40 years old) feather samples of Passeriformes and Charadriiformes.

Estimation of seasonal and annual survival of two Rosy-Finch species using RFID feeders

C. Cox, J. Gardner, K. Savides, C. Latimer, R. Norvell, C. Rushing
Presenting author: **Cody Cox**, University of Georgia, codycox75@uga.edu

Two species of Rosy-Finches winter in similar habitat in northern Utah: the relatively common Gray-crowned Rosy-Finch (Leucosticte tephrocotis) and the range-restricted Black Rosy-Finch (Leucosticte atrata). Both species inhabit remote, alpine areas during the breeding season and are semi-nomadic during winter, characteristics that have hampered research on Rosy-Finch demography and life history. The lack of demographic data also hinders conservation and management decisions in the face of growing threats, including climate change, non-native species, and habitat loss. We used bird feeders equipped with Radio Frequency Identification (RFID) devices to passively monitor Gray-crowned and Black Rosy-Finches at four sites in northern Utah and to develop a hierarchical multi-state capture-recapture model to estimate survival and migration phenology of each species. Between 2018 and 2022, we tagged 320 Gray-crowned Rosy Finches and 62 Black Rosy-Finches, which were detected a combined 129,408 times by RFID feeders. Our model produced the first within-season survival estimates for these species, which despite varying by site were comparable to those found in similar species. Our model also indicated that the feeders detected two separate populations of Black Rosy-Finches, one that overwintered and one that passed through during spring migration. Our estimates of Rosy-Finch survival and migration can help support local management and provide key baselines in the face of changes to migration timing driven by climate change. Furthermore, our approach can be used to estimate demographic rates in other species of management interest that readily visit feeders.

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*Climate and Anthropogenic Impacts on the Distribution of Migratory Landbird Stopover Across Texas and Louisiana

A. Crandall, T. Zenzal, R. Wilson, J. Smolinsky, L. Randall, J. Buler

Presenting author: **Amanda Crandall**, University of Delaware, acrand@udel.edu

Texas and Louisiana constitute a spatially heterogenous landscape that supports the stopover of billions of migratory landbirds, including many with declining populations. Understanding how variation in land cover, climate, and anthropogenic factors influences stopover distributions will help to identify areas of conservation priority. Using 13 years of spring and fall data collected from 15 weather surveillance radars located across TX and LA, we quantified the density of migratory birds departing from stopover sites at a 250m x 250m spatial resolution. We fit boosted regression tree (BRT) models among an ensemble of 200 overlapping modeling frames (400 km x 400 km in extent) stratified across the study area to determine the relative importance and relationships between 41 predictor variables and seasonal mean bird density. We found that the top 5 ranking covariates for each modeling frame BRT and the direction and strength of their linear relationships with bird density varied across space and sometimes between seasons. Notably, distance to areas with the brightest artificial light at night (ALAN) ranked highly across most of the study area and showed surprisingly strong positive overall linear relationships with bird density in northwestern and central TX in the fall, and in central TX and LA in the spring (i.e. broad-scale avoidance of bright areas). However, we still found positive relationships with ALAN brightness measured at grid cell scale in these regions, suggesting some birds may be attracted to ALAN at small scales while others avoid bright areas at broad scales. Overall, changes in bird community composition across the study area may explain differential responses to environmental variables.

Population expansion and central place foraging affect critical habitat estimation for Whooping Cranes (Grus americana)

A. Crosby, M. Bidwell, E. Bayne, J. Conkin

Presenting author: **Andrew Crosby**, University of Alberta, crosby@ualberta.ca

The Aransas-Wood Buffalo population (AWBP) of the highly endangered Whooping Crane (Grus americana), composed of approximately 550 individuals, nests exclusively in and around Wood Buffalo National Park in northern Alberta and adjacent Northwest Territories, Canada. A requirement for reaching and maintaining population recovery goals for the AWBP is to protect sufficient breeding habitat to support the desired number of breeding pairs. While the AWBP continues to grow and expand its nesting range, little is known about breeding habitat selection by AWBP cranes outside of a small number of nest location habitat studies. Therefore, our objective was to delineate critical nesting habitat for cranes while accounting for expansion of the nesting range, clustering of breeding pairs into nesting areas, and central place foraging behaviour while on nesting home ranges. We developed sequential, hierarchically structured habitat selection models that accounted for multiple levels of habitat selection. Our within-home range model explicitly incorporated central place foraging behavior. Our models showed that controlling for distance from the centroid of the original nesting area was important for modelling nesting area and home range habitat selection. We found evidence for functional responses to distance from the nest in our within-home-range models, suggesting that central place foraging influences foraging habitat decisions. Our modelling framework allowed us to develop maps of current and potential breeding range habitat that were independent of distance from a central location at all levels, which is critical for delineating areas of potential importance for breeding range and population expansion.

Field-validated species distribution model of Canada Warbler in Northwestern Ontario.

V. Cupiche Herrera

Presenting author: **Vianney Cupiche Herrera**, Lakehead University, vcupiche@lakeheadu.ca

The Canada Warbler (CAWA) is a species of conservation concern in Canada, but its ecological needs and distribution remain poorly understood. Additionally, contradictory findings exist regarding the impact of logging on the species, and its habitat needs may be distorted by limitations in current habitat availability compared to historical conditions. Using Maxent, I developed a fine-resolution (30m) predictive, field-validated species distribution model (SDM) to assess how logging affects CAWA's occurrence and distribution in an Ecoregion of Northwestern Ontario where little information about the species is available. The model used occurrences observations (2001-2021) from various datasets such as eBird project (among others) and covariables such as bared soil index, normalized water index,

enhanced vegetation index, digital elevation model, forest cover loss, and canopy height. I validated the model using independent field-collected data from 2022. The model showed moderate performance for training and test data (AUC > 0.68), with canopy height and forest loss being the most influential covariables (>20%). The model predicted a higher probability of CAWA occurrence in areas with forest loss due to logging, indicating that CAWA can take advantage of logged regenerated areas due to high shrub density while still relying on structures similar to old-growth forests (canopy height >10m). Retention of tall trees is crucial for CAWA conservation and management in logged areas. This study provides valuable insights into the habitat associations and distribution of CAWA in Northwestern Ontario. The predictive SDM approach could be useful for informing management decisions and conservation efforts for CAWA in other regions.

Field-validated species distribution model of Canada Warbler in Northwestern Ontario.

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Using Weather Surveillance Radar to describe phenology of offshore migration with application to wind farms in the US

S. Curley, A. Farnsworth, A. Dokter

Presenting author: **Shannon Curley**, Cornell University, The Cornell Lab of Ornithology, src243@cornell.edu

The Next Generation Weather Radar (NEXRAD) network is an important tool for movement ecologists because of its ability to detect birds, bats, and insects at scales ranging from kilometers to thousands of kilometers and from minutes to decades. Application of radar-based research is elucidating broad-scale migration patterns, phenology, and fine-scale movements to identify collision risks with human-made structures. This supports conservation actions to reduce bird mortality. Offshore habitats are becoming increasingly developed for clean energy technology. The U.S. Bureau of Ocean Energy Management is supporting efforts to assess the occurrence of migrating birds offshore environments using NEXRAD. We conducted a detailed analysis of four coastal radar stations in spring and fall by partitioning radar vertical profiles over land and offshore with a 10km coastline buffer. Due to the curvature of the earth, the radar beam at farther distances may pass over birds migrating at low altitudes. To address this challenge we used altitude differences between land and offshore vertical profiles close to the radar (15-35km) to model densities at low altitudes farther away (35-55km) using extreme gradient boosting (XGBoost), to reconstruct migration across 22 coastal radars along the Atlantic Ocean and Gulf of Mexico. We found that bird densities were higher over land than offshore, and higher densities of birds in spring versus fall,

however, densities were variable by radar, highlighting the importance of coastline geography. This methodology will be extended to develop risk assessment models and offshore migration forecasting for wind farm planning and lease areas.

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*Roads as Barriers to California Quail (Callipepla californica) Gene Flow in the Santa Monica Mountains, Los Angeles

J. Curti, B. Shaffer, S. Riley
Presenting author: **Joseph Curti**, University of California, Los Angeles (UCLA), jcurti3@g.ucla.edu

California quail (Callipepla californica) are a common bird species across Southern California that spend the majority of their active period foraging on the ground. In urban Southern California, quail-occupied habitat patches are often divided by large roadways and urbanization that are avoided by the species. Earlier research in Southern California has demonstrated the disruptive effects of roadways on gene flow of several taxa including large mammals, lizards and wrentits. However, little empirical research has been done to assess the extent to which ground-dwelling birds like quail might be impacted by roads. Given the recent assembly of many high quality reference genomes by the California Conservation Genomics Project, we designed a field sampling project to assess the impact of roadways on California quail gene flow with paired sampling of quail separated by major roadways in the Santa Monica Mountains. Given the small spatial extent and relatively short time of potential separation, we utilized whole genome resequencing for this project. We sequenced 18 California quail and analyzed our samples using standard population genomics-approaches including PCA, ADMIXTURE, and latent factor mixed modeling. Our initial analyses indicate some evidence for isolation by distance even over this restricted spatial extent, and suggest that our ongoing analyses should have sufficient power to detect effects of roads if they exist. The findings from this research will be used to provide baseline data for ongoing conservation management efforts to alleviate the negative impacts of habitat fragmentation in Los Angeles, including the Wallis Annenberg Wildlife Crossing that is now under construction.

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*Breeding season management is unlikely to improve population viability of a data-deficient waterbird species in decline

K. Davis, S. Saunders, S. Beilke, E. Ford, J. Fuller, A. Landgraf, E. Zipkin
Presenting author: **Kayla Davis**

A major challenge in conservation is developing effective approaches to mitigate population declines in the face of ongoing environmental change. For migratory species, it is often more feasible to implement management during periods of stationarity, like the breeding season. However, such management strategies are only successful if the demographic rates targeted (e.g., reproductive rates) contribute substantively to population growth. Thus, evaluation of population growth rate sensitivity to variation in demographic rates is needed to determine the most effective conservation strategies. This is especially true for small and declining populations that require targeted and urgent action to mitigate declines under current and future environmental change. We used a coupled integrated population model-Bayesian population viability analysis (IPM-BPVA) to estimate demographic rates and population viability within the context of climatic and management-related changes for a data-deficient, declining population of black terns in the Upper Midwestern United States. We found that current conservation efforts during the breeding season are unlikely to reverse the declines observed in the last decade (from an average of 307 breeding pairs in 2013 to 53 in 2022). Yet, interventions aimed at increasing adult survival are projected to reduce local extinction probability by 30–46% compared to no additional management or management targeting other rates, depending on the climate scenario. Our results highlight the importance of enhancing management efforts for migratory species during migration and nonbreeding periods, which constitute a much larger, and generally riskier, proportion of the annual cycle compared to the breeding season.

Identifying social science opportunities for bird conservation efforts

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Opportunities for conservation social science to inform bird conservation efforts are numerous, yet, not comprehensively articulated. By conducting a needs assessment for Audubon we aimed to develop and apply a novel method for assessment and explore the range of opportunities that exist. The assessment elicited four types of information: 1) how social science is currently informing work; 2) opportunities for social science information to improve conservation efforts; 3) constraints and facilitators of social science integration; and 4) potential strategies to overcome constraints and leverage facilitators. To ensure that participants considered the breadth of ways in which social science can be useful, we based our elicitation on a framework proposed by Bennett et al. (2017). Through six 90-minute focus groups with over 60 participants, we identified de-centralized social science efforts being conducted across the organization, commonly with consultants or by biologists without social science training. Participants described opportunities in all six areas of proposed social science benefits: instrumental, descriptive, diagnostic, disruptive, reflexive, and generative. Common perceived constraints included staff capacity, organizational buy-in, funding, and a culture of prioritizing biological over social science. Common facilitators were the new Audubon strategic plan, the social scientist in residence, new technology, and the experience with applications of social science in the organization. Participants described a variety of approaches to advance social science integration, such as training, priority articulation, and adding staff capacity. We will discuss next steps in application of results.

Complex evolutionary history of recently diverged sympatric Phylloscopus warblers on Kolombangara Is., Solomon Islands

L. DeCicco, D. DeRaad, P. Sweet, R. Moyle
Presenting author: **Lucas DeCicco**

Sympatry of closely related species in island systems has been thought to occur primarily through double-invasions from the same continental source population, however, secondary sympatry can also occur on a smaller geographic scale where divergent populations isolated from one another within an archipelago may come back into contact due to dispersal among islands. Depending on degree of divergence and evolution of reproductive isolating barriers, the result of this secondary contact could be gene flow between isolated populations, exclusion or extinction of one population via competition, or the establishment of closely related sympatric species. We provide strong evidence for intra-archipelago secondary sympatry within a radiation of Phylloscopus warblers in the Solomon and Bismarck archipelagos by presenting the first well-sampled phylogeny of Phylloscopus warbler populations in the region. Using genome-wide nuclear data and complete mitochondrial genomes we also present evidence for a complex history of mitochondrial-nuclear discordance within this radiation, particularly in the only pair of sympatric species east of Wallace's Line, located on Kolombangara Island in the Solomon Islands. Using genome-wide gene tree frequencies, we disentangle discordance among genomic regions under expectations of gene flow and incomplete lineage sorting in this sympatric pair of species to suggest the most likely evolutionary history of this unique pair. Our genomic data indicated that the divergent single-island endemic species on Kolombangara (Phylloscopus amoenus) is not a relictual lineage resulting from a double invasion, as previously thought, but instead resulted from relatively recent intra-archipelago diversification.

Evaluating diet of a free-living breeding bird, the Swainson's Thrush (Catharus ustulatus) along an elevation gradient

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Presenting author: **Sarah Deckel**, University of Massachusetts, Amherst, sdeckel@umass.edu

High elevation breeding birds require proper fuel and invertebrate availability during the entire duration of their nesting cycle to produce a successful nest. High quality diet is necessary for energetically expensive behaviors, brood quality, and fledgling survival, but food availability is dependent on climatic variables such as temperature, precipitation, and persisting spring snow depth. Diet has historically been studied using gut or fecal analysis, however, stable isotope analysis (SIA) is a newer tool and may allow a better representation of the food sources being consumed. However, evaluating diet using SIA in wild bird populations can be complex, due to the environmental variables that contribute to isotopic composition. We conducted a novel study investigating diet of adult breeding Swainson's thrush (Catharus ustulatus)

across an elevation gradient within the White Mountains, New Hampshire. We hypothesized Swainson's thrush diet would change as elevation increased due to the colder temperatures and increased rainfall at higher elevations. We captured adult birds and collected blood samples to compare carbon (Î´13C) and nitrogen (Î´15N) isotopes between plasma and invertebrates collected. Using MixSIAR posterior distributions, we did not identify a significant difference across the elevation between proportional source contribution in the consumer's plasma tissues. However, these models demonstrated higher proportions of detritivores in Swainson's thrush diet, providing evidence that ground dwelling invertebrates are important for this species. Our research highlights food sources consumed by a breeding montane bird using SIA along an elevation gradient, a novel approach to evaluating diet within this system

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Urbanization affects the morphology of adaptive traits in Galápagos Darwin's finches

A. Deeb, P. Carrión-Avilés, J. Chaves
Presenting author: **Adan Deeb**

Harsh environments result in the evolution of specialized traits. The Galápagos Islands of Ecuador are characterized by dramatically opposing seasons. Wet seasons result in abundant resources while dry seasons greatly limit resource availability. Limited resources force species to specialize and diversify to minimize interspecific competition. This environment has resulted in Darwin's finches' characteristic beak diversity. However, urbanization is rapidly changing selective pressures and affecting evolution in unprecedented ways. Previous research on Darwin's finches in urban areas have found reduced resource specialization along with a significant preference for human foods. Nevertheless, the generality of these effects across finch species, islands, and years has not been explored. Our research investigates the predictability of the impacts of urbanization on adaptive morphological traits in Darwin's finches across two species and two islands of the Galápagos across 6 years. We analyzed distributions of beak length, width, and depth of small and medium ground finches on San Cristóbal and Santa Cruz islands across urban and non-urban sites. Measurements were recorded for 1,717 birds in San Cristóbal and 2,516 birds in Santa Cruz from 2014-2020. Data were analyzed using Principal Component Analyses (PCA), Analyses of Variance (ANOVA), and a Phenotypic Trajectory Analysis (PTA). Results show significant morphological differences between urban and non-urban areas between and within species on both islands. Additionally, morphology responds similarly to urbanization across time, islands, and species. Our findings suggest that urbanization is a driving evolutionary force affecting species' trajectories in predictable ways.

Inferring the phylogenetic history of the Buzzing Flowerpecker despite extensive ILS and ongoing gene flow

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The bifurcating phylogenetic tree is the most widely used heuristic for understanding the evolution of life on earth. But, with the advent of genomic data, it has become clear that strictly bifurcating phylogenetic reconstructions often oversimplify the complex sequence of evolutionary events responsible for generating patterns of extant biodiversity. Here, we use the Buzzing Flowerpecker (Dicaeum hyploleucum), a Philippine endemic species comprised of three geographically isolated lineages, to investigate whether modern genomic methods are capable of accurately distinguishing phylogenetic history following a complex, non-tree-like evolutionary history. We show that the implicit assumption of species tree programs that the most common genome-wide gene tree topology or site pattern represents the true phylogenetic history can be easily violated by even small amounts of gene flow, preventing us from confidently identifying the phylogenetic history of our empirical system using these species tree approaches. Unlike species tree and ABBA/BABA approaches, we show that the distribution of pairwise sequence divergence among loci, a proxy for coalescent branch heights, can effectively distinguish between comparisons of sister lineages and comparisons of non-sister lineages sharing alleles through gene flow, even at levels of gene flow that alter the dominant genome-wide gene tree topology and site pattern. Overall, our results directly comment on best practices for understanding and reconstructing complex evolutionary histories, and highlight important limitations of bifurcating phylogenetic

reconstructions that should be widely recognized and discussed.

Dependency of climate-driven changes in shape on changes in size

T. Dias, M. Zimova, B. Weeks
Presenting author: **Tiffany Dias**

Body size reductions have been widely documented as a response to warming temperatures across taxa and, in some species, have been accompanied by unexpected shifts in shape. Across bird species, wing length has increased relative to body size as they have gotten smaller, presumably reducing wing loading and increasing flight efficiency. This raises the question: are changes in shape an adaptive response to compensate for warming-driven body size reductions, or have they occurred independently of changes in size? Using morphological data for over 15,000 specimens of 8 North American migratory bird species collected over 40 years, we (1) determine whether aspects of climate change can explain changes in relative wing length (i.e., shape) in our species and, if so, during which periods in species' life histories, and (2) determine whether changes in shape are size-dependent by assessing how and when the relationship between body size and wing length changes. We find a negative association between wintering precipitation and changes in wing length, which aligns with the hypothesis that climate-driven resource shortages select for more efficient flight. We also find an association between increases in wing length and warmer fall migrations that is stronger when body size has not declined, suggesting that warming-driven increases in wing length may compensate for a limited capacity to reduce wing loading by getting smaller. Thus, changes in shape appear to be a direct adaptation to climate change that reductions in body size may mitigate. Understanding the mechanism behind these changes is critical to estimating rates of and constraints on climate change adaptation, and predicting vulnerability to climate change.

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*Sexy song? Northern house wren (Troglodytes aedon) males that sing more close-communication song sire more recruits

R. DiSciullo, A. Forsman, R. Fitak, J. Hunt, P. Nietlisbach, C. Thompson, S. Sakaluk
Presenting author: **Rachael DiSciullo**

Bird song is a classic example of an intra- and intersexually selected trait. Although previous studies have identified individual components of song that foster male reproductive success, much of this work does not account for song itself being typically composed of multiple, often-correlated components, necessitating a multivariate approach. We explored the role of sexual selection in shaping the complex song of the northern house wren (Troglodytes aedon) by simultaneously quantifying its multiple components and relating these to fitness using multivariate selection analysis, a technique widely used in insect and anuran studies but not in birds. The analysis revealed significant variation in the form and strength of sexual selection acting on song structure across different selection episodes including success in nest-site defense, mate attraction, genetic paternity, and recruitment of young to the breeding population. Males that sang a greater preponderance of song typically employed in close communication compared with that used in far communication sired more offspring that subsequently recruited to the breeding population. However, this pattern was not consistent across earlier selection episodes, and was even reversed in the case of nest-site defense, indicative of a trade-off between song components over the course of the breeding season. We advocate the use of multivariate selection analysis in investigating multicomponent traits across taxa to address how selection shapes complex traits composed of correlated components.

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*All quiet on the nestling front: the nest environment attenuates Savannah Sparrow song

S. Dobney, M. Bornais, R. Norris, A. Newman, H. Williams, S. Doucet, D. Mennill
Presenting author: **Sarah Dobney**

Animals, such as humans and songbirds, learn to vocalize by imitating sounds heard from conspecific animals early in life. Young animals deprived of exposure to adult sounds have impaired vocal learning,

while increased exposure to adult sounds may improve vocal learning. In Savannah Sparrows (Passerculus sandwichensis), song learning begins during the first natal summer, and the first conspecific songs heard are those produced by fathers and nearby neighbours. Although the size of the acoustic environment is traditionally assumed to equal the average song transmission distance of adult singers, Savannah Sparrow nestlings are confined to ground nests surrounded by dense vegetation. To understand the size of the natal acoustic environment of this species, we examined the hypothesis that nestling exposure to adult song is limited by vegetation surrounding nests. We collected recordings of naturally singing Savannah Sparrows using two microphones: one microphone inside a nest (a typical nestling position) and another placed 1m high (a typical adult position). We measured amplitude and compared signal-to-noise ratios of songs recorded at variable locations around the nest by each microphone. Songs recorded inside the nest are more attenuated than songs recorded above the nest. The nest environment limits the acoustic environment by approximately 40m, reducing the number of adults heard. Future research on vocal learning should consider how the natal acoustic environment influences song detection from the learner's perspective.

Seasonal macro-demography of North American bird populations revealed through citizen science and radar monitoring

J. Socolar, B. Galtbalt, F. La Sorte, K. Rosenberg, A. Johnston, A. Dokter
Presenting author: **Adriaan Dokter**

Long-term population surveys and aerial surveillance of migration by weather radars has detected alarming population declines. Global anthropogenic changes are thought to be responsible, however where in the annual cycle these changes affect birds most strongly is poorly understood. To provide more insight into the processes underlying population change, we designed novel macro-demographic indices of recruitment and mortality, based on bi-annual estimates of population abundance from eBird and radar data across the contiguous US. eBird demographic indices were developed for two resident species (Carolina Wren, Northern Cardinal) and estimates of annual abundances were validated on Breeding Bird Survey (BBS) data. We applied these demographic indices to pinpoint whether population fluctuations are related primarily to variability breeding season recruitment ('tap-dynamics') or overwinter survival ('tub-dynamics'). We find evidence for a spatially varying association of mortality with winter severity for single species, and a strong association of population fluctuations with spring return rates for the migratory avifauna sampled by radar. These findings highlight the potential of the non-breeding season to affect population numbers.

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*With friends like these: A global synthesis of disturbance-based foraging associations of birds

J. Dominguez, M. Hauber, C. Tarwater, E. Williams, S. Macdonald, H. Pollock
Presenting author: **Jonah Dominguez**

Species interactions link animal behavior to community structure and macroecological patterns of biodiversity. One common type of trophic species interaction is disturbance foraging -- the act of obtaining food at a disturbance created by another organism. Disturbance foraging is widespread across the animal kingdom, yet previous research has been largely anecdotal and we currently lack a synthetic understanding of how the behavior varies geographically, phylogenetically, or ecologically. To address these questions, we conducted a comprehensive literature review of disturbance foraging behavior in birds. We found that avian disturbance foraging was geographically widespread, occurring in both aquatic and terrestrial habitats across six continents and four oceans. The majority of terrestrial disturbances occurred in forest habitats and at tropical latitudes, while aquatic disturbance foraging occurred most frequently in temperate waters. Disturbance foraging was widespread yet highly conserved across the avian phylogeny, with 7.5% of all bird species from 47% of families and 68% of orders recorded engaging in the behavior. Suboscine landbirds of the families Thamnophilidae, Furnariidae and Tyrannidae were the most common terrestrial responders, while seabirds of the families Laridae and Procellariidae were the most common aquatic responders. Swarm-raiding ants were the primary terrestrial disturbers and cetaceans were the primary aquatic disturbers. We anticipate that our comprehensive assessment of disturbance foraging will serve to generate additional hypotheses and spark future research and

management considerations about this fascinating but poorly studied suite of behavioral interactions.

Investigating the Prevalence and Effects of Agricultural Toxins in Loggerhead Shrikes in Arkansas, USA

E. Donahue, A. Worm, B. DeGregorio, L. Neuman-Lee, T. Boves
Presenting author: **Emily Donahue**, Arkansas State University, emilyrdonahue@gmail.com

Agricultural toxins are known to cause a variety of effects, either detrimental or adaptive, in off-target species. Sublethal doses of pesticides, heavy metals, and other agricultural toxins can influence all levels of biological function, from the cellular to organismal scale. To add to the currently limited knowledge of toxin accumulation and side effects in vertebrates, we conducted a study on Loggerhead Shrikes (Lanius ludovicianus) inhabiting both an intensive agricultural region and a semi-natural region in Arkansas, USA. First, we tested for residues of neonicotinoid pesticides in blood samples of shrikes. Second, we characterize the gut microbiome community of shrikes in both study regions. Third, we conduct genotoxicity testing on additional blood samples from agricultural shrikes. Samples were collected throughout the breeding seasons of 2021 and 2022, from May through July, from both adults and nestlings. Neonicotinoids were detected in 24 out of 30 (80%) individuals, including adults and nestlings, sampled during the 2021 breeding season. Within the intensive row-crop region, imidacloprid and clothianidin were each found in 54% of samples. We then built models to assess the relationships among residue loads, body condition, DNA integrity, and/or habitat type. Microbiomes of agricultural and non-agricultural shrikes were characterized and compared to look for disruptions in microbiota communities or the presence of toxin-degrading bacteria. These findings document the widespread prevalence of agricultural toxins in a predatory songbird across age classes in both agricultural and non-agricultural areas and elucidate some of the systematic effects of agricultural toxins in vertebrate wildlife.

Avian Range Plasticity Index (RPI): Spatial modeling reveals the mechanisms of avian range shifts.

W. Dorman, M. Ward
Presenting author: **Wendy Dorman**

While many studies state that they expect birds in North America to shift their ranges north, little attention has been paid to which species will move and the mechanism by which ranges shift. Extralimital occurrences involve individuals occurring outside of their species' core breeding distribution. The probability of extralimital occurrences may be used to infer the potential of a species to expand their range, while the location of extralimital occurrences could indicate potential areas where the range may expand. Combining eBird data, spatial modeling, and pattern analysis, I investigated range plasticity via extralimital occurrences of migrants north of their breeding distributions in the Midwest. Range plasticity is the combined result of phenotypic plasticity and the impacts of natural selection and may serve as a proxy for a species' capacity to respond to environmental change. Incorporating plasticity could both overcome a major limitation of Species Distribution Modeling and allow land managers to direct conservation efforts to facilitate range shifts in the face of climate change. I will discuss progress towards constructing Range Plasticity Index for all birds in North American and the implications for modeling climate change impacts.

Tropical rainfall determines breeding range dynamics for a long-distance migratory bird.

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Predicting how range dynamics of migratory species will respond to climate change requires a mechanistic understanding of the factors that control distribution and abundance throughout the annual cycle. We use 29 years of demographic data from a wintering population of American redstarts, a neartic-neotropical migratory bird, to show that tropical precipitation mediates the influence of migration distance on survival and hence directly impacts breeding ground abundance. Prolonged drought in the Caribbean, and subsequent higher mortality for individuals from the northern portion of the species'

breeding range (i.e., longer migration distances) has resulted in an approximate 150 km southward shift in breeding distribution of this wintering population. These results demonstrate that the climatic effects on demographic processes during the tropical nonbreeding season scale to shape range dynamics in a migratory bird and emphasizes the need for full annual cycle approaches to understand how animals will respond to climate change.

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*Investigating the influence of adaptive divergence in molting behavior on reproductive isolation and speciation in birds

P. Dougherty, S. Fossberg, M. Carling
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Environmental context can mediate the outcome of hybridization between evolutionarily distinct lineages. While most studies examining the role of the environment have focused on the breeding season, conditions during other times of the year can mediate introgression by influencing hybrid survivorship. Adaptive divergence in molting behavior between parental populations is a largely unexplored yet potentially consequential mediator of hybrid annual survivorship and fitness in birds. To investigate the extent to which molting behavior divergence influences reproductive isolation between hybridizing bird populations, we captured Indigo Buntings (P. cyanea), Lazuli Buntings (P. amoena), and hybrids from wild populations and observed their molting and migratory behavior in a captive setting. We found the expected phenological differences between parental species to persist in a common environment, supporting a strong genetic basis for relative molt and migration timing. Furthermore, hybrids exhibited a variety of molt and migration phenotypes, some of which incorporated elements from both parental strategies. While it is currently impossible to test the fitness of each hybrid phenotype, we investigated overall selection against hybrids by modeling cline width over time. Contrary to our prediction, we found the Passerina hybrid zone has become wider in the past 15 years, a reversal of the previously noted trend consistent with relaxed selection against hybridization. Given previous evidence of reduced reproductive output in hybrids, we explore the possibility that shifting environmental conditions outside of the breeding season now favor previously disadvantageous hybrid molt and migration phenotypes.

Chorus, solo, and duet distribution in a population of wild African grey parrots (Psittacus erithacus)

M. Edwards, D. Hedwig
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Parrots are among the most threatened taxa on the planet, but little is known about their wild populations. This is especially true of the African grey parrot (Psittacus erithacus), whose language capabilities produced prodigies like Alex and popularized the species throughout the illegal wildlife trade. This study takes inspiration from such examples of animal communication and marks the beginning of conservation planning for the grey parrot (GP) utilizing passive acoustic data. Specifically, I focus on a population of GPs inhabiting Dzanga-Ndoki National Park in the Central African Republic. Using the BirdNET algorithm developed at the Cornell Lab of Ornithology, I identified instances of GP vocalization between 05:00 and 10:00 on February 3 - March 31, 2020. These were captured with a passive acoustic array set by the Elephant Listening Project at the K. Lisa Yang Center for Conservation Bioacoustics. I defined and labeled choruses, duets, and solos and compared their distribution across all study days and within the 05:00-10:00 timeframe. Duet occurrence is expected to increase towards the end of the study period as the breeding season approaches, and variation in vocal type distribution within each day is predicted to model GP congregation in the study site. This project aims to provide insight into the ecology GPs through the analysis of these vocalizations for use in future studies and conservation of the species.

Monitoring Clapper Rail (Rallus crepitans) chick survival and estimating nest survival using a Bayesian framework

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Tidal marsh ecosystems are severely threatened by anthropogenically accelerated climate change, sea

level rise, and marsh degradation. Avian survey data from the northeast USA indicate population declines in saltmarsh specialist species, including a ~5% annual decline in the Northern Clapper Rail (Rallus crepitans crepitans) population. Few to no regional data exist for contemporary adult, juvenile, or nest survival along the Atlantic Coast. To estimate Clapper Rail nest survival, we located 165 nests on foot or using drone thermal imaging and monitored them every 3-5 days. We modeled daily nest survival using a logistic exposure model in Stan and constructed candidate models using nest site characteristics and time varying covariates. We included models both with ordinal date and ordinal date squared to model time as either a linear effect or quadratic effect, respectively. Visual obscurity, site, and ordinal day squared were important factors in nest survival. The estimated mean daily nest survival across the season was 0.97 (SE = 0.004) but varied across the season with nests initiated in early June being the most likely to hatch. We radio-marked 82 chicks in 2020-2021 and although chick tag retention was only 3-4 days on average, 16 chicks tracked for at least two weeks had an apparent period survival rate of 81%. These results include the first Clapper Rail chick survival information and reveal the importance of timing for Clapper Rail nest success. These demographic rates will serve as an important baseline to gauge the impacts of sea level rise and marsh degradation on avian populations.

Burrowing Owl (Athene cunicularia) nest survival across a latitudinal gradient

J. Ellison, F. Abadi, C. Britt, M. Desmond

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The western Burrowing Owl (Athene cunicularia hypugaea) has declined across its North American breeding range over the last century due to the collective impacts of human activities and the decline of black-tailed prairie dogs (Cynomys ludovicianus). Across the Great Plains, Burrowing Owls are highly dependent on black-tailed prairie dogs for nest burrows, with estimates of 80% of Burrowing Owl populations occurring within prairie dog colonies. We examined the effects of study site, nest age and prairie dog colony characteristics on Burrowing Owl nest survival across a latitudinal gradient from Janos, Mexico to Lemmon, South Dakota. Study sites included one Biosphere Reserve in Chihuahua, Mexico and six USDA Forest Service National Grasslands in New Mexico, Texas, Colorado and South Dakota. We modeled nest survival for 1182 nests using a modified Cormack-Jolly-Seber model in a Bayesian framework to estimate daily survival rates (DSR) and cumulative nest survival. Cumulative nest survival based on the null model was 0.535 (95% Credible Interval = 0.505, 0.565). Based on our top-ranked model, we found that DSR increased with nest age, but this effect differed across study sites such that DSR decreased with nest age in Janos but increased at all other sites. We also found that DSR increased with success of the nearest neighboring owl nest. These results suggest that the factors affecting nest survival in Janos, Mexico, our only desert grasslands site, appear to be different than the Great Plains sites and may be related to food availability or predator vulnerability.

Pump it up: The role of calcium pumping in the migratory and cold-temperature phenotypes of songbirds

C. Elowe, M. Stager, A. Gerson

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Migratory birds undergo substantial physiological changes to prepare for long-duration endurance flight, including hyperphagia, fat deposition, a reliance on fat as a fuel source, and flight muscle hypertrophy. Similar changes may appear in birds acclimated to cold winter conditions. Sarcolipin (SLN) is a protein that binds to sarco/endoplasmic reticulum calcium-ATPase (SERCA) and in mammals this has been shown to uncouple calcium transport from ATP hydrolysis, exacerbating energetic costs and increasing heat production or signaling for mitochondrial biogenesis, fatigue resistance, and a shift to fatty acid oxidation. In songbirds, contrary to expectations, muscle sarcolipin (SLN) transcription appears to increase in migratory songbirds and decrease in response to cold temperatures. We examined the functional role of SLN in the development of the migratory phenotype by measuring SERCA activity and calcium pumping efficiency in captive Gray Catbirds in the migratory condition. Additionally, we explored the transcription network of muscle calcium signaling genes that may respond to seasonal changes across multiple species. We found minor changes in SERCA activity associated with migratory fattening and strong support for reductions in SLN transcription in the winter and in response to cold temperatures.

These results suggest that avian SLN may not function in the same way as in mammals, while raising interesting questions about its role in modulating muscle function.

Vocal variation among and within four genomically similar, highly sympatric southern capuchinos (genus Sporophila)

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For many songbirds, acoustic signals constitute prezygotic reproductive barriers that are key for the co-existence of closely related species in sympatry and are thus the target of natural and sexual selection. This is the case in the southern capuchinos, a recent radiation in the genus Sporophila comprised of ten geographically overlapping species that have remarkably low genomic divergence but for which their notorious differences in coloration and vocalizations have been shown to be critical for species recognition. In this context, we studied the acoustic signals of four species of this group and recorded their songs at five localities where they breed in different degrees of sympatry. We measured acoustic variables per note and per song, and studied inter- and intra-specific patterns of variation, with focus on the effect of sympatry with other capuchinos and geographic distance among individuals. Overall, these capuchinos are very similar acoustically but differ in particular combinations of acoustic variables that characterized each species individually. The genomically more differentiated species (S. iberaensis) is also the most acoustically differentiated. At the population level, song characteristics can be affected by the presence or absence of other capuchinos in the area and intraspecific variation is associated with geographic distance among individuals. Our analysis found acoustic differences among these four genomically similar, highly overlapping members of the capuchino radiation that could be responsible for species recognition and also sets the ground for future research about the role of selective and neutral processes in shaping intraspecific variation in the acoustic signals of the group.

Can automated radio telemetry be used to detect the timing and location of stationary periods in a local context?

B. Evans, B. Rigley, J. Stabach, J. Kolowski, A. Johnson

Presenting author: **Brian Evans**, Smithsonian Conservation Biology Institute, evansbr@si.edu

Radio tracking with handheld antennae can provide crucial details on avian habitat use and survival but requires considerable effort. As such, radio telemetry is often prohibitively expensive in technician hours and may limit the sample size of tracked birds. Moreover, information gains are constrained by the frequency and time of day in which sampling is feasible. Advances in automated radio telemetry have made it possible to address these limitations, however the efficacy of applying this technology in a local context remains underexplored. Herein, we sought to determine whether automated telemetry could be used to detect the timing and location of stationary periods (e.g., roosting/death). To address this, we installed a network of 28 UHF receivers in a 120-ha grid located within grassland habitat. In a single-blind study, technicians traveled the study area with high-accuracy GPS units and three different models of UHF radio transmitters. At randomly determined times and locations, they placed tags on the ground for periods that ranged from 30 minutes to 3 days. We used the variance in signal strength to estimate when tags were stationary and trilateration to estimate tag location. By comparing GPS and tag data, we found that we could detect the start and end of stationary periods within ï‚± 2 minutes with a spatial accuracy of ~80 m. Spatial accuracy, but not the timing of stationary periods, was highly dependent on topography and proximity to buildings and receivers. Our findings suggest that automated telemetry can yield valuable information on the timing and location of stationary periods, however receiver distance and habitat context are important considerations when designing a study that employs this technology.

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*The art of winning and losing: an analysis of spatio-temporal variations in

dominance among hummingbirds

A. Fernandes, J. Perez-Eman, A. Rico-Guevara, D. Griffon
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Many studies about hummingbird dominance relationships agree that bigger species are more dominant than smaller ones. However, the asymmetry of interactions and their dynamics over time and space is far from understood. Here we describe spatio-temporal variation in dominance relationships among hummingbird species and discuss the potential implications of our results to understand species coexistence. We recorded agonistic interactions at artificial feeders in three sites with different feeder numbers located at different elevations in the northern coastal cordillera of Venezuela during February and May. We also estimated the relative abundance of hummingbird species through manual counts. Several inferential and Bayesian statistics (linearity index, transitivity, ranking indices) were used to characterize dominance relationships and interaction networks to visualize species pairwise interactions and their asymmetry. We found dominance hierarchies changed across time and space. Species composition and abundance changed over time and common species varied their dominance rank between months and within sites. This pattern was pronounced among dominant species and intermediate dominance groups (middle of the hierarchy), but subordinate species rank did not change. Though mostly asymmetric, interactions within each of these groups showed dominance shifts. Even against subordinates, the dominant species did not win every contest. Spatiotemporal changes in abundance likely influenced the outcome of species interactions. These patterns suggest a potential mechanism promoting species coexistence.

Local and range-wide patterns of song type variation in Ovenbirds (Seiurus aurocapilla)

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Songbirds show a diverse array of song repertoires and patterns of geographic variation in song. Ovenbirds (Seiurus aurocapilla) sing a single song that consists of a repeated phrase that has been shown to vary among individuals in local populations such that multiple phrase types occur on the landscape. However, patterns of local and geographic variation in song phrases has not been investigated. We used recordings from a single breeding season (2021) to examine song type variation at a local (n=158 birds; Sault Ste. Marie, ON) and breeding range scale (n=512 birds; eBird). We visually grouped song types into categories based on the number and arrangement of notes within song phrases. We found 10 song types in our local population and song sharing among neighoburs that was higher than expected by chance. Seven of our 10 song types were found across the breeding range where we characterized an additional 24 song types. All song types were randomly distributed across the breeding range and showed no evidence of clustering or dialects. Most song types were rare and sung by few (n=27; range ~0.1-1.8% of) recordings) while 7 were common and sung by ~90% of recorded birds. Ovenbirds are thus similar to some other wood warblers that have multiple song types spread over a wide area within their range and overlapping among populations.

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*Riskiness of movement lifestyle varies inversely with adult survival probability among species

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Why do species differ in their movement lifestyles? Animals that spend more time sitting motionless and acquire food using less conspicuous movements can be more vigilant and less obvious to predators. More active animals that use food types and sites that require more conspicuous behaviors increase vulnerability to predators. Life history theory predicts that aversiveness to mortality risk evolves inversely to adult survival probability. Consequently, we postulated that long-lived species evolved inconspicuous movement lifestyles whereas shorter-lived species use more conspicuous movement lifestyles. We tested this hypothesis by quantifying the movement lifestyles of nine tropical songbird species. Use of

conspicuous movement and foraging behaviors, such as flying and hovering, was greatest in shorter-lived species and decreased with increasing adult survival probability across species. Similarly, foraging speed decreased with increasing adult survival based on a meta-analysis of 64 songbird species. Faster and conspicuous movement lifestyles of shorter-lived species likely increase food acquisition rates which fits with faster life history strategies that include more feeding trips for young and faster growth. Similarly, slow movement lifestyles of long-lived species fit with the reduced food needs of slower life history strategies. Movement lifestyles may have evolved as an integrated component of the slow-fast life history continuum.

Evaluating assortative mating and reproductive isolation in a contact zone between lineages of the House Wren

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Diversification in the presence of gene flow is far more common than traditionally believed, both in the onset of divergence and during secondary contact, a notion that has changed our understanding of speciation. The House Wren (Troglodytes aedon) is the most widely distributed passerine in the Americas, including multiple lineages that differ in mitochondrial and nuclear DNA, as well as morphology and behavior. Two deeply divergent lineages come into contact in central Argentina and previous studies have found geographically restricted gene flow between them. Nonetheless, they have remained divergent and without significant levels of introgression outside the area of contact, suggesting the presence of reproductive isolation mechanisms. Assortative mating between individuals of the same lineage would indicate the existence of pre-zygotic isolation mechanisms, whereas a high proportion of mixed-breeding couples would suggest that post-zygotic isolation mechanisms might be preventing more widespread gene flow. To address this we captured, banded and bled 76 adult wrens (38 couples) and their offspring (220 nestlings) in Uspallata, a location in Mendoza province within the area of contact. To evaluate the presence of assortative mating, we assigned each adult to its lineage by sequencing its COI gene and identified the proportion of couples which members belonged to different lineages. We also analyzed nest success, the proportion of hatched eggs, and the sex ratios of the nestlings to check for post-zygotic reproductive isolation. This is being complemented with the analysis of coloration and vocalizations as putative pre-zygotic reproductive isolation mechanisms.

Collaborative Black Tern conservation in the Great Lakes region

J. Fuller, E. Ford, S. Beilke, S. Saunders

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Populations of Black Terns have declined worldwide, and the Laurentian Great Lakes region is no exception. Where the region once provided ample wetlands for breeding, 90% of historical colonies have been abandoned since 1991. While research to understand population losses has generally increased in the last decade, expanded efforts toward collaborative monitoring and adaptive management are needed to address this urgent conservation concern. We present our collaborative and multifaceted approach to better understand breeding Black Terns' population decline, implement effective management, and expand conservation work throughout the Great Lakes region. To identify threats to productivity and colony recruitment, juvenile survival rates and migration routes, and generate an integrated population model, we employed nest monitoring, spatial analysis, trap cameras, and Motus radio telemetry. To identify key breeding areas, share monitoring results, and collaborate on management plans, we conducted a statewide assessment of colonies in Michigan, are developing an interactive data hub and convened the annual Great Lakes Black Tern Conservation Initiative working group. Our work has identified multiple stressors to Black Tern breeding success, including invasive species, extreme water level fluctuations, and predators. To address some of these threats, we have conducted habitat management and deployed nest platforms. Monitoring and management in close collaboration with volunteers, researchers, and managers are ongoing and continue to adapt as we gather new findings. Our future goals are to support increased Black Tern populations, and for this work to serve as a model

for regionally addressing species declines.

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*Are aerial insectivorous birds dependent on aquatic-emergent insects for omega-3 fatty acids?

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In recent decades, North America has seen large population declines in aerial insectivorous songbirds. Prey quality may be a contributing factor, influencing the health and growth of nestlings. For example, aquatic-emergent insects can provide more beneficial omega-3 polyunsaturated fatty acids for growth than terrestrial insects. Some birds may synthesize long-chain polyunsaturated fatty acids endogenously through the conversion of shorter-chain precursors. We combined fatty acid compositions of blood plasma with naturally occurring stable H isotope ratios (Î´2H) in their feathers to infer diet quality and dietary sources of acquired and synthesized fatty acids. In southern Ontario, purple martin (Progne subis) and tree swallow (Tachycineta bicolor) nestlings had lower feather Î´2H values compared to barn swallows (Hirundo rustica), indicating a more aquatic-emergent diet. Furthermore, lakeshore purple martins and tree swallows had higher omega-3 fatty acid levels compared to inland populations. Yet, barn swallows having higher feather Î´2H, the most terrestrial diet, still had high levels of plasma long-chain omega-3 fatty acids. Barn swallows likely synthesize long-chain omega-3 fatty acids to supplement their diet to a greater degree than the other two species. Since birds have direct and indirect health consequences if they are lacking in these key fatty acids, it is important to assess species and landscape differences in the use and dependency of aquatic-emergent insects to better understand which species are vulnerable to changes in nutritional landscapes. Such knowledge will inform management decisions to provide habitat that supports aquatic-emergent insects through key placement of man-made nesting structures.

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*Floating seagrass rafts as natural alternative roosting habitat for shorebirds

J. Garcia Walther, D. Portillo Zavala, N. Senner
Presenting author: **Julian Garcia Walther**

Sea level rise, coastal development, and human disturbance are significantly reducing the availability of roosting habitat for shorebirds, contributing to their global decline. Currently, the responses of coastal ecosystems to these pressures are not well understood, which hinders our ability to conserve or create effective alternative roosting habitat. Here, we describe for the first-time floating seagrass rafts that serve as an ephemeral roosting habitat for waterbirds during spring tides when most roosts are temporarily unavailable due to inundation. Rafts are made of drifting seagrass (Zostera marina) that accumulates in the intertidal zone during neap tides; it then floats through the marshland during spring tides and clumps together near the supratidal zone, providing critical roosting space for 25 species of waterbirds in the Guerrero Negro Lagoon-one of the most important non-breeding sites for migratory birds in Mexico. Using standardized point-count surveys in different habitats (intertidal plains, intertidal terraces, marshes and seagrass rafts) and tracking data from a red knot (Calidris canutus roselaari), we demonstrate that despite their ephemeral use (2-3 hours per spring tide) and relatively small size (0.1- 20 m2), rafts supported significantly more birds (mean density: 60 birds/m2) than all other surveyed habitats combined (0.0022-0.05 birds/m2). With sea levels continuing to rise and coastal development accelerating, rafts may provide a crucial lifeline for species that rely on the supratidal zone for roosting and could serve as a model to create artificial roosting rafts as a nature-based solution.

Interactive capacity of weather and agro-intensity to influence food provisioning rates of Tree Swallows

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Climate change and agricultural intensification has been correlated with the decline of many avian species. Both processes potentially impact nestling rearing insectivores. For example, increased frequency of extreme weather stemming from climate change may result in parents augmenting foraging regimes for thermoregulation or due to thermal constraints of insect prey. Moreover, features associated

with intensely cultivated landscapes (e.g., landscape simplification, use of agrochemical agents and filling of wetlands) may hinder an individual's ability to provide food at an optimal rate for nestling growth. We hypothesized food provisioning adults, in contrasting agro-intensive landscapes, differentially respond to changes in ambient temperature. We assessed this hypothesis using a Tree Swallow population breeding across a gradient of agro-intensity in southern Quebec, Canada, by evaluating the rate nestlings were provided food. Adults provided food at an increasing rate with temperature until reaching 25 Â°C, at which point it declined. Food delivery rate decreased with increasing agro-intensity. In accordance with our hypothesis, the influence of ambient temperature was landscape dependent. Extreme temperatures had a similarly negative impacts on food delivery rate across the study. However, under more optimal temperatures, provisioning rates were greatest within less agro-intensive landscapes. We believe multiple features of agro-intensive landscape simultaneously influence the availability of food or constrain a foragers ability to respond to temperature changes. These results provide further evidence that drivers of population decline cannot be assumed to act additively and instead may be acting multiplicatively.

Reviving the Past: Genomic Studies of Museum Specimens to Unravel the Taxonomy of Woollyneck Storks

P. Ghimire, S. Lamichhaney
Presenting author: **Prashant Ghimire**

The taxonomic designation (merge or split) decision of a species is critical as it directly affect conservation status which in turn drives conservation efforts for the species. One such example is the Woolly-necked stork, a large wading bird whose conservation status has changed three times in the last decade. Prior to 2010, all Woolly-necked storks were known as a single species, but their taxonomy is still contradicted either as a single species or as two different species in Asia and Africa classified primarily based on morphological characteristics. Incorporating genetic information into taxonomic classifications can provide a more comprehensive understanding of species relationships, however genetic studies on these species is lacking. Here, we used ~100 years old museum samples of Woollyneck and carried out a genomic study to examine phylogenetic relationships and population structures. Using whole genome sequences, we generated 13.5 million SNPs that were polymorphic among five Asian and five African Woollyneck individuals, including 2 individuals of Storm's stork as outgroup. Our phylogenetic analysis clustered Asian and African Woollynecks into two genetically distinct groups with high genome-wide average divergence (Fst = 0.26), indicating they are possibly two separate species. We also identified 152 windows of high genetic divergence (Fst > 0.8) between Asian and African Woollyneck, which are possibly the genomic islands of speciation. These genomic resources pave the way to resolve taxonomic uncertainty by providing a more accurate picture of the evolutionary relationships between Asian and African Woollynecks.

Geographic variation of Eastern Kingbird nest construction and its effect on insulative capacity

S. Gillette, M. Murphy
Presenting author: **Samantha Gillette**

We characterized morphology, material composition, and insulative capacity of nests of the open-cup nesting Eastern Kingbird (Tyrannus tyrannus) breeding in Louisiana (LA), New York (NY), and South Dakota (SD). Nests from warmer and sunnier LA were, overall smaller, but had larger nest cup openings than nests from colder NY and SD. Despite a warmer and drier climate, SD nests were heavier and had more voluminous nest cups than NY nests. Nest heat loss coefficients, measured in the laboratory using heated iButtons Â® placed in nests that were either uncovered or covered by insulating foam, were unrelated to site and all nest properties when nests were uncovered. When covered, however, nest heat loss coefficients were higher in LA than both NY and SD (which were equal). Simultaneous evaluation of the relationship between heat loss coefficient and PCA axes summarizing variation in nest morphology and composition indicated that morphology mattered but composition did not; heat loss was highest in nests whose nest cup opening was large relative to nest cup volume, and which had symmetrically shaped nest cups that were deep and voluminous (i.e. PC2morph). By contrast, separate analysis of the better insulated nests from NY and SD showed that heat loss varied with both morphology and

composition; heat loss again varied with PC2morph, but was also high in nests composed mainly of grasses and forb stems rather than plant down, coarse woody stems, and/or fine stems and rootlets. Our results indicate that nest construction influences nest insulative capacity and that geographic differences in breeding season climate contribute to differences in nest construction.

Using UAV to discover secretive marsh bird nests

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Unmanned Aerial Vehicles (UAVs) may provide efficient new methods to study wildlife. UAV technology and accessibility is improving for a variety of applications and may be particularly useful in challenging terrains such as wetlands. We used UAVs to study breeding marsh birds focusing on Clapper Rail (Rallus crepitans), a secretive species found in eastern North America. We used a UAV and a thermal imaging camera to search for tidal marsh bird nests on the coast of Delaware, USA in 2021 - 2022. We also conducted ground-based systematic nest searches and compared the number of nests detected. In accessible areas, the UAV and ground surveys had similar performance but the UAV outperformed in less accessible areas. We also detected nests of tidal marsh passerines like Seaside Sparrow (Ammospiza maritima) and Red-winged Blackbird (Agelaius phoeniceus), indicating that UAVs could be used to document species breeding in tidal marshes. Given the current conservation challenge presented by rapid increases in sea-levels, survey methods that can efficiently document and quantify breeding marsh birds can aid in prioritizing marshes for conservation, management, or restoration.

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*Winter Habitat Associations of Roosting White-throated Sparrows (Zonotrichia albicollis) in Arkansas, USA

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A comprehensive understanding of bird habitat use during the nonbreeding season is essential for the effective implementation of full annual cycle conservation efforts, yet a significant knowledge gap remains for many species. In fact, even our understanding of basic habitat requirements-like roosting-for commonly studied species outside of the breeding season is limited. Some sparrow species are known to exhibit high levels of roost site fidelity and have a moderate amount of range overlap between foraging and roosting locations. Therefore, it had been hypothesized that White-throated Sparrow (Zonotrichia albicollis) roost sites would likely resemble the thick brushy field edges where they forage during the day. However, prior to our study, roosting behavior for this species had not been observed. Furthermore, the extent to which White-throated Sparrows roosted either independently or communally remained unknown. To characterize the habitat associations of White-throated Sparrows on the wintering grounds, we fitted radio transmitters to 15 individuals in Central Arkansas and recorded both foraging and roosting locations from 19 January – 02 March 2023. In addition, we collected detailed vegetative structure data at foraging and roosting sites. Sparrows selected significantly different habitat types for foraging and roosting, and exhibited a high degree of roost site fidelity over the course of the tracking period. In addition, we observed a significant amount of individual variability in home range overlap between roosting and foraging locations. Our results suggest that non-breeding season conservation strategies based solely on diurnal observations of White-throated Sparrow foraging behavior may not be sufficient.

Disturbance-mediated hybridization leads to extensive local introgression in common backyard birds

K. Grabenstein, A. Theodosopoulos, V. Pravosudov, S. Taylor
Presenting author: **Kathryn Grabenstein**

Hybridization due to human impacts is increasing, as is our ability to detect late-generation hybrids using whole genome datasets. Generally, we lack a mechanistic understanding of why human-mediated hybridization occurs and its long-term evolutionary consequences. Tackling these questions in wild systems requires first, identifying a system with disturbance-mediated hybridization and then integrating two components: 1) a field-based understanding of pre- and post-zygotic barriers within hybridizing

populations and 2) characterizing hybridization using high resolution genomic datasets. Here, we describe the reproductive barriers and consequences of hybridization in a wild, sympatric population of two common songbirds where human disturbances appear to cause hybridization. Using three years of population monitoring data paired with 477 high-resolution whole genomes, we characterize breeding dynamics and hybridization between black-capped (Poecile atricapillus) and mountain chickadees (P. gambeli) in a geographic region where disturbance-mediated hybridization occurs. We find that despite an unexpected amount of geographic and temporal breeding overlap, few F1s are produced. Yet, surprisingly, every chickadee sampled in our local population possesses a small amount of heterospecific ancestry. What drives hybridization in this system remains less clear, but sporadic movements/dispersal of mountain chickadees into low elevation urban forests with large black-capped chickadee populations might play a role. Ultimately, this study highlights that even infrequent initial hybridization can have lasting impacts on population admixture.

Does the parrot tongue serve as a mechanoreceptor during tripedal locomotion?

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Parrots (Order Psittaciformes) use their head as a functional third limb during various locomotor modes. This complex mode of locomotion necessitates fine-tuned sensorimotor feedback to aid limb placement and modulate loading, yet it remains unknown how parrots acquire such tactile sensation during tripedal locomotion. While both the mandible and maxilla have the capability to provide such information, it is the parrot's tongue that is truly unique in its concentration of sensory mechanoreceptors. In this study we report preliminary data on the frequency and duration of maxillary, mandibular, and tongue contact during vertical climbing trials in a model parrot species (rosy-faced lovebird; Agapornis roseicollis). From 114 trials we observed that the maxilla, tongue, and mandible contact the substrate in a cyclical manner, with maxillary and tongue contact ubiquitous across all trials and mandibular contact near-universal (94%). As a proportion of a stride, the tongue remains in contact with the substrate throughout 86% of the cycle, compared to 72% for the mandible. Moreover, incidental strides in which the tongue failed to contact the substrate resulted in the animal falling or readjusting prior to committing body weight. This preliminary data offers evidence to suggest that the parrot tongue serves as a mechanoreceptor during tripedal locomotion and offers the first example of the tongue contributing to a locomotor behavior. Temporary knockout experiments to validate this hypothesis are planned for the future.

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*High individual consistency in spatiotemporal migratory behaviors of American Herring Gulls across multiple years

A. Grewal, M. Mallory, A. Horn, R. Ronconi, K. Allard, S. Craik, S. Gutowsky
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Gull species are often generalists but with populations comprised of specialists. Behavioural specialization may be less pronounced during non-breeding if gulls are no longer constrained by breeding with lower intra-specific competition; non-breeding gulls may respond more flexibly to spatiotemporal changes in resources, both within and between years. We examined population- and individual-level variation in non-breeding American Herring Gulls GPS-tracked (n=18) over 2-3 years from colonies in SW Nova Scotia using repeatability in temporal and spatial metrics describing migratory behaviour. All gulls were consistent in general strategy; 3 remained resident and 15 migrated in all tracked years. Migrant overwinter areas ranged 320-4000 km from the colony with many southbound routes, but individuals were consistent in routes (mean nearest neighbour distance = 45 km between routes of same gull, 133 km between different gulls) and were highly repeatable in distance travelled and migration duration (R=0.95-0.99). Migrants and residents were repeatable during overwinter in daily travel rate, total distance, and duration (R=0.9-0.95), and area used (migrants: mean overlap between 50% kernel density contours = 70% between same gull, 10% between different gulls, resident: 88% same, 0% different). Tracked gulls exhibited higher than expected inter-individual variability and intra-individual specialization in migratory behaviour. While individual consistency may be beneficial from increased knowledge and thus foraging efficiency, it could be disadvantageous in years with poor conditions. Understanding migratory specialization in a typically flexible species provides insight into potential fitness consequences

in a changing world.

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*Effects of weather on arrival of migrating landbirds in fall at an inland stopover site in mid-Michigan, USA

E. Griffis, J. DeSimone, J. Owen
Presenting author: **Evan Griffis**

The effects of weather conditions on nocturnal migrant landbird arrival to coastal stopover sites in North America has been well-documented, but little is known about the factors affecting arrival to inland stopover sites. Our objective was to test whether specific weather events (i.e., precipitation, north winds) correspond with arrivals of migrating landbirds at a stopover site in mid-Michigan, USA, during fall migration. Data for this study was collected at the Burke Lake Banding Station, an inland stopover site in Bath, MI, USA. Over 36,000 birds of 109 species were captured during fall migration (15 August – 15 October) over a 10-year period (2013 – 2022). Using data from closest (17 km) Automated Surface Observing System (ASOS), we calculated the mean values for 13 weather variables each night (1900-0700 UTC), including precipitation occurrence and intensity, wind speed and direction, cloud height and cover, barometric pressure, and visibility. Weather was a driving factor in landbird arrivals but not in the way observed at coastal stopover sites, with impacts of weather being more nuanced than predicted. This study is one of few to examine the effects of weather on migrant arrivals to an inland stopover site. Better understanding the atmospheric conditions which prompt migrant arrival to inland stopover sites will provide insight into weather-migration relationships and atmospheric drivers of inland stopover site use during migration.

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*Plumage characteristics of the Long-eared Owl (Asio otus) in the visible and ultraviolet Spectrums of light

E. Griffith, N. Mackentley, C. Neri, A. Lindsay
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Recent research on the abilities of birds to see in the ultraviolet (UV) spectrum has led us to study the UV-reactive characteristics of bird plumage and ask questions about their biological significance. Long-eared Owls (Asio otus) possess a strong capability to see UV light, and deposit UV-sensitive pigments (porphyrins) in their plumage which fluoresce bright red when exposed to concentrated UV light. Further, they are one of the few owl species to exhibit visibly detectable plumage dichromatism. We investigated both the visible and UV-reactive properties of plumage color of the Long-eared Owl in relation to sex, age, and size. By studying owls banded at Whitefish Point Bird Observatory (Paradise, MI) from 2016-2022 (n = 1,967), we found that Long-eared Owls have a continuum of plumage coloration (which can be classified into 'light', 'intermediate' and 'dark' phenotypes) in which pigment concentration is positively correlated with size. Using molecular sexing techniques on a subset of these birds (n = 115), we reinforced previous findings that Long-eared Owls with 'light' and 'dark' plumage can be reliably classified in the field as male and female, respectively, and found that most Long-eared Owls with 'intermediate' plumage are small females, with some being large males. Then, with secondary coverts collected during from birds during banding in 2020 (n = 99), we used a fluorometer to measure the amount of fluorescent pigment in each feather and found age and sex to be the strongest predictors of fluorescent pigment concentration. Together, these results contribute to a larger conversation about subtle sexual dimorphism, fluorescent pigmentation, and developing practical methods to classify birds in the field.

Provisioning Rates, Nestling Growth Rates and Pre-Fledge Body Condition in Boreal Chickadees

K. Snow, S. Kolbe, A. Grinde, M. Windmuller-Campione
Presenting author: **Alexis Grinde**

The Boreal Chickadee is a boreal-obligate species of Paridae that live in the boreal coniferous forests of North America. While mainly found in Alaska and Canada, the most southern part of their range extends into the forested peatlands of northern Minnesota, where they are strongly associated with mature, black spruce dominated peatlands. There is limited knowledge on the specific habitat preferences of Boreal

Chickadees or how they respond to habitat loss or fragmentation. To investigate the effects of fragmentation on Boreal Chickadee breeding success and, in attempt to characterize high quality breeding habitat for the species, we compared arthropod (food) availability, provisioning rates, nestling growth rates and pre-fledge body condition in study sites which varied in their degree of fragmentation and forest composition. Results showed nestling growth rates were positively associated with percentage of black spruce forest cover type on the landscape. Pre-fledge body condition was positively influenced by higher arthropod diversity in our study sites and that higher diversity was associated with black spruce cover type within sites. These results suggest that breeding Boreal Chickadees benefit from larger, contiguous stands of black spruce forest. This information will help identify high quality habitats and inform species conservation plans and forest management decisions.

Marine biofilm-derived polyunsaturated fatty acids reduce endurance flight energy expenditure of a migratory shorebird

M. Dick, S. Lupi, K. Young, S. Walters, K. Hobson, C. Guglielmo

Presenting author: **Christopher Guglielmo**, University of Western Ontario, cguglie2@uwo.ca

The natural doping hypothesis proposes that diets rich in n-3 long chain polyunsaturated fatty acids (LCPUFA), such as found in marine biofilm diatoms and invertebrates, can prime the flight muscles of birds for endurance flight. The n-3 LCPUFA may act by enhancing membrane fluidity, promoting rapid fatty acid transport, and/or activating cellular signaling pathways to increase aerobic and fatty acid oxidation capacity. We captured migrating Western Sandpipers (Calidris mauri), fed them diets that were high or low in n-3 LCPUFA, and flew them for up to 8 hours in a wind tunnel under controlled conditions. Storage and membrane lipids of multiple tissues and mitochondria were enriched or depleted in n-3 LCPUFA in accordance with diet, maintaining a fatty acid profile similar to wild sandpipers in the high n-3 LCPUFA birds. Diet did not affect flight duration, or cellular markers of lipid metabolism and aerobic capacity in the flight muscles. The high n-3 LCPUFA diet significantly reduced in-flight mass loss, fat loss, energy expenditure, flight power, and cost of transport. Overall, flight energy efficiency increased by 12% in the high n-3 LCPUFA sandpipers. Our related experiments indicate insufficient ability of sandpipers to produce n-3 LCPUFA from dietary precursors, suggesting a dependence on dietary sources. The results demonstrate for the first time an energetic benefit of n-3 LCPUFA to endurance flight performance. The physiological mechanisms remains unclear, and we are investigating changes to mitochondrial function and in-flight metabolic suppression. These findings support a critical role for dietary sources of n-3 LCPUFA, such as biofilm, during migration in shorebirds.

Breeding season selection of anthropogenic resources varies across pre-breeding movement modes in the white ibis.

C. Gulick, K. Zhang, A. Powell

Presenting author: **Chris Gulick**, University of Florida, cgulick@ufl.edu

Humans have extensively altered landscape across the southeastern United States, which has impacted waterbird habitat. Anthropogenic changes in resource predictability can influence birds' foraging habitat and philopatry to breeding sites, thereby influencing population structure. To understand waterbird movement and connectivity in the context of landscape change, we tracked movements of twenty-three white ibises (Eudocimus albus) in the southeastern U.S. across successive breeding seasons using Argos telemetry. White ibises facultatively forage in modified landscapes and may alter their movements to capitalize on resources in these areas. We predicted that ibises which dispersed from their prior breeding range would be less likely to select anthropogenic resources, compared to those that returned to their previous breeding range. To test this, we estimated cover of human-altered landscape features (pastures, croplands, and developed areas containing human infrastructure) across the breeding home ranges of ibises from 2020 to 2022. We used logistic regression to estimate the probability that an individual would select anthropogenic resources during the breeding season. Dispersing white ibises selected against anthropogenic resources, while residents and migrants did not show a strong preference for or against modified landscapes. Preliminary results indicate that modified landscapes influence resource selection of white ibises, and that this effect is modulated by movements prior to the breeding season. This suggests that human-caused landscape change is correlated with wading bird movement

and habitat in the northern Gulf of Mexico. This project is awaiting an additional year of data before final analysis.

DNA-based techniques to assess avian diets: improving inference through validations studies

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DNA-based approaches are increasingly being used to study avian diets with equal or greater resolution than traditional methods and have the power to identify dietary components that may be otherwise undetectable. Our understanding of the quantitative potential of these techniques, however, is limited because of biological factors (e.g., gut transit time or digestion of complex diets) and technical factors (e.g., amplification bias or contamination) that complicate interpretation of results. To improve inferences about birds' diets from DNA-based fecal analyses, we used a captive model (Gallus domesticus) to (i) quantify the period during which DNA from arthropod prey can be detected in feces and (ii) evaluate the extent to which estimated dietary proportions based on DNA recovery reflect true proportion consumed. Based on qPCR assays, the period during which target DNA was detected in at least 50% of chicken fecal samples (i.e., detection window) varied between two arthropod species, as did peak detection rates and the influence of amount of prey consumed. Importantly, our models indicated strong support for meaningful relationships between true and estimated consumption for both prey items. Taken together, our results show that qPCR data based on fecal analyses can be qualitatively and quantitatively informative for assessing avian diets, although with key differences related to prey species, such that quantification data should be limited to relative or comparative analyses.

Leveraging citizen science data to fill knowledge gaps for sea ducks

S. Gutowsky, M. Mallory, G. Robertson, N. McLellan, S. Gilliland
Presenting author: **Sarah Gutowsky**

As higher-trophic level predators, sea ducks wintering in the Northwest Atlantic play an integral role in the coastal marine ecosystem, yet have been poorly monitored in both spatial and temporal scope relative to other North American waterfowl. Our objective was to combine data from infrequent winter aerial surveys with data from the Christmas Bird Count (CBC; a winter census conducted by volunteer citizen scientists) to address key knowledge gaps about trends and distribution for two species, the harlequin duck and the American common eider. For the eastern population of harlequin duck in Canada (a species of special concern), we found that distributions have expanded beyond historically surveyed regions, and that the increasing North American population has likely recovered according to previously-set management plan targets. For American common eider in Canada and the US (an Eastern Habitat Joint Venture priority waterfowl species for conservation action), we found consistent and widespread declines in local abundance throughout the entire Gulf of Maine and surrounding ecosystems, while abundance in the northern and southern extent of the overwinter range remained stable or increased, suggesting a large-scale redistribution away from the centre of the range but not an overall decline in the population. For both harlequins and eiders, the CBC was vital in the confirmation of suspected spatial patterns in trends and in the estimation of current population status. Our findings support the need for inter-jurisdictional coordination on management and habitat conservation efforts for both species, and highlight the general utility of citizen data for filling knowledge gaps for sea ducks.

Waves of Colonization and Hybridization in a Classic Archipelago Superspecies

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Secondary contact between once allopatric lineages offers a test of reproductive isolating mechanisms that may have accrued in allopatry. Such instances of contact can produce stable hybrid zones where reproductive isolation is enhanced via reinforcement or phenotypic displacement, or the once isolated lineages may fuse. Ongoing secondary contact is most visible in continental systems, where lineages may experience cyclical instances of secondary contact over time. In oceanic island systems, however,

secondary contact between closely related species of birds is relatively rare. When observed on sufficiently small islands relative to population size, secondary contact likely represents a recent phenomenon where species boundaries are newly tested. Here we examine the phylogeographic history of a geographic radiation of whistlers in Fiji that was influential for Ernst Mayr's contributions to the Modern Synthesis. He hypothesized the confluence of an 'old' and 'young' lineage coming into contact for the first time. We revisit this system with a genomic dataset (RADseq) to analyze population structure, phylogeny, and gene flow in the Pachycephala vitiensis species complex. We demonstrate two instances of secondary contact, one resulting in a hybrid zone on a larger island, and one resulting in a hybrid population on a smaller island. For the former, we found one genomic region associated with observed plumage divergence. Our hypothesized history emphasizes an initial wave of colonization followed by local pulses of gene flow. We support that the observed differences in phenotypes were due to rapid plumage evolution as opposed to hybridization between Mayr's hypothesized 'old' and 'young' lineages.

Widespread Northern Cardinal song elements may facilitate post-dispersal communication in new dialect areas

S. Halkin

Presenting author: **Sylvia Halkin**, Central Connecticut State University, Halkin@ccsu.edu

Song dialects have been documented mainly among species in which individuals have a single song type. Among species with larger individual repertoires, however, some songs may be widespread, and others more local, as is the case for Northern Cardinals. Cardinal males and females living in the same area share a repertoire of songs used apparently interchangeably in both territorial contests and intrapair communication. An important aspect of communication is song matching, which increases as behavioral interactions between individuals intensify, and which may serve to specifically direct songs to the matched individual. Widespread songs may facilitate song matching communication by individuals that disperse into new dialect areas. To better understand the genesis and maintenance of widespread song elements, I compared song element repertoires used from 1981-1986 and in 2021 at a Madison, Wisconsin study site. Ten song elements remained similar enough in structure, and in the ways they were combined to compose songs, to be considered shared between the two time periods; another 9 song elements were unique to the 1980s, and 20 were unique to 2021. To assess song variation across space, in 2021 I recorded songs at sites 50 miles N, S, E and W of the Madison site. Song elements shared between these distant sites in 2021 were also shared with the central Madison site, where most had been used in both the 1980s and 2021. Such widespread and relatively stable song elements may thus facilitate effective song matching communication after dispersal, contributing to Northern Cardinals' 100+ years of north- and westward breeding range expansion.

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*Flight altitudes of arriving spring migrants in the Gulf of Mexico region.

V. Halterman, A. Dokter, A. Farnsworth, B. Van Doren

Presenting author: **Virginia Halterman**

Billions of migrating birds cross the Gulf of Mexico each spring and fall. While recent technological advances have quantified avian passage through this corridor, many characterizations have focused on nocturnal migration. In spring, many migrants arrive along the northern Gulf Coast during the day, making diurnal analyses crucial for understanding their flight patterns. We characterized the flight behavior of migrants arriving during daylight hours, after (presumed) nonstop flights across the Gulf. Specifically, we assessed the flight altitudes of arriving migrants using six Doppler weather surveillance radars (WSR-88D) over a 15-year period. Our study investigated diel and seasonal variation in flight altitudes and their relationships to prevailing wind patterns and geographic location. We found striking relationships with prevailing winds: southerly winds consistently corresponded to increases in flight altitude, indicating that migrants flew at higher altitudes when tailwinds were present. Additional effects varied with geography: birds migrating over the eastern Gulf flew higher in westerly winds, but birds in the western Gulf showed the opposite pattern. Migrants differed in whether they flew higher over land or water between locations. Our results are the first large spatial and temporal scale analyses of diurnal migration in this critically important migration corridor, indicating that geographic location, timing, and weather conditions influence flight behavior. Given the current growth in both onshore and offshore infrastructure,

it is important to gain a better understanding of spatiotemporal variation and atmospheric drivers of airspace usage in this region.

Wild gray catbirds lack color constancy

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Reliable color discrimination is crucial for decision-making in wild animals. However, the color of light can vary dramatically between habitats, which could impact how colorful stimuli appear. It has long been assumed that animals compensate for these differences in light condition through a process called color constancy, and thus animals should be able to perform color discrimination tasks consistently even in habitats with very different light conditions. Unfortunately, color constancy in wild birds has not been tested, and thus the reliability of colorful cues is unknown. Here, we tested whether natural light conditions impact the color discrimination ability of the gray catbird (Dumetella carolinensis), which like other hosts of avian brood parasites, depends on color discrimination to detect its parasite's eggs. To do so, we experimentally parasitized gray catbird nests with model eggs, recorded whether the host accepted or rejected these model eggs, and measured the color of host and model eggs as well as the color of light at each nest. Gray catbirds did not compensate for differences in nest light conditions when making egg rejection decisions. Instead, the egg rejection was more likely when model eggs were viewed under greener nest lighting conditions. Thus, grey catbird rejection behavior suggests that they lack color constancy because their responses were directly related to the color of light. These findings suggest that nest light conditions may play a vital, and as of yet underappreciated, role in coevolutionary dynamics between hosts and parasites. More generally, our results provide experimental evidence that long-held assumptions about color vision may not apply under natural conditions.

Drivers of winter bird feeder use in American Tree Sparrows

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Daily foraging patterns in birds balance the competing risks of starvation and predation. Insufficient feeding can lead to starvation, whereas excessive feeding can reduce flight performance and increase predation risk. Supplemental feeding sites (e.g., bird feeders) provide a novel means of studying the foraging behaviour of birds. To evaluate the drivers of winter foraging of American Tree Sparrows (Spizelloides arborea), we tracked the movements of 77 birds carrying uniquely coded nanotags using the Motus Wildlife Tracking System. We placed omni-directional antennas beside bird feeders at two different sites in southern Ontario, and monitored tagged birds over the winters of 2019 and 2020. Based on 193 033 observations, we found individuals made longer visits to feeders just after sunrise and before sunset. In contrast, birds made frequent, short duration visits to feeders in the middle of the day. Increased wind speed and precipitation increased the length of feeder visits; higher snow depth increased the frequency of feeder visits. Conspecific density also influenced feeding behaviour, whereby more individuals present at a feeder resulted in longer visits. Similarly, as conspecific density increased, the frequency of feeder visits also increased, although at very high densities the frequency of visits eventually declined. Our results provide unique insights into the biotic and abiotic factors driving feeding behaviour and further supports starvation avoidance during winter.

Anatomical and ecological adaptation in Hawaiian large-bodied flightless waterfowl in an ontogenetic context

M. Hanson, H. James
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Prior to human arrival, Hawaii was home to several lineages of waterfowl independently adapted to a flightless, fully terrestrial lifestyle; the moa-nalo of Kauai, Oahu, and the islands of Maui-Nui descended from dabbling ducks, a flightless goose on the Island of Hawaii, descended from geese of the genus Branta, and possibly the mysterious Kauai 'mole-duck' (Talpanas). The moa-nalo and flightless geese

convergently became the largest herbivores on their respective islands. Compared with close continental relatives, these waterfowl have a heavily-built, graviportal body structure, many skeletal modifications in the hindlimb, pelvis, and vertebrae to support their mass, and highly reduced wings. Their bills are modified to be large, robust, and in some cases serrated to process tough plant matter. Fecal analyses provide evidence that, at least in the case of the moa-nalo, they processed this diet via hindgut fermentation. Such changes would have required many shifts in growth rates and timing in different regions of the body; furthermore, their dependency on hindgut fermentation would have required modification and rapid development of digestive organs to accommodate quick acquisition of the necessary gut microbiome. Here we present a growth series of hatchling to adult moa-nalo (Ptaiochen pau) skeletons found in Maui lava tubes revealing morphological changes distinctive to moa-nalo when compared with typical ducks during post-hatching ontogeny. We compare these with a growth series of flightless Hawaiian goose (Branta rhuax) which convergently occupied a similar ecological niche. Finally, we address the post-hatching growth of moa-nalo and flightless geese and rapid acquisition of hindgut fermentation in early life.

Adaptive patterns of flight initiation distance in a globally introduced bird species

M. Hauber, T. Grim, R. Dor
Presenting author: **Mark Hauber**

Introduced species represent quasi-experimental, anthropogenic case studies of both ecological and evolutionary principles. When these species are firmly established, native-introduced species interactions, including foraging, spacing, and breeding competition, become often cited costs of species invasions, whereas genetic or plasticity-driven changes in behavior and morphology can also be detected with increasing time since the onset of introduction in several species. Here we tested a priori predictors of predator-avoidance behaviors through the flight initiation distance (FID) assay of a globally invasive bird species, the common myna Acridotheres tristis, both within its native and across several of its independently introduced ranges across all hemispheres. Proximately, FID increased with greater starting distance, in the presence of fewer people, with flighted over walking escape responses, and at lower heights of a bird's perch above ground. In turn, functionally, FID decreased in more rural habitats, at higher latitudes from the Equator, and with more recent introductions. Respectively, these factors are informative regarding the sensory bases and imply an adaptive pattern of FID variability in a globally introduced species.

Thermal constraints impact reproductive investment in a breeding aerial insectivore

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In birds, flight results in the production of metabolic heat. With an increase in activity, there is presumably an increase in body temperature, which may limit the capacity for parental provisioning of nestlings. As a result, the capacity to dissipate metabolically-generated heat may modulate reproductive investment. Previously, we experimentally showed that the provisioning capacity of female tree swallows (Tachycineta bicolor) was limited by the risk of overheating. Given that male tree swallows have no brood patch from which they can dissipate heat, we predict that the risk of overheating during parental care may be more pronounced in males than in females. In 2021, we experimentally trimmed ventral feathers on male tree swallows to create a 'thermal window'. Using thermally-sensitive passive integrated transponders, we monitored feeding rate and core body temperature for adults as well as nestling growth rates. Similar to our previous work on females, we found that trimmed males increased provisioning at high environmental temperatures and decreased provisioning at low temperatures, but maintained similar core body temperatures as controls. This suggests that individuals modulate their activity to avoid increases in core body temperature. Preliminary analysis suggests that females paired with trimmed males increase their own activity to match that of their male partners; whether there are costs to females for increasing activity is unknown. Collectively, our results suggest that thermal limitations may functionally limit reproductive effort in a breeding aerial insectivore, the consequences of which remain largely underappreciated considering current climatic trends.

*Widespread heterogeneity in raptor communities suggests multifaceted drivers of assembly that vary over space and time.

S. Hejmadi, F. Barker
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Species' evolutionary histories shape their present-day communities. The assembly of communities ranges from in-situ diversification to prior diversification followed by dispersal. However, far from the simple indices of assembly mechanisms proposed by early models, myriad ecological and historical effects may shape community patterns over broad spatial and temporal scales. We investigated community assembly in diurnal raptors, expecting to find widespread heterogeneity in both phylogenetic and functional patterns, congruent with expectations from biogeographic history and habitat (biome). We used a new supermatrix phylogeny of raptors, and a large trait dataset to quantify the global phylogenetic and functional trait patterns using evolutionarily informed null models. We correlated phylogenetic and functional community variables with biome data to quantify the consistency of community patterns across current habitats; and inferred a new historical biogeography to examine how historical colonization and diversification have impacted community patterns. Our analyses reveal different biogeographic origins for Accipitriformes and Falconiformes, extensive geographic variation in community patterns, and clear differences between phylogenetic and functional patterns. We found that raptor community patterns bore the imprint of both immediate ecological influences (such as habitat) as well as evolutionary legacy effects (such as historical dispersal, diversification, and paleogeographic history) that vary over both geography and time. By integrating across scientific disciplines, we show the power that evolution and ecology have to elucidate community assembly at a global scale.

Population genomics of O‘ahu ‘amakihi before and after the introduction of avian malaria

A. Henschen, A. Kearns, M. Ochirbat, L. Cassin-Sackett, M. Medeiros, J. Neddermeyer, J. Foster, E. Paxton, M. Campana, R. Fleischer
Presenting author: **Amberleigh Henschen**

Like many island species, the avifauna of the Hawaiian Islands face severe population declines and extinctions. These declines are largely driven by anthropogenic factors, including the introduction of mosquito-vectored avian malaria (Plasmodium relictum) sometime before the 1930's. However, some bird species endemic to the Hawaiian islands have partially recovered, such as the O'ahu 'amakihi (Chlorodrepanis flava). In this study, we examined changes in the genetic structure of populations of the O'ahu 'amakihi before and after a bottleneck event, caused in part by the arrival of avian malaria. To do this, we compared DNA sequences from populations of O'ahu 'amakihi collected before (museum specimens) and well after the arrival of avian malaria. In addition, we collected samples at both time points from across the geographical range of O'ahu 'amakihi (e.g., highland and lowland populations). Using a previously developed SNP dataset, we determined changes in allele frequencies, geographical structuring, and effective population sizes before and after the bottleneck. In addition, we examine whether SNPs that differ in allele frequencies are associated with adaption to avian malaria. This study builds on previous work to understand how threatened populations change, and ultimately recover, after declines due to challenges such as disease or habitat destruction.

Photo survey reveals differential juvenile vulnerability to harvest in sea duck populations

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Sea duck (tribe mergini) populations in the Atlantic Flyway have experienced significant declines in recent years, though underlying causes are poorly understood. Information on population demographic parameters may provide insight for wildlife managers seeking to maintain sustainable harvest. However, population monitoring capacity for sea ducks is limited relative to other migratory bird species due to their

remote breeding distribution. The U.S. Fish and Wildlife Service organizes a Parts Collection Survey (PCS) which estimates recruitment in sea duck populations using juvenile proportions (juveniles per adult), though estimates are biased due to differential harvest vulnerability between age cohorts. We used a direct-count photo survey to calculate improved estimates of annual recruitment for long-tailed duck, black scoter, surf scoter, and white-winged scoter (hereafter sea ducks) populations in the Atlantic Flyway. We collected photos of flighted sea ducks from shore and by boat in 11 states from October 15-December 15 annually in 2019-2022. We classified photographed birds according to age and sex, and calculated juvenile proportions of each species using a Bayesian binomial model. To compare photo survey estimates with existing PCS estimates, we used a paired t-test organized by year. We found that photo survey estimates of juvenile proportions were significantly greater than PCS estimates for three sea duck species, indicating a consistent positive bias in PCS likely associated with harvest vulnerability. The differential vulnerability bias indicated by the difference between estimates could be used to correct past and future PCS estimates to represent annual recruitment more accurately in sea duck populations

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Carotenoid-based color displays are inherently honest signals

G. Hill, R. Weaver, M. Powers

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Even as numerous studies have documented that the red and yellow coloration resulting from the deposition of carotenoids serves as an honest signal of condition, the evolution of condition dependency is contentious. The genic capture hypothesis proposes that carotenoid coloration is an honest signal because there exist tradeoffs in use of carotenoids for body maintenance versus ornamental display. By this model, sexual selection on carotenoid coloration leads to increased resource investment and to the capture of genetic and phenotypic variation in condition. In contrast, the index hypothesis proposes that selection focuses mate choice on carotenoid coloration because expression of such coloration is tied to vital cellular processes and therefore is inherently condition dependent. These hypotheses for the origins of condition dependency of carotenoid coloration make strongly contrasting and testable predictions. We summarize evidence that, in songbirds, there are no tradeoffs in use of carotenoids for body maintenance vs sexual display. Furthermore, we document that traits can be condition dependent without the influence of sexual selection and that novel traits can show condition-dependent expression as soon as they appear in a population, without the possibility of sexual selection. These observations make a strong case that carotenoid coloration is inherently condition dependent.

Shorebird conservation through capacity building at the Flyway scale: the Coastal Solutions model.

O. Hinojosa-Huerta, V. Ruiz-Gutierrez, D. Ochoa

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The Coastal Solutions Fellows Program at the Cornell Lab of Ornithology was developed in 2017, with the goal of improving resiliency along the Pacific Flyway of Latin America to help recover shorebird populations and support a sustainable and regenerative development in the region. The program is based on 1) capacity building to cultivate a collaborative network of emerging conservation leaders, and 2) the implementation of effective conservation projects with measurable impacts. In 2023 we launched our fifth cohort, with which there are now 30 fellows working in 37 sites in nine countries. The fellows have created a network of over 120 mentors and collaborators and 150 partner organizations that are participating in shorebird conservation through science, engineering, public policies, landscape design, engagement of the private sector, and community participation. Some of the common elements for success in these initiatives include the cultivation of leadership, planning, governance, conflict resolution and communication skills, as well as the implementation of science-based innovative projects with cross-sectoral collaborations, ranging from the real estate sector and shrimp producers to indigenous communities and social justice groups. The program has catalyzed outcomes that includes the creation of new natural protected areas and the establishment of conservation easements, as well as the development of federal laws for the protection of urban wetlands and the creation of local ordinances to reduce human disturbance, with an estimated conservation impact on 180,000 hectares and benefits to at least 28 shorebird species, including Snowy Plovers, American Oystercatchers, Red Knots, Hudsonian

Godwits and Whimbrels.

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*Factors influencing altitudinal migratory decisions in a tropical lek-breeding frugivore

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Facultative partial migrants offer opportunities to test alternative hypotheses explaining individual-level variation in migratory behavior. White-ruffed manakins (Corapipo altera) are tropical birds that make facultative downhill migrations during the rainy non-breeding season. Previous work has demonstrated that in males, those movements mediate reproductive costs and survival benefits. However, the causes of individual variation in male migratory tendency are poorly understood. We hypothesized that either (a) highly migratory males might be those suffering physiological costs of intense display, (b) the highest quality males may be capable of withstanding non-breeding climatic conditions, or (c) males value the costs and benefits of migrating differently depending on their age and number of potential future reproductive opportunities. Using behavioral and claw isotope data from 2008 – 2013, we compared breeding display rates to isotopic proxies of migratoriness of both known-age and minimum-aged males (n=52) from a population in Costa Rica. Display rates did not positively nor negatively correlate with migratoriness, contrary to predictions of the quality and condition hypotheses, respectively. Additionally, C. altera males were more likely to migrate with increasing age in contrast to patterns predicted by the residual reproductive value hypothesis. These results suggest a role for senescence in shaping migratory tendencies over the lives of individual males.

An automated weighing system reveals interbrood differences in timing of mass loss in breeding female European starlings

B. Hodinka, T. Williams
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Patterns of mass loss in breeding birds have historically been interpreted as a proximate response to the peak energetic demands of nestlings during chick-rearing ('reproductive stress' hypothesis). However, it has also been recognized that it could represent a strategy for ameliorating costs of increased activity ('adaptive mass loss' hypothesis). While many predictions of these hypotheses remain difficult to disentangle (e.g., heavier birds lose more mass), we should expect key differences in timing of mass loss. Yet studies to date have largely relied on overall rates of mass change in a single breeding bout, thus ignoring (1) the critical workload transition (i.e., at hatch) where a 'well-timed' loss of mass preceding peak energetic demands may ameliorate workload costs and (2) how mass loss strategies may differ across breeding attempts as local prey availability declines later in the season for many avian species. Using an automated weighing system to weigh female European starlings (Sturnus vulgaris) from the start of incubation through day five chick-rearing, we aimed to uncover temporal mass loss signatures across first and second broods and determine if a 'well-timed' loss of mass confers greater reproductive success. Preliminary results suggest adoption of a mass loss strategy during first broods with a stepwise pattern of mass loss occurring rapidly around hatch (in 1–2 days) relative to the incubation and chick-rearing stages. Conversely, mass loss during second broods showed a linear negative relationship from the beginning of incubation. Future analysis will explore the relationship between timing of mass loss and reproductive success.

Avian Biodiversity on Florida Rangelands: Using AI to Determine the Impact of Cattle and Land Management Strategies

Z. Holmes, H. Ellington
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The avian community indicative of grassland habitat has seen the highest decline in recent decades across North America. In south-central Florida, rangelands can serve as a suitable alternative habitat for over 75 avian species that relied on historic grassland systems at some point in their life history, including six state or federally listed species. The objectives of our study were to determine how avian biodiversity

varied across pasture types and under different cattle grazing and land management techniques. We expected that avian biodiversity would increase as vegetation structure heterogeneity and vegetation composition increases. Furthermore, any cattle or land management techniques that lead to increases in the heterogeneity of vegetation structure or composition would have similar effects on the avian community composition. We conducted our study at the Deluca Preserve, Osceola County, Florida and at the Range Cattle REC, Hardee County, Florida. To estimate avian species richness, we deployed automated recording units (ARU; Wildlife Acoustic Micro, n = 70) in twenty pastures, we recorded sound continuously for one hour during dawn and dusk chorus and sampled 15 minutes of every hour in between. All avian species were identified using a deep neural network, BirdNET (Kahl et al. 2021 Ecol. Inform. 61:101236). We tested BirdNET performance under a variety of situations (location, time of day, season) and settings (sensitivity and overlap) using approximately 200 hours of manually annotated recordings from our study areas. Our study allows us to provide cattle and habitat management recommendations for a declining suite of grassland avifauna in Florida.

Conservation Actions to Benefit Burrowing Owls in the Canadian Prairies

G. Holroyd, H. Trefry, S. Liccioli

Presenting author: **Geoff Holroyd**, Beaverhill Bird Observatory, geoffholroyd@gmail.com

In Canada, the Burrowing Owl is an endangered under the Species at Risk Act. The number of breeding pairs declined 90% during the 1990's despite voluntary protection of over 37,000 hectares of the species habitat on private grasslands. Low recruitment exacerbates the Burrowing Owl's decline in response to habitat loss; typically only 3-4 young fledge from the average clutch size of 9 eggs. Food supplementation experiments indicated that the wild food supply was inadequate for this species to reach its reproductive potential in some years. Migration and dispersal are important ecological processes and understanding them is a requirement for species conservation efforts. Studies of movements of Burrowing Owls using banding, VHF telemetry, stable isotopes, geolocators, and satellite transmitters demonstrate that annual dispersal is a second factor driving the owl's decline in Canada. Supplemental feeding at nests in Grassland National Park has helped increased the recruitment of fledglings in a cost-effective way. This talk summarizes 30 years of research into the population dynamics, breeding biology, migration and dispersal of this species in Canada, Texas and Mexico and suggest considering supplemental feeding of nests to be incorporated in recovery action plans and further research at the larger landscape scale, alongside with protection of critical habitat. Greater international cooperation and direct conservation actions on the ground are needed to achieve recovery of this species across the northern Great Plains.

Reshaping avian migration in the Anthropocene -- continental scale attraction to artificial light at night revealed

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Presenting author: **Kyle Horton**

As billions of nocturnal avian migrants traverse North America, twice a year they must contend with ever-changing landscapes driven by natural and anthropogenic forces, including the rapid growth of artificial glow of the night sky. While airspaces facilitate migrant passage, terrestrial landscapes serve as essential areas to restore energy reserves and often act as refugia - making it critical to holistically identify stopover locations and understand drivers of use. Leveraging over 10 million remote sensing observations, we developed seasonal contiguous US layers of bird migrant stopover density. Across the US, in over 70% of our models we identify skyglow as a highly influential and consistently positive predictor of bird migration stopover density. This finding points to an expanding threat to avian migrants: peri-urban illuminated areas may act as ecological traps at macroscales, bringing migrants into dangerous, modified habitats.

Experimental cold exposure in adulthood increases the glucocorticoid sensitivity to future stressors

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C. Taff
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As the global climate shifts, many species are negatively impacted by changing thermal regimes. Despite rising global temperatures, some populations must contend with more frequent or extreme cold. In these populations, the ability to cope with cold may be an important determinant of fitness; however, the mechanisms underlying these phenotypic shifts are not well understood. Recent research from our lab found that cold temperatures cause shifts in two potential mediators of thermally-induced plasticity including the hormonal stress response and gut microbiome in wild tree swallow nestlings (Tachycienta bicolor). In this study we aimed to determine how cold temperatures impact adult tree swallow phenotype including stress responsiveness and gut microbial composition. We predicted that cold-exposed adults would have increased stress- induced plasma corticosterone levels and different microbial composition relative to controls. We experimentally lowered internal nest box temperature by 5C from day 4 to day 6 of nestling provisioning and then simulated an acute cold snap on day 12. Experimental cold exposure impacted the hormonal stress response by upregulating the sensitivity to future challenges (increased stress-induced levels). Experimental cold exposure also increased the initial speed and duration of the acute hormonal stress response but did not impact gut microbial diversity. Together these results suggest that thermally-induced increases in glucocorticoid sensitivity to future challenges may prime individuals to respond more strongly or rapidly to worsening conditions.

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*The physiology of torpor in ruby-throated hummingbirds

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Ruby-throated hummingbirds (Archilochus colubris) are small-bodied (2.5-5 g) with a surface-area-to-volume ratio; maintaining a body temperature (Tb) of ~40â„ƒ is energetically costly. To survive cold nights, hummingbirds use torpor, a state of inactivity characterized by low Tb and metabolic rate (MR) that can be spontaneously reversed using endogenously produced heat. In mammalian models, mitochondria have been implicated as a major site of metabolic suppression (Roberts and Chaffee, 1973; reviewed in Staples, 2014). In mitochondria isolated from torpid mice and Siberian hamsters, phosphorylating respiration is suppressed by as much as 30% compared to normothermic, active animals (Brown et al., 2007). My objective was to determine how cellular and mitochondrial physiology change to facilitate metabolic suppression in hummingbirds experiencing daily torpor. I used flow-through respirometry to measure the rate of O2 consumed and CO2 produced by birds when ambient temperature is lowered to 10â„ƒ. MR dropped by ~90%, Tb dropped to ~10â„ƒ and the RQ was ~0.7 indicating fatty acid metabolism. Next. I used high-resolution respirometry to measure respiration in isolated pectoralis (flight muscle) mitochondria. Oxidative phosphorylation was suppressed in torpid birds (by ~30%) when the mitochondria were fueled with a carbohydrate-based substrate, but not with a fatty acid. I also measured the activity of relevant rate-limiting enzymes to determine if metabolic pathways are differentially prioritized to support the extreme metabolic shift that occurs during torpor (ongoing data analysis). These findings highlight interesting contrasts between birds and mammals and provide insight into their evolutionary paths to heterothermy.

Evidence for the effect of urbanization on neotropical bird species using three acoustic abundance indices

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Passive acoustic monitoring (PAM) has become an important survey method for birds and approaches to infer abundance from recordings are now in demand. We argue that recorded bird calls can be counted in different ways, and that the information obtained might have different interpretations of abundance, depending on a species' social system and degree of territoriality. In this study, we calculated the vocal activity rate (VAR) and two novel abundance indices (DR, MAX) for three neotropical bird species (collared forest-falcon, Micrastur semitorquatus; gray-headed tanager, Eucometis penicillate; black-headed saltator, Saltator atriceps) based on four months of PAM in 25 sites in the Yucatan

Peninsula, Mexico. We assessed the effect of the amount of urban area around sites on bird abundance comparing the results obtained with the three indices. We used Audiomoth and Wildlife Acoustics' SM4 autonomous recording units and an open-access semi-automated detection program (Arbimon Pattern Matching) to detect species vocalizations and manually counted them. We found high correlations between the three indices and lower variation coefficients for DR and MAX compared to VAR. Using N-mixture models, the three indices indicated similar effects of urbanization on species' abundances. We suggest that DR is a more accurate abundance index for territorial species that have a high degree of signal stereotypy in their vocalizations, whereas MAX can be adequate for estimating group or flock size in gregarious birds. Although future studies will need to test our hypotheses, our data show the potential usefulness of the novel abundance indices DR and MAX to evaluate effects of habitat disturbance on bird populations.

Strong migratory connectivity indicates Willets need subspecies-specific conservation strategies

A. Huysman, N. Cooper, J. Smith, S. Haig, S. Heath, L. Johnson, E. Olson, K. Regan, J. Wilson, P. Marra

Presenting author: **Allison Huysman**

We combined all available banding and tracking data and found that Willets (Tringa semipalmata) have strong migratory connectivity between breeding and nonbreeding locations at the range-wide and subspecies levels. The two subspecies are exposed to varying threats such as hunting for the eastern subspecies (Tringa semipalmata semipalmata) and climatically-altered coastal habitats for both subspecies. Western Willets (Tringa semipalmata inornata) primarily used nonbreeding habitats along the Pacific Coast of the United States, although their reported nonbreeding range extends to the US Atlantic and Gulf Coasts and the Pacific Coast of Central and South America. Eastern Willets wintered in Central and South America, which covers much of the subspecies' known nonbreeding range. By quantifying migratory connectivity within and between two subspecies, we suggest subspecies-specific threats and potential limiting factors in the breeding and nonbreeding periods of the annual cycle of a declining migratory shorebird. Effective management of the species will likely require a range of conservation strategies across the diverse nonbreeding regions the two subspecies occupy within the United States, Central America, and South America. However, more data are needed from Willets breeding in mid-continental North America to understand the complete extent of overlap of the two subspecies throughout the annual cycle. The strong migratory connectivity presented here highlights the need to manage Willets by subspecies and protect a diversity of breeding and nonbreeding habitats, which will benefit the conservation of other shorebird species that overlap with Willets throughout the annual cycle.

Conversion of CRP Grasslands to Cropland, Grazing Land, or Hayland: Effects on Breeding Bird Abundances.

L. Igl, D. Buhl, D. Johnson, M. Post van der Burg

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Recent declines of grassland bird populations in North America are linked to habitat loss and fragmentation associated with agricultural practices. One tool used to conserve soil, water and wildlife habitat on agricultural lands is the U.S. Department of Agriculture's Conservation Reserve Program (CRP). Managers and conservationists recognize CRP as an important component of conserving grassland birds in the U.S. However, recent widespread expiration of CRP contracts could negatively impact grassland bird populations. In this paper, we analyzed data from a long-term (1996–2017) study aimed at comparing grassland bird abundance (24 species) between undisturbed CRP grasslands and fields where the CRP contracts expired. Some of these fields where contracts expired were maintained as pasture or hayland, and others were converted back to cropland. Estimated abundances of most species were considerably higher in undisturbed CRP than in fields with expired CRP contracts. Post-CRP land use also appeared to affect most bird abundances, with grazed grasslands and haylands being lower than undisturbed CRP, but higher than cropland. The responses of obligate and facultative grassland specialists to post-CRP management varied among species, with some being negative and some being positive depending on post-CRP land use. Our results have implications for wildlife managers who must

design conservation strategies around the land use decisions of private landowners. Our results support the idea of maintaining a mosaic of undisturbed CRP grasslands and post-CRP grasslands that are hayed or grazed, which should guarantee some undisturbed nesting cover for some bird species and some disturbed grasslands that benefit others.

Is the hypoxic chemoreflex altered in long-distance migratory warblers?

C. Ivy, K. Young, C. Guglielmo

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Migratory flight is an intensive exercise that requires birds to maintain high aerobic capacities for many hours to days. Maintaining O2 supply to flight muscles is therefore important during migration. Recently, tracking studies have shown that songbirds that migrate for multiple days will ascend to altitudes of 6,000 m during migratory flight. At these altitudes O2 is less readily available (hypoxia), so whether migratory songbirds have prevented over stimulation of the hypoxic chemoreflex to maintain O2 movement to tissues is unknown. Here, we investigated whether sympathetic nervous system (SNS) activation was altered in blackpoll warblers (multi-day migrants) compared to yellow-rumped warblers (overnight migrants). Using the hypobaric wind tunnel, yellow-rumped warblers were found to have a maximum altitudinal tolerance of 4,000 m above sea level (asl), but would only maintain flight for >1 hour at 75% of their maximum altitude (~3000 m asl). To assess SNS activation, 1 hour migratory flights at sea level and 3,000 m asl were conducted with a blood sample taken at the end of the flight for plasma catecholamine concentrations. Resting samples were also taken at sea level and 3,000 m. Preliminary data suggests that blackpoll warblers exhibit blunted SNS activation when at rest at 3,000 m compared to yellow-rumped warblers. Yellow-rumped warblers exhibited increases in adrenaline and noradrenaline concentrations during flight at 3,000 m and at rest at 3,000 m. These findings suggest that blackpoll warblers may have a blunted SNS and hypoxic chemoreflex, which would be beneficial for maintaining O2 transport to flight muscles during high-altitude migratory flight without over-stimulation of the SNS.

The Rich Mid-Pleistocene Fossil Avifauna of Ulupau Head, Oahu

H. James, M. Spitzer

Presenting author: **Helen James**, National Museum of Natural History, Smithsonian Institution, jamesh@si.edu

The Hawaiian Islands are a hotspot for the evolution of plants and animals and a renowned venue for the study of island biogeography and evolution. Prior research on these topics relies mainly on observations of distribution and phylogeny in the modern biota to make inferences about evolutionary rates and ecological community assembly in deeper time. A perfect companion to these studies would be a fossil record that is old enough to provide direct evidence of the ecological communities, biogeographic distributions, and evolutionary forms that have existed in the past. The Hawaiian Islands have a rich but recent fossil record, dating mainly to the Holocene and consequently informative about recent, human-era extinctions. Here, we report on a much older, mid-Pleistocene fossil bird locality on Oahu, where extensive fossil-bearing lacustrine sediments occur in the Ulupau Head tuff cone, located on the Marine Corps Base Hawaii. Fossil birds from the site now number over 1700 specimens and are held at the Bishop Museum and the National Museum of Natural History. Based on stratigraphic evidence of high sea stands and U/Th dating, the fossil-bearing sediments correlate with marine isotope stage 11 (about 400 ky ago) although stage 10 (about 300 ky ago) is not ruled out. The fossils are well-preserved and representative of the avian habitats of Hawaii (land birds, shore birds, water birds, seabirds). We review the Ulupau Head assemblage in terms of evidence for ecological turnover and evolutionary stasis in each major category of birds represented. We compare the mid-Pleistocene fossil assemblage of Oahu with important mid-Pleistocene fossil bird assemblages from North America.

Determining the effects of glass visual properties on avian window collisions

Q. Jamison, S. Smith, D. Hanley, D. Luther

Presenting author: **Quentin Jamison**

Window collisions are the second largest source of anthropogenic mortality for birds, with an estimated

599 million bird deaths in the United States per year. Previous studies have looked at why birds strike windows and how to reduce the number of window collisions. These studies determined that birds do not recognize windows as a barrier, and instead see the interior of the building or the reflected environment behind them as unobstructed passageways. To combat window strike mortality, companies have developed bird-safe windows and stickers with visible or UV patterns to alert birds that there is a barrier between them and their destination. While window collision research has come a long way, few studies have assessed the influence of visual properties of glass, including reflection, gloss, and transmission, on the frequency of bird-window collisions. In this study, we quantify these properties and correlate them to the frequency of window collisions. We surveyed for window strikes at buildings on the George Mason University campus during the fall migration. We continued surveys during the spring migration, focusing on a subset of buildings that received window strikes, and a comparable set that did not receive strikes. We then measured the visual properties of these windows and compared the properties of buildings with and without strikes. In the fall we recorded over 3,400 observations at 101 buildings. Of those, 86 strikes were recorded at 33 buildings, with 26 species represented. We expect that buildings with strikes will have higher measures of gloss and reflectance than buildings where strikes did not occur, as higher measures for these properties are more likely to present an unobstructed passage.

Establishment of a long-term banding program for migratory birds in Island Contoy National Park, México.

J. Nochebuena Jaramillo, M. Gaytán NíºñEz
Presenting author: **Jonathan Nochebuena Jaramillo**

The geographical position of the Island Contoy National Park (PNIC) in the Caribbean region constitutes an important element within the migratory routes of the Atlantic coast and the Mississippi. Isla Contoy is considered 'the island of birds', since it is home to more than 160 species of migratory and resident birds. Island Contoy receives more than 60 species of Neotropical migratory birds throughout the year, most of these species are registered during the autumn migration and come from the migratory routes of the Atlantic coast and the Mississippi. What makes it one of the most strategic places to study aspects of bird migration. The Ringing Program within the PNIC was born in 2019 as a community initiative where the main objective is to reinforce the importance of the conservation and protection of birds and their habitats, as well as to publicize the great value that they represent within the island and the Mexican Caribbean. During this time, more than 30 species of resident and migratory birds have been recorded, data have been collected during the winter season, and birds that were ringed in 2014 in previous programs have been recaptured, which allows obtaining parameters that include longevity and survival for resident birds (e.g. hooded oriole - Icterus cuculatus and mangrove warbler - Setophaga petechia). Local Protected Area stakeholders have also received training. The establishment and continuation of this ringing station in one of the best preserved Protected Areas in the Mexican Caribbean is a great step for the conservation of migratory birds that transit through this region on their way to their wintering grounds.

Higher tree diversity could buffer the effect of phenological mismatch on breeding ecology of Varied Tits

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Climate change is causing a phenological mismatch between the breeding timing of birds and the peak timing of their prey availability. Phenological mismatch can affect breeding performance by limiting nestlings' food. Such adverse effects may be mitigated if the prey is available for extended periods. Forests with diverse tree species could host various caterpillars and provide extended food availability. We investigated whether the effects of phenological mismatch on diet use and reproductive outputs of Varied Tits (Sittiparus varius) differed depending on the peak duration of caterpillar availability in a temperate mixed deciduous forest in South Korea. We used two-year data from five plots on the temporal pattern of caterpillar availability, carbon and nitrogen stable isotope (SI) of nestling blood, and nestling conditions at fledging. We examined the relationship between vegetation diversity and the peak duration of caterpillar availability. The SI values of nestlings suggested that parents of later breeding broods might feed fewer caterpillars than earlier breeding broods regardless of the peak duration of caterpillar

availability. The nestling condition decreased when the mismatch was greater, but the effect of mismatch was alleviated when the peak duration of caterpillar availability was longer. In addition, we found that the tree diversity composing the canopy best explained the variation of the peak duration of caterpillar availability between plots. These findings suggest that the effect of phenological mismatch on songbirds' reproductive output would be mitigated by an extended peak duration of caterpillar availability, which could be achieved by increasing tree diversity in temperate deciduous habitats.

Thermoregulation of understory birds in lowland Amazonia

V. Jirinec

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Understanding the capacity for thermoregulation is key for predicting organismal vulnerability to climate change, especially in lowland tropical rainforests, where warming conditions combine with high humidity and limited refugia in elevation and latitude. Here I focus on nine species of ground-foraging insectivorous birds-sensitive specialists characterized by declines in both disturbed and undisturbed forests, including at this study site in Brazilian Amazonia. Using high-resolution data from loggers deployed on birds and their environment, I examined whether and how birds used thermoregulation and whether water access played an important role. Variation in the rate of temperature change over the diel cycle suggested that all species employed behavioral and physiological thermoregulation, but the patterns differed by phylogeny. Most species warmed before sunrise and then experienced lower temperature increases at midday relative to the ambient thermal flux. Six species, especially leaftossers (Sclerurus spp.), exhibited pronounced oscillations in temperature change, consistent with regular bathing around sunset. Although local rainfall reduced ambient temperature and resulted in the cooling of six species, these rain-induced cooling events were markedly absent in all three leaftossers, which are known for their capacity to shelter. These results suggest that access to water and rainfall contribute to both the options and challenges in thermoregulation. Importantly, birds appear to maintain thermal homeostasis throughout the diel cycle, with a preference for some of the lowest temperatures in their environment.

Harnessing intraspecific variation in social group size to elucidate ecological correlates of cooperative breeding

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Cooperatively breeding species exhibit a range of social behaviors associated with different costs and benefits to group living, often in association with different environmental conditions. For example, recent phylogenetic studies have collectively shown that the evolution and distribution of cooperative breeding behavior is related to the environment. However, little is known about how environmental variation may drive differences in social systems across populations within species, and how the relationship between environmental conditions and sociality may differ across species. Using a combination of transect observations and eBird data gathered in the Malurus fairywrens, as well as theoretical modeling, we examine how different benefits of social living can generate variable patterns of group size in response to ecological variation. Specifically, we show that group augmentation benefits (e.g., increased reproductive success) produces the largest groups in harsh environments, while the lack of such benefits and the presence of high reproductive conflict produces the largest groups in benign environments. These findings suggest that nuanced differences in the benefits of helping and dispersal behavior observed in the Malurid fairywrens likely contribute to misaligned ecogeographic patterns of variation in group size across species and suggest integration of ecogeographic studies within and between species can provide novel insight into social trait evolution.

Resident, but not migratory, songbird eye size varies with urban-associated light pollution levels

T. Jones, A. Llamas, J. Phillips

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Urbanization now exposes large portions of the earth to sources of anthropogenic disturbance, driving rapid environmental change and producing novel environments. Changes in selective pressures as a result of urbanization are often associated with phenotypic divergence, however, the generality of phenotypic change remains unclear. Our research examined whether morphological phenotypes (body size and eye size), in two migratory and two residential songbird species, differed between urban core and edge habitats and with respect to urban-associated sensory pollution (light and noise) across San Antonio, Texas, USA. We found no differences in body size between urban core and edge habitats for all species except the Painted Bunting, in which core-urban individuals were smaller. Rather than a direct effect of urbanization, this was due to differences in age structure between habitats, with urban-core areas consisting of higher proportions of younger buntings which are, on average, smaller than older birds. We also found that residential birds inhabiting urban-core areas had smaller eyes compared to their urban-edge counterparts, resulting from a negative association between eye size and light pollution across study sites; notably, we found no such association in the two migratory species. Our findings provide some of the first evidence that birds may adapt to urban environments through changes in their eye morphology. Additionally, our results demonstrate how urbanization may indirectly influence phenotypes by altering population demographics and highlights the importance of accounting for age when assessing factors driving phenotypic change.

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*The width effects: Response of songbird communities to linear features of varying width in the boreal forest of Alberta

T. Kalukapuge, J. Martínez-Lanfranco, L. Leston, E. Bayne
Presenting author: **Tharindu Kalukapuge**

Linear features, such as seismic lines, pipelines, and transmission lines, are widespread across Alberta and can have different impacts on birds depending on line attributes such as age, vegetation recovery, level of human use, orientation, and width. This study aimed to determine how songbird communities respond to linear features of varying width and whether this influences the magnitude of the edge effect. We conducted fixed autonomous recording unit (ARU) surveys and digital mobile point count surveys across a range of linear features of different widths and quantified the songbird community-level and species-specific responses to gap width. Our findings suggest that linear feature width has a significant impact on the community composition and alpha diversity of boreal songbirds. Species richness and evenness appear to be changed in response to gap width. Moreover, different songbird species showed varying threshold responses to gap width. Specifically, mature forest species like the Ovenbird (Seiurus aurocapilla) decreased abruptly in abundance above gap widths of 4-10m, whereas species that prefer disturbed or open vegetation, such as the Lincoln's Sparrow (Melospiza lincolnii) tended to be more abundant with increasing width. The results highlight the importance of incorporating gap width into research and impact assessment processes that aid in making management and policy decisions related to the restoration of disturbed boreal landscapes and wildlife communities in Alberta.

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*Too much of a good thing: the role of MHC class I against West Nile virus in American Robins

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American robins (Turdus migratorius) are a reservoir host for West Nile Virus (WNV). As a reservoir host, they serve as an intermediate carrier of this pathogen. Collaborators at Michigan State University infected juvenile robins, naive to WNV, to see the effect of food availability on infection intensity. Although nutrition had an effect on overall viremia in these birds, there was a noticeable variation in WNV titer levels within treatment groups, which may be explained by underlying genetic effects. A candidate gene to study potential genetic effects on WNV resistance is the major histocompatibility complex (MHC) class I, which recognizes and presents viral antigens to killer T cells. We hypothesized that the American robins would experience a heterozygote advantage at MHC class I, whereby those with the greatest diversity of MHC class I alleles would have the lowest levels of WNV titers. We performed polymerase chain reaction (PCR) to amplify MHC class I exon 3 and characterized alleles using high-throughput sequencing. We found that the American robins had 4.70 (Â± 1.61) alleles at MHC class I exon 3, which encodes the

hypervariable antigen binding site of the MHC molecule. Contrary to our hypothesis, we found a heterozygote disadvantage at this gene family, whereby the birds with high MHC class I allelic diversity had the highest WNV titer levels. Recent research suggests high MHC diversity in vertebrate animals can lead to T cell repertoire depletion, leaving the animals with maximal MHC diversity susceptible to infection. Overall, our study will expand the field avian immunogenetics by presenting unique results that contrasts the traditional theory of pathogen-mediated heterozygote advantage at immune genes.

Sensory modalities used by Downy Woodpeckers (Dryobates pubescens) to find food: A captive study

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Using Referential Alarm Calls to Investigate Mental Time Travel in Free-living Songbirds

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Mental time travel (MTT) is a cognitive process which combines episodic memory and future planning. Although MTT is well-understood in humans, studies of MTT in animals has largely been limited to lab experiments, which lack ecological relevance. We tested the hypothesis that hearing referential 'seet' calls on one day causes yellow warblers (Setophaga petechia) to alter patterns of nest vigilance at dawn the following morning when brown-headed cowbird (Molothrus ater) brood-parasitism is most likely to occur. We exposed female warblers to three treatments: recordings of seet calls, chip calls (general alarm call), and control (silence). We presented playback recordings at warbler nests and monitored their extended vigilance patterns using remote-sensing trail cameras. Binary logistic regression showed no difference in whether a warbler roosted overnight following playback ($p > 0.05$). We also ran generalized linear models (GLM) to assess the relationships between playback and vigilance patterns 1) in the afternoon of the same day as playback treatments, 2) at night on the day as playback treatments, and 3) at dawn the morning following playback treatments. Although the results of the GLMs for afternoon and dawn were insignificant ($p > 0.05$), there is a significant difference between warblers' response to chip treatment and night vigilance when compared to control and seet treatments ($t = -2.503$, $p = 0.0235$).

Faecal matters: gut microbial diversity and composition during experimental avian malaria infection in house sparrows

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Host gut microbiomes are important contributors to host health, including the defence against pathogens. The relationship between the host gut microbiome and resistance to infection has mainly been investigated in humans and lab-bred rodents, which limits our knowledge about this relationship in wild animals. To inform this knowledge gap, we inoculated wild-caught house sparrows (Passer domesticus, $n = 18$) with avian malaria (Plasmodium relictum) and quantified the interactions of the host gut microbiome and resistance to infection. Before and after the inoculation, we collected blood samples to evaluate infection success, as well as faecal samples of which we extracted, amplified, and sequenced the 16S rRNA gene via PCR targeting the V4 region of bacterial DNA. Sequences were quality filtered, clustered to OTUs, and OTU taxonomy was identified to quantify the diversity and composition of the sparrows' gut microbiome. Alpha (species richness and evenness) and beta diversity (community composition) did not significantly differ between infected and resistant sparrows prior to nor during avian malaria infection. However, several OTUs occurred at higher prevalence and abundance in resistant sparrows. These results suggest that broad-scale host gut microbiome diversity and composition do not contribute to resistance to avian malaria infection, but specific bacterial taxa could.

Assessing spatiotemporal risk of avian influenza spillover events from wild waterfowl into domestic poultry

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Avian influenza viruses pose clear risks to the poultry industry, and by extension, public health. These risks can be mitigated by a strong understanding of when and where spillover events from wild waterfowl hosts into domestic poultry operations are likely to occur. Here we present a fine-grained spatiotemporal model of this risk based on the abundance of wild waterfowl, the prevalence of avian influenza in these waterfowl, and the spatial distribution of poultry operations at weekly time intervals for the contiguous United States. In broad terms, we predict that the overall risk fluctuates annually with natural cycles in disease prevalence, with areas of elevated risk shifting spatially with waterfowl movements. Additionally, some locations of high poultry production retain elevated risk throughout the year. We performed model validation using outbreak data from the ongoing European highly pathogenic avian influenza Clade 2.3.4.4b H5N1 incursion that began in 2022. Despite the fact that this model was trained on endemic viruses of low pathogenicity, we find that our model performs well at predicting spillover locations of this novel virus. This demonstrates the potential strengths of this model at both predicting the location of low pathogenicity spillover events as well as planning for and responding to novel outbreaks.

Colour as a between-species social dominance signal

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Animals as diverse as cephalopods, insects, fish, and mammals signal social dominance to conspecifics to avoid costly fights. Even though between-species fights may be equally costly, the extent to which dominance signals are used between species is unknown. Here, we test the hypothesis that differences in color are associated with dominance between closely related species that aggressively interact over resources, examining between-species variation in colors that are used in within-species badges of status (black, white, and carotenoid coloration) in a comparative analysis of diverse species of birds. We found that dominant species have more black, on average, than subordinate species, particularly in regions important for aggressive signaling (face, throat, and bill). Furthermore, dominant species were more likely to have more black in comparisons in which the dominant species was similar in size or smaller than the subordinate, suggesting that black may be a more important signal when other signals of dominance (size) are missing. Carotenoid colors (i.e., red, pink, yellow, and orange) were not generally associated with dominance, but may signal dominance in some taxonomic groups. White may have opposing functions: white was associated with dominance in species in which black was also associated with dominance, but was associated with subordinance in species in which carotenoid-based dominance signals may be used. Overall, these results provide new evidence that colors may function broadly as signals of dominance among competing species. Such signals could help to mediate aggressive interactions among species, thereby reducing some costs of co-occurrence and facilitating coexistence in nature.

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*Seasonal patterns and drivers of avian functional diversity across Eastern North America

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Seasonality structures local species diversity and creates conditions that are necessary for the maintenance of biodiversity. Species are distinguished by a suite of traits (e.g., morphology), and as the composition and abundance of species changes in response to seasonality, so does the diversity of these traits. Consequently, the composition and diversity of species' traits – functional diversity (FD) – is likely dynamic in seasonal environments. ~20% of extant birds are migratory, are functionally divergent from resident birds, and increase proportionally with latitude. This suggests strong variation in seasonal trait composition within seasonal communities and across broad geographic regions. Yet, we lack an understanding of how local FD changes seasonally and which environmental drivers promote these

differences. We reconstructed local community composition with seasonally dynamic species distribution models developed by eBird Status and Trends for Eastern North America. We coupled reconstructed communities with a database of avian morphology to estimate seasonal FD and turnover. Finally, we modeled seasonal FD as a function of environmental predictors capturing productivity and climate. We found evidence that bird communities experience marked changes in FD across seasons. Productivity, temperature, and precipitation were all influential in predicting various aspects of FD. Notably, functional turnover was positively related to variation in productivity, suggesting seasonal pulses in energy availability dictate the functional composition of bird communities. Climate change is impacting seasonal ecosystems and our results suggest that these effects may impact bird FD potentially disrupting ecosystem functionality.

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*Anthropogenic hybridization within a community of multiple endangered parrot species: What does the future hold?

S. Kiacz, W. Grant, H. Wang, D. Brightsmith
Presenting author: **Simon Kiacz**

Hybridization is recognized as a potential threat to rare species and can complicate conservation and management efforts. Anthropogenic hybridization, which results from the direct or indirect actions of humans, can complicate matters further by increasing the array of potentially hybridizing species. In order to show the possible conservation and management consequences of anthropogenic hybridization, we built an age-structured compartment model based on a complex community of congeneric parrots from south Texas. Our model community consists of both native and naturalized populations of Amazona parrots, including the Endangered Red-crowned Parrot (A. viridigenalis) and Lilac-crowned Parrot (A. finschi). Our simulation results suggest that in the absence of outbreeding depression or reduced fitness of hybrids, even at low levels of hybridization the future of the community is likely to resemble a hybrid swarm. Future management of these naturalized/native populations will need to explicitly consider the possible impacts of hybridization and its implications on genetic integrity and diversity. Our models serve as a foundation for building field testable hypotheses about hybridization broadly across these and other hybridization-prone communities to help us better predict the potential impacts of hybridization and inform conservation management decisions.

Biotic–abiotic interactions constrain avian abundance distribution along temperate range boundaries

H. Kim, N. Anich, B. Zuckerberg
Presenting author: **Hankyu Kim**

The study of range boundaries has been a central focus of biogeography for more than a century, but recent developments in range limit theory suggest that species' range limits are driven by interactions between abiotic and biotic drivers (interactive range limit theory). We tested the predictions of the interactive range limit hypothesis using abundance data from a state-wide network of over 16,542 point counts conducted as part of Wisconsin's 2nd Breeding Bird Atlas (2015–2019) data for 42 species of birds that meet their distributional limits in the state. To capture potential biotic interactions for each species, we calculated functional distance to more than 110 common breeding birds in Wisconsin using morphological and ecological traits. Using these distances as inverse weights, we calculated the spatial distribution of potential avian competitors with a weighted sum of abundance of common breeding bird species to compute a potential competition index (PCI). For abiotic constraints, we integrated information on various climate conditions. We compared model fit and effect sizes for a combination of PCI and climatic conditions while accounting for land cover and topography. We found that two-way interactions between the climate and PCI model and the model simultaneously accounting for both climate and PCI explained abundance distribution of most bird species better than models with climate or PCI only. Our study provides support for the interactive range limit theory on breeding birds in temperate ecosystems and shows the strength of systematic atlas surveys for investigating ecological processes in biogeography of avian populations.

Conservation management of hill pigeons facing local extinction and interspecific hybridization in South Korea

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The hill pigeon (Columba rupestris) is broadly distributed (southern Russia, southern China, Mongolia, southern Tibet, and the Korean Peninsula) and evaluated as under 'Least Concern' by IUCN. However, the population continuously decreased and is closed to local extinction in South Korea after the late twentieth century. To suggest a helpful conservation plans for hill pigeon populations in South Korea, we are conducting an in- or ex-situ conservation studies. First, we investigated a distribution range, population fluctuation, and evidences of hybridization in South Korea. Second, we examined the factors of interspecfic hybridization between hill pigeons and feral pigeons, developing eight InDel markers using WGS data and conducting ex-situ experiments to understand the changes in population genetics, gene flow, and introgression affecting the hill pigeon population. Conclusion of research is continuing to determine which method will be effective and successful for the conservation of hill pigeons in South Korea.

Comparative phylogeography reveals genetic distinctiveness of Appalachian populations of migratory boreal songbirds

A. Kimmitt, T. Pegan, A. Jones, B. Winger
Presenting author: **Abigail Kimmitt**

Pleistocene glacial refugia are thought to have shaped modern population distributions and genetic structure. However, teasing apart the relative significance of historic versus ongoing evolutionary processes for explaining contemporary patterns of genetic and phenotypic divergence remains an ongoing challenge. In this study, we sequenced over 900 low-coverage whole genomes from 13 species to evaluate population structure and gene flow across the ranges of seasonally migratory songbirds with wide breeding ranges throughout the boreal forest and Appalachian Mountains. As these contemporary ranges include both historically glaciated and unglaciated regions, we tested the putative role of Appalachia as a glacial refugium as well as a stepping-stone expansion model across a larger post-glacial geographic range. We find evidence for continuous genetic variation across the geographic range in these species, as well as distinct population structure between Appalachian populations and boreal-belt populations. However, we found genetic diversity within some species to be higher in the boreal populations than the southern Appalachian populations, which does not support the hypothesis of Appalachia as a glacial refugium. Overall, our findings suggest that ongoing evolutionary processes of isolation by distance might play a stronger role in modern population structure and that genetic diversity might have been maintained during recent glacial cycles. Additionally, our analyses resolve geographically fine-scale genetic structure in species often considered to be panmictic, which could have future significance for assessing migratory connectivity and assigning breeding origin of individuals based on genetics alone.

The effect of conspecific brood parasitism on incubation length and hatching success in Red-breasted Mergansers

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Conspecific brood parasitism (CBP) is an alternative reproductive tactic observed in at least 50% of waterfowl species. The effects of CBP on host fitness are not fully understood in most species, so it remains generally unknown whether the behaviour is a truly parasitic interaction with fitness benefits to the parasite and costs to the host. We studied the costs of CBP to hosts in a population of colonial Red-breasted Mergansers (Mergus serrator) in which CBP is common and up to 30% of nests are heavily parasitized (i.e., â‰¥15 eggs in the clutch). The objectives of our study were to investigate whether clutch size (i.e., an indicator of CBP) affects two parameters linked to host fitness: 1) length of the incubation period and 2) egg hatching success. We assessed hatching success by monitoring nests (n=59) until their fate was determined. The length of the incubation period was assessed by processing data from

temperature loggers placed in the nest (n=21) and used to identify the presence of an incubating hen. We found that hatching success increased from small to medium clutch sizes and then decreased in larger clutch sizes (17+). Some of the largest nests failed to hatch young. The length of the incubation period averaged 31.6 Â± 2.9 days (range 25-35 days) but was unaffected by clutch size. Thus, females incubating the largest clutches do not extend the length of the incubation period but instead may abandon them, suggesting that hens favour their survival at the expense of that of their offspring. Our study shows that there are costs incurred by hosts in heavily parasitized nests of Red-breasted Mergansers.

Habitat use and movements of Boreal Chickadees during the post-fledging period

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The Boreal Chickadee (Poecile hudsonicus) is a nonmigratory cavity-nesting species with a range that is strongly tied to the spruce forests of the North American boreal forest. This species is undergoing range contraction and associated population declines at the southern edge of its range, but the mechanisms driving this decline are poorly understood. One hypothesis is that bottlenecks in the post-fledging dispersal period are causing low levels of recruitment into the breeding population. Additionally, little is known about the post-fledging dispersal of resident and/or cavity-nesting species such as the Boreal Chickadee, and these life history strategies pose different challenges than those faced by migratory open-cup nesters and may also contribute to population declines. To better understand these knowledge gaps, we used radio telemetry to study post-fledging movements, cover type associations, and survival of fledgling Boreal Chickadees in northern Minnesota, USA from 2019-2022. We tracked the post-fledging movements of individuals from 24 broods and, for the first time, documented the post-fledging behavior of the Boreal Chickadee. Our findings indicate that fledglings prefer areas with higher percentage of black spruce and a greater distance to edge. Results from this study will be used by land managers to develop conservation strategies that will provide and retain critical habitat to support this declining species.

Genetic structure and range delineation in the Least Bell's Vireo and the Arizona Bell's Vireo

B. Kus, A. Vandergast, D. Wood
Presenting author: **Barbara Kus**

Increasingly, genomic data are being used to supplement field-based ecological studies to help evaluate recovery status and trends in endangered species. We collected genomic data to address two related questions regarding the Least Bell's Vireo (LBVI), an endangered migratory songbird restricted to southern California riparian habitat for breeding. First, we evaluated genetic structure among LBVI populations in coastal California, and estimated effective population size for sites with at least 10 samples. Second, we sought to delineate the range limits and potential overlap between LBVI and its sister subspecies, the Arizona Bell's Vireo (AZBV), by analyzing samples from the deserts of eastern California, southwestern Nevada, Utah and Arizona. Clustering analyses based on 10,571 SNPs from 317 samples collected between 2011 and 2022 supported two major groups that aligned closely to the previously defined subspecies ranges. The first cluster included birds in the Central Valley, all coastal drainages, and westernmost deserts of California, with no further sub-structuring among coastal populations evident. Almost all birds from the Amargosa River in eastern California and eastward assigned to the second cluster; however, 9% of birds in the California desert were of mixed ancestry, suggesting occasional movement and gene flow between subspecies. Effective population size for both subspecies was high, at least exceeding 500 and possibly 1000. California desert populations may be important for maintaining and replenishing genetic diversity and facilitating the movement of potentially adaptive genes between subspecies.

New evidence suggests the persistence of the Ivory-billed Woodpecker (Campephilus principalis) in Louisiana

S. Latta, M. Michaels, T. Michot, P. Shrum, P. Johnson, J. Tischendorf, M. Weeks, J.

Trochet, D. Scheifler
Presenting author: **Steven Latta**, National Aviary, steven.latta@aviary.org

The history of decline of the Ivory-billed Woodpecker is long and complex, but the status of the species since 1944, when the last widely accepted sighting in continental North America occurred, is particularly controversial. Reports of Ivory-billed Woodpeckers have continued, but none has reached the threshold of quality for general acceptance by ornithologists or the birdwatching public. In 2021, the U. S. Fish and Wildlife Service opened for public comment a proposal to declare the species extinct. Here we present evidence suggesting the presence of the Ivory-billed Woodpecker at our study site, based on a variety of data collected over a 10-yr search period, 2012-2022. These data are drawn from visual observations, recordings by acoustic recording units, trail camera images, and drone video footage. Using multiple lines of evidence, the data suggest intermittent but repeated presence of multiple individual birds with field marks and behaviors consistent with those of Ivory-billed Woodpeckers. Data indicate repeated re-use of foraging sites and core habitat. Our findings, and the inferences drawn from them, suggest that not all is lost for the Ivory-billed Woodpecker, and that it is clearly premature for the species to be declared extinct.

What evidence exists on the effects of anthropogenic land use on colonially breeding Saunders's gulls?

S. Lee, J. Yoon
Presenting author: **Seon-Ju Lee**

Some colonially breeding seabirds commonly use artificially reclaimed lands that are frequently located next to mainland environments. Nest predators such as birds and mammals from the mainland have negative impacts on fitness-related costs and distribution of breeding colonies. Here, we investigate whether or not direct and/or indirect factors, specifically nest predation and anthropogenic land use, are linked with breeding performance, breeding dispersal, and anti-predation behavior in the Saunders's gull (Saundersilarus saundersi), a vulnerable species, on a large reclaimed area in South Korea. This reclaimed area has experienced rapid changes in communities of nest predators from the surrounding mainland after reclamation. Our results from long-term observations and experiments showed two anti-predation behaviors. First, heavy nest predation in a previous year induced colonial movements in a consecutive year to overcome nest predation risks. Second, colonially nesting parents distinguished displayed predator decoys and defended the nests through collective mobbing and bombing attack-like behavior. This study highlights that high nest predation may exert strong pressure on seabird colonies in reclaimed lands, and anthropogenic impacts from the reclamation of mudflats presumably act as an ecological trap, leading to colonially breeding dispersal and nest defense as anti-predation strategies for this vulnerable seabird in a reclaimed land.

Increasing familiarity reduces fighting in interspecific dominance hierarchies

G. Leighton, J. Drury, E. Miller
Presenting author: **Gavin Leighton**

Dominance hierarchies often form between species, especially at common feeding locations. However, large-scale analyses of interspecific dominance hierarchies have been rare compared to research on intraspecific dominance hierarchies. Given that interspecific behavioral interference mediates access to resources, these dominance hierarchies likely play an important and understudied role in behavioral evolution and community assembly. To test alternative hypotheses about the formation, maintenance, and consequences of interspecific dominance hierarchies, we employ an especially large, community-scientist generated dataset of displacements observed at feeders in North America. Overall, we find broad support for the hypothesis that familiarity (measured as fine-scale habitat overlap) predicts adherence to the structure of the dominance hierarchy. Specifically, we find that species with similar foraging ecologies and more fine-scale habitat overlap are more likely to engage in costly aggression over resources. However, among interacting species, fine-scale habitat overlap leads to less aggressive encounters than expected and higher directionality of encounters. These results suggest that the previously documented agonistic hierarchy in North American birds is perhaps adaptive, with familiar species typically abiding by their place in the interspecific dominance hierarchy so as to avoid costly aggression.

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*Effects of irregular shelterwood cutting on a species dependent on old-growth attributes: the Black-backed Woodpecker.

M. Lemieux, J. Tremblay
Presenting author: **Myriam Lemieux**

The extensive use of clearcuts is carried out at forest revolutions that are often shorter than natural disturbance cycles, so old stands do not have time to acquire a more complex structure. Irregular shelterwood cutting is often proposed as a tool for preserving attributes of old-growth, structurally complex forests. Because of its affinity for old forest and dead wood, the black-backed woodpecker was chosen as a focal species to address ecosystem-based management issues related to old-growth boreal forests. We expect woodpeckers to select partial cuts only at the home range scale. We evaluated habitat selection at two different scales: landscape and home range. Habitat selection was performed using simple generalized linear models with a logit link. Irregular shelterwood cutting were selected by woodpeckers at both the landscape and home range scales. At the home range scale, the diameter of recently dead snags most dictated selection of foraging and nesting habitat. Contrary to our hypothesis, the volume of recent snag did not dictate the habitat selection at the home range scale. This may be explained by the fact that dead wood did not appear to be a limiting element in the different habitats in our study area. The minimum value observed in our home ranges was 39 m3/ha of total dead wood including 17 m3/ha (43%) in recent dead wood. Recent irregular shelterwood cuts allow the maintenance of a species dependent on old-growth attributes if large snags are present. Partial cuts should be made in old-growth forests where moderate disturbance is beginning to occur. This study contributes to filling the gap in effectiveness monitoring of ecosystem-based management and species sensitive to forest management.

A framework to support the identification of critical habitat for wide-ranging species at risk under climate change

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To recover species at risk, identifying habitat critical to their recovery is necessary. Challenges for species with large ranges (thousands of square kilometers) include delineating management unit boundaries within which habitat use differs from other units, along with assessing amounts of and threats to habitat over time. We developed a reproducible framework to support identification of critical habitat for wide-ranging species at risk. The framework (i) reviews species distribution and life history; (ii) delineates management units across the range; (iii) evaluates and compares current and (iv) potential future habitat and population size; and (v) prioritizes areas within management units based on current and future conditions under various scenarios of climate change and land-use. We used Canada Warbler (Cardellina canadensis) and Wood Thrush (Hylocichla mustelina) in Canada as case studies. Using geographically weighted regression models and cluster analysis to measure spatial variation in model coefficients, we found geographic differences in habitat association only for Canada Warbler. Using boosted regression trees to predict current habitat amount for each species in different management units, then future habitat amount under simulated land use and climate change, we projected that: 1) Canada Warbler populations would decrease in Alberta but increase in Nova Scotia; and 2) Wood Thrush populations would increase under most scenarios run in Quebec, New Brunswick, and Nova Scotia, except in Ontario. By comparing results from future scenarios and spatial prioritization exercises, our framework can be used to support identification of critical habitat in a way that incorporates climate and land-use projections.

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*Nocturnal heterothermy use in four North American songbird species during migration

R. Leys, L. McGuire
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Stopovers are crucial opportunities for migrating birds to rest and refuel. Despite the high energetic cost of migratory flight, birds use twice as much energy during stopovers, largely driven by thermoregulatory

costs. Birds are generally assumed to be homeothermic, which would present an extreme challenge in replenishing fat stores, their primary migration energy source, on cold nights. Further, heat loss is greater in smaller species due to their high surface area to volume ratio. Nocturnal heterothermy allows individuals to reduce the amount of energy expended on thermoregulation during inactive periods, providing energy savings which could dramatically alter migratory strategies. Our study focusses on four target species likely to use nocturnal heterothermy: Brown Creepers (Certhia americana), Golden-crowned Kinglets (Regulus satrapa), Ruby-crowned Kinglets (Corthylio calendula), and Yellow-rumped Warblers (Setophaga coronata). We measured body temperature using temperature-sensitive PIT tags and measured metabolic rate using open-flow respirometry at 2, 7, 12, and 25Â°C. All focal species reduced body temperature >3Â°C from active phase (~42Â°C), an approximate threshold to be considered heterothermic. The lowest body temperatures recorded were 34.6Â°C (Brown Creeper), 28.8Â°C (Golden-crowned Kinglet), 33.8Â°C (Ruby-crowned Kinglet), and 33.4Â°C (Yellow-rumped Warbler). Metabolic rate increased at colder ambient temperatures, but there was as much as a 36% difference in metabolic rate within a temperature treatment. Reduced thermoregulatory costs result in an increased net refueling rate, allowing individuals to reach their breeding territories and wintering grounds more rapidly.

The role of glacial cycles on the diversification and speciation of the birds of southern South America

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Glacial cycles have been a key driver of speciation in the Nearctic, but they had a milder effect in most of the Neotropics. We are studying their relevance in the temperate south of South America at different geographic and taxonomic scales. The analysis of 235 avian sister species pairs showed that the Andean-Patagonian region has a higher proportion of young species (i.e. originated in the Pleistocene) than the rest of the Neotropics, suggesting a relevant effect of glaciations. Detailed analyses of the Southern Lapwing (Vanellus chilensis), the Rufous-collared Sparrow (Zonotrichia capensis) and the House Wren (Troglodytes aedon) were consistent with a significant role of glaciations. Lineages restricted to Patagonia were found in the three species, although with differences in the timing of their separation. In addition to genetic differences, in the Southern Lapwing and the Rufous-collared Sparrow the Patagonian lineages differ in morphology and/or song. In the latter, in fact, the recently originated Patagonian subspecies is the most differentiated in coloration, a consequence of differences in a single genomic area that contains ST5, a gene involved in the regulation of melanogenesis. In the House Wren, the colonization of the Malvinas Islands from Patagonia and the lack of further gene flow with the continent led to speciation in the insular population, originating T. cobbii. In spite of these differences among species, northward postglacial expansions from Patagonia led to secondary contact in the three of them, promoting gene flow and intermediate color or vocal traits. The results of this study highlight the relevance of glaciations for avian diversification and speciation in southern South America.

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*Machine learning and genomics: Using neural networks for population assignment of a threatened migratory seabird

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Seabird life history traits such as long time to maturity, low reproduction rate and seasonal migration make them vulnerable to rapid environmental change associated with human activities. Many threats to seabird populations occur away from breeding colonies, making colony-specific impacts difficult to assess. Our current inability to delineate populations accurately and assign individuals to their colony of origin makes effective management difficult. Leach's Storm-Petrel (Hydrobates leucorhous) is a migratory pelagic seabird that breeds in large colonies throughout the North Atlantic and Pacific oceans. In the past 50 years, Atlantic populations have declined by an estimated 54% due to increased threats including predator pressure, collisions with offshore structures and climate change. Additional sources of mortality have been identified, however the impact of these threats on specific colonies is unknown. The weak

population genetic structure in this species means that population markers for impact assessment are especially elusive. We are using double-digest restriction-site associated sequencing to provide single nucleotide polymorphisms to investigate in detail the genetic structure of Leach's Storm Petrels across the North Atlantic Ocean. We then use a novel neural network program popfinder to assign individuals of unknown origin to their respective breeding colonies to determine if identified threats are exhibiting colony-specific effects. Our results will aid the formation of effective conservation plans for this species, as well as demonstrate the effectiveness of popfinder in performing population assignment on a species with low population structure, a long-standing challenge in population genetics studies.

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*The effects of 120 years of urbanization on the avifauna of the Los Angeles Basin

S. Lyon, P. Ethington, L. Hall, T. Longcore, S. Safran, A. Shultz, E. Wood
Presenting author: **Sean Lyon**, California State University, Los Angeles, slyon@fieldmuseum.org

Los Angeles, California (L.A.) is a megacity that has experienced a meteoric rise in land area, population and global stature since the early 1900s. Importantly, the unique biodiversity of the region has been preserved through a robust natural history record of bird nests and eggs collected during the latter part of the 19th century. Few cities have such a complete record of biodiversity before intense development. The L.A. data present an opportunity to quantify the temporal effects of urbanization on breeding birds, which is important given that birds are indicators of environmental change. To address this opportunity, we used over 3,200 bird nest and egg records from the Western Foundation of Vertebrate Zoology and other collections, coupled with statistical modeling approaches, to characterize the historical avian community of L.A. between 1870 and 1913. We then compared historical patterns of species occupancy with more contemporary patterns, using data from the Los Angeles Breeding Bird Atlas collected from 1995-1999. We found that historically-common species affiliated with grasslands and freshwater marshes have been nearly extirpated from the region. Species affiliated with woodland habitats continue to occupy foothill communities of the Santa Monica and San Gabriel Mountains, which retain habitat that supports their populations. Our results suggest that the near-total conversion of grassland and wetland ecosystems in the L.A. region has also negatively affected birds that require those habitats, demonstrating the uneven effects of urbanization on species guilds. Restoration projects that restore grasslands and freshwater marshes could likely help return the region's avifauna closer to its historical state.

Long-term patterns in relative abundance of short- and long-distance migrant Red Knots at Delaware Bay, USA, 2006-2021

J. Lyons, H. Bellman, P. Atkinson, A. DeRose-Wilson, G. Austin, G. Breese, J. Clark, R. Du Feu, K. Kalasz, R. Robinson, J. Woods, N. Clark
Presenting author: **Jim Lyons**

Red Knots using the Atlantic-Americas flyway have three main wintering areas: southeastern USA, northern Brazil, and Tierra del Fuego/Patagonia. Stable isotope ratios in feather samples can distinguish individuals as 'short-distance' (southeastern USA and northern Brazil) or 'long-distance' (Tierra del Fuego/Patagonia) migrants. Historically, it was thought that Red Knots passing through Delaware Bay during spring migration included short- and long-distance migrants in nearly equal proportions. We collected feather samples on the Delaware shore of Delaware Bay, USA, from 2006–2021 and tested three hypotheses: 1) the proportion of long-distance migrants on the Delaware shore has not changed over time, 2) long-distance migrants arrive at the Delaware shore later than short-distance migrants, and 3) individual birds use the same wintering area consistently across years. From 2006–2021, the annual mean proportion of long-distance migrants was 0.47 but increased over time. In 2006, the proportion of long-distance migrants was 0.38 but by 2016 had increased to 0.64. Long-distance migrants arrived later than short-distance migrants in some years, but not all. Results from birds that were sampled in multiple years indicated that birds rarely change wintering area. The trend in proportion of long-distance migrants may be explained by phenotypic flexibility and changes in space-use patterns within Delaware Bay. Long-distance migrants face constraints imposed by atrophy of digestive organs, whereas short-distance migrants have greater flexibility in diet and therefore space-use at Delaware Bay and other stopovers.

Low genetic differentiation in a New Guinean passerine family despite strong relictualisation in peripheral habitats

I. Müller, S. Rajan, F. Thörn, P. Ericson, J. Dumbacher, G. Maiah
Presenting author: **Ingo Müller**

New Guinea, the largest tropical island, is topographically complex and is dominated by a large central mountain range surrounded by multiple smaller isolated mountain regions along its perimeter. The island is biologically hyper-diverse and harbours an avifauna with many species found only there. The family Melampittidae is endemic to New Guinea and consists of two monotypic genera: Melampitta lugubris (Lesser Melampitta) and Megalampitta gigantea (Greater Melampitta). Both Melampitta species exhibit scattered and disconnected distributions across New Guinea in the central mountain range and some of the outlying mountains. While the Lesser Melampitta is rather common and found in most mountain regions of the island, the Greater Melampitta is elusive and known from only a few localities in isolated pockets on New Guinea with very specific habitats of limestone and sinkholes. In this project we apply museomics and have resequenced the genomes of the seven known Greater Melampitta samples hosted in museum collections as well as 19 Lesser Melampitta samples across its distribution. By contrasting the population structure of these two species we studied how specific habitat requirement, such as in Greater Melampitta, may affect population connectivity. Phylogenetic and population genomic analyses as well as song differentiation revealed that the Greater Melampitta seemingly consists of a single population in contrast to the Lesser Melampitta that shows much stronger differentiation between localities. This work shed new light on the mechanisms which shaped the intriguing distribution of this family and is a prime example of the importance of museum collections for genomic studies of poorly known and rare species.

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*Offspring Provisioning Rates in an Urban Passerine: Do they Change with Parental Age?

S. MacArthur, C. Barber
Presenting author: **Sasha MacArthur**

Studies have shown that provisioning offspring is one of the most demanding of parental activities in terms of both time and energy. European Starlings (Sturnus vulgaris) are socially monogamous yet facultatively polygynous species. They exhibit biparental care in which both parents incubate the eggs and provision the offspring. Adult European Starlings return to the study site to breed every year, making them an ideal species to examine the relationship between parental age and offspring provisioning rates. They have hackle (throat) feathers whose iridescent length allows classification of adults into one of two age categories 1) second year (SY), or 2) after second year (ASY). The objective of my study was to examine offspring provisioning rates by both males and females who have been observed over at least two years. I predicted that adult males and females will provision their offspring at a high rate than they did when they were younger (from a prior year). In support of my predictions, ASY males tended to provision more on day 7 or 8 of the nestling period. However, ASY males on day 13 or 14 of the nestling period tended to have a lower provisioning proportion (provisions/hr/nestling). I found no significant differences between the provisioning rates of ASY females on days 7 or 8 and 13 or 14, which did not support my predictions. There were no significant differences in the proportion of provisions/nestling/hr made by SY or ASY males or females on day 7 or 8 of the nestling period.

Migration distance covaries with exploratory behaviour in Song Sparrows

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Presenting author: **Beth MacDougall-Shackleton**, University of Western Ontario, Emacdoug@uwo.ca

Movement is a hallmark of animal life: individuals move to feed, to explore their local environment, and to avoid adverse conditions. If factors influencing propensity to small-scale movements such as exploration also influence larger-scale movements such as seasonal migration, these supposedly distinct behaviours may covary among individuals. We characterized the relationship between exploration in a novel room environment, and migration distance inferred from stable isotopes (d2H) in winter-grown tissue, in a breeding population of Song Sparrows (Melospiza melodia). Individuals returning from longer migrations were more exploratory, and unexpectedly, were first captured earlier in the season. We also investigated

candidate mechanisms that if common to both exploration and migration, could explain the correlation between these behaviours. Circulating androgen levels did not predict either exploration or migration distance. Sequencing exon 3 of the dopamine receptor DRD4 identified one variant associated with exploration and a second variant (associated with exploration in other birds) associated with migration distance, but no variants associated with both movements. The relationship between small- and large-scale movement supports the existence of a movement syndrome and provides insight into the evolution of movement over multiple geographic scales. Although our findings are consistent with a common mechanism underlying both exploration and migration, the nature of such a mechanism remains elusive.

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*Nesting patterns, elevational shifts and thermal niche evolution in a Neotropical radiation

F. Machado-Stredel, A. Peterson
Presenting author: **Fernando Machado-Stredel**

Caciques and oropendolas (Cacicinae, Icteridae) occur in a wide diversity of habitats, with most species exhibiting colonial nesting and/or polygynous mating systems. Polygyny is frequent in ecosystems with unevenly distributed resources, such as isolated nesting trees near forest edges. In this work, we investigate the associations between climatic factors, vegetation structure, and nesting patterns of solitary and colonial Cacicinae taxa. We analyzed Google Earth Engine satellite images in areas holding nesting records with the R package rgee, and extracted estimates of vegetation structure (NDVI). Moreover, we estimated mean temperature tolerance intervals in 23 Cacicinae taxa, in order to assess ecological niche conservatism or evolution across the radiation through ancestral reconstructions done in the R packages grinnell and nichevol. We show that solitary nesting caciques tend to breed in areas with higher NDVI values, such as lowland wet forests (e.g., Cacicus u. microrhynchus). On the other hand, colonial polygynous taxa nest in a wider range of ecosystems (e.g., second growth, urban areas). Through our reconstructions, we found signals of expansion and contraction of thermal niches in some of these colonial taxa. For instance, C. chrysonotus exhibits a niche shift into colder temperatures, which corresponds with an elevational shift into habitats of denser canopies (e.g., Andean subtropical forests). Further, polygynous montane taxa also show colonies that are scattered in multiple trees and/or with fewer nests, relative to closely related lowland lineages. We discuss the implications of historical and ecological factors in shaping the distributions and social mating systems of these Neotropical birds.

Conifer specialist or stunted generalist? Competition and habitat use by Chestnut-backed Chickadees (Poecile rufescens)

R. Macklin, J. Jankowski
Presenting author: **Rory Macklin**

It is well understood that interspecific competition can lead to habitat partitioning, but it is challenging to assess whether habitat preferences have evolved due to historical competition with other species or another factor. The Chestnut-backed Chickadee (CBCH; Poecile rufescens) overlap with the Black-capped Chickadee (BCCH; Poecile atricapillus) on the Pacific Northwest's mainland but are isolated from BCCH on Vancouver Island, BC. On the mainland, CBCH are largely restricted to coniferous forests; however, on Vancouver Island CBCH are common in deciduous forests and urban areas. This geography allows us to test the hypothesis that BCCH competitively exclude CBCH from deciduous forests and urban areas in sympatry. We applied eBird data to assess this hypothesis, building an occupancy model for CBCH with sites coded as in or out of the BCCH range. Our analysis showed reductions in occupancy probability across all habitats in sympatry with BCCH, with strongest effects in mixed forests and urban areas. Point counts conducted in the Lower Mainland, BC, and on Vancouver Island suggested a similar pattern: high abundance of CBCH in deciduous and urban habitats on Vancouver Island and near absence in these habitats in sympatry with BCCH. Playback experiments at coniferous forest edges on the mainland will assess CBCH's response to BCCH vocalizations. We predict that CBCH will exhibit subordinate behaviour in playback trials, suggesting that BCCH are competitively dominant in these areas and restrict CBCH to coniferous forest. By assessing habitat preferences in sympatry and allopatry, along with other indicators of competition, we can gain insight into how historical

species interactions impact current distributions

Impacts of vegetation encroachment on American Oystercatcher nest-site selection and reproductive success

T. MacLaurin
Presenting author: **Trevor MacLaurin**

American Oystercatchers (Haematopus palliatus) (AMOY) are experiencing an alarming decline in their productivity in a historically important part of their range, coastal Virginia. Understanding the drivers of this decline is crucial for meeting future conservation goals. We aim to assess if AMOY select areas of available habitat with less dense vegetation and if nests laid in dense vegetation will experience decreased hatching and fledging success. Nest-monitoring surveys took place on two study islands at Chincoteague National Wildlife Refuge, Virginia, between 2007 and 2022 to determine the location, and fate, of AMOY nests. United States Geological Survey Landsat imagery was used to calculate normalized difference vegetation indices to assess vegetation density. Oystercatchers selected areas with significantly less vegetation than expected in surrounding available habitat. Nests in dense vegetation experienced a significant increase in the hatch and fledge success at one of our study islands but showed an inverse relationship at the other. Oystercatchers may select areas with less dense vegetation as it may allow earlier detection of predators. As vegetation encroachment occurs in nesting habitats, a reduction in nesting attempts can be predicted. The role vegetation plays in determining the fate of oystercatcher nests may be strongly influenced by the primary driver of nest failure. Our findings suggest that vegetation negatively impacts nest fate when predation is higher.

Cross-Border Bird Conservation with Climate Change: Co-Production to Overcome Ecological and Jurisdictional Complexity

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A challenge of forest conservation is maintaining biodiversity in managed forests with climate change. In the cross-border Bird Conservation Region (BCR) 12, Boreal Hardwood Transition, historical and current management systems, policy frameworks, human population density, and ecological and economic factors have combined to create more highly fragmented landscapes in the USA than in Canada. As a result, bird species spanning the nations within BCR 12 experience different conservation challenges and may need different conservation solutions. Through a cross-border partnership with the Boreal Avian Modelling Project, the Sustainable Forestry Initiative and the American Bird Conservancy, we developed a co-production framework that engages with forest products, government, non-government (e.g., science and advocacy organizations), and academic sectors to guide research development on bird conservation in managed forests of BCR 12. The initial result of our co-production is a call for increased communication and leadership for conservation throughout BCR 12. Plans for sustainably managing forests that create and/or maintain high quality habitat to support thriving bird populations that are resilient to climate change must further integrate forester, landowner, and manager knowledge of the landscape mosaic of vegetation and known rates and patterns of regrowth. Our research informs how conservation plans must be compatible with the decision-making process, including needs and constraints of the forest products sector and providing non-timber value. Next steps include improved relationship building with landowners, such as Indigenous knowledge keepers with multi-generational insight into landscape ecology.

Barriers to gene flow in North American barn swallows

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In North America, Barn swallows (Hirundo rustica) have experienced a rapid population decline of 59% over the past few decades and, more recently, especially in the northeast of the continent. Across their range, differences in migratory connectivity have been noted. Using light-level archival geolocators, an east-west continental migratory divide was identified for this species with western populations

(Washington and Saskatchewan) migrating shorter distances to Oregon through northern Colombia, and eastern populations to northern South America, to southern Brazil and northern Argentina. Even though eastern populations from Ontario and New Brunswick both migrate long distances, they apparently use different migratory flyways. Such migratory divides could act as barriers to gene flow and so we used a genomic approach (triple digest restriction-site associated sequencing (3dRAD), and whole genome sequencing) to delineate continental-level genetic patterns with respect to migratory patterns. Our preliminary results using 3dRAD data, from six breeding populations across North America indicate, populations in far-eastern Canada have restricted gene flow which could be due to different migration pathways as well as isolation from the last ice age.

Coastal wetlands in Sri Lanka: Ecologically important wintering grounds for thriving shorebirds (order: Charadriiformes)

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Sri Lanka, being a tropical island in the Indian ocean rich with coastal and inland wetlands serves as a wintering destination for migrant avifauna, including shorebirds. The present study assessed the shorebird species richness in selected coastal wetlands in Northern and Southern Sri Lanka from May 2022 to March 2023. Point count stations fixed along transects were surveyed in Vankalai Sanctuary, Mannar islands, TalaiMannar islands and Vidatalativu Reserve in the Northern coast, and Kumana National Park, Bundala National Park, and Kalametiya Sanctuary in the Southern coast of Sri Lanka in both migratory and non-migratory seasons. A total of 32 migrant shorebird species and 8 breeding resident species belonging to 9 families were recorded in the Northern coastal wetlands. In the Southern coastal wetlands, a total of 17 migrant species and 8 breeding resident species belonging to 6 families were recorded. Globally Near Threatened Limosa lapponica, Limosa limosa, Numenius arquata, Calidris ferruginea, Haematopus ostralegus, Rostratula benghalensis and Esacus recurvirostris were among the winter visitors. Nationally threatened breeding residents Gelochelidon nilotica, Thalasseus bergii and Charadrius alexandrines were also observed within the same habitats. Results elaborate that diverse habitats such as lagoons, mixed-mangroves, sandy shores, grasslands, and inland water bodies found within the selected sites facilitate shorebird species by providing resting, feeding, and nesting grounds for winter migrants and breeding residents. Therefore, conservation of wetlands, the wintering grounds of migrant shorebirds will ensure the continuity of their migration while sustaining their populations.

Spatial variation in the association between agricultural activities and bird communities in Canada

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Agriculture is one the main drivers of bird decline in both Europe and North America. While it is clear that agricultural practices and changes in the rural landscape directly and indirectly affect bird communities, we still do not know the extent to which these impacts might change across broad spatial and temporal scales. To address this question, we combined information on agricultural activities with occurrence and abundance of 358 bird species across five time periods spanning 20 years in Canada. As a proxy for agricultural impact, we used a combined index that included different agricultural metrics, such as cropland and tillage area and area treated with pesticides. We found that agriculture impact was often negatively associated with bird diversity and evenness across all 20 years studied, but these associations seemed to vary by region. We found good support for an overall negative association between agriculture impact and bird diversity and evenness the Eastern and Atlantic regions and weak associations in the Prairies and Pacific. These findings suggest that agricultural activities result in bird communities that are less diverse and disproportionately benefit certain species. The spatial variation in the impact of agriculture on bird diversity and evenness we observed is likely a result of regional differences in the native vegetation, the type of crops and commodities produced, the historical context of agriculture, as well as the native bird community and the extent of their association with open habitat. Thus, our work

provides support for the idea that the agricultural impact on bird communities, while largely negative, is not uniform, and can vary in space.

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*The indirect effects of a biological insecticide on habitual diet in Bay-breasted and Cape May warblers

F. Maika, R. Johns, M. MacIvor, J. Nocera
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The spruce budworm (Choristoneura fumiferana, hereafter SBW) is a key prey source for wood-warblers during the breeding season, constituting up to 90% of their diet. However, due to SBWs cyclic population trends which result in severe defoliation, Lepidoptera-specific insecticides such as Bacillus thuringiensis var. kurstaki (Btk) are used to regulate their population density. Thus, our study sought to examine the indirect effects of Btk on the dietary habits of two species of wood-warblers that specialize in foraging on SBW, namely the bay-breasted warbler (Setophaga castanea) and Cape May warbler (S. tigrine). We hypothesized that both specialists would display a functional response to compensate for the reduced prey availability resulting from Btk applications. Our research investigated dietary changes by analyzing isotopic signatures of Î´13C and Î´15N in fecal samples collected from individuals captured via mist net throughout the 2020 and 2021 breeding season. Stable isotope mixing models were used to determine the proportional diet contributions of insect orders in bird fecal samples collected from Btk and control sites. Our findings suggest that the consumption ratio of Lepidoptera in SBW specialists is comparatively insignificant among treatments. This observation implies a conspicuous lack in functional response during the post-spray period in Btk sites. Therefore, it is likely that individuals residing in Btk treatment sites will need to intensify their search behaviour and activity to sustain their Lepidoptera consumption. Further research should investigate the extent to which Btk effects overall fitness as well as reproductive success.

Diversification and rapid plumage evolution within a clade of “Great Speciators” (Alcedinidae:Todiramphus)

J. McCullough, C. Eliason, S. Hackett, M. Andersen
Presenting author: **Jenna McCullough**

Distinct from adaptive radiations, geographic radiations involve rapid diversification across space without the evolution of key innovations or obvious adaptive changes. Determining the drivers of geographic radiations requires multiple lines of evidence that include molecular phylogenetics, biogeography, and trait evolution. One genus of woodland kingfisher, Todiramphus, encompasses several species complexes that are exemplary geographic radiations, such as the Collared Kingfisher (Todiramphus chloris) complex. Distributed from the Red Sea to French Polynesia, Todiramphus kingfishers live in a wide variety of habitats and the genus has diversified rapidly into 28 species and 93 described taxa. However, phylogenetic relationships of Todiramphus are unresolved, owing to their high speciation rate and the relative inadequacies of prior Sanger and reduced-representation sequencing datasets. In addition, less than half of the taxa within this clade have been incorporated into molecular systematic studies. Here, we broadly investigate the tempo and mode of evolution within Todiramphus using the first completely sampled, time-calibrated phylogeny of all described diversity within the genus using whole-genome resequencing at 30X coverage. In addition, we use UV-vis spectrophotometry of hundreds of specimens to assess previously hinted rapid plumage evolution across the clade. We discuss novel relationships found within the genus and how integrative taxonomy is redefining species-level diversity within Todiramphus kingfishers.

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*Distribution and migration chronology of a rapidly increasing population of Sandhill Cranes (Antigone canadensis)

K. McLean, C. Sharp, C. Lepage, K. Lee, B. Fedy
Presenting author: **Kelly McLean**, University of Waterloo, kelly.mclean@uwaterloo.ca

At the beginning of the 19th century Sandhill Crane (Antigone canadensis; 'cranes') populations were largely extirpated from their range. Conservation actions have since enabled the species recovery, and the migratory Eastern Population (EP) breeding range is expanding eastward from its core in the Great

Lakes region to the Canadian provinces of Ontario and Quebec. Given this recent expansion, little information exists for EP cranes breeding in Ontario and Quebec. Our objective is to determine the distribution, chronology, and important use areas of EP cranes that breed in Ontario and Quebec. We deployed GPS-GSM transmitters on 84 adult EP cranes captured on fall stopover sites in Ontario and Quebec in 2019-2022. We calculated kernel density estimates and used the 75% isopleth to delineate breeding, wintering, and stopover locations. Chronology was calculated as the arrival and departure dates between these areas. Cranes initiated fall migration late August to mid-September, and spring migration in late February in all years. Cranes used between one to four stopovers before arriving on wintering grounds in early-mid December. Majority of cranes that travelled beyond southern Ontario during fall migration made at least one stop in Indiana at the south end of Lake Michigan. Cranes used one of three main migration pathways: north of Lake Huron and East or West of Lake Michigan, or through southern Ontario. Which pathway individual cranes used varied between years and seasons. Winter locations were widely distributed between Long Point, Ontario to Peninsular Florida. We document the annual distribution and chronology of cranes using Ontario and Quebec on the rapidly expanding eastern geographic edge of their range.

Artificial intelligence (BirdNET) supplements manual methods to maximize bird species occurrence from acoustic datasets

L. Ware, C. Mahon, L. McLeod, J. Jette
Presenting author: **Logan McLeod**

We examined two manual and two automated acoustic processing methods to obtain reliable and cost-effective bird occurrence information. We processed acoustic data collected from remote ecoregions in northern Yukon, Canada, and assessed the total cost in human effort (hours) and the number of bird species detected. We used comprehensive Visual Scanning to document all bird species detectable on the recordings. We processed ~1% of the recordings using a standard Listening procedure and detected 56% of the present bird community with 71.5 hours of human effort. We used a Recognizer (BirdNET) to detect 139 species with one hour of human effort, although the accuracy of detections was not confirmed. We then used Recognizer with Validation and detected 89% of the present bird community with ~22% of the effort required for Visual Scanning. We reduced the proportion of false positive species from 38% to 2% and decreased the time required to complete validation by increasing the confidence threshold in BirdNET. As an application of our approach, we combined Listening and Recognizer with Validation to process recordings from five northern ecoregions and found a 23-63% increase in the number of bird species detected with little additional effort. Recognizer with Validation detected waterfowl, waterbirds, and shorebirds, and passerines and other terrestrial birds not detected by Listening. Combining Listening and Recognizer with Validation can maximize detections from large passive acoustic monitoring (PAM) datasets. In particular, these methods have high utility for regions with low bird abundance and diversity (i.e., arctic, sub-arctic, alpine ecosystems) where species distributions are expected to shift with a changing climate.

Consumed dietary antioxidants make it to where they are needed most (the mitochondria) but only if birds are exercising

C. Cooper-Mullin, W. Carter, R. Amato, D. Podlesak, S. McWilliams
Presenting author: **Scott McWilliams**, University of Rhode Island, srmcwilliams@uri.edu

Whether dietary antioxidants are effective for alleviating oxidative costs associated with energy-demanding life events first requires they are successfully absorbed in the digestive tract and transported to sites associated with reactive species production (e.g. the mitochondria). Flying birds are under high energy and oxidative demands, and although birds commonly ingest dietary antioxidants in the wild, the bioavailability of these consumed antioxidants is poorly understood. We show for the first time that an ingested lipophilic antioxidant, Î±-tocopherol, reached the mitochondria in the flight muscles of a songbird but only if they regularly exercise (60 min of perch-to-perch flights two times in a day or 8.5 km day-1). Deuterated Î±-tocopherol was found in the blood of exercise-trained zebra finches within 6.5 hrs and in isolated mitochondria from pectoral muscle within 22.5 hrs, but never reached the mitochondria in caged sedentary control birds. This rapid pace (within a day) and extent of metabolic routing of a dietary

antioxidant to muscle mitochondria means that daily consumption of such dietary sources can help to pay the inevitable oxidative costs of flight muscle metabolism, but only when combined with regular exercise.

The Effects of Structural Size on Swainson's Hawk Natal Dispersal Distance and Recruitment Dynamics

E. Meisman, C. Vennum, C. Briggs, M. Johnson
Presenting author: **Elizabeth Meisman**, Cal Poly Humboldt, edm170@humboldt.edu

Larger structural size is typically viewed as a positive individual trait assumed to benefit survival chances and overall fitness. For territorial species, increased structural size relative to conspecifics could aid with obtaining a territory, finding a mate, and territorial defense. We explore this dynamic in a hemispheric migrant, Swainson's Hawk (Buteo swainsoni), which exhibits strong breeding and natal philopatry. Previous research from the Butte Valley breeding population has shown that average natal dispersal was 9 km in the mid-1990s, and has remained constant, despite the population doubling. From 2009 to 2018, over 800 individual Swainson's Hawks were marked as nestlings; of those, 111 (55 females, 56 males) were later observed breeding within the boundaries of our long-term study area. From previous work we know nestlings that are recruited into the local population are structurally larger than those never resighted. We also know that females disperse farther than males. Given these population observations, we hypothesize that nestling structural size influences natal dispersal distance, age of recruitment, and quality of territory obtained. We predict that relatively smaller recruits will have larger natal dispersal distances, recruit at older ages, and be relegated to less productive territories.

Imitation, territoriality, and acoustic variation in Savannah Sparrows; the vocal learning program of a wild songbird

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Presenting author: **Daniel Mennill**, University of Windsor, dmennill@uwindsor.ca

Vocal learning underpins both human language and bird song, and shapes social relationships, sexual behaviour, and animal culture. A growing body of research supports the idea that vocal learning allows songbirds to gain a fitness advantage by adopting songs that are similar to territorial neighbours. Through a decade-long field study of Savannah Sparrows (Passerculus sandwichensis), we studied vocal learning in free-living migratory birds. We followed individuals from birth to adulthood to investigate their vocal learning program. Through a six-year playback experiment, we provide the first ever experimental evidence supporting the longstanding hypothesis that wild birds learn songs by listening to conspecific tutor song. Through long-term studies of vocal ontogeny, we demonstrate that birds learn a surplus of songs early in life but retain only one song into adulthood, selecting a song that shows high similarity to neighbours' songs. Through bioacoustic mapping, we reveal that these behaviours give rise to a pattern of microgeographic variation with spatial clusters of similar-sounding males. Through both territory recordings and playback simulations, we show that common and rare song types elicit different responses from territorial adults, revealing benefits of acoustic conformity to locally common phenotypes. Taken together, our observational and experimental results reveal a complex vocal learning program for Savannah Sparrows, where the songs learned early in life have fitness consequences for territorial adults, and cultural consequences that shape patterns of geographic variation.

Complexity matters when investigating relationships between birds, insects, and pesticides

N. Michel, T. Meehan
Presenting author: **Nicole Michel**, National Audubon Society, nicole.l.michel1@gmail.com

North American bird populations have experienced dramatic and ongoing losses since 1970, making identification of the drivers a task of critical importance. Recent scientific studies and news articles have reported an 'insect apocalypse,' and subsequent studies have attempted to link insect declines with declines of insectivorous birds, particularly aerial insectivores. However, neither insect nor insectivorous

bird declines are universal, and the relationships between them – and the pesticides often linked to the declines – are highly complex. Here, we present a literature review as well as the results of three new studies investigating relationships between birds, insects, and pesticides. Recent publications show that insect population change varies both among taxa and across space, with a mix of declining, increasing, and stable trends. Similarly, bird population trends – including of aerial insectivores – vary among and within species, with limited concurrence. Moreover, only a small subset of insects is available to and consumed by any species or group of birds. We found that North American landbird proportional population losses since 1970 were not related to insect dependence. Further, while pesticide use at a local scale was linked to population declines in highly insectivorous birds, at a continental scale insectivorous bird population trends showed a mix of positive and negative relationships with pesticides. While many bird species are dependent on insects, the multiple factors influencing both insect and bird populations and species- and scale-specific variation in their relationships add a level of complexity that limit our ability to make simple causal linkages.

Experimental alteration of male parental care reveals benefits of pairing with good fathers in a wild bird population

K. Miller, A. Mueller, A. Atkins Coleman, K. O'Neil, E. Bowers
Presenting author: **Kelly Miller**, University of Memphis, kdmller3@memphis.edu

In sexually reproducing species, mate choice can profoundly impact individual fitness, as males and females usually face fundamentally different selective pressures. Consequently, individuals should be selected to alter parental investment strategies according to social and environmental conditions. Here, we experimentally manipulated male wing length (and, inherently, flight costs) in a wild population of prothonotary warblers (Protonotaria citrea) to investigate whether this is a preferred, sexually selected trait that induces females to differentially invest in offspring on the basis of male attractiveness and perceived 'quality.' Males with longer wings acquired more mates and were more likely to mate polygynously but provisioned their offspring less than males with reduced wing lengths. Females, in turn, responded to changes in heightened male provisioning – which had a strongly positive effect on eventual recruitment of offspring as adults into the local breeding population. Specifically, females paired with experimental males, who provided an increased level of food provisioning for their nestlings, were less likely to switch mates before producing a subsequent brood. In these subsequent broods, females produced a larger proportion of sons than daughters, and increased levels of paternal provisioning led to greater nestling fledging success. Thus, our results are consistent with life-history theory, and suggest that, although females might initially prefer longer-winged males as mates, decisions about whether to mate with them in the future hinge strongly on their assessment of male parental abilities.

Incorporating automated sound identifications from the Merlin app into species distribution models

E. Miller, C. Gomes, V. Ruiz-Gutierrez, G. Van Horn, C. Wood, D. Fink
Presenting author: **Eliot Miller**

In this talk, we provide an early look inside a project with immense potential to improve our understanding of the natural world: harnessing the model behind the Merlin app's automated sound identification features to process large streams of audio data and integrate these detections with eBird citizen science data. To date the primary use case for Merlin Sound ID has been live detection on mobile devices. Our current work seeks to extend the model for use over existing recordings, such as those collected by autonomous recording units. We present a preliminary assessment of the model's precision and recall rates, both in terms of live phone usage and at the level of the entire file/recording. We show how these detections can be incorporated into species distribution models, and discuss next steps for the project.

Estimating the weight of the Great Auk and its egg

R. Montgomerie, T. Birkhead
Presenting author: **Robert Montgomerie**

The presumed body mass of the Great Auk was derived from hearsay in a report from the 18th century

and a more recent comparative analysis based on skeletal measurements. We calculated new estimates for body and egg mass from both skeletal measurements and new data on the volume and shape of birds' eggs, using comparative methods that control for the effects of phylogeny. We found that the previously reported body mass (4.5-5 kg) and egg mass (327) of the Great Auk have likely been in error and are closer to 3700 g and 380 g, respectively. Correcting the estimates of body and egg mass of this extinct bird has implications for comparative studies that estimate the body mass of other extinct Pan-Alcidae, as well as to predict aspects of chick development, ecology, and life history of this iconic species.

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*Assessing the migratory basis and role of climate in a cryptic mtDNA haplotype contact zone in Audubon's Warblers

K. Montoya, J. Schmitt, A. Johnson, S. Szarmach, D. Toews, C. Witt
Presenting author: **Kyana Montoya**

Audubon's Warblers (Setophaga coronata auduboni) breed across a broad latitudinal range in montane forests of western North America. In the northern part of its range, its mitochondrial (mt) genome appears to be one that introgressed from the Myrtle Warbler (S. c. coronata), its close relative to the north. The mt genome in the southern part of its range is approximately four percent divergent from that of the Myrtle Warbler and is thought to have evolved alongside the original divergence of these two taxa. Between 32.5Â°N and 40Â°N, these two highly divergent mt genomes co-occur, cryptically, in Audubon's Warbler populations. The frequency of each mt type varies clinally over several hundred kilometers of discontinuous, montane forest habitat. This pattern of incomplete introgression suggests that the Myrtle Warbler mt genome conferred a selective advantage when paired with an Audubon's Warbler nuclear genome, but only at northern latitudes. Previously, it was hypothesized that energetic demands associated with migratory flight in northern Audubon's Warblers, but not southern ones, formed the basis of this advantage. Here we critically examine that hypothesis by looking for evidence of a migratory divide associated with the mt contact zone occurring in the Southwest. Further, we examined the mt frequency cline across the landscape by compiling 565 haplotyped and georeferenced Audubon's Warblers from throughout the mt contact zone. Population frequencies that deviated from clinal expectations were used to test whether climate conditions favor one mt type over another, providing a potential explanation for the pattern of incomplete introgression.

The importance of agroforestry systems to Blackpoll Warblers during the non-breeding season in Colombia

A. Morales Rozo, P. Taylor, K. Hobson, G. Colorazo Zuluaga, N. Bayly
Presenting author: **Andrea Morales Rozo**, Universidad Nacional de Colombia, Universidad de los Llanos, anmoralesr@unal.edu.co

The Blackpoll warbler (Setophaga striata) is one of the few -Nearctic-Neotropical migrants that over-winters in the Orinoquia-Amazonian region of South America. Despite being in steep decline, virtually no information is available on the species' winter ecology and demography. Using surveys and VHF tracking, we contribute to the knowledge of the non-breeding ecology of Blackpoll Warbler in Colombia by addressing 1) How occupancy rates of Blackpoll Warbler vary across the core over-wintering range in eastern Colombia and 2) Which habitats (i.e., forest vs. agroforestry) are of higher quality based on home range size and the distribution of sex- and age classes between habitat types and habitat-specific overwinter survival. Our results show that precipitation and net primary productivity influenced occupancy rates at the regional scale, while at the landscape level occupancy rates were higher in agroforestry systems than forested habitats. At the habitat scale, occupancy rates were negatively related to tree density. We detected inter and intra-seasonal site fidelity, with variation in home range between habitats, being larger in citrus plantations than shade cocoa plantations. We also found variation in survival between non-breeding seasons but no clear pattern in sex and age ratios between habitats. These results suggest that agroforestry systems such as shade-grown cocoa could offer an alternative for Blackpoll Warblers considering the high rates of deforestation and continuing expansion of intensive agriculture/livestock in the region. Research targeted at comparing different agroforestry systems would help to combat Blackpoll population declines.

Winter population trends and environmental drivers for three species of temperate shorebirds

E. Muñoz Salas, E. Palacios, L. Alfaro, M. Reiter
Presenting author: **Estefania Muñoz Salas**, CICESE, afet.360@gmail.com

Current assessments indicate that populations of several species of North American shorebirds are declining. However, limited monitoring programs south of the U.S.-Mexico border have precluded assessments of the conservation status of temperate breeders on their principal wintering grounds. The Migratory Shorebird Project (MSP), active since 2012 throughout the Pacific Americas Flyway, provides an opportunity to detect changes in non-breeding shorebird distribution and abundance. We used annual survey data collected using the MSP monitoring protocol to assess population trends of three temperate breeders: Marbled Godwit, Willet, and Long-billed Curlew on their main wintering grounds in northwest Mexico and California. We also analyzed the associations between fluctuations in their abundance and environmental variables using Generalized Linear Mixed Models. We found a significant negative trend in the wintering population of these three species in the study area. Marbled Godwit and Willet also presented significant negative trends in California and the Baja California Peninsula (BCP). In addition, we determined that Marbled Godwit and Willet abundance presented a significant positive association with minimum temperature and a significant negative association with precipitation. For Willet, we also found a negative and significant association with sea surface temperature. Our study provides evidence that temperate shorebirds are responding to a warming climate and highlights the importance of long-term winter shorebird surveys and their need to continue.

The importance of renesting to the viability of an urban population of Willow Flycatchers

S. Doorly
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The Willow Flycatcher (Empidonax traillii) is a geographically widespread species that is declining in western North America, and in Oregon, where it is listed as an at-risk species due to habitat loss and fragmentation. Its nesting biology has been well-studied in 'natural' habitats but has heretofore not been studied in urban environments. We studied the reproductive/nesting biology of Willow Flycatchers in two parks in urban Portland, Oregon, to determine if (1) WIFLs nested successfully in urban parks, (2) and produced sufficient young to support locally viable populations. WIFLs bred successfully; 47% of nests yielded young (after correction for exposure time) and at rates that did not differ from studies conducted in nonurbanized native habitats. Nest success differed among the 12 plant species used for nesting with the highest success occurring when nests were placed in either Himalayan blackberry (Rubus armeniactus) or Pacific Ninebark (Physocarpus capitatus). Our modeling of the viability of local population used observed nest productivity, 'borrowed' adult survival rates from other WIFL populations, and variable rates of nest replacement (0.6, 0.7, and 0.8), and number of replacement nests (0, 1, or 2). Our results showed that population decline (Î» < 1.0) was inevitable. However, additional simulations that assumed that WIFLs nested solely in Himalayan blackberry and Pacific ninebark showed marked population growth at even the lowest renesting rates. Renesting thus appears vital to successful WIFL reproduction, and our data suggest that with proper management, WIFL populations are sustainable in urban areas in the Pacific northwest.

Phylogenomic analysis and novel taxon of a widespread Amazonian antbird, Myrmoborus myotherinus

M. Mutchler, A. Schoonmaker, B. Costa, H. Handika, A. Hiller, G. Lima, B. Matinata, J. Salter, D. Schmitt, B. Faircloth, R. Brumfield, G. Del-Rio
Presenting author: **Marquette Mutchler**

The Amazon Basin, renowned for its incredible biodiversity shows a striking biogeographic pattern of species replacement across its rivers. This pattern is well-illustrated by birds in the Suboscine tribe which represent 20% of Amazonian bird diversity. Due to the remoteness and size of the region, little work has been done to examine the exact impacts of these tributaries on local avifauna. During a three-week-long

scientific expedition along a tributary of the Amazon historically reported as insignificant in shaping the distributions of birds across its banks, the Juruá River, our group collected specimens with pronounced plumage differences in a suboscine species inhabiting opposing banks. Females of M. myotherinus from the west bank of the Juruá River show white underparts while females from the east bank show buff orange underparts. Using 65 scientific specimens of all currently described subspecies of Myrmoborus myotherinus, we built phylogenetic trees based on reduced representation genomic data (ultraconserved elements and mitochondrial genome), assessed phylogeographic patterns, and described morphological and vocal variation in birds in the genus Myrmoborus. Our results show that monophyletic groups align with river barriers, including the Juruá River. We also found that phylogenetic trees built with genomic data and mitochondrial markers show significant discordance. In addition, vocal differences align with phylogeographic patterns, with the exception of an interesting case in a series of headwaters. Our results suggest the presence of a novel taxon of Myrmoborus myotherinus in Western Amazonia, and highlight the importance of scientific collections to fully describe Amazonian bird diversity.

The effect of feather microstructure variation on water repellency.

F. Muzio, M. Rubega

Presenting author: **Frank Muzio**, University of Connecticut, fmsmuzio@gmail.com

Feathers are complex structures that serve a variety of vital functions. Of these functions, water repellency is crucial; its loss can eliminate the others. Past research has attempted to explain how exactly feathers repel water, but important gaps in our understanding of what is happening at the water-feather interface remain. Most prior studies have used the diameter and distance between barbs to calculate a structural index of functional pore size, as a proxy for wettability, rather than measuring wettability directly. Barbules are largely ignored in previous work on feather water repellency. Yet, they constitute most of the feather surface: pore size is in fact set by barbules, not barbs. Barbules, and barbule density, show considerable morphological variation across birds. Little is known about the causes or consequences of this variation. Nearctic sparrows provide a phylogenetically controlled opportunity to examine feather structure and wettability among closely related land birds that experience a gradient of water exposure, from dry uplands to wetlands. We used contact angles to directly measure the wettability of different feather types across different species. We used electron microscopy to compare the morphologies of the barbules from the different feather types and species. We present evidence there are structural differences at the barbule level that play a part in a feather's ability to shed water. We suggest that a reevaluation of our understanding of how feathers keep a bird dry, and how and why their water repellency varies with phylogeny, life history, and habitat, is necessary.

Interspecific territoriality has facilitated increases in the breeding habitat overlap of North American passerines

D. Nesbit, M. Cowen, G. Grether, J. Drury

Presenting author: **Daniel Nesbit**

As species' ranges shift in response to human-induced global changes, species interactions are expected to play a large role in shaping the resultant range dynamics and, subsequently, the composition of modified species assemblages. Most research on the impact of species interactions on range dynamics focuses on the effects of trophic interactions and exploitative competition for resources, but an emerging body of work shows that interspecific competition for territories and mates also affects species range shifts. As such, it is paramount to build a strong understanding of how these forms of behavioural interference between species impact landscape-scale patterns. Here, we examine recent (1997-2019) range dynamics of North American passerines to test the hypothesis that behavioural interference impacts the ease with which species move across landscapes. Over this 22-year period, we found that fine-scale spatial overlap between species (syntopy) increased more for species pairs that engage in interspecific territoriality than for those that do not. We found no evidence, however, for an effect of reproductive interference (hybridisation) on syntopy, and no effect of either type of interference on range-wide overlap (sympatry). Examining the net effects of species interactions on continent-scale range shifts may require species occurrence data spanning longer time periods than are currently available for North American passerines, but our results show that interspecific territoriality has had an overall

stabilising influence on species coexistence over the past two decades.

Song evolution in Antpittas (Aves: Grallariidae), morphology and frequency not always go together

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The evolution of songs in birds is subject to different selection pressures. The variation in the acoustic features of songs can be explained by interspecific differences in morphology or by the physical properties of the habitat. We evaluated these two hypotheses to explain the variation in the songs of Antpittas (Genus: Grallaria). We collected song and habitat data for 47 taxa, body mass data for 42 taxa, and bill morphology for 25 taxa. We ran linear and phylogenetic models of frequency and temporal variables of the song vs. body mass, bill morphology, and habitat, relying on a recent phylogeny of the genus that showed two well-defined clades. Body mass explained part of the variation observed in peak frequency; this relationship was evident in one clade; but not in the other. This suggests that selective pressures are operating differently in the two clades. We hypothesized that the clade where birds share similar frequencies might reflect convergence on ideal sound transmission features of their mountain habitat. In addition, we found that habitat features explained variation in temporal features, and phylogeny explained bandwidth variation. To our knowledge, this is the first evidence of a group of birds that show no variation between frequency and body mass. Surprisingly, two sister clades exhibit different relationships between body size and frequency, whereas only one clade shows the widespread allometric relationship between frequency and body mass. The most striking result is that sister clades exhibited two different relationships between body size and peak frequency; there must be a strong selective force operating in one of these clades to produce such an unusual pattern.

Song variation drives weak asymmetric patterns of aggression between subspecies of Variable Seedeater

D. Ocampo, L. Sandoval, J. Uy
Presenting author: **Diego Ocampo**, Louisiana State University, dcrscout@yahoo.com

Sexual signals that convey information on population identity may be used for conspecific recognition and reduce hybridization after secondary contact, by promoting assortative mating. Here, we studied visual and acoustic signals that are commonly used in sexual selection and species recognition in birds, to evaluate their role in reproductive isolation in a recently diverged clade of Neotropical birds. Subspecies of the Variable Seedeater vary in plumage color and song, and established secondary contact at two independent contact zones, hybridizing in one but not in the other. We evaluated divergence in song in allopatric populations close to the contact zone where two subspecies do not hybridize. Then, we used an experimental approach to evaluate the role of divergent secondary sexual traits in reproductive isolation. We found significant differences in song structure and composition of song elements between subspecies. However, playback experiments did not show clear effects of color and song on aggressive response. Plumage coloration did not elicit differential aggression in territorial males; however, in one population males were more aggressive towards homotypic than heterotypic songs. Lastly, we characterized the song structure of hybrid individuals at the second contact zone to evaluate how songs vary with secondary contact. Hybrid individuals sang songs of intermediate characteristics compared to parental subspecies. Overall, these results suggest that behavioral isolation based on secondary sexual signals is weak in this clade, and divergent signals may converge after secondary contact, favoring further hybridization.

Performance of novel remotely-sensed variables in predictive species distribution models for Argentinean forest birds

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Presenting author: **Ashley Olah**

Halting biodiversity loss is a major conservation goal, and requires understanding the environmental correlates of biodiversity patterns. One way to assess these relationships is through species distribution modelling. In such models, commonly used environmental variables include land cover classes and climate metrics. However, these may fall short of adequately characterizing factors that influence species distributions. Recently developed remotely sensed measures may offer additional predictive power, complementarity, or even replace commonly used environmental variables in species distribution models. We modeled species distributions for 181 forest-affiliated bird species in Argentina, using three sets of environmental variables: 1) remotely sensed variables characterizing forest structure, phenoclusters, spatial-temporal variability in greenness and land surface temperature, 2) commonly used environmental variables characterizing elevation, land cover, soil type and precipitation 3) the combination of all remotely sensed and commonly-used variables. Within the remotely sensed variable set, spatial heterogeneity in winter land surface temperature, phenoclusters, and mean forest height were important for many species. Within the 'commonly used' variables, precipitation of the driest quarter was important for the most species. When all variables were combined, phenoclusters and precipitation of the wettest quarter were the most important variables in models. The best models using remotely-sensed, non-remotely sensed, and all variables in combination performed similarly. In areas where land cover classes are not well delineated, the use of remotely sensed variables expands options for modeling species' distributions.

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*Phenotypic and genomic variation in five subspecies of Song Sparrow (Melospiza melodia) in Alaska

C. Oliver Brown, K. Collier, K. Mills, F. Spaulding, T. Glenn, C. Pruett, K. Winker
Presenting author: **Caitlyn Oliver Brown**

Under local adaptation populations evolve traits in response to the local environment. Island and isolated populations experience different selection pressures than their mainland counterparts, which enables study of how phenotypes and genotypes respond to selection pressures. We use a group of five subspecies of Song Sparrow (Melospiza melodia) in Alaska to examine local adaptation. Song Sparrows occur across southern Alaska from Attu Island to southeast Alaska, and from west to east these populations demonstrate striking body size differences (larger-to-smaller) and a change from a sedentary to a migratory/partially migratory life-history strategy. We examined the phenotypic attributes of these populations and used whole-genomic data to determine relationships and test candidate loci for evidence of selection. Phenotypic measurements of museum specimens (n = 227) quantified the dramatic size differences among these populations, with westernmost maxima being ~1.7 times larger than easternmost rufina. Ultraconserved elements (UCEs) and candidate genes were extracted from whole-genomic data. Phylogenetic analysis of UCEs showed the westernmost subspecies (M. m. maxima) as sister to the other Alaska M. melodia subspecies, suggesting maxima colonized earliest and that Alaska was later recolonized by ancestors of the remaining subspecies. Among the candidate genes we analyzed for body size, migration, color, and salt tolerance, we found no evidence of positive selection. This likely stems from limitations of data or methodology.

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*Is the Grass Always Greener? The Response of a Migratory Warbler to Key Environmental Factors

M. Ore, C. Rayne, C. Bossu, K. Ruegg, G. Graves, M. Webster
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Species across the globe are experiencing unprecedented rates of change to their environmental conditions. How these species are responding is a major question in ecology and evolutionary biology today. High-throughput sequencing advances allow us to directly examine changes to the genome as a result of climatic variables. We asked how genetic markers vary across the landscape in a Neotropical migrant, the Black-throated Blue Warbler (Setophaga caerulescens). Then, we used existing variation of climate variables across that landscape to find regions of the genome highly associated with climate variables. We conducted whole genome sequencing on 200 individuals from 12 populations and mapped genetic variation across the landscape using a gradient forest. Then we ran a genotype by environment analysis to determine genetic variation that is best explained by environmental variation and which environmental factors are most closely associated with genetic variation. Results show there are narrow

regions of the genome that are highly associated with environmental variables such as elevation, precipitation seasonality (how consistent is precipitation throughout the year), and isothermality (how similar daily temperature fluctuation is to annual temperature fluctuation) . This suggests there may be local adaptation to environmental conditions within breeding populations.

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*Investigating physiological tradeoffs associated with avian haemosporidian infection during migration stopover

G. Orfanides, S. Pagano
Presenting author: **Gabriella Orfanides**

Migration is a demanding period of the songbird annual cycle, and both migratory flight and refueling at stopover sites require significant physiological effort. As such, songbirds may reallocate physiological resources away from energetically costly processes such as immune function during migration. However, persistent chronic blood parasite infections could necessitate that birds maintain an active immune system throughout migration, which could force tradeoffs with refueling rates at stopover sites and/or migration pace. Here, we sampled Canada Warblers (Cardellina canadensis) and Black-Throated Blue Warblers (Setophaga caerulescens) at a Lake Ontario stopover site (Braddock Bay) during spring migration to evaluate physiological tradeoffs that could be associated with avian haemosporidian infections. Warblers were screened for haemosporidians using a PCR-based method, total leukocyte counts were derived as indices of immune status, and plasma metabolite profiling was used to assess refueling rates and nutrient utilization of birds during migration stopover. Arrival timing with respect to uninfected and infected individuals was compared to evaluate potential effects on migration pace. Results provide insight into the impact of blood parasite infections on migrant birds and illustrate tradeoff scenarios that could influence stopover behavior and overall migration successfulness.

Small-scale land-use changes in a desert environment reduce breeding success in a cooperative breeding bird

K. Oswald, U. Roll, O. Berger-Tal
Presenting author: **Krista Oswald**

Human settlements can provide resources in an otherwise stark environment, potentially buffering against high temperatures and thus climate change. It is thus expected that breeding in settlements would result in higher fitness, However, choosing to raise offspring in these resource-rich environments may have unintended negative consequences. Between March and July 2022, we monitored 43 breeding attempts from 15 groups of Arabian babblers (Argya squamiceps) around Sde Boker in the Negev desert, Israel. Nests were recorded as being in areas of either high (Orchards, Settlements) or low (greater Plateau) human disturbance. Using remote cameras we examined overall breeding success, brood size, and causes of nest failure (e.g. predation). When nestlings were 6-days old we also calculated daily change in body mass (~ 800–1800 IST) as well as adult provisioning rate. For babblers nesting in Settlements, breeding succes was lower for all examined areas: lower overall success, smaller brood sizes, and smaller nestlings. Despite higher abundance of resources in Settlements, provisioning rate did not differ between habitat types and nestlings in Settlements gained less mass than those in Orchards, although there was no difference between Settlements and Plateau. The implications of our study remain to be seen, but it does seem increasing development in the babbler's desert habitat could result in declining populations. Whether Settlements presented a potential ecological trap versus a sink remains up for debate, but a small amount of human intervention (e.g. encouraging residents to keep cats indoors) could help improve their overall fitness.

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*Why did the sparrow cross the dike? Trade-offs for a saltmarsh specialist breeding in human-made dikelands

K. Owen, M. Mallory, N. McLellan, J. Nocera
Presenting author: **Kiirsti Owen**

The Acadian subspecies of Nelson's Sparrow (Ammospiza nelson subvirgata) breeds in saltmarshes from northern Massachusetts to New Brunswick and eastern Quebec. In the Canadian Maritimes, these birds

also successfully breed in diked agricultural lands (i.e., 'dikelands') that were originally created by Acadian settlers in the 1600s. Little is known about how and why Nelson's Sparrows use dikelands for breeding habitat. To fill this knowledge gap, we attached radio tags to adult Nelson's Sparrows (n = 76) over two summers in southeastern New Brunswick, Canada. We tracked birds in saltmarsh and dikeland habitats through the breeding season and used kernel density estimation to look at habitat use for each individual. Most birds tracked in dikeland habitats also used saltmarshes, but most birds tracking mainly in saltmarsh did not use dikelands. To understand why these 'saltmarsh specialists' are choosing to breed in human-made dikelands, we monitored nest fates in natural saltmarsh and human-made dikeland habitats. We also quantified competition and vegetative cover. We hypothesized that flood risk in saltmarshes played an important role in Nelson's Sparrows' decision to nest in dikelands given that the Bay of Fundy has the highest tides globally. Therefore, in addition to regular nest-checking for signs of predation, destruction, and abandonment, we used temperature loggers in nests to monitor flood risk. With rising sea levels and continued habitat alteration, it is important to better understand how populations use natural and human-made habitats to carry out important life stages.

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*Investigating the relationship between ancestry and song repertoire in a chickadee hybrid zone

S. Palmer, J. McEntee
Presenting author: **Shelby Palmer**

Birdsong is a complex vocalization that functions in territory defense and mate attraction in passerine birds. In the oscine passerine clade, young birds develop song largely by learning from conspecifics rather than innately from a neural template. In taxa that form hybrid zones, the simultaneous presence of two distinct species' songs can result in mismatch between song behavior and genetic ancestry. One such example is the hybrid zone between the Black-capped chickadee (Poecile atricapillus) and Carolina chickadee (P. carolinensis), oscine passerines that hybridize at their range interface stretching latitudinally from New Jersey to Kansas, United States. Many hybrid zone-dwelling chickadees sing atypical songs, and song has not been shown to correlate with ancestry in hybrid zone populations. In allopatry, however, the two species' songs remain exceptionally distinct, suggesting an innate constraint on song development. The aim of this project is to elucidate a connection between ancestry and song in Black-capped and Carolina chickadees. To address this aim, I combine genotype scores and recordings of full song repertoires of individual chickadees in a small hybrid zone population in Missouri. Preliminary results suggest that most singing chickadees at this site produce songs that seem typical of both species, as well as obviously atypical songs. Rather than choosing acoustic measurements considered typical of either species' song as variables to be predicted by genotype, I perform a principal component analysis on many fine-scale acoustic measurements of song. This allows me to quantify how each individual's song repertoire is arranged in the multivariate space generated by the entire population's song production.

Are Birds a Dispersal Vector of Litylenchus crenatae mccannii, the Nematode Associated with Beech Leaf Disease?

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Presenting author: **Spencer Parkinson**, WVU, srp00019@mix.wvu.edu

Beech leaf disease is a novel forest pathogen first discovered in Lake County Ohio in 2012. It has since been detected in 10 other states, and Ontario Canada. Symptoms of beech leaf disease include darkening green stripes or bands between lateral veins on leaves progressing to crinkling and puckering of leaves and heavy chlorotic striping eventually often leading to tree mortality. In 2021 it was discovered that a novel nematode, Litylenchus crenatae mccannii, is highly associated with beech leaf disease. Our objectives are to determine if birds can act as a vector for the spread of beech leaf disease (1) through endozoochory or ingestion of infected beech buds and excretion of viable nematode (2) through ectozoochory or having nematodes externally on mites or in the feathers, feet, or beaks of the birds. We mist netted for songbirds in Winter of 2021-22, Spring 2022 and Winter 2022-23, and collected fecal and ectoparasite samples at the Allegheny National Forest, PA and Holden Arboretum, OH, two areas affected by Beech Leaf Disease. We used bird feeders to attract species that could consume beech buds,

and thus the nematode. In Winter 2022-23 we caged birds for < 6 hours and fed them beech buds with the nematode present and collected fecal samples. We used PCR to determine the presence of Litylenchus crenatae mccannii DNA in samples. We captured 139 birds of 21 different species and from those collected over 200 samples. We have had 14 positive PCR results so far. Our next step is determining the viability of the nematode after it has passed through the bird's gut to understand it ability to colonize new beech stands.

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*Sitting ducks: Landscape factors, impacts, and management for black vulture conflicts near animal care facilities

H. Partridge, S. Gagné, C. Hammelman

Presenting author: **Hannah Partridge**, UNC-Charlotte Dept of Geography and Earth Science, hpartrid@uncc.edu

The black vulture (Coragyps atratus) is expanding its range across North and South America. This expansion has led to more conflicts, especially in areas with more livestock due to concerns of livestock depredation by black vultures. Due to the complexity of conflicts, we used a mixed-methods approach that incorporates quantitative and qualitative methods to understand (1) the social and environmental factors contributing to human-black vultures conflicts near animal care facilities, and (2) the most appropriate management solutions for these situations. To address our objectives, we are investigating a case of human-black vulture conflict at an animal care facility in the Charlotte Metropolitan Area, USA. Landscape analyses using eBird black vulture observations, changes in landcover and road density, and the availability of transmission towers and landfills show no significant changes and suggest that broader environmental factors are not contributing to this conflict. To investigate the social factors, we conducted semi-structured interviews of researchers and practitioners that work with conflicts globally as well as community members that are impacted by this conflict. These results suggest that food is a major determinant of black vulture conflicts, mediated by the human management of potential food sources. In this case, a variety of available and accessible food sources have likely caused the black vulture population to increase rapidly in the area, concerning the animal care facility and impacting the community. To coexist with black vulture populations globally, we need to evaluate the factors contributing to each conflict and address the human management of food sources available to black vulture populations.

Wood warbler population dynamics in response to mast seeding regimes in Europe

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Presenting author: **Gilberto Pasinelli**, Swiss Ornithological Institute Sempach, gilberto.pasinelli@gmail.com

Mast seeding is the episodic mass production of plant seeds synchronized over large areas. The resulting resource pulse can profoundly affect animal populations across trophic levels. Over the past 30 years, the frequency of tree masts has increased while populations of the ground-breeding wood warbler Phylloscopus sibilatrix have declined in several regions of Europe. We hypothesized that increasing mast frequencies have contributed to the observed population declines due to suboptimal breeding conditions in years after masting becoming more frequent. We found that reproductive output in four study areas in central Europe was between 1.5 and 1.8 times lower in years following masting than non-masting. For each study area, we then compared population trends predicted from matrix projection models based on local reproductive output and mast frequencies with observed population trends to investigate if population trends were related to mast year frequency. In Wielkopolska National Park (Poland) and Hessen (Germany), masting occurred only every 4 years and populations were stable, whereas in Jura (Switzerland) and BiaÅ‚owieÅ¼a National Park (Poland), masting occurred every 2 and 2.5 years, respectively, and populations were declining. The simple matrix projection models predicted the relative difference among local population trends of the past 10-20 years well, suggesting that the masting frequency may in part explain regional variation in population trends. Simulations suggest that further

increases in mast frequencies will lead to further declines of wood warbler populations. We show that changes in a natural process, such as mast seeding, may contribute to the declines of animal populations through cascading effects.

Neurogenomics of competition and parental care in a socially polyandrous shorebird

Presenting author: **Tessa Patton**

Using citizen science to assess change in breeding phenology of Virginia's birds

A. Peele, E. Hunter
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One of the major questions facing both wildlife researchers and managers is how diverse taxa are responding to climate-driven shifts in seasonal phenology? Many studies show that long-term change in breeding phenology can vary within and among species across relatively small spatial scales. This suggests that breeding phenology should be studied at regional scales, but such effort requires extensive behavioral monitoring over many years and is rarely available for more than a few, easily observable species, e.g. Eastern Bluebird. However, breeding bird atlases (BBAs) use trained citizen science volunteers to collect detailed breeding behavioral observations for a diverse range of bird species at regular intervals of 15-30 years. We used the first (1984-1989) and second (2016-2020) Virginia Breeding Bird Atlas datasets to evaluate change to breeding chronologies for 97 bird species. We compared median dates and restricted our analysis to behaviors clearly indicative of local breeding attempts, e.g., nest building, nest with eggs, fledged young, and feeding young. We found that the magnitude and direction of change in breeding chronology varied both within and among resident and migratory bird species, including marked advances in median date of nesting observations (range: 0-37 days earlier) and retreat of nestling/fledgling dates (range: 0-30 days later). While our data indicate that the length of the breeding season may be increasing for many bird species, the disconnect between early nesting dates and later observations of fledglings underscores the need for additional research. We review the implications of this potential phenological mismatch and highlight priority species for further investigation.

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*Evidence for widespread genomic inversions without phenotypic breaks in passerine birds

T. Pegan, A. Kimmitt, B. Winger
Presenting author: **Teresa Pegan**

Inversions are genomic structural variants thought to be important for adaptation because they suppress recombination, allowing many adaptive alleles to remain linked. Prior studies have focused on inversion-associated phenotypes in single species, often due to their putative association with phenotypic breaks such as sympatric morphs or geographic phenotypic variation. These studies reveal how inversions facilitate phenotypic and behavioral evolution, but a comparative framework is needed to contextualize the broader role that inversions play in genome evolution. How common are inversions within and across species? We generated whole genome population data from 31 North American passerine species and two woodpeckers and conducted a survey for putative inversions. We identified regions of suppressed recombination across each species' genome and assess linkage disequilibrium and heterozygosity. We found evidence for putative inversions in all species surveyed. Some putative inversions appear in similar genomic locations across multiple species, suggesting that some genome regions may be especially prone to inversion or that inversion polymorphisms can be plesiomorphic. The putative inversions we identified are not associated with known phenotypic variation. They may be adaptively neutral or associated with yet-unidentified phenotypic variation. Finally, we discuss how putative inversions can interfere with ability to detect subtle spatial population genetic structure. Our study takes a uniquely comparative approach to reveal how inversions evolve across many species and

provides a basis for future hypotheses about the link between inversions and phenotype in our specimen-vouchered dataset.

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*Modeling habitat suitability of Yellow-eared bulbul (Pycnonotus penicillatus) in Sri Lanka

N. Perera, J. Ross, M. Patten
Presenting author: **Nuwanthika Perera**

Climate change is expected to alter the structure and functions of an ecosystem including species distribution. It is frequently proposed that species' ranges shift in response to climate change in order to keep the species within their climatic niche. Knowledge of potential distributions and habitat preferences of island endemic Yellow-eared bulbul (Pycnonotus penicillatus, hereinafter YEBU) under current and future climate conditions is important for ecologists and policy makers to develop suitable measures to mitigate population decline due to unfavorable effects of climate change. Without broad awareness of climate suitability and potential changes in bulbul habitats, species conservation efforts would remain ineffective. This study aimed to model the habitat suitability of YEBU in Sri Lanka in response to the current and future climate change scenarios, using the correlative habitat suitability model MaxEnt. Global climate model, MIROC5 was used under the climate change scenario SSP126 for the years 2030, 2050, 2070 and 2090. Results show that elevation is the main variable affecting YEBU distribution (63.9%). Precipitation of driest month (bio14) and mean temperature of warmest quarter (bio10) are the next significant variables for YEBU distribution (6.9% and 6.1% respectively). While the country's unique ecosystem is currently able to provide a suitable habitat for YEBU, their distribution is negatively affected by future climate change. Most suitable habitat for YEBU will be decreased by 45.9% by 2090. Since YEBU require a very distinctive habitat and their habitat is predicted to be negatively affected by future climate, conservation of the species is crucial.

Diet macronutrient composition affects pathology and feeding behavior of Serinus canaria facing an immune challenge

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Individual dietary macronutrients possess unique roles within immune processes, which could have a profound effect on disease response and host recovery. Using an avian host-pathogen system and isocaloric diets, we explored the effects of dietary macronutrient composition, specifically lipid and protein content, on disease pathology and behavior of canaries (Serinus canaria) infected with Mycoplasma gallisepticum (MG). We then tested whether infection caused macronutrient-specific shifts in feeding behavior. In the first experiment, we found that regardless of infection status (exposed vs. unexposed), canaries provided a protein-rich diet consumed more calories per week than birds fed a lipid-rich diet. Infected canaries exhibited illness-induced anorexia in the first week post infection and experienced a significant decline in body mass. Infected birds fed the lipid-rich diet maintained fat stores during infection, whereas birds fed the protein rich diet did not. However, birds fed the lipid-rich diet experienced clinical signs of infection (swollen eye conjunctiva) for longer than birds fed the protein diet. Interestingly, diet did not affect pathogen load or MG-specific antibody concentrations of infected birds. In the second experiment, providing both diets during infection reduced negative effects birds experienced in experiment 1 when given a single diet (i.e., loss of fat stores and prolonged conjunctiva inflation), and birds maintained intake of the lipid rich diet, but decreased intake of the protein rich diet immediately followed inoculation. These data indicate that diet macronutrients could play an important role in individual variation in disease severity among hosts infected with a pathogen.

Dampened soundscapes in degraded oak woodlands reflect loss of avian richness and abundance

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Oak woodlands are a biodiverse habitat type that has become rare in eastern North America due to land

use change and fire suppression. Excluding periodic fires from woodlands causes degradation even within protected areas intended to conserve species. Using bioacoustics, we evaluated (1) the influence of oak woodland degradation on acoustically active species, and (2) how well bioacoustics reflects the bird community. We predicted that in degraded woodlands daily and seasonal soundscape peaks would be less pronounced than in managed woodlands due to lower avian richness and abundance. Working in five managed and five degraded woodland sites in southern WI, USA from late-April – early-August 2022, we collected bioacoustic data, conducted avian point counts, and measured vegetation. We found that bioacoustic index values were correlated with field-measured bird richness and abundance (Adj. R2 = 0.38–0.62), indicating that bioacoustic indices reflect the bird community. Degraded woodlands had quieter soundscapes with lower mean soundscape saturation (20.08% vs. 24.54%, $p<0.01$) and mean acoustic complexity (0.475 vs. 0.485, $p<0.01$). Based on results from linear models, both soundscape indices were best predicted by herbaceous plant species richness, which is a good indicator of the success of woodland restoration. Soundscapes in degraded sites exhibited dampened seasonal and daily peaks. Perhaps most surprisingly the avian dawn chorus (0430 – 0630) soundscape saturation peak, which lasted for a mean of 38 days in managed sites, was reduced to 13 days in degraded sites. We conclude that open woodland degradation reduces soundscape fullness and complexity, due to losses in richness and abundance of acoustically active animals.

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*Comparative vocalizations, genomic divergence, and demographic histories in three North American East-West species pairs

L. Phung, D. Toews
Presenting author: **Lan-Nhi Phung**

In song-learning birds, vocalizations act as premating reproductive barriers that could affect the speciation process initiated by geographic barriers. However, variation of songs across geographical regions (i.e., cultural evolution) is oftentimes not considered when identifying taxonomic boundaries, and it is unclear if certain genetic polymorphisms exist in closely related taxa that might correlate with vocalization boundaries. This project aims to understand the variation of vocalization across space as it relates to genomic differences and assess the relationship between genetic and cultural evolution. We quantify songs of three species pairs that have eastern and western counterparts that were likely isolated during the Pleistocene: (1) Setophaga virens vs. Setophaga townsendi, (2) Leiothlypis ruficapilla ruficapilla vs. Leiothlypis ruficapilla ridgwayi, and (3) Setophaga coronata coronata vs. Setophaga coronata auduboni, and found that these pairs represented high, moderate, and low divergence in song, respectively. We then examine each pair's genomic difference and estimated their historical effective population sizes (Ne) of each counterpart to uncover both current and historical demographic changes. Our results show that whole-genome divergence is high with many highly differentiated loci in pairs (1) and (3), and moderate with fewer of such loci in pair (2). We also show that historical Ne fluctuations track the timing of Pleistocene events, and most recent Ne of the eastern counterparts are consistently larger than those of the western counterparts. These findings provide insights into the role of vocalization in defining each pair's taxonomic relationship and the legacy of the Pleistocene in their genomes.

The Group Composition and Dynamics of a Cooperatively Breeding Population of Harris's Hawks in South Texas

B. Poplin, J. Bednarz, A. Gibbons, W. Clark
Presenting author: **Brooke Poplin**

Harris's Hawks (Parabuteo unicinctus) have been observed in New Mexico forming mean group sizes of ~2.7 individuals and in Arizona mean group sizes of ~3.8 hawks. We conducted censuses on 65 Harris's Hawk groups from 2018 to 2023 to monitor occupancy across a gradient of territories from natural thorn scrub habitat to anthropogenic urban areas. Over the study period, we color banded 503 Harris's Hawks and territories were checked in both the spring-summer (May-Jul) and winter (Dec-Jan) seasons to determine occupancy and estimate group membership. Territories were classified as either urban or natural habitat based on the National Land Cover Data base and a ground truth assessment. Group size was low the first year of the study (2018; mean = 2.29Â±0.09 [SD]) during which south Texas experienced a drought. Since then, group membership grew yearly by about 10%. Year was a significant predictor of

group size ($p < 0.01$). Seasonality also had a significant effect on group size ($p < 0.01$) with groups in south Texas averaging 2.5Â±0.06 members in the during spring and summer and 2.9Â±0.07 members in the winter. Our observations suggest that group sizes are larger in the winter, in part, due to delayed dispersal of juvenile hawks. Delayed dispersal by juveniles through the winter season may be favored due to fitness benefits all group members accrue through cooperative hunting. Average group size in urban territories was 2.58Â±0.07 birds nonsignificantly less than a mean 2.75Â±0.09 hawks in natural territories ($p < 0.213$). These data suggest that average Harris's Hawk group size in south Texas was similar to that reported in New Mexico (mean = 2.7), but is influenced by year to year climatic variation as well as seasonal factors.

The perception and characterization of acoustic fine structure in bird vocalizations

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One of the great challenges facing animal behavior research is understanding the sensory and perceptual worlds in which an organism lives (or umwelt). Humans and birds have an overlapping hearing range, and thus birdsong research has traditionally focused on characterizing acoustic features that are highly salient to us. However, birds have an exceptional auditory temporal processing ability which makes them about 10X better than humans at discriminating acoustic fine structure (AFS), the rapid modulations of the time-waveform. So far, perceptual studies suggest this ability may be widespread amongst parrots and songbirds, but only 7 captive species have been studied. Thus, it remains unclear how widespread and important this ability is for informing bioacoustics and social behavior research across bird species. A key challenge to expanding this research to wild birds is that there are no standard approaches to characterize AFS. In fact, many bioacoustics programs are insufficient to capture the temporal resolution birds can perceive. Furthermore, AFS is easily distorted and degraded by different environmental conditions. Here we used artificially constructed harmonic stimuli, which allows us to precisely control and manipulate patterns of AFS. Using these artificial stimuli, we determined which acoustic parameters across bioacoustics programs capture variation in AFS, and whether these parameters have the temporal resolution necessary to capture AFS on the order which birds may be able to perceive it. Altogether, we propose some first steps and approaches that could optimize studies of acoustic fine structure in field research.

Differentiating the effect of latitude versus temperature on passerine body size

C. Probst, D. Fouhey, T. Dias, H. Skeen, K. Alofs, B. Weeks
Presenting author: **Charlotte Probst**

Bergmann's Rule states that individuals or species occupying colder climates tend to have larger body sizes than those occupying warmer climates. Although Bergmann's Rule originally invoked thermoregulatory demands to explain temperature-size relationships, the high correlation between temperature and latitude complicates mechanistic explanation of the observed pattern. Further, recent large-scale assessments of Bergmann's Rule within bird species have called the presence of the pattern into question. Here, we take advantage of Skelevision, a high-throughput computer-vision method for measuring skeletal specimens from photographs, to generate skeletal trait estimates for 1,478 passerine species using 7,636 museum specimens. This Skelevision-based dataset provides an unprecedented opportunity to explore skeletal trait variation, including skeletal size, at macro-scales, and because of the global scale of our dataset, the correlation between latitude and temperature was sufficiently low to disentangle their independent associations with body size. Using Bayesian phylogenetic linear mixed models, we test the effect of latitude and temperature on body size both inter- and intra-specifically. Across species, we find a significant positive relationship between body size and latitude, but no independent relationship between variation in body size and temperature. Within species, we find mixed support for relationships between temperature or latitude and body size. These results raise fundamental questions about the universality and mechanistic basis of a temperature-body size relationship in birds.

Dialect differences correlate with environment in migratory, but not sedentary, coastal White-crowned Sparrows.

J. Yang, B. Carstens
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Vocalization behavior in birds, especially songs, strongly affects reproduction. Differences in vocalizations between two populations often act as evidence of divergence. The White-crowned Sparrow (Zonotrichia leucophrys) is known to have multiple dialects, including between neighboring (and genetically distinct) subspecies nuttalli and pugetensis. However, it is unknown whether the divergence in their songs correlates to environmental or geographical factors. Further, traditional methods to study bird songs by manually annotating individual syllables are time-consuming, limiting the amount of data that can be analyzed. Whether automatic methods, which can process large datasets more efficiently, work as well as manual methods remains to be seen. To answer these questions, we used a recently published artificial neural network to automatically annotate hundreds of White-crowned Sparrow vocalizations across these two subspecies. By analyzing differences in syllable usage and composition, we find that nuttalli and pugetensis have significantly different dialects. This may be caused by reducing the number of shared syllables in their repertoire, which is consistent with previous research. This divergence in dialects is related to environmental differences, but does not correlate to geographical distance, and is associated with migratory status. Our findings support the hypothesis that the evolution of vocalization behavior is affected by both biotic and abiotic environments, in addition to population structure.

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*Flexibility in the Face of Climate Change? Shifts in Hudsonian godwit Migration Timing

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As climate change shifts the phenology of the resources on which migratory species rely, shifts in migration timing are vitally important for maintaining fitness over time. To achieve such shifts, populations can shift their non-breeding ground departure timing, skip stopover sites, or spend less time at stopover sites altogether. Long-distance migrants were initially thought to be unable to flexibly adjust their migration timing due to inherent factors that would potentially constrain them from effectively utilizing different time-shifting strategies. Despite this, shifts in the migration timing of many long-distance migrants have been documented. Nonetheless, it remains poorly understood how long-distance migrants achieve shifts in migration timing and whether they are continuing to effectively track increasingly variable climate trends over time. The Hudsonian godwit (Limosa haemastica) is an extreme long-distance migratory shorebird, that appears to be effectively tracking recent slow, linear, climate-driven shifts in phenology. We used long-term light-level geolocator tracking data from 2009-2012 to 2020-2022 to assess on-going shifts in godwit migration timing and to determine time-shifting strategies utilized by investigating (1) non-breeding ground departure timing (2) breeding-ground arrival timing and (3) migration duration. Surprisingly, our results suggest godwit departure and arrival has shifted ~6 days later in the last decade, while the population has maintained an average migration duration of ~26 days. While the implications of these results are currently unknown, they suggest the need for further investigation to accurately assess the current and future vulnerability of godwits in this era of change.

Group size and territory quality are fledging success trade-offs in the Smooth-billed Ani (Crotophaga ani)

Presenting author: **James Quinn**, McMaster University, quinn@mcmaster.ca

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Relative abundance and habitat use of Swainson's Warblers (Limnothlypis swainsonii) in the Appalachian Mountains of TN

D. Rader, D. Buehler

Presenting author: **Dawson Rader**

The Swainson's Warbler (SWWA) is a Nearctic-Neotropical songbird that occurs across the southeastern U.S in two major breeding populations; the Coastal Plains population and the less-studied Appalachian Mountains population. Swainson's Warblers are a species of conservation concern in 13 states range-wide and are considered especially vulnerable to habitat loss. In this study, we are documenting habitat use and relative abundance of SWWA across the 88,222ha southern districts of the Cherokee National Forest. Based on these data, we are developing a model to predict available habitat and potential population size of this species at a landscape scale. In 2022, we conducted 5-min counts with playback at 198 randomly-selected points distributed every 500 m along roads to locate breeding territories. Each point was surveyed twice during the breeding season (15 May – 15 Jul). We measured geographic, hydrologic, and vegetative features at 30 of the 80 SWWA territories we located, and at an additional 30 random plots without SWWA. In the 2023 field season we are replicating the sampling by evaluating 30 more territory and random plots and plan to increase the roadside survey effort. Based on 2022 data, territories are significantly related to several variables: high percent understory cover (80% avg.), high understory density (49% avg.), relatively shallow slopes (13% avg.) and a tree basal area >25 m2/ha. Through this research, we have documented a previously unknown population of Swainson's Warblers with the greatest density of any known population in the Appalachian Mountains portion of the range.

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*Climate drives rapid, multi-ocean range expansion in a tropical seabird

J. Ramirez-Garofalo, S. Curley

Presenting author: **Jose Ramirez-Garofalo**

Brown boobies (Sula leucogaster) are pantropically-distributed seabirds that have recently increased as vagrants in the northern latitudes of the Pacific and Atlantic oceans. To better understand why these tropical seabirds are now being regularly found at such high latitudes, we used General Linear Models to test for an association between changes in broad-scale oceanic climate, sea surface temperature anomalies, and the frequency with which vagrant Brown Boobies occur. We found a strong association between records of vagrant Brown Boobies and anomalously warm sea surface temperatures, as well as the El Niño-Southern Oscillation. Breeding and non-breeding range expansion was evident in the Pacific. In the Atlantic, increased vagrancy may indicate a northward expansion in the non-breeding range, but no breeding-range expansion was evident. We suggest that breeding range expansion has not occurred because of a lack of suitable habitat, though it is possible that highly successful off-shore seabird colonies may attract Brown Boobies in the near future. The increase in vagrant brown boobies in the northwest Atlantic is particularly interesting when taking into account the imperiled nature of their colonies throughout the tropical Atlantic.

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*Birds ringing the bell on climate change in the Northern Canadian boreal forest

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Presenting author: **Angeles Raymundo Sanchez**

Climate change is considered one of the most important threats to biodiversity. Canada's boreal forest is predicted to experience abrupt climate change. Boreal birds are both sensitive to the direct and indirect effects of climate change, and some studies have predicted that as the climate warms up, the distribution of species in the north will change. To anticipate specific spatially explicit changes in the density of boreal birds under climate change, we evaluated density projections for 72 bird species based on integrated models of climate change and forest dynamics in the Northwest Territories (NWT), Canada, over the next 70 years. Our objectives were to 1) identify boreal bird 'winners' and 'losers' over short and long-term forecasts and 2) evaluate spatial variation in responses among three contrasting Global Circulation Models (GCMs). We integrated our model using R's open modeling toolkit, SpaDES. From 2011-2031, 2/72 species (2%) were considered winners, and 3/72 (4.1%) were losers under at least two GCMs. From 2011-2091, 26/72 (36.1%) were winners, and 10/72 species (13.8%) were losers under at least two GCMs. Four species were bellringers (Gray-cheeked Thrush, White-crowned Sparrow, Fox Sparrow, and

American Tree Sparrow). Overall, range shifts are strongly oriented along the southeast and northwest. Shifts to the north and south are about evenly divided among all three GCMs. Integrating forest change and climate models to forecast spatially explicit responses of bird density provides an important advance for vertebrate biodiversity under climate change.

Genome-wide population divergence between and within-islands upon colonization of Macaronesia by the Common Chaffinch

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Avian radiations in archipelagos provide ideal systems for understanding the relative roles of drift and selection in the speciation process. The common chaffinch (Fringilla coelebs) is a widespread Eurasian species that sequentially colonized the Atlantic archipelagos of Azores, Madeira and the Canary Islands from the continent, resulting in a species-level radiation. The sequential route has led to a reduction of genetic diversity at each step due to consecutive founder events. Interestingly, the chaffinches on the island of La Palma expanded from the humid cloud forest to the dry pine forest, and this habitat-shift has resulted in local adaptation. Local adaptation can drive divergence at small spatial scales when populations occupy contrasting habitats and dispersal is low. Birds in both habitats show differences in diet, plumage coloration and morphology, all consistent with ecomorphological predictions. A genome-wide survey using single nucleotide polymorphism loci from a genotyping-by-sequencing approach revealed that neutral loci structure between localities was consistent with geography, showing significant isolation-by-distance and indicating restricted dispersal. Genome-Wide Association Study (GWAS) and Genotype-Environment Association (GEA) methods revealed numerous loci involved in local adaptation spread across the genome, as expected for polygenic traits. Among the candidate genes we find some involved in morphological development, plumage coloration and metabolism, which are consistent with the phenotypic differences identified. Our results suggest a strong role for local adaptation in the chaffinch of La Palma, an excellent model for studying the evolutionary mechanisms of adaptive phenotypic divergence.

Risk assessment during nest defense against three simulated predators by female House Wrens (Troglodytes aedon aedon)

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A diverse guild of nest predators presents threats of varying risk to parental birds and their offspring. Smaller predators, for example, frequently pose a high risk to eggs or offspring, but a low risk to the adult parents, while larger predators can pose an equal risk to both. Do parents respond equally to all threats, or do they engage in risk assessment and vary the strength of their nest defense accordingly? We tested this question in cavity-nesting House Wrens (Troglodytes aedon aedon) by presenting three different predator decoys at the nest box during the nestling stage: two nest predators - an eastern chipmunk (Tamias striatus) and an eastern ratsnake (Pantherophis alleghaniensis) - as well as a predator of both offspring and adults - a juvenile Cooper's hawk (Accipiter cooperi). Female antipredator behavior did not differ detectably in response to the two nest predators, which posed a high risk to the nestlings, but lower risk to the parents as neither species is known to capture adult wrens. Response to the snake did not differ significantly between years, indicating that the population-level response might be consistent through time. In contrast, female wrens never dove at or attacked the Cooper's hawk despite frequently attacking both the snake and chipmunk decoys. Collectively, these results show that female house wrens exhibit plasticity in their nest defense behavior and assess the risk posed by different predators. This approach to nest defense is consistent with the predictions of parental investment theory and could maximize lifetime fitness despite risking the loss of the current offspring.

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*Changes in tissue tropism of Mycoplasma gallisepticum following host jump

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Mycoplasma gallisepticum, a pathogen of worldwide economic importance in poultry, is recovered in chickens, especially from the respiratory tract. Some strains, however, are specialized to other tissues and because it jumps from poultry to wild birds, the new strains also cause severe conjunctivitis in new hosts. Nevertheless, most studies of M. gallisepticum in wild birds use choanal swabs or combine choanal and conjunctival swabs to quantify bacterial load. Because the clinical signs associated with M. gallisepticum infection differ markedly between poultry and House Finches (Haemorhous mexicanus), we compared the bacterial load in choanal and conjunctival samples following experimental inoculation of House Finches with M. gallisepticum isolates originating from poultry or from House Finches. This allowed us to test two hypotheses: M. gallisepticum changed tissue tropism, or M. gallisepticum simply expanded its within-host niche. By comparing bacterial loads from choanal and conjunctival swabs in birds inoculated with one of a suite of M. gallisepticum isolates, we found support for hypothesis 2. The choanal loads in House Finches did not differ between isolates, while the conjunctival loads of birds inoculated with poultry isolates were lower than in birds inoculated with House Finch isolates. When measuring the bacterial load of M. gallisepticum in birds, it is important to sample and analyze separately choanal and conjunctival swabs, as quantifying bacterial loads in pooled samples may not provide reliable information on differences in virulence.

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*Implications of methodological choices: raptor survey techniques in open habitats

J. Reynolds, N. Joakim, C. Kirol, B. Fedy
Presenting author: **Jordan Reynolds**

Wildlife ecology and management rely on accurate estimates of species abundance. The standards of practice and methodological approaches vary widely, even among similar species. This can cause confusion in the interpretation of existing studies and in the design of new studies. In the case of birds of prey, multiple survey approaches are presented in peer-reviewed literature to estimate this taxa's abundance and distribution. Our objective was to conduct a systematic review of peer-reviewed literature to summarize and critique survey approaches used to research birds of prey. We limited our review to ground-based surveys because they are more common, and avoid the cost and risk associated with aerial surveys. Within the literature, survey strategies varied in terms of spatial and temporal distribution of survey efforts. In particular, survey duration varied from 10 minutes to 8 hours. Then we used empirical data from a case study to quantify the impact of survey effort on estimates of species abundance and community composition. Our empirical data were gathered from point counts conducted in northeastern Wyoming, 2022 that were up to 20 minutes in duration. Our results suggest there are a wide variety of methods used to survey birds of prey with little consistency and a lack of exploration into the implications of methodological choice. This analysis is an initial step in organizing and conceptualizing methods used in surveying birds of prey, the statistical ramifications for two different methods used, and aids in the formation of future birds of prey management projects.

Mitochondrial capacity in two Mimidae species: a migratory and non-migratory comparison

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Although mitochondria produce 90% of the energy that fuels migration, their role in the evolution of life histories that include migration is essentially unstudied. We collected 11 Gray Catbirds (Dumetella carolinesis, GRCA), which are migratory, and 10 Northern Mockingbirds (Mimus polyglottos, NOMO), which are non-migratory, in coastal Alabama during fall migration. Our goal was to investigate mitochondrial capacity of both a migratory and non-migratory species from the same avian family. Because they are migratory, we predicted that GRCA would have higher maximum mitochondrial respiration (state 3), basal respiration (state 4), respiratory control ratio (RCR) (state 3/state 4), and mitochondrial density compared to NOMO. We excised pectoralis muscle for mitochondrial isolation. Mitochondrial isolation was conducted via differential centrifugation and the mitochondria was tested with Hanestech Oxytherm chambers for both Complex I and II respiration. We also collected hematocrit, beta-hydroxybutyrate (BOH) levels, and fat scores. We found no significant differences in state 3, state 4,

or RCR data among the two groups. Additionally, while not significant, the NOMO respiration data trended higher overall than GRCA. GRCA had higher mitochondrial density than NOMO although this was not significant ($p = 0.07$) until fat score was included in the linear model ($p = 0.05$). The two groups did not vary with hematocrit and BOH levels, however, GRCA had significantly higher fat scores than NOMO ($p < 0.01$). Our study demonstrates that variable life history traits may determine mitochondrial capacity other than migration. While NOMO are non-migratory, they are exceptionally active birds, engaging in flapping flight throughout the day.

Tracking grasslands birds with automated telemetry reveals clues about post-fledging habitat usage

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Grassland bird populations have declined precipitously over the last half-century and are the most imperiled ecological group of birds in North America. In many areas of the Southeastern United States, grassland habitats are restricted to pastures on working farms. This provides landowners with a unique opportunity to implement land management practices that help foster the recovery of grassland bird populations. Effective conservation of these populations, however, necessitates an understanding of the habitats that support them across each life stage. While there is growing evidence that farm management decisions impact adult survival and nest success, the fate of juvenile birds after fledging the nest remains largely unexplored. To address this, we assessed how farm management decisions influence the spatial distribution of juvenile birds. Juvenile bobolinks and American kestrels were fitted with CTT Hybrid UHF tags on a working farm in the Piedmont region of Virginia. We monitored the foraging movements and roost locations of these birds within a network of 28 automated receiving nodes spaced 250 m apart. We did not find evidence that management decisions influence bobolink foraging locations, but they preferentially roosted in habitats dominated by native warm-season grasses. Kestrels, however, preferentially hunted along tree and fence lines adjacent to open fields and roosted in foliated tree lines. Our findings suggest that the habitat features utilized by grassland birds are species-specific and may therefore require a diversity of management strategies. Further work is needed to determine how these management decisions influence the survival of birds during the post-fledging period.

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*Paternal deprivation in a biparental bird: consequences on social behavior, song, and beak color

A. Riley, A. Ayon, J. Grindstaff
Presenting author: **Angela Riley**

In altricial birds with biparental care, care from both parents often determines the later success of offspring. Accordingly, reduced parental care can negatively impact offspring success, yet studies utilizing experimental removal of male parents (paternal deprivation) are limited. In this study, we paternally deprived lab-reared zebra finches (Taeniopygia guttata). We hypothesized that paternal deprivation would act as a stressor and that this would be reflected in adult offspring social behavior and two secondary sexual traits: male song and beak color. To test this, we set up groups of zebra finches that experienced paternal deprivation at hatching, paternal deprivation at fledging, and a control group where both parents were present throughout the nestling and fledgling stages. Once these sons and daughters were adults, we recorded their social behavior in response to novel, same-sex conspecifics. We also recorded songs of adult sons and analyzed them for song complexity. Finally, we measured adult sons' beak color using a spectrophotometer. Our results show no difference in social behavior nor song complexity, suggesting that paternal deprivation does not impact normal development of social behavior nor song. However, sons paternally deprived at fledging had less red beaks as adults, with no growth cost. This suggests that in a lab setting, loss of paternal care at fledging might have long-term consequences for the attractiveness of sons' beak color, and that female parents may be unable to compensate in other ways unrelated to nutrition. We are making continuous efforts in analyzing parent-offspring interactions to determine what behaviors female parents alter in response to the loss of their mate.

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*Sexual selection and gene duplication in an immune system gene complex

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The coevolutionary arms race between hosts and parasites results in strong natural selection on host immune defenses. Sexual selection can amplify selection on immune defenses e.g. when uninfected males are preferred by females, better able to defend territories, or perform more energetically costly displays. The highly polymorphic major-histocompatibility complex (MHC) exemplifies parasite-mediated selection: greater MHC diversity implies a wider range of antigen recognition. The MHC is characterized by large copy number variation, and passerine birds have especially complex MHC regions with many duplications. The duplicated nature of the MHC makes it challenging to characterize on the genomic scale and the identification of MHC gene copies may be influenced by genome assembly quality. To test the prediction that sexual selection increases MHC gene duplication we estimated the number of MHC Class I and Class IIÎ² copies for 72 passerine bird species with genomes available on the NCBI database and representing a range in the degree of polygyny. We tested whether this proxy for the strength of sexual selection was related to MHC copy number using a phylogenetic linear model and controlled for genome assembly quality by including genome Contig N50 as a predictor. We found that Contig N50 was a significant predictor of the number of MHC Class I, but not Class IIÎ², copies identified. Our proxy measure of sexual selection did not predict either MHC Class I or Class IIÎ² copy number. This study highlights the challenges of investigating the genomic structure of duplicated gene regions in non-model organisms and suggests that sexual selection does not influence rates of MHC gene duplication in passerine birds.

Song syntax in hermit thrush (Catharus guttatus): What's the point?

S. Roach, L. McLean

Presenting author: **Sean Roach**

The songs of many songbird species follow syntactical rules that govern the order of song units (e.g., song types or syllables) within vocal sequences, yet we know very little about the communicative function of song syntax. Specifically, it is unclear whether syntactical patterns convey important information (e.g., related to territorial defense or mating) between senders and receivers. Hermit thrush (Catharus guttatus) males sing with immediate variety, never repeating the same song type twice, and deliver their song types in a semi-predictable order that cycles up and down the frequency spectrum. To assess how song syntax changes over the course of the breeding season, we intermittently recorded 20 hermit thrush males over the 2022 breeding season (late April to mid-July) using autonomous recorders. A preliminary within-subjects analysis (n = 5 males) revealed that the predictability of song type sequences declined significantly over the course of the breeding season (linear mixed effects model: p = 0.009), such that that sequences were more rigidly ordered early in the season when males are most actively defending territories and seeking mates. Given that our previous work did not find support for a role of syntax in territorial defense, it may be that song type ordering plays a role in mate attraction. We will discuss the full results in the context of our previous work on song syntax and planned future studies designed to further understand the its function.

The Red-tailed Hawk Project: Developing a Model System in Studies of Raptor Ecology and Evolution

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The Red-tailed Hawk (Buteo jamaicensis) is a common and widespread raptor with the potential to serve as a model for patterns and processes in the ecology and evolution of raptors because of its abundance, the great variation in population-level plumage characteristics, geographic variation in presence of plumage polymorphism, and variation in migratory tendencies. This potential is limited, however, by many gaps in our knowledge of the evolution, geographic variation, migratory connectivity, and landscape genomic patterns of the species. The Red-tailed Hawk Project is a research collaboration focused on filling these gaps, with the primary goal of empowering its use as a system for increasing our

understanding of patterns and processes in the ecology and evolution of raptors at large. At present, our research focuses primarily on movement ecology, population genomic and phylogenomic patterns, as well as the distribution, development, and maintainence of plumage polymorphism. Our hope is that through studying and understanding these aspects in this species, we will develop a framework for similar research on other species. Over the past 3 yrs, we have built a continuously growing dataset comprising more than 350 individuals from 8 of the 14 described subspecies. We have also deployed more than 100 GPS-GSM tracking units on individuals to gather full annual-cycle movement data and connect standardized photographs and genomic data to remote breeding locations. Moving forward, we will focus on completing both the comprehensive distribution-wide genomic and phenotypic sampling of breeding individuals, and increasing the diversity of full annual-cycle movement data.

Stewardship responsibility of public lands for bird conservation

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Recent national and international commitments to protect and restore 30% of the planet warrant careful assessment of the extent to which public lands contribute to conservation goals. In particular, understanding how stewardship responsibilities vary among agencies can be used to guide strategic planning. A frequent challenge for these assessments is the need for standardized information on species distributions and trends at fine spatial resolution. Here, we leverage fine-scale data products from eBird Status and Trends to examine the relative responsibilities among federal (separately for USFS, BLM, USFWS, NPS) and state agencies across different designations of protected areas (i.e., IUCN GAP status) for conserving bird populations in breeding and non-breeding seasons. For each land manager and type of protected area, we estimated relative abundance (3x3 km) for breeding and non-breeding season, the maximum proportion of total population across the year, average population trend (27x27 km), and proportion of species within major biomes that are declining within lands managed by each agency. Not surprisingly, agencies varied widely in the degree to which they are responsible for different species and biome guilds, with the greatest conservation urgency occurring for guilds with sharply declining populations. We expect that the availability of these novel, localized data on species distributions and trends will be a valuable resource for priority-setting and management and help coordinate cooperative efforts across agencies.

Previously undescribed behaviors of Afrotropical ant-following birds suggest specialization on Dorylus driver ants

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Presenting author: **Patricia Rodrigues**

Despite the popularity of their Neotropical counterparts, we know nothing about the specialization of Afrotropical ant-following birds (AAFB). Here, using analogous Neotropical ant-following birds as a comparative framework, we demonstrate that AAFB exhibit behavioral adaptations indicative of specialization on Dorylus driver ants. These definitive, previously undescribed, behaviors are ant nest-checking, social information use, large home range size, and dominance at ant swarms. At our site in Equatorial Guinea, birds varied in their dependency on ants, with putative specialists displaying all four behaviors. For ant nest-checking behavior, we deployed 360Â° cameras at driver ant nests and recorded over five species regularly checking focal nests. We used playback experiments to evaluate social information use, finding that vocalizations of putative specialists elicited higher and more diverse responses compared to controls. To estimate home range size, we used GPS and radio transmitters. Putative specialists used areas roughly five times larger compared to less specialized insectivores. Lastly, to assess dominance we observed AAFB at Dorylus swarms. We used network analysis to characterize the relative importance of individuals at swarms and found putative specialists were crucial to the formation and maintenance of AAFB aggregations. Describing these behavioral adaptations is a critical first step in understanding why ant-following birds-a convergently evolved guild across the tropics-are particularly vulnerable to anthropogenic forest disturbance.

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*Thermal imaging confirms tidal marsh sparrow bills are key adaptations for heat loss in a freshwater-limited environment

M. Roeder, D. Levesque, K. Cammen, B. Olsen, A. Kovach
Presenting author: **Mackenzie Roeder**

The Greenberg-Tattersall corollary to Allen's rule suggests avian bill size increases with temperature in freshwater-limited environments due to selection on water conservation and thermoregulation. The seaside (Ammospiza maritima), saltmarsh (A. caudacuta), and Acadian Nelson's sparrows (A. nelsoni subvirgata) independently colonized North America's tidal saltmarshes and have significantly larger bills compared to non-tidal relatives. Within these taxa, bill size positively correlates with the degree of adaptation to tidal marsh habitat. We tested the hypotheses that 1) tidal marsh sparrow bills aid in heat loss and minimize reliance on evaporative thermoregulatory behaviors (e.g., panting), 2) the extent of heat loss via the bill varies across species and is correlated with adaptation to tidal marsh habitat, and 3) within species, larger bills are associated with greater heat loss. We recorded the responses of individuals of each species to increasing temperatures (10 – 35Â°C), within a portable temperature-controlled chamber, using a thermal imaging camera to quantify the role of the bill in heat loss. Compared to saltmarsh and Nelson's sparrows, seaside sparrows (which have the largest bills and are best adapted to tidal marsh habitat) lost higher overall percentages of heat from the bill, lost more heat per square millimeter of the bill, and utilized fewer evaporative strategies. Within species, bill size was positively correlated with heat loss. These results support the proposed Greenberg-Tattersall corollary and suggest evolution has shaped the bills of these birds for their role in thermoregulation and water conservation.

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*Examining migratory flight performance in Black-throated Blue Warblers using Motus Wildlife Tracking System

P. Rokitnicki, Y. Morbey
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Songbirds can vary in physiological, morphological, and behavioural traits depending on their age and sex class, affecting their movement ecology. Previous studies have focused on differences in stopover behaviours, but little is known about migratory flight performance. In this study, I examine whether migratory flight performance differed between age and sex classes in Black-throated Blue Warblers (Setophaga caerulescens) using movement data obtained by Motus Wildlife Tracking System and meteorological data from the NCEP/NCAR Reanalysis II project. The data collected with Motus in 2021 and previous data from 2014 and 2015 were used to calculate ground speeds during inter-tower nocturnal movements. Ground speeds were decomposed into airspeeds and tailwind advantage using information on a bird's heading, wind speeds, and wind directions. Across the three years, 58 birds had inter-tower movements. The average airspeed was 8.78 mâ€¢s-1, ground speed was 12.18 mâ€¢s-1, and tailwind advantage was 3.39 mâ€¢s-1. Both age and sex classes had similar ground speeds (LMM: F1,19=0.01, p=0.94; LMM: F1,19=3.23, p=0.09, respectively). Age and sex classes also had similar post-departure movements (WRST: W= 627.5, p=0.40; WRST: W=294.0 p= 0.84, respectively). Using morphological data from 2021, we found some differences in wing morphology between the age and sex classes. Age classes differed in wing wear, while sexes differed in wing size (t-test: t=2.56, df=28, p=0.02; t-test: t=8.21; df=28, p<0.001, respectively). Interestingly, age and sex classes displayed similar flight characteristics despite some wing morphology differences. This study demonstrates how Motus data can estimate flight performance in known aged and sexed individuals.

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*Habitat selection of overwintering White-throated Sparrow flocks in an Ohio experimental wetland ecosystem.

A. Rose
Presenting author: **Anna Rose**

The White-throated Sparrow (Zonotrichia albicollis) is a native songbird that breeds in the boreal and mixed forest ecosystems of Canada and mainly overwinters in the United States. During nonbreeding, White-throated Sparrows are gregarious and form large, foraging flocks. The species is in steep decline with its population decreasing over 30 percent the last 50 years with a particularly steep decline in the

Eastern U.S. (Hill, 2022). A lack of understanding on what habitat variables sparrows use for survival in winter could contribute to current failures to mitigate the species' decline. This study seeks to answer what fine-scale habitat variables in forested wetland ecosystems could improve winter flock survival. The hypothesis states that flocks will demonstrate avoidance of emergent marsh patches and select for early successional forest including fine-scale elements like brush piles, eastern redcedar (Juniperus virginiana), and Amur honeysuckle (Lonicera maackii). The study is conducted at the Wilma H. Schiermeier Olentangy River Wetland Research Park in an experimental wetlands system. In the winter of 2021-22, 55 White-throated Sparrow flocks were identified by call and sound with their behaviors noted and locations marked with a GPS. During this second winter field season of 2022-23, vegetation surveys were conducted on flock locations and generated random points. Top models of habitat variables are currently being analyzed through selection of logistical regression candidate models. Further information on the winter habitat selection of the White-throated Sparrow could be used to improve future management plans to help slow population decline.

Birds as indicators of native bee richness

J. Rousseau, A. Johnston, A. Rodewald

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Spurred by concerns about declines in pollinator populations, there is growing demand for tools to monitor pollinators across large spatial scales. These demands have largely gone unmet because current bee data are insufficient to support broad monitoring efforts. In the absence of data, current large-scale estimates of bee populations are based upon remotely-sensed land cover data, which fails to capture information about local habitat attributes, like nesting and foraging resources. We evaluated the suitability of birds as indicators of bee populations, given that birds are a well-surveyed taxa that integrate information about habitat and landscape attributes across multiple scales. We used data from eBird, a citizen science project led by the Cornell Lab of Ornithology, and a Bayesian variable selection algorithm to select bird species and land covers that best predicted bee richness. We compared three models – a bird only, a land cover only, and a birds and land covers model – to assess the added value of birds over land cover data. Model predictions were best when birds and land covers were combined. Our best model includes a combination of 8 bird species and 2 land covers. We suggest that in cases where bee data are lacking, birds and land covers can be served as useful indicators to guide bee monitoring and conservation priorities.

Male and female tropical wrens vary their vocal behaviour when density changes: responses to a multi-speaker experiment

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For territorial animals, the density of conspecific neighbours may have a profound effect on territorial behaviour and animal vocal signals. Despite numerous investigations of vocal behaviour in the context of territory defense and female attraction, the effect of neighbour density has received little attention, particularly in tropical animals and animals where both males and females produce complex acoustic signals. In this study, we used an innovative multi-speaker playback experiment to manipulate the apparent density of neighbours in Rufous-and-White Wrens living in a tropical dry forest. The Rufous-and-white Wren provides a compelling study species because both males and females defend year-round territories and sing complex, learned songs for territory defence. We recorded singing behaviour of 18 subjects (9 social pairs) and then simulated the presence of six territorial neighbours (3 simulated pairs) for three days using playback. We recorded the singing behaviour of the subjects a day prior the stimulus (control) and in response to the playback. We found that the song rate of both males and females increased by almost fifty percent in response to a simulated increase in the number of territorial neighbours, including increases in both male and female independent songs and vocal duets. In addition, females showed lower song-type switching rates following a simulated increase in the number of territorial neighbours. These findings reveal variation in the vocal behaviour of male and female songbirds in response to manipulations of territory density, demonstrating, experimentally, that conspecific neighbours have a major impact on animal vocal behaviour.

Transgenerational effects of experimentally increased maternal corticosterone in a wild bird population

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Corticosterone regulates the physiological and behavioural responses of birds to changes in their environment. Exposure to elevated levels of corticosterone during development can profoundly affect offspring phenotype, but whether effects of elevated, maternally derived corticosterone extend beyond the first generation remains unknown. We experimentally manipulated maternal corticosterone by orally dosing female house wrens with corticosterone-injected mealworms during breeding, replicating corticosterone treatments within two experimental brood-size regimes created via cross-fostering. We found no within-season effects of experimentally increased maternal corticosterone on nestling phenotype, but offspring of corticosterone-treated mothers were more likely to recruit to the breeding population in the following season than offspring of control mothers. F2 nestlings reared by these recruited first-time breeders exhibited sex-specific effects of maternal corticosterone treatment on body mass and size. There was also a significant sex-specific transgenerational effect of maternal corticosterone treatment on stress reactivity of F2 nestlings. Collectively, these results suggest that an experimental increase in maternal corticosterone not only has a direct maternal effect on offspring recruitment, but also influences growth, development, and physiology of F2 progeny, specifically with respect to development of the hypothalamic–pituitary–adrenal axis.

A quantitative test of Gloger's Rule and its underlying mechanisms in Northern Bobwhites (Colinus virginianus)

J. Salter, B. Higa, C. Mason, K. Bell, A. Shultz

Presenting author: **Jessie Salter**

Understanding how the environment affects phenotypic traits within species has been a central focus of ornithological research for over a century. Repeated observations of convergent traits across taxa in response to similar environmental conditions have been formalized as ecogeographic rules, such as Gloger's Rule, which describes the relationship between temperature, humidity, and melanin coloration. Support for Gloger's Rule is widespread among birds, yet the mechanisms responsible for producing this pattern remain largely untested. The prevailing hypothesis suggests that melanin is adaptive for crypsis in different vegetation and light environments, while an alternative theory suggests that melanin is selected for in warmer, wetter climates where ectoparasites are more prevalent because melanin strengthens feathers against wear; however, the link between ectoparasites and Gloger's Rule has never been directly tested. Furthermore, a common limitation of studies examining plumage variation is a focus on color without accounting for differences in feather structure, which has a significant effect on feather color independent of melanin. To assess the underlying mechanisms responsible for Gloger's Rule and their effects on composite plumage phenotypes, we examined the remarkable plumage variation in Northern Bobwhites (Colinus virginianus). We quantified plumage color, pattern, and feather macrostructure in 300 bobwhite museum specimens, as well as collected feather lice preserved on the specimens to directly assess geographic variation in ectoparasite abundance. Using a modeling approach, we tested alternative hypotheses regarding Gloger's Rule and identified ecological correlates of plumage variation in bobwhites.

Waterbird species Diversity and Abundance at Golinga Dam, Northern Region - Ghana

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The aim of this research is to assess the richness and abundance of waterbirds at Golinga irrigational dam in the Northern Region of Ghana. The Golinga dam was established by the kind courtesy of the

government of Ghana to help local people within the Tolon district cultivate crops all year round in order to reduce the rate of poverty and improve the livelihoods of the people. Eighteen (18) bird species were recorded whereby, eight (8) were identified in the rainy season and ten (10) in the dry season. Seven of the waterbirds species were Intra African-Migrant, six were Resident and five were Palearctic Migrant. Habitat destruction, hunting and vegetation disturbance are the major threats facing waterbird conservation and sustainability in the Northern region of Ghana. Continuous practice of these acts will lead to the death and extinction of some waterbirds species because most of them depend on the water bodies to survive. The conclusion of this study was, Golinga dam has the potential of receiving more and different kinds of aquatic birds if scientific measures are put in place to protect the resident and migratory birds that lives around. However, bird Species such as the resident and Palearctic were mostly found which can aid in further research. It is recommended that further studies be carried out on the richness and potential threats to waterbirds to help create a more reliable conservational purpose.

Mapping hemispheric risk to migratory birds using multi-species migratory connectivity

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Migratory birds have experienced precipitous declines globally. To prevent the collapse of migratory populations, effective conservation relies on empirical knowledge of individual animal movements that scale up to species-level patterns across expansive landscapes. Migratory connectivity is defined as the patterns of connection between populations in different seasons. Despite growing documentation of migratory connectivity for individual species, a method for estimating average connectivity within species groups (i.e., multi-species migratory connectivity) has not been developed. For 127 North American-breeding migratory bird species, we integrated five data types (band re-encounters, GPS, satellite tags, light-level geolocators, radio telemetry) and used a hierarchical Bayesian approach to estimate migratory connectivity across the Western Hemisphere, defined as the relative proportions of individuals migrating between breeding and overwintering regions. We used these species-specific estimates to quantify average multi-species proportions and associated uncertainties as a novel metric of migratory connectivity between breeding and overwintering regions for both landbirds (56 species) and waterbirds (71 species). To evaluate and map the implications of multi-species connectivity for understanding risk to migratory birds, we combined our results with data on a suite of hemispheric hazards (e.g., urbanization), as well as species' vulnerabilities. Our findings represent a new, full-annual-cycle assessment of risk for hundreds of migratory bird species, which can inform multi-species conservation strategies aimed at recovering migratory birds globally.

Are tracking data available to inform North American migratory bird conservation?

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Animal tracking has become an effective way to identify where and when migratory species encounter threats throughout their annual cycle and to quantify the migratory connectivity of species. Yet, untracked or poorly tracked species and undiscoverable or inaccessible data for the species that have been tracked lead to gaps in the knowledge of where and when species occur throughout their annual cycle. Here, for the first time we comprehensively review full annual cycle tracking data for North American migratory birds and identify gaps and biases in how, when, where and what species are tracked with electronic tracking devices. We found 44% of North American migratory bird species have been tracked. The number drops to 33% when considering species with data available in peer-reviewed publications or open access data repositories, further limiting access to this information for conservation applications. We estimate no data for 321 species and restricted or reduced data accessibility for an additional 59 species. These deficiencies remain a constraint to improving conservation strategies for 56% of North American migratory bird species, particularly for smaller-bodied species of the greatest conservation need. By

identifying these gaps, we hope to inform future tracking efforts, conservation management, and data archiving practices

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Fear of Feathers: Do nest decorations deter nest usurpation and brood parasitism?

M. Scerbicke, B. Peer
Presenting author: **Matt Scerbicke**

Competition for limited nest sites is common in secondary cavity-nesting birds. Nest usurpation and nest destruction are common in these competitive interactions. Birds attempt to reduce nest usurpation by building multiple nests and one study has shown that the presence of feathers creates hesitancy by potential nest usurpers because it gives the appearance that the feathers are those of a former nest owner who was killed by a predator. The Prothonotary Warbler (Protonotaria citrea) is a secondary-cavity nester and its populations has declined by 40% in the past 50 years. The greatest cause of warbler nest failure at my study site along the Mississippi River floodplain in eastern Iowa is nest destruction and usurpation by House Wrens (Troglodytes aedon) and to a lesser extent nest usurpation by Tree Swallows (Tachycineta bicolor). I tested the hypothesis that the presence of feathers in a nest box would create hesitancy and possibly deter competitors from usurping nests. I did this by blocking the entrance of a nest box once a breeding pair of wrens or swallows claimed a box and then erected two boxes within 5m. Each box had an old warbler nest and one also had six white feathers added to it. Video cameras were placed near the boxes to record the competitive interactions for 4 hours. I discuss the hesitancy of wrens and swallows to enter nests with and without feathers and the implications of these results for interspecific competitive interactions.

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*Evaluating the fitness tradeoffs of reproduction across the annual cycle of Greenland white-fronted geese

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Presenting author: **Alexander Schindler**, University of Saskatchewan, alecschindler@gmail.com

Reproduction is energetically demanding, and migratory species evaluate tradeoffs of long-distance movement with reproduction and survival. Long-lived migratory species may lower reproductive effort or forgo reproduction altogether in a particular breeding season to maximize survival and increase potential for producing future offspring. The Greenland white-fronted goose (Anser albifrons flavirostris) is a long-distance migrant whose population has experienced a ~50% decline in the past 23 years. We used GPS-acceleration devices deployed on Greenland white-fronted geese to quantify individual decision-making throughout the full annual cycle. We quantified the effects of preparation for reproduction during spring migration on subsequent breeding outcomes, breeding outcomes on fall migration characteristics, and fall migration characteristics on subsequent survival of parents. We found weather and land cover affected behavior of geese during spring and fall migrations. Individuals that spent more time feeding in early and late spring migration were more likely to successfully reproduce. Individuals that successfully reproduced expended less energy and spent less time feeding during fall migration, potentially demonstrating a negative fitness consequence to breeding. These comparisons improve our understanding of the potential fitness trade-offs between attempting and deferring breeding, which is an important step in understanding the mechanism(s) for declines in Greenland white-fronted geese. Our analysis provides a flexible and reproducible framework for full annual cycle modeling using location and behavior data, which could be applied to any migratory bird population where similar data are available.

Calibrating eBird detection probability for open-ocean records

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The data available for describing the distribution and abundance of offshore pelagic bird species is limited, and the factors that affect variation in birds' detectability differ between marine and terrestrial environments. We gathered novel data to identify the information required to calibrate ship-based observations collected by bird watchers. Our objective was to characterize detection bias and observation

uncertainty for such volunteer-collected data, paving the way for them to be more useful in informing conservation and addressing ecological questions. Fieldwork occurred aboard expedition cruise vessels transiting the Southern Ocean en route to Antarctica, during which we measured seabird densities from line-transect surveys concurrent with eBird data collection. Although variable (as expected), and relatively low in number, eBird observations were able to resolve many of the same spatial and temporal patterns visible in the line-transect surveys. These included seasonal patterns likely related to post-breeding dispersal not previously described. Our analysis was aided by data on several factors, including the tendency of different species to follow ships and the vantage point of observers on the vessel, suggesting that the inclusion of such process-related metadata fields in future project-specific eBird protocols could greatly improve data quality. This study demonstrated the usefulness of performing dedicated calibration of volunteer-collected data to better understand detection processes. It also provided insights into how to successfully partner with ecotourism operations to study bird distributions.

Non-native invasive plants support similar arthropod biomass and quality, and are foraged on by birds as intensively as native plants in a Connecticut, USA forest

Presenting author: **Chad Seewagen**

Exploring the genetic architecture of reproductive isolation in hybridizing Black-capped and Carolina chickadees

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Hybrid zones continue to advance our understanding of the mechanisms promoting or eroding reproductive barriers between nascent lineages and, broadly, the process of biological diversification. While whole genome sequencing has allowed the identification of candidate barrier genes in numerous avian taxa, the use of experimental approaches to validate the functional role of genes and their connection to phenotypes of interest remains uncommon. Here, we combine genomic and experimental techniques to better understand reproductive isolation between Black-capped and Carolina chickadees. Previous studies have suggested that chickadee hybrids suffer from both physiological and cognitive breakdown. In particular, the impaired spatial memory of hybrids might cause reduced overwinter survival due to a decreased ability to recover food sources cached in the fall. We first used whole genome sequencing of hundreds of individuals sampled in replicate geographic transects across the Black-capped and Carolina chickadee hybrid zone to identify genomic regions, and associated genes, exhibiting a consistent signal of reduced introgression and potentially involved in reproductive isolation. We then assessed the performance of captive-raised chickadees with Black-capped, Carolina, and hybrid ancestries on several cognitive tasks and used a genome-wide association approach to identify genes significantly associated with phenotypic variation in experimental birds. We discuss our findings in light of understanding the genetics of cognition and the maintenance of reproductive isolation in chickadees and other birds.

The importance of the Amazon Basin for Nearctic breeding shorebirds during southward migration

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Long-distance migratory shorebirds are among the most rapidly declining of all bird species. One of the biggest challenges in reversing these declines is the fact that we still lack even cursory knowledge about many species' whereabouts over the course of the year. This is especially true for shorebirds using the

Amazon Basin in South America. While the recent emergence of community science databases and proliferation of miniature tracking devices has begun to change this situation, the imprecision of these tracking devices, as well as the relative paucity of on-the-ground observations, has largely precluded drawing conclusions about where and when shorebirds stop in the Basin. Here we use GPS and Argos satellite transmitters combined with a continuous-time stochastic process modeling approach to investigate the distribution and habitat use of six species of shorebirds in the Basin during southward migration - Hudsonian Godwit Limosa haemastica; Lesser Yellowlegs Tringa flavipes; Buff-breasted Calidris subruficollis, Pectoral Calidris melanotos, and Upland Sandpipers Bartramia longicauda; and American Golden-Plover Pluvialis dominica. Our results suggest that large proportions of each species' populations utilize the region, with stopovers ranging in duration from 1 to 24 days. Across species, many individuals stopped over in riverine floodplain habitats along the main stem of the Amazon River, while others used agricultural and grassland habitats. The Amazon Basin thus likely supports a significant number of migratory shorebirds during southward migration. When combined with on-the-ground efforts, we hope our data can offer an opportunity to focus research and conservation efforts in this vast and fast-changing region.

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*Comparing species richness estimates from Breeding Bird Survey Taiwan and eBird

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Citizen and community science, in both structured and semi-structured forms, has emerged as a valuable tool for collecting biodiversity data. However, semi-structured citizen science data can suffer from potential data quality issues such as uneven duration and imperfect detection, which may impact the accuracy of species richness estimates. In this study, we evaluate the effectiveness of Chao1 estimator in individual eBird checklists by comparing it to averaged species richness in Breeding Bird Survey Taiwan (BBS) and measuring bias using a power function while controlling for uneven duration. The results showed that the Chao1 estimator increased eBird species richness estimates from 56% to 69% compared to the averaged observed BBS, and from 47% to 59% compared to the estimated BBS. We concluded that biases in species richness estimates can result from variability in detectability skills, habitat heterogeneity, and incomplete short-duration samples. Incorporating the Chao1 estimator improved species richness estimates from both structured and semi-structured data, but caution should be taken to evaluate the occurrence of singleton species in advance to reduce uncertainty in estimation processes. This study provides the potential application of citizen science as a tool to address ecological questions in biodiversity-impacted areas.

Asymmetric and limited introgression of sex chromosomes in recently sympatric Myzomela honeyeaters

E. Shogren, C. Muirhead, E. Martí, D. Presgraves, J. Uy
Presenting author: **Elsie Shogren**

Secondary contact of formerly geographically isolated populations or species provides a compelling test of the strength of reproductive isolation. In the Solomon Islands, museum and expedition records indicate that the Cardinal honeyeater (Myzomela cardinalis) expanded its range to the island of Makira within the last 150 years, becoming sympatric with the endemic Sooty honeyeater (M. tristrami). Both species possess neo-sex chromosomes, likely formed by a W-autosome fusion. Given this change in genomic architecture and recent establishment of sympatry, patterns of introgression may reveal drivers of reproductive isolation at very early stages of secondary contact. Using whole genome re-sequencing, we characterize the diversity and history of these two species in allopatry and delve into the consequences of hybridization at the individual and genomic level in sympatry. Demographic histories are strikingly different for the two species, with M. cardinalis showing a decline in effective population size, while M. tristrami has remained stable. There is higher differentiation on ancestral and neo-sex chromosomes than on autosomes between species, but we detect late generation admixed individuals in sympatry. However, introgression varies by chromosome type; autosomal sequence appears to introgress in both directions more than Z sequence. By contrast, gene flow is asymmetric for the W, with only M. cardinalis W

sequence present in phenotypic hybrids and admixed individuals. This variation in amount and direction of introgression contributes to our understanding of the role of sex chromosomes in speciation and highlights the potential for changes in genomic architecture to influence generation and maintenance of biodiversity.

Development of a prototype early warning system for avian influenza in the EU based on risk-mapping

H. Sierdsema

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High Pathogen Avian Influenza (HPAI) has become an important source of mortality in wild birds. Most of the attention for HPAI however, is focused on its effects on poultry. In 2021 the European Food Safety Authority requested a consortium of the European Bird Census Committee (EBCC) and Ausvet to make a predictive model of expected HPAI-outbreaks based on changes in abundances of water birds, the movements of these birds across Europe and known HPAI-outbreaks. We pursued two different modelling procedures, INLA and AdaSTEM, to predict the weekly abundance of 12 water bird species based on data of the Euro Bird Portal (https://eurobirdportal.org/). This was combined with movement information from ringing data as collected by EURING in the Migration Mapping Tool (https://euring.org/research/migration-mapping) to make maps of fluxes of these 12 bird species across Europe. Finally, the abundance and movement data were combined with known HPAI-outbreaks, as reported in EMPRES-i, to make weekly maps for the probability of an HPAI-outbreak amongst wild birds in Europe, on a 50x50 km grid scale. The procedure was published in an EFSA-publication (https://www.efsa.europa.eu/en/supporting/pub/en-7762) and explained in a short tutorial (https://youtu.be/0LfFbZe_lrg). In 2023 we started a follow-up project that includes more bird species and more near-real time movement data to improve predictions of HPAI-outbreaks. We also want to expand the model to include the prediction of the risk of introduction and establishment of HPAI in poultry.

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*The influence of atmospheric conditions on airspace usage by aerial insectivores

V. Simons, E. Bridge, A. Abbott, K. Horton

Presenting author: **Victoria Simons**

Airspace is a critical habitat area for trillions of birds, bats, and insects, but a lack of recognition of this habitat has resulted in a knowledge gap. For aerial insectivores, this lack of knowledge is particularly concerning given current population declines and pressure from climate change. Moreover, this relationship becomes more complex at high elevations that undergo rapid shifts in daily weather conditions. To investigate the relationship between aerial insectivore provisioning and weather conditions at a high elevation breeding site, adult Tree Swallows (Tachycineta bicolor) were captured and fitted with a passive integrated transmitter (PIT) tag at Colorado State University's Mountain Campus during the 2022 breeding season. Radio-frequency identification (RFID) antennas were fixed to active nest boxes, which were monitored for egg laying, hatching, nestling development, and mortality to investigate how adult foraging effort impacts nestling growth. We compared parental effort to weather data to track individual responses in foraging behavior given changes in atmospheric conditions. We predicted that aerial insect abundance would decline quickly under cold and rainy conditions, and for this reason Tree Swallows would adapt to short term food unavailability but still provision for their growing nestlings. Temperature, precipitation, wind speed, and barometric pressure were all found to have a significant effect on provisioning effort, and nestling growth metrics have a positive relation to the number of parental visits to the nest box. These results give insight into the utilization of airspace as habitat and can be applied to understand the broader landscape of aerial insectivore population declines.

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*The nesting and diurnal habitat requirements of the American woodcock (Scolopax minor) in New Brunswick, Canada

L. Simulik, J. Nocera, A. Taylor

Presenting author: **Larissa Simulik**

The American woodcock (Scolopax minor) is a forest-dwelling shorebird whose population has fluctuated substantially over the past 123 years. Nearly hunted to extinction in the early 1900's, the population rebounded around the 1930s; however, since 1970, the population has declined 1% annually. The Eastern Habitat Joint Venture now considers woodcock to be a priority species and seek to have management plan in place for the eastern Canadian provinces. Little field data has been collected on their diurnal and nesting habitat requirements in Canada's Acadian Forest. We surveyed forests in New Brunswick from late April to early June across 5 sites in 2022 using thermal cameras to locate woodcock and, in total, found 13 nests and 33 diurnal sites. At woodcock occurrence and control (absence) sites (n= 46) we conducted habitat surveys in 0.04 ha plots where we measured tree basal area and density, shrub density, canopy cover at 30 cm height, overstory tree height, downed woody debris, and distance to nearest opening. We took five, 10 cm depth soil samples to test for soil texture and pH. We found woodcock prefer forests composed predominantly of shade-intolerant hardwood species with an average of 34.7% cover at 30 cm in height. Contrary to other studies, alder (Alnus spp.) was not an important component for woodcock habitat in New Brunswick during the spring. These results will assist in supporting the development of forest management plans and highlight the fact that understanding habitat requirements through on-ground assessments is important for improving management decisions for protect woodcock.

Migratory strategy on differences in immune gene evolution and genome-wide neutral markers in Dark-Eyed Juncos

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Theory predicts that migratory animals are exposed to a higher diversity of pathogens than resident species. These pathogens can impose strong balancing selection on immune genes, such as at the major histocompatibility complex (MHC). In contrast, sedentary species may exhibit good gene effects at MHC since they likely coevolve with local pathogens. Dark-Eyed Juncos have been identified as a candidate species for studying evolution-in-action, such as the two seasonally sympatric subspecies, the migratory Nothern Slate-Colored Junco and the resident Carolina Slate-Colored Junco in the Virginia Appalachians mountains. This system provides a unique opportunity to study the relationship between migratory behavior and the evolution of immune genes. We explored how patterns of molecular selection, allelic diversity, and phenotypic variation at MHC class I and II may be explained by migratory behavior. We hypothesized that MHC class I and II in the migratory Juncos are under stronger positive selection and are more diverse than the resident species. We also predicted genetic structure between both subspecies at both classes of MHC. We characterized both classes of MHC and are currently characterizing genome-wide neutral markers. Contrary to our hypothesis, we detected purifying selection at MHC class I and positive selection at MHC class II for both subspecies. We found genetic structure for class I but not for class II MHC, and found MHC class I alleles are associated with subspecies membership. Future work will contrast selected and neutral markers for demographic analysis. Ultimately, our study will advance our understanding of how migratory behavior may drive the evolution of immune genes and population divergence in birds.

BirdFlow: Inferring migratory routes and connectivity from range-wide relative abundance data

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Presenting author: **David Slager**

Patterns of migratory connectivity between breeding and non-breeding populations are key to understanding avian ecology, population dynamics, evolution, and conservation across the full annual cycle. Measuring connectivity typically relies on logistically challenging tracking of individuals, thus we lack direct measures of connectivity for hundreds of species, even in well studied regions like North America. Here, we present BirdFlow, an innovative graphical modeling framework that combines a cost

function for movement with weekly population-level relative abundance estimates from eBird Status and Trends to fit a probabilistic spatio-temporal model of migration across a species' range and across the annual cycle. From this model, we can infer a distribution of synthetic migratory tracks across individual birds and in turn estimate migratory connectivity and other measures, including arrival and departure dates. The current BirdFlow model includes several hyperparameters that control aspects of the model fit, including parameters and relative weights describing movement cost, fit of marginals to relative abundance data, and an entropy term adjusting for over-fitting to optimal tracks. We present metrics and results from validating BirdFlow model parameters for multiple species using existing tracking and mark/recapture data. In particular, we examine the ability of the model to capture patterns of migratory connectivity. Finally, we summarize open-source R and Python packages in development for preprocessing BirdFlow input data, fitting the models, and summarizing model outputs. This software will allow ornithologists to use BirdFlow models to address the full suite of urgent research questions related to avian movement.

Spatially explicit Bayesian hierarchical models for avian population status and trends

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Population trend estimates form the core of avian conservation assessments in North America and indicate important changes in the state of the natural world. The models used to estimate these trends from structured monitoring data, would be more efficient and more informative for conservation, if they explicitly considered the spatial locations of the monitoring data. We created spatially explicit versions of some standard status and trend models applied to long-term monitoring data for birds in North America. We compared the spatial models to simpler hierarchical (i.e., non-spatial) versions of the same models, fitting them to simulated data, and to real data from three broad-scale monitoring programs: the North American Breeding Bird Survey (BBS), the Christmas Bird Count (CBC), and a collection of programs we refer to as Migrating Shorebird Surveys (MSS). All of the models generally reproduced the true underlying trends and population trajectories when there were many data, but the spatial models outperformed the hierarchical models when there were fewer data and in locations where the local trends varied more from the range-wide means. When fit to real data, the spatial models revealed interesting spatial patterns in trends that were much less apparent in results from the hierarchical versions. The spatially explicit sharing of information also means the models can be fit with much smaller strata, allowing for finer grained patterns in trends. Spatially informed trends will facilitate more locally relevant conservation, highlight areas of conservation successes and challenges, and help generate hypotheses of the spatially dependent drivers of population change.

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*Experimental evidence for how error rates shape animal communication and the influence of background noise

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Anthropogenic noise in urban environments is ubiquitous and may occur within the same frequencies that many birds use when communicating. In response, some birds may adjust their signals to maximize receiver responses while receivers may adjust their thresholds to better detect signals. This makes the detection and discrimination of signals more challenging for receivers and likely increases communication errors such as missed signals or responses to imagined signals (false alarms). To date, research has primarily focused on changes in signals in the presence of noise rather than the detection of signals by receivers. For this study, we sought to determine whether communication errors are influenced by anthropogenic noise. We measured background noise and conducted playback experiments with northern cardinals (Cardinalis cardinalis) at 29 sites across northern Virginia, Washington, DC, and southern Maryland. We estimated receiver error rates by observing the behavioral response of cardinals to simulated territorial intruders. We found that cardinals committed communication errors almost as frequently as they correctly responded to signals, only responding correctly 55.2% of the time. While

noise levels at our sites ranged from 49.4 to 74.4 dB, we did not observe an association between anthropogenic noise and communication error rates. To our knowledge, this is the first study to assess communication error rates of any animal in response to anthropogenic noise. Given previous findings that cardinals adjust their signals in the presence of anthropogenic noise, this study highlights a need to incorporate both signals and receiver responses when evaluating the influence of noise on avian communication.

The influence of cognition on fine scale parental investment behavior

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The delegation of parental care is often complex and dependent on pair quality, experience, and composition. Higher quality individuals are expected to not only produce more offspring but of superior quality. The mechanisms that generate these offspring are based both in genetic composition but often more importantly on the condition of the developmental environment, which is largely dictated by parental investment (e.g., nest building, incubation persistence, feeding rates). Mountain chickadees (Poecile gambeli) are a species of resident passerine songbird that exhibit biparental care. Additionally, this species relies on highly specialized spatial memory to survive during harsh winter months in montane environments, a trait that is known to be under selection. Past work has shown that offspring condition and quality is dependent on pair composition, with experienced pairs producing larger offspring. In this study, we measured fine scale nest box visitation rates throughout development using radio frequency identification (RFID) technology. We had predicted that the pairs with better spatial memory performance would feed more frequently and that males would feed more frequently than females. However, we found no relationship between provisioning rates and cognition and no differences in provisioning rates between males and females. We did find that females that fed offspring more during early and mid-development, but not late development, produced offspring of larger mass.

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*Exploring density dependence in cavity nesting ducks: Insights from 35 years of nesting data

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Nest boxes for cavity nesting waterfowl have proven highly effective in supplementing areas with low natural cavity availability. Nest box management can be costly due to labour and materials to maintain boxes; understanding nest box efficacy provides managers with information for planning future expenditures (i.e., changing the number of boxes). As an exemplar, we examined the efficacy of a nest box program in the lower Saint John River (New Brunswick, Canada). We used 35 years of hatching and box usage data to better understand direct and delayed density dependence in cavity nesting waterfowl. Wood duck (Aix sponsa) numbers in New Brunswick have been increasing since the 1970's, while common goldeneye (Bucephala clangula) and hooded merganser (Lophodytes cucullatus) populations have seen little or no growth in recent years, indicating a population nearing its carrying capacity, and the addition of nest boxes would provide few conservation benefits. To examine density dependent patterns in these three species we used an autoregressive integrated moving average model which allows for the detection of autoregressive events occurring at different lags. We found that none of the species demonstrated density dependence in their nesting success over the last 35 years and therefore increasing the number of nest boxes in the lower Saint John River would likely have positive effects on local populations.

The comparative morphology of the avian bony columella

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In birds, the columella is the only bony element of the sound conducting apparatus, and conveys vibrations of the cartilaginous extracolumella to the fluid of the inner ear. Although avian columellar

morphology has attracted some attention over the past century, it nonetheless remains poorly described in the literature. The few existing studies mostly focus on morphological descriptions in relatively few taxa, with no broad, quantitatively-informed surveys having been published. To fill this knowledge gap, here we use both qualitative and quantitative observations, gathered from 401 taxonomically-diverse species, to provide a comprehensive survey of columellar morphology in a phylogenetic context. We find that, generally, the morphology of the columella shows substantial homoplasy, but several clades exhibit characteristic derived morphologies. Newly described is a columellar morphology, which characterises a large subclade of the Accipitridae.

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*Bamboozling Interactions: Interspecific associations within mixed-species bird flocks in bamboo in the Eastern Himalaya

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Bamboo is one of the most understudied habitats in the world, although it is widespread and supports significant biodiversity. Several species across taxonomic groups are partial to bamboo, with some being obligate bamboo specialists. Mixed-species bird flocks (flocks) are an important and regular feature of tropical and temperate forest bird communities, and have been well-studied in forests. However, how and why flocks might differ between bamboo and non-bamboo habitats have never been examined. We studied flocks in rainforest and bamboo stands in winter and summer in the Eastern Himalaya, where bird and bamboo species richness are amongst the highest in the world. We used network analysis to quantify and compare interspecific associations within flocks between the two habitats and seasons. We also quantified arthropod abundance to understand if resource availability might be driving flocking. We found that bamboo and rainforest flocks differed greatly in their composition and interspecific associations, with bamboo flocks mainly consisting of bamboo specialist species. These were more cohesive, less modular and more consistent in their composition across seasons than rainforest flocks. Arthropod abundances increased in both habitats in the summer, probably leading to the partial disintegration of rainforest flocks, whereas this increase was possibly insufficient to allow non-flocking in bamboo. We demonstrate the reliance of the bamboo bird community on flocking and their interdependence within flocks, making them highly vulnerable to anthropogenic habitat changes in this successional, ephemeral ecosystem. We emphasise the need to conserve large bamboo stands at the landscape level in the Eastern Himalaya.

The genetic architecture of reversible plasticity in a complex physiological trait

M. Stager, S. Taylor
Presenting author: **Maria Stager**, University of Colorado Boulder, maria.stager@gmail.com

When environmental fluctuations occur, the ability to reversibly modify trait values can allow individuals to optimally match their phenotype to the environment. Such phenotypic flexibility is ubiquitous across the tree of life and determining the causes of variation in flexibility may be critical to our understanding of individuals' capacity to cope with accelerating global change. However, the genetic basis of variation in flexibility has rarely been characterized – a pursuit which necessarily requires linking genotype to phenotype. Birds exhibit substantial flexibility in physiological traits and can therefore serve to help characterize these connections. For instance, Junco populations vary in their physiological flexibility and this variation correlates with the temperature variability of their native environment. Utilizing tissue samples collected during laboratory acclimation experiments, we performed whole-genome resequencing and muscle transcriptome sequencing to quantify genomic and transcriptomic patterns of variation associated with differences in physiological flexibility for 95 Junco individuals. We then identified allelic variants related to physiological flexibility using association methods and validated these sites with gene expression profiles and additional phenotyping. Taken together, this work helps to provide a mechanistic understanding of the ability of natural populations to respond to environmental change.

Range-wide Western Yellow-Billed Cuckoo survey results and occupancy estimates

J. Stanek, M. Whitfield, E. Juarez, R. Norvell, E. Duvuvuei, N. Clipperton, N. Beauregard

Presenting author: **John Stanek**

The western Yellow-billed Cuckoo (Coccyzus americanus) was historically described as common in appropriate habitat (Grinnell and Miller 1944) and could be found west of the Continental Divide from Texas to British Columbia. Following the extensive loss of riparian forest over the last century, the western Yellow-billed Cuckoo population suffered significant range reductions and extirpations from large areas of its historical range (Gaines and Laymon 1984, Halterman et al. 2001, Hughes 2020). In 2014, the U.S. Fish and Wildlife Service estimated the United States western Yellow-billed Cuckoo population (the western distinct population segment [DPS]) at 395-450 pairs in its decision to list the western Yellow-billed Cuckoo DPS as Threatened under the Endangered Species Act (USFWS 2014). Given the significant lack of information on the species, in the summer of 2022, eleven states across the western DPS coordinated a range-wide survey effort, conducting surveys at 319 randomly selected sites on federal, state, county, private, and tribal lands. Over three surveys at each site, surveyors had 575 cuckoo detections in total, with the majority detected in Arizona, New Mexico, and California. In this presentation, we will discuss range-wide occupancy estimates that will provide a basis for future science-based, data-driven management actions to directly improve cuckoo populations.

Extreme weather alters nest provisioning rates but not productivity or nestling mass in a temperate forest owl

E. Stein, S. Midway, B. Linkhart

Presenting author: **Eliza Stein**, Louisiana State University, elizadstein@gmail.com

As global temperatures and precipitation become more extreme, habitat specialists are at particular risk of being pushed past their environmental tolerance limits. Flammulated Owls (Psiloscops flammeolus) are small migratory owls that breed in temperate conifer forests of western North America. Their highly specialized nesting and foraging requirements make them an indicator of ecosystem health. Using 17 years of nest observations, we investigated how annual weather patterns affected Flammulated Owl nesting and foraging behaviors during the breeding season. We used generalized linear models with a changepoint parameter to evaluate nest provisioning and nestling growth rates in years of extreme temperature and precipitation. We also evaluated how adult mass, division of labor, and productivity varied based on precipitation and temperature. Compared to wet and warm years, adults made more frequent prey deliveries to nestlings in dry and cold years, particularly early in the night and early in the season, and they experienced earlier changepoints in these years. We found a significant positive effect of temperature on the number of fledglings in broods, but weather did not affect other parameters, including productivity, nestling growth rates, adult masses, and division of labor. Our findings suggest that extreme annual weather patterns influence insect prey availability during the Flammulated Owl breeding season, forcing adults to work harder to provision for nests during dry and cold years. While productivity and nestling growth did not vary between years, these may incur a long-term tradeoff in adult survival.

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*Influence of functional traits on the sensitivity of aerial insectivores' migration timing to climate change

A. Strand, J. Kelly, C. Youngflesh

Presenting author: **Alva Strand**

Over the past few decades, a number of species of birds have changed their migration timing in response to climate change. There is considerable variation in the magnitude and direction of these phenological changes across species, suggesting that the migration timing of some species is more sensitive to climate change than that of others. However, the mechanisms driving this variation are poorly understood. Here, we used eBird data to investigate the influence of functional traits such as body mass, migration distance, migration speed, and mean arrival date on the sensitivity of species' spring migration timing to climate change between 2002 and 2019. We considered the influence of these traits on ten species of North American migratory aerial insectivores, as it is likely that their migration timing is sensitive to the emergence of insects and, thus, to changes in air temperature. We found that mean arrival date, migration distance, and migration speed explained 16.8%, 12.8%, and 11.4% of the variation in sensitivity, respectively, while body mass only explained 2.8% of this variation ($p < .001$). We also investigated whether migration timing was more sensitive to climate change in places that had experienced greater

warming between 2002 and 2019 and found that this was the case for seven of the ten species. Finally, we investigated the influence of functional traits on sensitivity across space and found that migration distance explained 48.5% of the variation in sensitivity with climate change (p = .025). As aerial insectivores have experienced significant population declines in North America since the 1970s, this study sheds light on the factors that shape their ability to persist in the face of a changing climate.

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*Influence of a previous infection on Mycoplasma gallisepticum transmission and long-term immunity in canaries.

M. Sudnick, E. Sauer, S. DuRant
Presenting author: **Madeline Sudnick**, University of Arkansas, ms224916@ohio.edu

Physiological processes of hosts govern how pathogens can establish infection. Physiological differences between first infection and reinfection can influence disease patterns by altering transmission dynamics. The bacterium Mycoplasma gallisepticum (MG) causes severe conjunctivitis in birds and the likelihood of birds encountering the pathogen multiple times is high. Birds infected with the same MG strain maintain partial immunity to reinfection and have milder eye lesions for at least 14 months. We conducted two experiments to investigate questions related to MG immunity and transmission. First, to determine if previous infection with MG alters the likelihood of transmission during a subsequent MG infection event we placed birds into flocks of four individuals either completely naÃ¯ve to MG or previously exposed to MG once, then inoculated an index bird in each flock with MG. We found that MG only transmitted in flocks experiencing first infection (n = 3 of 8) and none of the flocks experiencing second infections (n = 0 of 9). Second, to investigate whether birds maintain partial immunity after an extended period without infection, we re-inoculated birds with MG three years after their original infection. We analyzed differences in physiological response, antibody presence and bacterial load to determine resistance and tolerance. Determining the strength of long term retention of immunity and differences in transmission between naÃ¯ve and previously infected birds will lead to a better understanding of disease dynamics in wild birds.

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*Impacts of increasing isolation and environmental variation on Florida Scrub-Jay demography

J. Summers, E. Cosgrove, R. Bowman, J. Fitzpatrick, S. Schoech, N. Chen
Presenting author: **Jeremy Summers**

Populations that maintain consistent sizes are regulated by both density-dependent and density-independent forces, such as cyclic environmental conditions or intraspecific competition for resources. Understanding how populations respond to changes in these forces over time is crucial for determining the risks presented by environmental changes in climate or available habitat. Populations may also be sensitive to the demography of neighboring populations; a population that relies on regular immigration to maintain stability will decline along with neighboring populations or experience shifts in demographic rates. Here we characterize environmental drivers of demographic rates of a long-studied population of the Federally Threatened Florida Scrub-Jay (Aphelocoma coerulescens). Surrounding populations have rapidly declined in recent years due to habitat loss and degradation, resulting in a declining immigration rate into our study population. However, the annual population growth rate has fluctuated rapidly over this time period, with the focal population size remaining stable. We performed a life table response experiment using 30 years of data and found that variation in the population growth rate was mostly driven by variation in fecundity and survival, which were most strongly affected by the ENSO cycle. We did not find a large effect of the decline in immigration due to compensatory trends in breeder recruitment, breeder survival, and fecundity. Despite previous results that the decline in immigration has caused an increase in the levels of inbreeding, our results indicate that our focal population is robust to the demographic effects of increased isolation.

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*The evolution of alternate migration routes in high-latitude myrtle warblers (Setophaga coronata coronata)

S. Szarmach, D. Pierce, A. Brelsford, D. Toews
Presenting author: **Stephanie Szarmach**, The Pennsylvania State University, sjs7465@psu.edu

Seasonal migration allows many birds to breed at high latitudes where conditions are unfavorable for part of the year. However, this behavior may constrain breeding range size for some taxa due to the energetic costs of longer migrations. In parulid warblers breeding in the North American boreal forest, species that migrate farther tend to have smaller ranges that do not fill the extent of available habitat. The few parulid species with large ranges extending from the Atlantic Coast to Alaska may employ different migratory strategies allowing them to persist far from the species' core wintering areas. The myrtle warbler (Setophaga coronata coronata) has two distinct wintering ranges–one on the Atlantic Coast and the other on the Pacific. Previous work has indirectly linked birds breeding in Alaska with the Pacific wintering area, suggesting that high latitude myrtle warbler populations evolved an alternate, shorter migration route as the species' range expanded. We deployed geolocators on myrtle warblers breeding in Anchorage, AK to directly track the migrations of individual birds, predicting that these birds will all follow a shorter route to the Pacific wintering ground, rather than migrating to the Atlantic Coast. We also inferred the wintering areas of myrtle warblers breeding along a transect from Alaska to northern British Columbia using stable isotopes to identify a possible migratory divide. In addition, we quantified how a divergent genomic region varied across this transect and between individuals differing in migratory phenotype. This study will increase our understanding of myrtle warbler migratory connectivity and of the relationship between migration and geographic range.

Body size shifts in North American birds since the Late Pleistocene

O. Takano

Presenting author: **Oona Takano**, University of New Mexico, omtakano@gmail.com

Recent studies suggest that modern birds are decreasing in body size by up to 1.8% per decade, in conjunction with climate change. The Late Pleistocene (126,000–12,000 years ago) was a time of climatic fluctuations tracking glacial-interglacial cycles. As the climate warmed at the end of the Late Pleistocene, large-bodied birds and mammals in North America experienced elevated extinction rates. Body size is an important trait that determines metabolic rate, diet, and species interactions. I examined body size changes across multiple bird orders from the Late Pleistocene to today using fossils from Rancho La Brea in California to understand whether climate or competition is driving body size shifts. I quantified size changes for 22 bird species from the Late Pleistocene to today by measuring large wing and leg skeletal elements as body size proxies. I used t-tests to analyze average size differences in each species between time periods. Preliminary results indicate no evidence for consistent body size decrease across bird orders since the Late Pleistocene, which would imply climate-driven change. Rather, the direction of size change differs between species and skeletal elements measured, suggesting complex effects potentially related to changes in competitive pressure. Studying the effects of past climate change and faunal extinction on surviving species will provide better predictive power for understanding how modern birds will respond to climate change and lower species diversity.

Exploring Molecular Signatures of Seasonal Variations in Local Bird Populations

T. Taucher, S. Lamichhaney

Presenting author: **Trixie Taucher**

Phenotypic plasticity is the ability of an organism to alter its phenotype in response to changes in its environment. While there's been significant research on phenotypic plasticity, there are still knowledge gaps in our understanding of how it functions and affects the fitness and survival of organisms. One major gap is we still do not fully understand the genetic and molecular mechanisms underlying phenotypic plasticity. â€‹â€‹Studying seasonal changes in local bird populations is a valuable approach to investigating phenotypic plasticity since birds are known to exhibit a range of plastic responses to changes in their environment. This study utilizes an integrative approach of transcriptomics, epigenomics and metabolomics to quantify molecular processes associated with seasonal differences in birds. The three species chosen for this study are small songbirds that are locally present throughout the year in Northeast Ohio; American goldfinch (Spinus tristis), black-capped chickadee (Poecile atricapillus), and House Finch (Haemorhous mexicanus). We have collected multiple tissue samples (brain, liver, muscle, heart, gizzard, and gonads) from these birds (n=499) across multiple seasons throughout the year. Till date, we have generated transcriptome resources from (n=44) samples. Gene expression analysis has

identified a list of candidate genes that are differentially expressed in these local bird populations across different seasons. We are currently generating epigenomic and metabolomic data from the same samples. By combining these approaches, we expect to gain insights into how seasonal changes in the environment are translated into changes in gene expression, epigenetic modifications, and metabolic processes in birds.

Climate-Induced Range Contractions in Boreal Birds

J. Taylor, H. Kim, B. Zuckerberg, N. Anich
Presenting author: **Janelle Taylor**, University of Wisconsin Madison, jtaylor8@wisc.edu

Earth is rapidly approaching a new planetary state. High-latitude ecosystems such as boreal forests will bear the brunt of climate change with warming trends 2-3 times higher than global trends. Across northern Wisconsin and the Great Lakes region, the boreal forest reaches its southernmost range extent. Resident boreal bird species in Wisconsin, Boreal Chickadees, Spruce Grouse, Black-backed Woodpeckers, and Canada Jays are especially vulnerable to negative effects of a warming climate. Caching species including Canada Jays are susceptible to warming winter temperatures, as caches are more prone to spoilage as temperatures increase. Wisconsin Breeding Bird Atlas is a grid-based citizen science project covering Wisconsin in two past survey windows, 1995-2000 and 2015-2019. Using these data, we explored dynamic changes in occupancy of each species between these periods across atlas blocks (4.5 km Ã— 4.5 km), and integrated information on climate and land-cover changes that could explain these changes. NaÃ¯ve occupancy changes between these two periods with comparable efforts (n = 1,130 atlas blocks) indicated range contraction and decline in population size of all four species between, with changes in occupancy ranging from -33% in Spruce Grouse to -92% in Boreal Chickadees. Patterns of block-level retractions were associated with increases in winter climate. We offer detailed investigation on the mechanisms of climate-induced decline in these cold-adapted species in Wisconsin, such as fine-scale microclimate changes and cache decomposition rates. While local management actions may aid in persistence, it is likely that without large-scale intervention, populations will continue to decline and contract in their ranges.

A gene network and pathways perspective on the genetics of spatial cognition in chickadees

S. Taylor, G. Semenov, B. Sonnenberg, C. Branch, V. Heinen, J. Welklin, E. Bridge, V. Pravosudov
Presenting author: **Scott Taylor**, University of Colorado Boulder, scott.a.taylor@colorado.edu

We recently provided evidence that spatial cognition in chickadees has a heritable genetic basis, providing the critical link between a fascinating adaptive behavior and natural selection. However, we still know very little about how candidate behavioral genes are connected from a developmental and physiological perspective, and the extent to which the genetic architecture of spatial cognition is shared among distinct taxa. Here, we used an expansive whole-genome dataset coupled with the state-of-art chromosome-scale reference genome assembly, and species-specific gene annotation, to refine our understanding of the genetics of spatial cognition in the mountain chickadee (Poecile gambeli). Variation in spatial memory in wild chickadees can be quantified using experimental feeder arrays. Previous studies found that individual variation in spatial memory affects the ability of mountain chickadees to recover cached food sources, resulting in reduced overwinter survival for birds with poorer spatial performance. Expanding on previous findings, we identified a set of genes most likely playing key roles in determining variation in spatial memory in the mountain chickadee. We then investigated the connections of individual genes to broader genetic pathways, as well as physiological and developmental processes underlying spatial cognitive performance. We discuss our findings and compare them to data from other chickadee species.

Fine- and broad-scale population differentiation in New Zealand Fernbirds

S. Taylor, A. Settlecowski, N. Torr, B. Robertson
Presenting author: **Sabrina Taylor**, Louisiana State University, staylor@lsu.edu

The New Zealand Fernbird (Bowdleria punctata) is a neglected, imperiled species that is declining due to depredation by introduced mammalian predators and loss of its wetland habitat. No peer-reviewed research exists to address broad, range-wide conservation concerns. First, the validity of the five extant subspecies has never been explored with modern genetic approaches and the current descriptions are contentious and based on few data. Second, wetland habitat is being lost and fragmented due to land conversion, possibly stranding weakly flying Fernbirds in small patches. Small habitat patches mean small population sizes, which often lead to loss of genetic variation due to drift and a consequent inability to adapt to change; and inbreeding, leading to a reduction in survivorship and reproductive success. We used a double-digest RADseq method to sequence single nucleotide polymorphisms and examine genetic structure across 13 sampling locations (n=245 birds) that included all extant subspecies. Four of the sampling locations were in the Te Anau basin to examine gene flow among small habitat patches. These analyses will identify lineages that are genuinely distinct and direct conservation resources to protecting areas where these lineages are found. It will also clarify whether gene flow exists or whether Fernbirds are now restricted to small habitat patches where they are vulnerable to further declines from genetic problems and must be managed with translocations or habitat corridors. Our findings will help allocate conservation resources rationally and inform management decisions.

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*Spatial and historical dynamics of the Northern Flicker (Colaptes auratus) hybrid zone in the Colorado Front Range

K. Meek, T. Imfeld, G. Spellman
Presenting author: **Kaily Taylor-Meek**, Regis University, kmeek@regis.edu

Hybrid zones are known to be impacted by environmental and anthropogenic factors. Studies have shown that increased anthropogenic disturbance affects hybridization in unique ways often driving an increase in the frequency of hybridization in more disturbed areas. Northern Flicker subspecies hybridize across the North American Great Plains. These taxa have low levels of genomic divergence and distinct plumage characteristics that vary between red-shafted, yellow-shafted, and hybrid individuals that allow for hybrids to be effectively scored genetically or morphologically. The Flicker hybrid zone has been extensively studied across the Great Plains from both an historical and contemporary perspective, but how urbanization and human disturbance has influenced Flicker hybridization is unknown. Our study evaluated how hybridization frequencies and dynamics have changed in the last century along the Front Range of Colorado between red-shafted and yellow-shafted Northern Flickers. We assessed flicker hybridization historically and spatially by quantifying hybrid scores from study skins (N=291) using a published standardized plumage scoring system. Plumage characteristics had major gradients between pure red-shafted and pure yellow-shafted individuals. Additionally, we observed sex bias in major plumage characteristics between males and females where crown covaries with other plumage characteristics between sexes in PC2 (16.4% variance, SD= 0.9057). Hybridization changed spatially over the last century, and in response to urbanization based on land use categories and hybrid frequencies have increased with increased urbanization.

The role of phenotypic traits in mediating elevational replacement in Andean birds

E. Tenorio, J. Merwin, V. Tager-Geffner, X. Larrieu, B. Smith
Presenting author: **Elkin Tenorio**, City University of New York, ek.tenorio@gmail.com

The exceptional biodiversity of the Andes is linked to high levels of species turnover, which results from elevational replacements among closely related species. These replacements are attributed to ecological interactions, such as competition, where phenotypically similar species exclude each other along elevational gradients. However, evidence supporting this idea is often limited to distributional information, and in the absence of the phenotypic data that may inform the degree of competitive interactions. In this study, we tested whether elevational overlap was positively correlated with phenotypic divergence, indicating that coexistence occurs when species are sufficiently divergent. To test this hypothesis, we measured plumage color in the visible and UV spectra and external morphology that reflects the size and shape of 11 pairs of bird sister species with varying elevational overlap. We found color divergence increases with elevational overlap. In contrast, morphology showed the opposing pattern, with species

being more similar when they overlap. Our results suggest that plumage color may mediate competitive interactions, where species recognition may be important in the early stages of divergence when species occupy similar elevations in secondary contact. On the other hand, high similarity in body size and shape in overlapping elevations may suggest a predominant role of local adaptation over interspecific competition during incipient morphological evolution. Our results support the idea that ecological interactions through species recognition, may underlie the origin of elevational replacements and turnover in tropical mountains.

Random mating in the face of balancing selection at the major histocompatibility complex class I in Song Sparrows

S. Thompson, J. Slade, D. Potvin, B. MacDougall-Shackleton
Presenting author: **Scout Thompson**, Western University, athom95@uwo.ca

The major histocompatibility complex (MHC) is a family of genes involved in pathogen detection, with class I (MHCI) and II (MHCII) recognizing and interacting with intracellular and extracellular pathogens, respectively. MHC genes are under heavy pathogen-mediated selection, most commonly balancing selection resulting from rare-allele and heterozygote advantage. Whereas theory predicts that sexual selection should reinforce natural selection (usually by disassortative mating), previous studies of song sparrows (Melospiza melodia) revealed assortative mate choice at MHCII despite balancing selection. We asked whether this seemingly paradoxical finding would be paralleled at MHCI. Given previous evidence of heterozygote advantage at MHCI, we predicted signatures of balancing selection and disassortative rather than assortative mating. We sequenced the hypervariable exon 3, scanned for positively selected sites and trans-species polymorphisms, and compared the genetic similarity of 42 socially mated pairs to that expected under random mating. We identified 10 codons with signatures of positive selection, and trans-species polymorphisms suggesting ancient and longstanding balancing selection. However, socially mated pairs were neither more nor less similar than expected under random mating. We suggest that although disassortative mating at MHCI would likely enhance fitness, song sparrows may be constrained by the inability of song sparrows to assess MHCI genotype.

The “Parulome” project: Divergence and introgression in a rapid vertebrate radiation

D. Toews, A. Wood, M. Baiz, L. Phung, I. Lovette, A. Brelsford
Presenting author: **David Toews**

Evolutionary radiations are groups of organisms that produce new species at an exceptionally high rate. Biologists have long used such radiations as model systems to study the process of speciation. Past studies have commonly focused on the traits of organisms or their habitats that might have facilitated the formation of new species. With the development of genome sequencing methods, however, it is now possible to identify specific genes that might be involved in producing evolutionary radiations. In this presentation I'll discuss how we have tried to identify genes that may be associated with the exceptional diversification of a group of small, colorful songbirds in North, Central, and South America. These are the wood warblers (Parulidae), a family of birds with over 100 species that diversified within the last 10 million years, and which has one of the fastest rates across songbirds. I will discuss how we have used hybrid zones and whole genome sequencing of multiple individuals of every species in the radiation to better understand the genetic substrate which has given rise to one of the most diverse vertebrate species groups.

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*Neural trade-off in the sensory regions of waterfowl (Anatidae)

K. Toler, J. Corfield
Presenting author: **Kellee Toler**

Studies have shown that a relative enlargement in a particular brain region is correlated with increases in sensory, motor, memory, or cognitive capabilities; however, brain size is limited. If selection favors one brain region to evolve to be larger, other brain regions will decrease in size to accommodate it – a neural trade-off. Neural trade-offs have never been directly tested. Anatids are ideal candidates to examine

neural trade-offs due to the variability of ecological niches they inhabit, which allows them to be an excellent bridge to the understanding of neurology in many other animals. I will describe patterns of sensory neural trade-offs in 19 species of waterfowl using unbiased stereology methods, residual analysis, and a phylogenetic canonical correlation analysis (PCCA). It is expected that closely related species or species with similar feeding behaviors will have similar patterns in neural trade-off. The result of this study will give us clues to how evolution, behavior, and ecology affect the sizes of brain regions in other animals, including humans.

Status and reproduction of a Caribbean Brown Pelican subpopulation in northwestern Puerto Rico

A. Tossas

Presenting author: **Adrianne Tossas**, University of Puerto Rico, Aguadilla, agtossas@gmail.com

Since 2019 we have been assessing the population status of the Caribbean Brown Pelican (Pelecanus occidentalis occidentalis) in the coast of Aguadilla, northwestern Puerto Rico. No surveys were conducted in this area since 1993 even though the site has been reported as one of only three breeding sites in the island. From 2019 to 2021, we counted up to 49 individuals in 38 monthly surveys, including adults with reproductive plumage and juveniles. In October 2021 we found an active breeding colony with 53 nests in a steep cliff bordering the seashore. The nests were constructed in the canopy of tall deciduous trees growing on a rocky cliff. Two to three eggs were observed in each nest (n= 51), but only one to two chicks fledged (n=40). The number of nests reported in this study doubles that from previous studies, but the mean number of young produced per successful nest remained stable. We are currently monitoring a second breeding season. However, this time, the high precipitation and strong winds related to hurricane Fiona in September 2022, caused the loss of a high number of nests, and decreased reproductive success in general. Our results suggest the need of a long-term island-wide monitoring of Brown Pelican nesting colonies in order to understand fluctuations through time, and particularly since its populations in the Caribbean region are declining due to breeding habitat loss and human disturbances, among other threats.

Migrating shorebirds and dabbling ducks increased use of wetlands disturbed by agricultural practices

D. Toy, M. Anteau, A. Pearse, E. DeKeyser, J. Norland, D. Roberts

Presenting author: **Dustin Toy**

The Drift Prairie has been largely converted from grasslands to croplands, but still contains thousands of wetlands used by shorebirds and ducks during breeding and migration periods. Consequently, many of the remaining wetlands are situated within cropland where natural disturbance regimes (i.e., fire, grazing, and water-level dynamics) have been highly altered. Smaller wetlands within crop fields are subject to various disturbances stemming from agricultural practices such as burning, disking, harvesting, and mowing. We evaluated vegetation structure of idled and manipulated agricultural wetlands to investigate if management method or resulting vegetation structure resulted in changes to occurrences and densities of dabbling ducks and shorebirds during spring. All manipulation methods reduced vegetation heights compared to idled wetlands and most manipulations reduced the vegetation coverage in inundated areas of wetlands. Manipulation methods influenced shorebird occurrence, whereas vegetation structural characteristics explained duck occurrence. Duck occurrence peaked in wetlands with lower percentages of vegetation coverage (32%), and duck densities decreased as percentage of vegetation coverage increased beyond 10%. Thus, reducing vegetation coverage in wetlands situated within cropland is expected to increase use by most staging dabbling duck and shorebird species in the Drift Prairie. While more studies are needed to understand the underlying mechanisms driving these results, waterbird conservation efforts should encourage periodic disturbances to reduce dense vegetation in undisturbed wetlands and increase potential use of wetlands in agricultural areas by migrating and breeding shorebirds and dabbling ducks.

The gut microbiome influences digestive phenotypes in a wild passerine

B. Trevelline, J. Houtz, C. Andreadis, J. Sanders, M. Rowe, A. Moeller
Presenting author: **Brian Trevelline**, Cornell University, brian.trevelline@gmail.com

The digestive system is a major interface between an animal and its environment, and harbors complex microbial communities that can profoundly influence host phenotypes. However, the vast majority of this research has been conducted in model organisms, leaving a large knowledge gap regarding how the gut microbiome shapes the phenotypes of wild vertebrates. Advancement has been further slowed by a lack of diverse animal models reared under germ-free conditions in which microbiome composition can be precisely controlled, precluding experimental investigation of the impacts of the microbiome on vertebrate ecology and evolution. We used a novel experimental system to generate germ-free House sparrows (Passer domesticus) to experimentally test whether the gut microbiome affects avian digestive phenotypes. We hand-raised a total of 27 germ-free sparrow hatchlings, the gut microbiome of which were compositionally indistinguishable from negative controls, demonstrating the feasibility of generating germ-free birds using simple aseptic techniques and open-source gnotobiotic isolators. After hatching, chicks were hand-raised on sterile formula and were inoculated with either sterile water (germ-free) or 7.5 mg of adult sparrow feces (conventionalized) 7-times per day for 7 days. Conventionalized sparrows exhibited enhanced development of digestive organs compared to germ-free individuals, providing the the first experimental evidence that the gut microbiome shapes host digestive phenotypes in a non-model vertebrate. These results demonstrate that the gut microbiome is essential to the digestive function of wild passerines, which may have far-reaching consequences on animal physiology, performance, and its role in the environment.

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*Post-breeding ecology in the Prothonotary Warbler: Evaluating potential trade-offs between breeding, molt, and migration

B. Tsuru, E. Ames, C. Tonra
Presenting author: **Brian Tsuru**

The post-breeding period is a transitionary stage of the annual cycle of migratory birds, linking the breeding season with migration to the non-breeding grounds. In this short period of time, migrants must finish breeding, undergo molt, and prepare for migration. These events may impose competing demands on migrants, potentially forcing birds to make trade-offs among them. We assess evidence of such trade-offs in the Prothonotary Warbler (Protonotaria citrea), a long-distance migrant and species of conservation concern. We monitored color-banded Prothonotary Warblers in central Ohio through their breeding and post-breeding activities, recording the timing of major events such as spring arrival, nest fledging, and the cessation of post-fledging care. We deployed radio-transmitters on focal adults (n=38) to track them throughout the post-breeding period and determine the timing of their migratory departure from the site. We assessed the timing of prebasic molt in a smaller number of individuals (n=14), and found that many breeding birds overlapped molt with parental care (i.e., an energetic trade-off between breeding and molt). We found evidence that individual birds caring for offspring later into the season were more likely to overlap these life history stages. Furthermore, later-breeding individuals also showed delayed migratory departure dates, indicating a phenological trade-off between breeding and fall migration. Our findings demonstrate that adult Prothonotary Warblers make multiple trade-offs between breeding, molt, and migratory phenology in the post-breeding period, and have implications for how breeding season events can produce individual-level carry-over effects in subsequent stages of the annual cycle.

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*Tracking the process of egg ejection in the American robin

A. Turner, V. Sluis, E. Williams, T. Benson, M. Ward, M. Hauber
Presenting author: **Abbigail Turner**

Birds remove diverse objects from their nests for many reasons. One reason is the removal of foreign eggs when they are laid in host nests by obligate brood parasites. Although host egg rejection behavior has been studied extensively, we know relatively little about certain characteristics of the ejection process, such as latency of, distance, and direction in which eggs are carried from the nest. American robins (Turdus migratorius) are among the few hosts of parasitic brown-headed cowbirds (Molothrus ater) that frequently eject parasitic eggs from their nests. In this study, we used radio transmitters inserted into 3D-printed model eggs, to examine egg rejection in female robins as a function of egg coloration (i.e.,

robin-blue, non-mimetic deep blue, and cowbird-like beige). We predicted that female robins making egg ejection decisions would be both repeatable across individual females and dependent on egg coloration. As predicted, we found a significant effect of female ID and model egg color on egg ejection, but neither predicted ejection distance or direction. In turn, deep blue model eggs were ejected more quickly than beige and robin blue mimetic model eggs. This is the first study to date to examine the distance at and direction in which model parasite eggs are rejected. More experimental studies are necessary to tease apart the sensory cues impacting these antiparasitic behavioral traits.

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*Mixed-species flock members show evidence of ecological selectivity and flexibility in flock participation

L. Vander Meiden, D. Shizuka, I. Hoppe, A. Johnson
Presenting author: **Laura Vander Meiden**, University of Nebraska-Lincoln, lvanderm21@gmail.com

Mixed-species groups are hypothesized to allow animals to minimize competitive interactions and maximize facilitative interactions. Individuals' participation in mixed-species groups may reduce rates of competition and increase the social information available about predators or food availability. Behavioral plasticity may further increase these benefits as plastic species alter their rates of niche overlap with group mates. We investigate two axes of behavioral plasticity that may modulate how species interact with group mates in mixed-species groups-flexibility and selectivity. Specifically, we assess avian species' patterns of selective preferences for participation in flocks of certain strata and whether behavioral flexibility in foraging strata corresponds with the foraging strata of flock mates. All species in our study maintained or increased their foraging strata overlap with flock mates, supporting the hypothesis that facilitation plays an important role in flock formation. Notably, the methods that species used varied: some species moved closer to flock mates via flexibly matching their flock mates' behavior, some showed selectivity for flocks of certain stratums, and others did both. Ultimately, we show that species balance facilitative and competitive interactions with flock mates via multiple methods and that consideration of behavioral plasticity is integral to understanding the nuances of mixed-species flock interactions.

Does the colonisation of guilds of native avian biodiversity differ among the types of invasive tree stands?

J. Varughese, R. Chanda, C. Harikrishnan, S. Lawrence, M. Mubeen, D. Jathanna, V. Robin
Presenting author: **Jobin Varughese**, IISER Tirupati, jobin@students.iisertirupati.ac.in

Invasive landscapes negatively impact the richness of avian biodiversity. On the other hand, studies also show their potential for avian colonisation. Given the rapid depletion of natural forests, looking for the conservational aspects of such landscapes becomes a prerogative. Our study examines the ecological settings within invasive habitats that permit forest bird guilds/species establishment. Western Ghats' sky-islands' heavily modified landscape provides an excellent system to study this phenomenon. Timber management has created a complex wooded landscape of Shola forests and Acacia, Eucalyptus and Pine stands. Several endemic, understory birds inhabit these novel invasive woodland habitats. The reasons and drivers of colonisation are, however, unclear. This study assesses the impact of the structural and landscape characteristics associated with the invaded habitats on avian colonisation. We also looked at the differences in the variety of birds' trophic and locomotory traits due to the overstory's compositional attributes. We conducted occupancy sampling of birds and vegetation in 0.5% of the Shola Sky Islands (>1400m MSL) gridded into nested cells (~450 grid cells). We found that understory structure, canopy cover and altitude determine the presence of most study species. Our results also suggest that biodiversity services supplied by birds are more effectively restored in specific invasive stands (i.e. Eucalyptus stands) than in others. This study indicates that a novel habitat of exotic timber plants can form suitable habitats for endemic, endangered, understory birds when the overstory composition and vegetation structure are appropriate.

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*Winter movement patterns of overwinter Lark Buntings at the Mexican high plateau resemble a seasonal nomadic strategy

F. Vega-Reyes, L. Chapa-Vargas, A. Celis-Murillo, E. Huber-Sannwald, M. Ward

Presenting author: **Francisco Vega-Reyes**

There are many knowledge gaps pertaining to grassland migratory bird lifecycle. Regarding the overwinter phase, the most understudied portion of their cycle, basic information related to habitat preferences, daily activity, roosting behavior, etc. is still lacking. The Lark Bunting (Calamospiza melanocorys) is a North American grassland species listed on the common bird species at steep decline with missing overwinter information. Lark Bunting has been proposed as a seasonal nomadic species, which implies a challenge for future conservation strategies. We investigated overwintering movement patterns of this species in the northern portion of San Luis PotosÃ state, Mexico, within the semi-arid Chihuahuan desert, the southernmost part of its distribution. 19 individuals were tagged using transmitters with a 15-to-20-day long battery. Individuals were monitored, from October 2022 to March 2023. We used Automated radio-telemetry systems, consisting of three towers covering an effective area of 53 ha. Additionally, we conducted on-foot behavioral observations of overwintering flocks on the study site between 7 a.m. and 6 p.m. We evaluated landscape use with detection points and remote sensing, additionally we evaluated detection probabilities. We found high detection variability, and an increase in dispersion as winter progressed. Individuals began the season with daily movements of less than 800 m around the roosting site; by the end of the season individuals had daily movements >4 km. Our results support the hypothesis that this species may have the strategy of seasonal nomadism while overwintering.

A test for imperfect mimicry: host-parasite diffuse coevolution in the brown-headed cowbird system

J. Villa, Q. Jamison, D. Hanley

Presenting author: **Juliana Villa**, George Mason University, jvilla8@gmu.edu

The exquisite eggshell mimicry displayed by some avian brood parasites is an oft-cited example of coevolution. However, the eggshells of many parasites, like the brown-headed cowbird (Molothrus ater, hereafter 'cowbird'), exhibit imperfect mimicry to the eggshells of their multiple host species. Diffuse coevolution can explain imperfect mimicry, whereby each host species independently selects for a cowbird phenotype that matches its own egg. These collective selection pressures select for a generic cowbird phenotype that is intermediate to the phenotypes of all of its hosts. Recent research using a species-specific dataset found that diffuse coevolution can select for generic cowbird phenotypes, rather than a mimetic to any particular host. To determine whether natural host communities select for imperfect cowbird eggshell phenotypes, we experimentally parasitized seven cowbird host species and measured eggshell features of both host and cowbird eggs in the field. Then, we calculated community-level selection pressures: rejection rates, host species relative abundance, and natural parasitism rates for each host species. Using these data, we predicted a cowbird eggshell phenotype and compared that to the cowbird phenotypes that we measured in the field. We showed that the eggshell phenotypes and selection pressures of this natural host community accurately predicted natural cowbird eggshell phenotypes. Our findings indicate that diffuse coevolution may underlie the imperfect mimicry of cowbird eggs and potentially other parasite species. More generally, we provide a quantitative approach for predicting either imperfect or perfect mimicry of traits of avian brood parasites.

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*Status and habitat relationships of the Yuma Ridgway's Rail (Rallus o. yumanensis) in the Ciénega de Santa Clara, Mexico

S. Villagomez, E. Palacios, O. Hinojosa-Huerta

Presenting author: **Stefanny Villagomez**

Populations of secretive marsh birds have declined in North America in the last decades. Despite drastic habitat changes, the Colorado River delta support populations of the protected marsh bird: Yuma Ridgway's Rail. The Cienega de Santa Clara in the delta has been identified as one of the most important area for this species in the Sonoran Desert ecoregion and northwestern Mexico, supporting about 75% of the total population of Yuma Ridgway's Rails. This research aims to evaluate and detect changes in the population trend of the Yuma Ridgway's Rail (Rallus obsoletus yumanensis) in the Cienega de Santa Clara, with special focus on hydrology and habitat dynamics due to direct and indirect management, to help guide restoration actions and water allocation decisions for wetland conservation in

this area.

Effects of site and migration season on the consumption of biofilm and essential fatty acids in Western Sandpipers

S. Walters, C. Guglielmo, K. Hobson

Presenting author: **Scott Walters**, University of Western Ontario (Western University), swalte42@uwo.ca

Western Sandpipers (Calidris mauri) stop at mudflats along the Pacific Flyway where surface biofilm is thought to be a major component of their diet. Omega-3 (n3) long-chain polyunsaturated fatty acids (LC-PUFAs) within biofilm diatoms have been hypothesized to improve the physiological condition and migration performance of marine-associated birds. These LC-PUFAs are abundant in aquatic environments, with longer forms such as eicosapentaenoic acid (EPA; 20:5n3) and docosahexaenoic acid (DHA; 22:6n3) being strongly tied to marine sources. The fatty acid composition of biofilm diatoms may vary among mudflats due to different environmental conditions tied to location and season. For example, at Robert's Bank in the Fraser River Delta (FRD) of British Columbia, Canada, the spring snowmelt freshet is suspected to induce n3 LC-PUFA proliferation in biofilm diatoms. We investigated whether consumption of biofilm by refueling sandpipers varied depending on mudflat location and season, and whether it affected the fatty acid composition of plasma lipids. In 2020 and 2021, we sampled Western Sandpipers at Robert's Bank and two other FRD mudflats farther from the river outflow, as well as at marine-dominated mudflats on the west coast of Vancouver Island (Tofino, B.C.). Mudflat invertebrates and biofilm were also collected from these sites during both seasons. Bayesian isotopic (Î´13C, Î´15N) mixing models were created to determine the probabilistic proportions of biofilm and invertebrate functional groups in the diet. Gas chromatographic analysis of plasma revealed significant differences in LC-PUFAs by site and season, with a particularly strong seasonal shift occurring at Robert's Bank.

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*Breeding ecology and management of Pueo (Hawaiian Short-eared Owl; Asio flammeus sandwichensis)

O. Wang, C. Wilhite, M. Garcia-Heras, M. Price

Presenting author: **Olivia Wang**

Short-eared Owls (Asio flammeus) are a globally distributed species, but whether their ecology varies biogeographically is unknown and results in a lack of regionally relevant knowledge to inform conservation needs. In Hawai'i, Pueo (Hawaiian Short-eared Owls, A.f.sandwichensis) populations are thought to be in decline and state-listed as endangered on O'ahu, yet little information exists on their breeding ecology. We investigated the breeding ecology of Pueo using data from both focal study sites and incidental observations across the state of Hawai'i. At focal sites, we used a binomial logistic regression model to examine nest site selection and found that greater visual obstruction readings were top predictors of use of a site for Pueo nesting. However, these same metrics did not necessarily translate to increased nest survival; using a logistic exposure model to examine daily nest survival rates, we found that nests initiated earlier in the season and with higher percent vegetation cover had higher daily nest survival rates. Breeding Pueo diet at focal study sites included a variety of rodent, bird, and insect species, but diet composition did not vary significantly among nests. State-wide nesting observations served to inform our understanding of the diversity of Pueo breeding phenology and habitat. Across both focal and incidental state-wide observations, we found that Pueo nesting season spans from November through July, and breeding habitats ranged from coastal vegetation on nearby atolls to high elevation native wet forest. This study is the first to describe Pueo breeding ecology, providing a baseline for management in Hawai'i and filling a geographical knowledge gap for this widely distributed raptor.

Changing Body Size in a Changing Climate: How Birds Respond to Environmental Pressures

M. Watson, J. Kerr

Presenting author: **Matthew Watson**, University of Ottawa, mwats041@uottawa.ca

Decreasing body size has commonly been observed across many species as an adaptation to increased temperatures. Although smaller individuals may benefit from more rapid heat dissipation, they also run a

higher risk of dehydration through evaporative cooling. Smaller body size becomes increasingly detrimental in regions where the demand for evaporative cooling is exacerbated by increased frequency and duration of extreme heat events. As climate change alters global temperature and precipitation patterns, shifts in body size will likely reflect the specific needs of species to balance thermal and osmotic homeostasis. Using Aridity Index (AI) and Thermal Position Index (TPI) measurements of species specific environmental conditions we investigate how these factors interact to influence the pattern and intensity of body size change for terrestrial vertebrates. We compiled body size measurements from available databases for a subset of bird species, as well as mammal species, at a global scale. We then used linear mixed effects models to evaluate trends of body size change for both Classes in response to change in TPI and AI. The strength and direction of changes in body size were variable across species in response to tested metrics, however overall patterns of body size change are similar for both Classes over time. Similar shifts in body size over time despite variable responses to specific variables indicates that birds and mammals are likely facing different pressures due to climate change. Understanding the differences in how species will respond to specific environmental changes over time will be vital for informing future conservation strategies.

Influence of diet on reproductive success of urban Blue Tits (Cyanistes caeruleus)

A. Welch, R. McConnell, J. Makins-Elliott, P. Capilla Lasheras, D. Dominoni
Presenting author: **Andreanna Welch**, Durham University, a.j.welch@durham.ac.uk

Urbanisation has altered environmental conditions, the composition of biodiversity, and food available to wildlife, thus leading to lower species richness. Understanding what factors impact species' success in these ubiquitous settings is crucial. For birds, higher temperatures and supplemental food in urban habitats may attract adults during the winter, but if these food resources don't sustain breeding efforts, then reproductive success can suffer. This contradiction is exemplified by the blue tit (Cyanistes caeruleus), a well-known European garden bird, that demonstrates lower reproductive success in urban as compared to forest habitats. These differences are potentially due to a shift in diet, as caterpillars necessary for nestling growth are scarce in cities and human provided food may lack vital nutrients. Using DNA metabarcoding (simultaneous sequencing of all prey DNA found in the diets of many birds), we have examined nestling diet during the breeding season across an urbanization gradient, as well as adult diet during the non-breeding season in both urban and forest habitats. Further, we conducted brood manipulation experiments as well as cross-fostering experiments, sequencing diet DNA obtained from chicks, to further examine how diet is related to chick survival and growth in these habitats. We found that diets of forest-reared chicks predominantly contained Lepidopteran prey (i.e., caterpillars). Diets of urban chicks were much more diverse and reproductive success in urban areas was lower. Fledgling success did not change regardless of whether broods were artificially increased or decreased. Thus, we are gaining a better understanding of how diet impacts chick survival and growth in urban areas.

Aging is associated with improved breeding performance rather than senescence in Mountain Chickadees (Poecile gambeli)

J. Welklin, B. Sonnenberg, C. Branch, A. Pitera, V. Heinen, L. Benedict, L. Whitenack, D. Kozlovsky, V. Pravosudov
Presenting author: **Joseph Welklin**, University of Nevada-Reno, jwelklin@gmail.com

Most animals exhibit an increase in breeding performance in early ages, then a decline, or senescence of breeding performance in late ages. However, our understanding of the mechanisms that underly the relationships between age and reproduction remains limited, particularly in reference to the effects of male versus female age on pair breeding performance, and whether these relationships are driven by changes in physiology or parental care. Here we report results from a longitudinal study on age and breeding performance in resident Mountain Chickadees. First egg dates and clutch sizes, measures of physiological quality, and brood size, a measure of parental care, were most associated with female age, whereas mean nestling mass, also a measure of parental care, was most associated with male age. Each of these breeding performance measures showed a positive relationship with advancing age and exhibited little to no signs of senescence at up to nine years of age. We observed no evidence of

selective disappearance or effects of prior investment on current reproductive investment. Our results indicate that both female and male age can contribute to pair breeding performance and that senescence of breeding performance may not be as common in nature as often presumed.

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*Mate Fidelity in a Double-Brooded Urban Passerine, the European Starling (Sturnus vulgaris)

A. Wells, C. Barber
Presenting author: **Alyssa Wells**, Saint Mary's University, ajwells12311@gmail.com

Every bird requires a mate to have a successful breeding attempt. After each brood, they are faced with the choice to stay with or separate from this mate. The choice to stay together is referred to as displaying mate fidelity and can provide great benefits to the future reproductive success of the pairs who exhibit it. Despite these benefits, separation is still common in many populations of passerines. In this study, we examined the frequency of mate fidelity in a population of urban-dwelling European Starlings (Sturnus vulgaris) over 15 years. A total of 68 broods were raised by 28 faithful breeding pairs, accounting for 19% of all broods raised during the study period. Our second objective was to determine if mean brood condition affected the decision to stay together or to separate. We predicted that mean condition of 1) first broods would be higher than that of last broods raised by pairs who had stayed together and 2) that first brood of a pair who then stayed together would be higher than that of the first and only brood raised by a pair who then separated. We found no statistical differences in mean brood condition and the decision to remain together in the future or to separate. These findings still warrant investigation, as the difference in brood condition was noticeable, such that that brood condition could still influence rates of mate fidelity within this population.

Evaluating landbird community metrics and survey effort at small-scale monitoring sites in Indiana

B. West, M. Wildhaber, N. Green, J. Isanhart, M. McDonald, M. Hooper
Presenting author: **Benjamin West**, U.S. Geological Survey, bwest@usgs.gov

Many sampling and analytical methods can estimate abundance, distributions, and diversity of birds and other wildlife. However, challenges with sample size and analytical capacity can make these methods hard to implement for resource-limited monitoring programs. Using observed species richness data from breeding season bird point surveys collected in 2016 at four forest restoration sites in Indiana, USA, we evaluated three diversity metrics to apprise efficient and attainable sampling designs for monitoring programs with resource constraints. Simulated surveys based on field data were used to conduct Bayesian Michaelis-Menten curve analyses estimating observed species as a function of sampling effort. Modeling effort as the number of visits per survey point, we found simulated survey sets with multiple habitat types had an estimated 39 to 83% greater observed richness of Partners in Flight species of regional conservation concern (PIF RCC) compared to survey sets with one habitat type. Additionally, survey sets with multiple habitats required 41 to 55% fewer visits per point to observe an equivalent proportion of PIF RCC species compared to survey sets with one habitat. Even when multiple habitat types were included in a survey set, the number of visits per point required to detect 50% of observable species was 30% higher for PIF RCC species than for total breeding landbird species. Our results suggest that deriving specialized species diversity metrics from point survey data can add value when interpreting those data. Additionally, designing studies to collect these metrics may require explicitly planning to visit multiple habitat types at a monitoring site and increasing the number of visits per survey point.

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*Winter movements and habitat use of marsh sparrows in coastal North Carolina

M. West, J. Carpenter, E. Buckland, M. Buddy, R. Danner
Presenting author: **Marae West**

There are large gaps in knowledge regarding the winter movements of Saltmarsh Sparrows (Ammospiza caudacuta, SALS), Seaside Sparrows (Ammospiza maritima, SESP), and Nelson's Sparrows (Ammospiza nelsoni, NESP). Marsh species are losing essential habitat due to sea level rise,

development, and other anthropogenic forces. All three marsh sparrow species are listed as Species of Greatest Conservation Need in the NC Wildlife Action Plan and the USFWS will determine if SALS should be federally listed as Threatened or Endangered in 2024. Understanding winter movements and habitat utilization of marsh sparrows throughout their winter stationary period is important to understand the impacts of sea level rise and design effective conservation solutions. During the winters of 2019 through 2022 we researched marsh sparrows at five sites in Southeastern North Carolina (Rachel Carson Reserve, Hammocks Beach State Park, Masonboro Island, Fort Fisher, and Bird Island) using a combination of mark recapture and radio telemetry, including use of Cellular Tracking Technologies. All species used regularly flooded tidal marshes and their daily movements tracked the tidal cycle, suggesting that both supratidal roosting and intertidal foraging areas are important to conserve. Home range size differed significantly among species, leading to different patterns of habitat use, which suggests a need for different management priorities for each species. Winter marsh sparrows had high site fidelity within seasons, suggesting little flexibility in habitat use. This study helps identify priority habitats to conserve for wintering SALS, SESP, and NESP.

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*Relationship between arthropod phenology and reproductive timing and success in a resident montane bird

L. Whitenack, J. Welklin, B. Sonnenberg, V. Heinen, V. Pravosudov
Presenting author: **Lauren Whitenack**

Global climate change is expected to increase phenological mismatches across trophic levels, potentially leading to population declines. Most studies on trophic level mismatches have taken place at sea level, but much less is known about montane ecosystems. In the mountains, phenology may vary across elevations due to differences in climate. It is unclear whether trophic levels synchronize phenology equally, or if mismatches have different consequences, across elevations. For many animals, matching breeding timing with optimal food availability is key to reproductive success. We investigated whether phenology of arthropod abundance was associated with reproductive phenology and success of resident mountain chickadees (MOCH) in the Sierra Nevada, USA at two elevations (low = 1900m, high = 2400m). We sampled arthropods from spring to fall using beat sheet sampling and Malaise traps and measured nestling diet using fecal metabarcoding. The peak total foliage-dwelling arthropod biomass occurred at the same time at low and high elevations even though MOCH breeding phenology was approximately 2 weeks later at high elevation. However, different arthropod groups peaked at different times, with some groups peaking significantly later at high elevation (ex., soft-bodied larvae). High elevation nests were more closely matched with the timing of peak total arthropod abundance during the peak nestling food demand period (~day 16) than low elevation nests. Despite variation in breeding phenology among nests at each elevation, there were no differences in breeding performance based on timing relative to the arthropod peak.

Yellow-billed Cuckoo (Coccyzus americanus) population dynamics on the South Fork Kern River, California.

M. Whitfield, A. Meyer, N. Jamie-Escalante, S. Robinson, J. Stanek
Presenting author: **Mary Whitfield**

The South Fork Kern River Valley has been recognized as an important Yellow-billed Cuckoo (Coccyzus americanus) breeding area for over 40 years and has a long history of cuckoo research (Gaines 1977, Laymon et al. 1997, Whitfield and Stanek 2011, Jacobo et al. 2020). Currently it has one of the two largest populations of cuckoos that occur in California. The population has historically fluctuated between 2 to 24 pairs, with an average of 11 pairs (Laymon et al. 1997). During the 2012-2016 drought, the estimated South Fork Kern River Valley cuckoo population plummeted from eight breeding territories in 2012 (Stanek and Stanek 2012) to only one in 2016. The impact of this drought was likely exacerbated by the onset of the prolonged megadrought (2001-2022) that affected most of California and other parts of the southwest (Williams et al. 2022). The Kern cuckoo population, however, has recovered to 10 breeding territories in 2022 despite the ongoing drought. In this presentation, we will talk about the population dynamics of the cuckoos over the past 35+ years and the habitat changes that have occurred in the study area.

Is nest box orientation important for occupancy and breeding success in European Starlings (Sturnus vulgaris)?

T. Williams, A. Dsouza, J. Tang
Presenting author: **Tony Williams**, Simon Fraser University, tdwillia@sfu.ca

Bird's nests are external structures critical for the development and survival of eggs and young, directly increasing fitness of parents, and they can serve as sexual signals. Recently, increasing attention has focused on nest 'quality' or the specific components of nest structure (size, amount or type of construction material) that might predict reproductive success. However, there is only equivocal, very mixed, evidence that one aspect of nests, nest orientation, is important for reproductive success. Interestingly, bird conservation organizations stress the importance of nest box orientation in advice to the general public about putting up nest boxes to attract birds, but there appears to be relatively little scientific data to support this. We investigated occupancy, laying date, clutch size, partial brood loss, and brood size at fledging in relation to nest orientation in the European starling (Sturnus vulgaris). Our specific predictions were: a) potential low-quality (south/west facing) nest boxes would have lower occupancy compared with high-quality (north/east facing) nest boxes; b) occupied low-quality (S/W) nest boxes would have later laying dates and smaller clutch sizes compared with occupied high quality (N/E) nest boxes and c) occupied low quality (S/W) nest boxes would have lower fledging success (brood size at fledging) compared with occupied high quality (N/E) nest boxes. In a first year of (preliminary data) we found little support for any of these predictions, questioning the idea that nest orientation matters. Further analysis will look at annual variation in effects of nest orientation in good/poor years and hot dry/cold wet year.

Hummingbird blood traits track oxygen availability across space and time

J. Williamson, E. Linck, E. Bautista, A. Smiley, J. McGuire, R. Dudley, C. Witt
Presenting author: **Jessie Williamson**, Cornell University, jwilliamson0110@gmail.com

Predictable trait variation across environments suggests shared adaptive responses via repeated genetic evolution, phenotypic plasticity, or both. Matching of trait-environment associations at phylogenetic and individual scales implies consistency between these processes. Alternatively, mismatch implies that functional divergence has changed the rules of trait-environment covariation. Here we tested whether species adaptation alters elevational variation in blood traits. We measured blood for 1,217 Andean hummingbirds from 77 species across a 4,600 m elevational gradient. Unexpectedly, elevational variation in hemoglobin concentration ([Hb]) was scale-independent, suggesting that physics of gas exchange, rather than species differences, determine responses to changing oxygen pressure. However, mechanisms of [Hb] adjustment did show signals of species adaptation: Species at either low or high elevations adjusted cell size, whereas species at mid-elevations adjusted cell number. This elevational variation in red blood cell number-versus-size suggests that genetic adaptation to high altitude has changed how these traits respond to shifts in oxygen availability.

The science behind Audubon's 2023-2028 strategic plan

C. Wilsey
Presenting author: **Chad Wilsey**

The National Audubon Society has developed a new 5-year strategic plan, unprecedented in Audubon's history for its integration of science and its commitment to measurable impacts for birds. The strategic plan orients Audubon towards a measurable North Star Vision and shared conservation milestones that will drive impact through contributions from the entire Audubon community. The plan is also a response to three present-day external drivers: the existential threat of climate change, the need for a hemispheric approach to bird conservation, and the importance of equity, diversity, and inclusion to organizational culture and partnerships. Audubon utilized a criteria-driven process grounded in science to identify a suite of priority bird species to focus its conservation work. Then, it utilized systematic conservation planning to map priority geographies forming a connected network of climate resilient lands and waters across the hemisphere. We selected a suite of approximately 160 priority species, 40 of which are residents of Latin America, to focus and measure the impact of Audubon's conservation work across the Americas. Mapped

priority geographies will direct habitat conservation activities and deployment of natural climate solutions. These species and geographic priorities guide 5-year milestones in habitat conservation, climate action, policy, and community building. Following the science towards greater conservation outcomes for birds is a key attribute of Audubon's latest strategic plan.

Estimating seasonal changes in bird abundance, composition, and habitat associations in the south Okanagan Valley, B.C.

O. Wilson, E. Baerwald, D. Blair, T. Luszcz, E. Gow
Presenting author: **Olivia Wilson**

Estimates of bird abundances and biodiversity have focused on the spring breeding period. This creates a seasonal bias as it only provides information about breeding birds and limits understanding of bird abundance to single time periods within the annual cycle. The South Okanagan Valley is characterized by relatively mild temperatures with little snow during the winter and thus has a suitable macroclimate, weather, and habitat for altitudinal, partial, and short-and-long distance migrants. Yet, how bird abundances and biodiversity differ across seasons and how this may vary among different habitats is not well documented in most regions, let alone regions with high abundances and biodiversity year-round. We will present findings from a repeated measures design consisting of bird point counts being conducted during five time periods relevant to birds at 120 bird point count stations between March 2022 and March 2023 in the south Okanagan Valley, B.C that spanned a variety of land use types. Point counts were conducted in urban, peri-urban, agricultural, and protected areas between the towns of Okanagan Falls, Oliver, and Osoyoos, B.C. With these data, we will test hypotheses on which habitats birds are associating with during different seasons and how species abundance and composition changes throughout the year. When considering possible anthropogenic impacts on bird species, conducting point counts throughout the entire year provides a deeper analysis into which species might be affected, that might otherwise be overlooked.

Evolutionary integration of the geography and pacing of the annual cycle in migratory birds

B. Winger, F. La Sorte, T. Pegan, M. Hack
Presenting author: **Benjamin Winger**, University of Michigan, wingerb@umich.edu

In migratory species with geographically distinct breeding and nonbreeding areas, the temporal phases of the annual cycle are intrinsically linked to seasonally shifting geographic ranges. Despite intense interest in the ecology of the annual cycle of migratory species, a synthetic understanding of the relationship between the biogeography of the migratory annual cycle and its phenology remains elusive. Here, we interrogate the spatiotemporal structure of the annual cycle in a novel comparative framework by developing a method to demarcate the pacing of annual cycle stages using eBird, a massive avian occurrence dataset. We show that the amount of time spent migrating varies little among species and is unrelated to the distance between breeding and nonbreeding locations, implying that longer-distance migrants perform their migrations at a faster pace. Owing to this surprising invariance of migratory durations across species, the amount of time spent on the stationary breeding grounds is strongly inversely related to the time spent on the stationary nonbreeding grounds. Our results further show that the amount of time spent annually on the breeding versus nonbreeding grounds predicts the distance between breeding and nonbreeding locations, demonstrating key linkages between the biogeography of seasonal migration and the phenology of migratory annual cycles. Our study helps untangle the complexity of seasonal distributions and schedules to reveal delicate interconnections between the biogeography of the migratory cycle, its pacing, and life history strategy.

Some history and new data on changing eponymous English bird names

K. Winker
Presenting author: **Kevin Winker**

A proposal by Foley & Rutter (2020) to eliminate all eponymous English bird names was published in the Washington Post, a Washington, D.C. newspaper, on 4 August 2020. This article generated hundreds of

online comments, many quite negative. I used sentiment analysis on these comments to quantify public reaction to this proposal. Among the 364 comments scored, negative opinions outnumbered positive ones by ~3:1. Scoring comments by relative magnitude of their sentiment (-3, -2, -1, 0, 1, 2, 3) yielded an average score of -1.1. These results indicate this proposed action would cause pronounced divisiveness, and they also suggest asymmetric polarization. Politicization and the left-right nature of the issue was rampant in the comments, indicating that the topic was immediately brought into the culture wars. These results likely underestimate public negativity to this proposal, because this newspaper is left-leaning. More data like these are needed. There is risk that broadly de-commemorating eponymous names will create more negative than positive outcomes (e.g., through asymmetric polarization and the culture wars). We must also ask: Does excluding people who do not share our views achieve our objective of inclusiveness? When is it okay to take away someone's hard-won knowledge by changing key terms in our shared biodiversity linguistic infrastructure? There are likely more constructive ways to address diversity, equity, and inclusion.

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*Experimental evidence that egg-laying order impacts growth of American Robin nestlings

S. Winnicki, T. Benson, M. Hauber
Presenting author: **Sarah Winnicki**

Within-nest variation in growth rates can result from parental behavior (early incubation onset can produce asynchronous hatching) and/or variation in maternal investment (egg resources). Our previous research on American Robins (Turdus migratorius) indicated that robin eggs varied with laying order (hormone content, size), nestlings hatched asynchronously, and nestling growth trajectories varied within the same clutch. However, it was not clear if the nestling growth variation was a product of laying order or delayed hatching. Therefore, to assess the effect of egg-laying order on nestling growth we performed a foster experiment, removing eggs on the day they were laid to prevent early incubation (replacing them with a model egg), and returning them to a new nest within 6 days (mean: 2.1 days, SE: 1.5) in a clutch with one of five treatments: three unrelated eggs of a single laying order (1st, 2nd, 3rd, or 4th) or a mixed clutch (egg orders 1-3 from different nests). Upon hatching, we returned every other day to measure the nestlings (N=174) and modeled mass gain over time with nonlinear mixed models that assessed the impact laying order, hatching delay, and pre-incubation egg mass on each nestling's maximum mass reached, maximum growth rate, and age at maximum growth. Laying order alone predicted mass gain, but only the age at which the nestlings reached their maximum growth (nestlings from 4th-laid eggs reached it earliest, 2nd-laid latest); maximum size and growth rate were not significantly impacted by laying-order. Future analyses will assess the growth of individual body parts (feathers, bill, tarsus).

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*Fear of predators has enduring effects on the avian brain and behaviour

L. Witterick, S. MacDougall-Shackleton, M. Clinchy, L. Zanette
Presenting author: **Lauren Witterick**, Western University, lwitteri@uwo.ca

Predators affect prey by killing them, but the fear of being killed also can have profound effects. Responding to predation risk is critical for prey to survive, however trade-offs from anti-predator behaviour can carry costs. Our research integrates biomedical research examining the enduring effects of fear on the brain with fear-induced behavioural changes documented by ecologists in the field, to understand the mechanisms leading to the demonstrated population and community level responses to fear. To experimentally test the enduring effects of fear on the brain and behaviour we manipulated perceived predation risk using auditory playbacks of predators or non-predators in wildlife. We conducted a series of manipulations through increasingly natural conditions, starting with acoustic isolation on birds in the lab, to semi-natural conditions on birds outdoors, to free-living wildlife. We found that fear had enduring effects on behaviour and brain regions associated with fear processing, but that the responses varied between laboratory and semi-natural conditions. In the lab, we found that predator exposure led to enduring anti-predator behavioural responses, and signatures of enduring brain activation signalling a continued sense of heightened alert in black-capped chickadees. In semi-natural conditions we found immediate, but not enduring, effects of fear on anti-predator behaviour, and enduring neuronal changes in brown-headed cowbirds in the spring, but no enduring effects on brain activation in an experiment on

black-capped chickadees in the fall. We are currently analyzing the effects of fear on the brains of free-living meadow voles to contrast with effects we have seen with animals in captivity.

Differential gene expression between torpor and normothermy in four brain regions in Anna's hummingbirds (Calypte anna)

S. Wolfe, E. Blackwell, N. Prior, D. Powers, A. Shankar
Presenting author: **Sophia Wolfe**

Hummingbirds conserve energy overnight through daily torpor by drastically lowering their energy expenditure to 10–30% of their basal metabolic rate. In heterothermic mammals, the central nervous system regulates this metabolic suppression, with the hypothalamus remaining active during torpor/hibernation to control thermoregulation, hormones, and the timing of torpor. The hippocampus has also been implicated in regulating hibernation: It loses activity last during transition into hibernation and regains it first upon arousal. The cerebellum controls motor coordination in both birds and mammals and controls unconscious posture adjustments and occasional vocalizations in hibernating mammals, indicating its potential involvement in torpor. We compared the transcriptome of these three brain regions, using the rostral telencephalon as a control, in normothermic sleep versus deep torpor in Anna's Hummingbirds. We found 60 genes significantly upregulated in torpor relative to normothermy and 104 genes downregulated in torpor relative to normothermy (adjusted p-value <0.05, log2-fold change threshold Â±0.5). The genes upregulated in torpor tend to relate to circadian rhythms, blood coagulation, inflammation, oxygen homeostasis, and the cell cycle, while the genes downregulated in torpor largely relate to the cell cycle, DNA damage checkpoints, and heat and energy production. We aim to determine which genes control hummingbird torpor in the brain and to investigate genetic differences between hummingbird and mammalian torpor.

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*The effects of native plant cover on avian physiological indicators of habitat quality in California coastal rangelands

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Prescribed grazing management can have myriad effects on wildlife, with low to moderate grazing being associated with an increased abundance of some, but not all, grassland birds. Specifically, the abundance of grasshopper sparrows (Ammodramus savannarum) and savannah sparrows (Passerculus sandwichensis) have been shown to be positively associated with both grazed grasslands and grasslands with a higher percentage of native plant cover. However, relatively little work has occurred on these species in California grasslands. Moreover, measures of abundance provide an incomplete assessment of habitat quality for birds. Physiological and morphological measurements can help indicate environmental stress to individual birds, which can then help reveal more information about habitat quality. To examine the effect of native plant abundance on grassland bird stress, we sampled 70 individuals of each sparrow species on 6 California Coastal Prairie rangelands. We took morphological measurements to estimate body condition and took blood samples for heterophil: lymphocyte (H:L) ratios. In order to quantify the amount of native plant cover in a sparrow's territory, we conducted vegetation surveys using the line-point transect method. We used generalized linear mixed models to assess the relationship between avian physiological markers and native perennial plants, and implications for rangeland management are discussed.

Allochronic speciation with gene flow? Genomics of parallel breeding time divergence among storm-petrels (Hydrobatidae)

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Presenting author: **Gihyun Yoo**

Parallel evolution, in which similar phenotypes arise among independent lineages, provides strong insights into the mechanisms and constraints on evolution. However, whether the same genomic regions underly the evolution of parallel traits is often unclear. Storm-petrels (Procellariiformes: Hydrobatidae), a cosmopolitan family of island-breeding seabirds, provide a useful case study for parallel evolution.

Several sister races of storm-petrels have independently diverged in breeding season - an example of parallel allochronic divergence. We are using low-coverage whole-genome sequencing to disentangle the origins of repeated breeding time switches in storm-petrels. We are examining allochronic sister races in the band-rumped storm-petrel species complex (Hydrobates spp.), as well as an allochronic species pair from Guadalupe Island, Mexico: Townsend's (H. socorroensis) and Ainley's storm-petrels (H. cheimomnestes). Firstly, we are using outlier analyses to determine whether the same genomic regions differentiate sympatric population pairs. Secondly, we are assessing the role of adaptive introgression in promoting parallel evolution and inspecting the overlaps between introgressed regions and genomic outliers. Preliminary results confirm that allochronic populations arose in parallel across the breeding range. Moreover, the identification of outliers and evidence for widespread introgression among seasonal populations suggest that gene flow may have facilitated parallel divergence in the storm-petrels. The use of annotated genome databases will complement these results by matching potential gene functions to the outliers, which will further improve our understanding of the drivers of population divergence and adaptation.

Annual variation in territory size and abundance of forest songbirds: 50 years at Hubbard Brook

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Relations between habitat suitability and habitat use are fundamental to the biology and conservation of populations. For many birds, territory size is a function of population density and habitat quality, with increasing abundance leading to 1) increased density and decreased fitness in suitable habitats (ideal free distribution) and decreasing territory sizes as birds pack into the suitable habitats, or 2) increased use of marginal habitats by less dominant birds and little effect on density and fitness of the dominant birds in the best habitats (ideal despotic distribution) and increasing territory sizes for the birds in the marginal habitats. Most existing knowledge on this topic comes from relatively short-term studies of individual species. In this study, we analyzed territory sizes of six migratory songbirds occupying the same 10-hectare plot in the Hubbard Brook Experimental Forest, New Hampshire, USA over a 50-year period. All species varied in abundance over the duration of the study, some dramatically. For all species, changes in territory sizes were inversely related to changes in abundance within the study plot, supporting the ideal free distribution. However, the strength of this relationship varied among species. Territory sizes in areas within the study plot with the highest average probability of occupancy among years were quite plastic for some species and relatively invariant for others. Results are relevant for understanding how variation among species in territory size is related to 1) how habitat use changes with bird abundance and 2) which habitat features are associated with the highest occupancy.

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*Sex-specific territoriality and duetting in the Carolina Wren (Thryothorus ludovicianus) during the non-breeding season

D. Zapata, J. McEntee
Presenting author: **Danny Zapata**

Territorial behavior is a crucial aspect many bird species, where mated pairs cooperate to defend year-round territories. In these species, differences in the degree of aggression during territorial interactions are often found between sexes. Additionally, defenders respond differently depending on the intruder's sex, and most current knowledge is restricted to the breeding season. Many species that cooperate in territory defense exhibit complex vocal interactions called 'duets,' where one member of a pair overlaps its partner's song. Despite their importance, duet function is often unknown. To develop a comprehensive understanding of territorial behavior in these species, we need to determine (1) the roles of each pair member in territorial defense, (2) whether responses are biased towards individuals of the same or opposite sex, and (3) the function of duets. We conducted a stereo playback experiment to investigate these aspects by studying territorial pairs of Carolina Wrens (Thryothorus ludovicianus) to playback of male solo vocalizations, female solo vocalizations, and male-female duets, during the non-breeding season. Our analyses indicate that males were more aggressive than females, except during playback of female solos. Both sexes exhibited stronger responses to same-sex versus

opposite-sex vocalizations. Lastly, females were more likely to complete duets in response to playback of male and female solos than to duets. This pattern in duetting behavior is consistent with mate-guarding and signalling commitment functions and counters the predictions of a joint territorial defense function.

A bioenergetic model to facilitate migratory landbird conservation along the northern Gulf of Mexico coast

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In order to implement sound and effective conservation strategies for migratory landbirds, we need to know where birds stopover and how those stopover sites function (i.e., rest or refuel). However, this basic information during the migratory period is limited, despite migratory species in decline and mortality during migration being substantial. To provide managers with a decision support tool to understand the function of stopover habitat for migratory birds, we developed an energetic model to determine whether there are sufficient food resources to support forest landbirds during migratory stopovers in spring and fall across the U.S. Gulf of Mexico coast. To build the model and assess energy availability and demand, we used a combination of 1) field collected data on invertebrate, fruit, and nectar abundance; bird stopover duration; and forest composition; 2) bird food item energy content from the literature or lab analyses; 3) migrant forest landbird densities derived from weather surveillance radar; and 4) the 2016 NOAA Coastal Change Analysis Program land cover data. Specifically, we estimated an average day's food energy availability, bird energy demand, and their difference (i.e., energy surplus or demand) at a 240-m resolution across the entire U.S. Gulf Coast for four semi-monthly periods during spring migration and four semi-monthly periods during fall migration. By integrating field-based data collection with remotely sensed weather surveillance radar data, we have used a co-production process to develop a decision support tool that can prioritize important stopover areas and identify resource gaps to help implement successful conservation practices.

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*Haemosporidian parasites on wading birds captured from breeding colonies in coastal Alabama

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Presenting author: **Ke Zhang**, University of Florida, kezhang1122@ufl.edu

Avian malaria and malaria-like diseases, caused by haemosporidian parasites in Plasmodium, Haemoproteus, and Leucocytozoon, are common infectious diseases in birds. There has been limited study on the haemosporidian parasites in wading birds, which can travel across long distances during their life cycles, creating opportunities for them to encounter diverse parasites. We hypothesized that wading birds would have a high prevalence of haemosporidian parasites due to the dense spacing of nests and abundance of vectors present in their breeding colonies. We also hypothesized that they encounter different lineages of parasites at their breeding grounds compared to their wintering grounds. We investigated the prevalence and diversity of Haemosporidian parasites in White Ibis (Eudocimus albus, n = 97) and Tricolored Herons (Egretta tricolor, n = 68) captured at breeding colonies in coastal Alabama, USA, 2020-2022. We also deployed transmitters on captured individuals to study their movement. Our preliminary data suggests that both species only carried parasites in the Haemoproteus genus, consistent with reports in Florida. We also observed a higher prevalence of infection in White Ibis (52%, n = 42) compared to Tricolored Heron (14%, n = 28). We found that gene fragments of parasites from four infected White Ibis matched with the lineage EUDRUB01, previously reported in Scarlet Ibis (Eudocimus ruber) in Brazil. We found infections in both resident and migratory birds, suggesting the possibility of parasite exchange within the breeding colony. However, the relationship between migration strategy and infection status requires further investigation with regard to gender and age class (juvenile vs. adult) of all birds sampled.

Genome-wide adaptive divergence may influence introgression from conservation translocations in Greater Sage-grouse

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Implementing and evaluating conservation translocation efforts can be difficult, but genetic data can provide unique insights about selecting suitable source populations and quantifying impact. The isolated and declining Washington Greater Sage-grouse (Centrocercus urophasianus) population has been the target of conservation translocations in recent years. We used genetic data to 1) look for evidence of genetic change by comparing observed and predicted genetic diversity values given translocation efforts, 2) quantify the reproduction attributed to transplants as evidence of population integration, and 3) retrospectively characterize adaptive similarity (e.g., adaptive divergence) of source and recipient populations. We found evidence of increased genetic diversity and transplant reproduction, but to a lesser degree than predicted. Our adaptive divergence patterns suggest differing abilities to navigate unfamiliar environments (brain and neurological function, development, and differentiation functional terms) and reproductive potentials (reproductive process and limb morphology functional terms) may have influenced the impact of conservation translocations. Our findings illustrate adaptive divergence may contribute to lower-than-expected impact from conservation translocations and may be used to guide future efforts.

Grassland bird sensitivity to climate variability in North America

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Grassland birds in North America have experienced sharp declines over the last 60 years driven by the widespread loss and degradation of grassland habitats. In recent decades, modern climate change has amplified these pressures. Climate change is occurring more rapidly in grasslands relative to other ecosystems, and exposure to extreme and novel climate conditions may affect grassland bird ecology and demographics. To understand the potential effects of climate change on grassland birds, we systematically reviewed published empirical relationships between temperature and precipitation, and demographic responses in grassland bird species of North America. We used a vote-counting approach on 858 research articles to quantify the frequency and direction of significant effects of climate on grassland birds. We found that grassland birds were likely to experience both positive and negative effects of increasing temperature and altered precipitation, with moderate, sustained increases in mean temperature and precipitation potentially benefiting some species, but extreme heat and heavy rainfall more often reducing abundance and nest success. These patterns varied among species, climate region, and temporal scales of climate variability. The sensitivity of grassland bird populations to future climate change will likely be mediated by regional climates, life history strategies of various species, and species' tolerances for novel climate conditions.

Poster Presentations

How does variation in predation pressure influence chickadee hissing behavior along an elevation gradient?

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Mimicry has evolved many times in the natural world. Morphological and behavioral defensive mimicry can be fixed in an organism or induced. Induced defenses are plastic (deployed only when defense is needed) and are triggered by environmental contexts. Chickadees are cavity nesters and exhibit an interesting behavior that is hypothesized to be a form of snake mimicry: when chickadees are incubating eggs or chicks and are approached by a predator they slap their feathers on their sides and produce a startling hissing noise. I plan to determine (1) how hissing behavior is distributed along an elevational gradient, over which nest predator species and abundance vary, (2) the repeatability of the hissing behavior for a given female, (3) whether the frequency of the hissing display differs between black-capped and mountain chickadees and (4), the relationship between hissing behavior and nest depredation. I hypothesize that the number of females making the hissing display to deter predators should be highest in areas with greatest nest predator richness (more small mammal species). I also hypothesize that nests with females that frequently hiss will be less likely to be depredated. Understanding the relationship of the chickadee hissing behavior to local small mammal communities and the within-individuals repeatability of the behavior will allow us to determine if this behavior is an induced defense, which will then give us insight into the plasticity of the trait. This study will also examine the effectiveness of this behavior by determining if incubating females that hiss are less likely to lose their eggs or chicks to predation events.

Population status and habitat suitability mapping for Hooded Vultures (Necrosyrtes monachus) in The Gambia using SDM

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The Hooded Vultures are currently critically endangered, but has been reported to have plummeted to their lowest numbers in the recent past. We carried out road surveys to compare vulture population trends in The Gambia. Here we present data from road surveys to count Hooded Vultures (Necrosyrtes monachus) in The Gambia in 2017 and 2021. Overall, the densities of Hooded Vultures counted in The Gambia as at 2021 indicate that population densities are higher in The Gambia than in any other country where road surveys have taken place. We also carried out a habitat suitability study for planning their conservation in The Gambia. We employed a common species distribution model (MaxEnt) to map and predict suitable habitats for the species in the country based on environmental factors that could potentially affect habitat suitability. We related these environmental factors to a dataset of Hooded Vultures occurrence points recorded during road surveys in the built-up areas and surrounding forests. Up to 88% of the study area is unsuitable for Hooded Vultures, while 12% of the study area represents suitable habitat, with a high proportion of highly suitable habitats located near the built-up areas due to the fact that they are commensal to settlements. The most significant indicators of habitat suitability for the Hooded Vultures in The Gambia were elevation, secondary forest density, distance to villages, and primary forest density. The study's results could be applied to the planning of vulture conservation in The Gambia.

Reproductive biology of the birds of southern Ecuador, how much information is missing?

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Presenting author: **Ibeth Alarcón**

Throughout the Neotropics, nests, eggs or chicks of several bird species remain undescribed. Especially in the southern region of Ecuador, which has a high concentration of endemic and threatened species. The compilation of natural history data is the basis for the development of conservation measures, and allows us to formulate and test hypotheses in ecology or evolution. We collected 287 reproductive biology events (i.e., courtship, copulation, transport of nest building materials, incubation, provision of food for young, parental care, presence of individuals with juvenile plumage, or other details of the nesting process) from 127 bird species, 5 of which lacked previous reproductive information and 12 species had incomplete information. Observations were made opportunistically, in southern Ecuador, between 2007 and 2021, in the provinces of El Oro, Cañar, Azuay, Loja, Morona Santiago and Zamora Chinchipe. Although our data are temporally and spatially dispersed, which did not allow us to make quantitative analyses, we obtained relevant data: we found 152 cup-shaped nests, although open nests could be more vulnerable to predation, 18 closed nests and 23 cavities. Most clutches were two-egg clutches (n= 69), as already known from the Neotropics. In addition, we found cases of parasitism. Egg dwarfism. Architecture, reuse and variation in the location of nests. Ability to build nests in human structures, roadsides and introduced plants. More studies on the reproductive biology of birds are still needed, but the publication of these punctual data increases the sample, since nests are not always found in field trips.

Influence of habitat characteristics and predators on declining grassland birds

A. Amiri, M. Eichholz, G. Bastille-Rousseau

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It has been largely accepted that one of the fastest-declining bird groups in Northern America is grassland birds. This consistent population decline has created particular interest in different aspects of the conservation and management of grassland birds' habitats. Thus, numerous studies have investigated grassland bird habitat associations. However, little is known about the mechanisms through which habitat characteristics may influence grassland birds directly or indirectly. Understanding these acting mechanisms could lead to the development of appropriate management recommendations for grassland areas. The effects of habitat structure on grassland birds might be mediated through changes in the whole grassland community such as predator abundance, alternate prey availability, or arthropod biomass as a food resource. Predation is known to be one of the leading causes of avian nest failure and predator avoidance creates selective pressure for grassland birds to minimize this risk. In eastern North American grasslands, the most common nest predators include snakes and meso-mammals. In this study, we will investigate how habitat characteristics might indirectly influence grassland bird communities through changes in the activity and abundance of their predators.

Breeding tidal marsh bird distributions under predicted sea level rise scenarios across the Mississippi Gulf Coast

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Across the contiguous U.S., predicted relative sea-level rise (SLR) rates for 2020-2050 are greatest for the northern Gulf Coast (0.35-0.45 m). As tidal marshes migrate landward in response to SLR, freshwater marsh will transition to brackish and saline conditions, causing shifts in vegetation and bird species distributions. Meanwhile, land subsidence and urban development will exacerbate future impacts of SLR. It is unknown how marsh bird communities will respond to these changes, but responses are likely to vary by species considering their diversity of habitat preferences. Using marsh bird point-count data from 2021 and 2022, we estimated species-specific abundances across coastal Mississippi using a generalized multinomial mixture model including local and landscape level predictors. We estimated a total of 32,635 Â± 1,196 Clapper Rails, one of our most abundant species, across 264 points distributed among 12 marsh complexes. Additionally, Clapper Rail abundance was negatively impacted by percent developed land. Using these spatio-temporal estimates, we projected marsh bird species distributions across predicted land cover for 2050, 2075, and 2100 with a 2-ft SLR scenario and medium and high accretion rates from NOAA's SLR viewer. We combined these projections with land cover data from an

urban-expansion model, SLEUTH, forecasting a 95% probability of becoming urban. Finally, we evaluated marsh bird distribution shifts based on comparisons between current and predicted distributions under combined SLR and urbanization models. These results will help inform future conservation efforts for marsh birds of concern across coastal Mississippi and serves as a benchmark for neighboring states in the northern Gulf of Mexico.

Migratory movements of long-distance shorebirds that use Peru as non-breeding site

M. Antezana Aponte, E. Tavera Fernández
Presenting author: **Mariamercedes Antezana Aponte**

Shorebirds have an annual life cycle that includes breeding, molting, non-breeding survival and migration. For years, shorebirds have been marked with colored flags to identify important stop-over sites along the migratory flyways. From 2012 to 2022, the Paracas Shorebird Project flagged a total of 6,898 individuals at Paracas National Reserve in Peru. We placed a 3-character-coded yellow flag on the right tibia following the Panamerican Shorebird Program and an incoloy band on the right tarsus to 4,075 Semipalmated sandpipers, 2,042 Western sandpipers, 417 Sanderlings, 304 Semipalmated plovers and 60 Ruddy turnstones. We received 143 international sightings of those birds, covering the Atlantic, Midcontinent and Pacific migratory flyways. The observations for Semipalmated sandpipers confirm the use of the Midcontinent flyway during northward and southward migration from, but a few use the Atlantic flyway going north bound. Western sandpipers reports show us that they use only the Pacific flyway during both migrations, and that Sanderlings perform their elliptical migratory pattern, using the Atlantic flyway for the southbound migration and the Midcontinent and Pacific flyways migrating north. Also, Semipalmated plovers use the Atlantic flyway on southward migration and the Midcontinent flyway migrating north. We only obtained one observation of Ruddy Turnstone that might indicate the use of the Atlantic flyway south bound, but further observations are required to confirm this. Our results document long-distance movements of shorebirds thanks to resightings across the hemisphere from citizen volunteers, corroborating the importance of citizen-science as a fundamental tool for management and shorebird conservation.

Museomica: Building a molecular library for Peruvian amazonian birds

A. Arana, C. Arana, M. Erkenswick Watsa, M. Tobler, J. Ramirez, V. Pacheco, M. Arakaki, M. Martin, J. Mena, L. Salinas
Presenting author: **Alejandra Arana**

The advancement of technology for DNA extraction and sequencing has allowed specimens held in scientific collections to become highly relevant in evolutionary and conservation studies as an important source of genetic information. The UNMSM Museum of Natural History (MHN) in collaboration with San Diego Zoo Global-Peru and San Diego Zoo Wildlife Alliance are implementing a molecular reference library of birds of the Peruvian Amazon as part of the Museomica project. A set of 1208 tissues have been obtained and registered in curated databases to be analyzed in the molecular laboratories implemented at the MHN. Thus far, 352 bird muscle tissue samples, representing 285 species, were processed, from which DNA was successfully extracted from 337 individuals. On the other hand, from 95 feather samples, DNA was successfully extracted from 65 samples. In view of the need to modify the protocols for processing feather and dry skin tissues, we processed a subset of the samples at the Norwegian University of Science and Technology. In this laboratory, DNA was successfully extracted from 100 bird dry skin samples, and NGS libraries were constructed. Sequences from 97 individuals (representing 97 species) were obtained. We report the progress of this project and the lessons learned so far. A molecular library of Peruvian amazonian birds will be an important tool in the fight against illegal wildlife trafficking and will contribute to the evolutionary, biogeographical and ecological studies that are required in the Peruvian Amazon for its conservation. Likewise, it will provide the groundwork for environmental DNA assessments and biodiversity monitoring without the need to invest funds in collecting new specimens.

Gap analysis of common molecular markers in public DNA reference libraries for

Peruvian Amazonian Birds

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The Peruvian Amazon is a region with high species richness of birds, with Peru ranking among the three most biodiverse countries in terms of birdlife. However, birds in this area are currently facing serious threats such as habitat modification and loss, illegal wildlife trafficking and poaching. Nowadays, several conservation strategies are enhanced by the use of genetic data. All-inclusive molecular libraries that are publicly available are key to the effective employment of conservation genetic efforts. We show the results of the analysis of information gaps of four molecular markers in the most important libraries or databases of genetic sequences, Barcode of Life Data Systems (BOLD) and NCBI GenBank, for bird species of the Peruvian Amazon. The markers selected are the most commonly used in phylogeny, biogeography, ecology and environmental DNA analysis, among others: COI, Cytochrome b, 12S and 18S. We used the BOLD public API to perform the sequence search of the species list in the BOLD database and the R package 'Rentrez' for the sequence search in Genbank. We found that there are 992 Peruvian amazonian bird species (64% of the total) with COI gene sequences in these databases, 886 (57.68%) species with cytochrome b sequences, 257 species (16.73%) with 12S sequences, and only 11 species (0.72%) with 18S sequences. We argue the importance of scientific collections as a source of genetic information and propose them as a strategy to fill these information gaps. A comprehensive molecular library would enhance the ability of researchers and conservation managers to monitor and safeguard birdlife diversity in Peru.

Genetic and vocal variation between subspecies of White-breasted Nuthatch in a northern California contact zone.

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Presenting author: **Emma Arulanantham**

The White-breasted Nuthatch (Sitta carolinensis) has been a subject of study due to its high genetic variability among populations and its varied vocalizations. Studies using molecular data have determined that populations fall into four reciprocally monophyletic clades that are largely congruent with current subspecies: Eastern, Pacific, Eastern Sierra Nevada (ESN), and Rocky Mountain, Great Basin, and Mexico (RGM). Likewise, vocal analyses have shown distinct geographic differences between subspecies. We examine the contact zone between Pacific (S. c. aculeata) and ESN (S. c. tenuissima) clades across the Modoc Plateau region in northern California. Specifically, the goal is to more precisely define the geographic range limits of each subspecies in the contact zone using molecular and vocal data, and to assess whether the two subspecies deserve species status. Our ND2 analysis of 163 tissue samples found the contact zone to predominantly consist of mitochondrial haplotypes associated with aculeata while the mean pitch of songs aligned more closely with tenuissima. Furthermore, our analysis confirmed the findings of previous work that showed aculeata had a significantly higher average song frequency (pitch) than tenuissima, and that note rate and number of notes per song did not differ significantly between subspecies. Our results suggest a potential dissociation between cultural and genetic divergence, urging further exploration. We will analyze morphological variation, sequence whole genomes, and conduct vocal playback experiments to assess levels of gene flow and reproductive isolation between these two subspecies. We will also examine these data in the context of environmental variation across the contact zone.

Consistent apparent adult survival and nest-site fidelity of Whimbrel Numenius phaeopus near Churchill, Manitoba, Canada

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Reliable estimates of adult survival for many shorebird species are lacking. We used Cormack-Jolly-Seber (CJS) methods to provide an estimate of apparent, or local, survival (Ï†) of a population of Whimbrels, Numenius phaeopus, breeding in the subarctic Churchill, Manitoba region. We

used data collected in two time-periods: 1973 – 1976 and 2010 – 2014. We also quantified nest-site fidelity in 2010 – 2014 to provide context to our apparent survival estimates because mark-recapture analyses cannot distinguish between mortality and permanent emigration. The most parsimonious CJS model did not include effects of sex or time on apparent adult survival in either period (Ï† = 0.76 Â± 0.13 SE; Ï† = 0.75 Â± 0.04 SE, 1973 – 1976 and 2010 – 2014, respectively). Additionally, observations of marked Whimbrels between 2010 and 2019 (n = 124) showed that 61 of the 105 marked individuals (58.1%) were resighted. These estimates of return rates are, as expected, much lower than estimates of apparent survival. The median distance between nests (n = 139) in 2010 to 2014 was 198 m Â± 88 SE and did not differ significantly (p = 0.84) between females (x Ì… = 721.9 m Â± 119.8 SE) and males (x Ì… = 720.3 m Â± 83.1 SE). If our apparent survival estimate is indicative of true survivorship, then adult mortality during the nonbreeding season has remained constant over the last five decades, implying that the recent decline in Whimbrel populations may stem largely from reduced fecundity, including egg or juvenile survival, rather than primarily from reduced adult survival.

Social contexts of extra-pair paternity in Florida Scrub-Jays

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Extra-pair copulations (EPC) and extra-pair paternity (EPP) is common in socially monogamous birds. EPCs are initiated by females in search of a higher quality male to potentially increase genetic diversity in her offspring. The cooperative Florida Scrub-Jay Aphelocoma coerulescens is socially and genetically monogamous, with rare exceptions of EPP. However, intense competition among males for breeding space reduces variance in the quality of breeding males, thus we hypothesize that EPPs are a result of researcher errors assigning social paternity rather than true mismatches between social and genetic paternity. We compare genetic paternity data from 1987-2013 in conjunction with field assignments of social 'breeding pairs' and identify 54 cases of mixed paternity in 1,181 nests (4.57%). We describe the social contexts in which mixed or incorrectly assigned paternity occurs and characterize them as consistent with predictions of EPC hypotheses or social contexts in which male breeding status might be incorrectly assigned. Identifying rare social contexts in which males other than the putative breeder attain paternity improves our ability to correctly assign social paternity and understand social structure in Florida Scrub-Jays.

Building a reference genome for the endangered Roseate Tern using non-invasive sampling methods

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Roseate Terns (Sterna dougallii) are federally endangered seabirds that undertake long migrations from South American wintering grounds to breeding in tropical and temperate islands. Despite their status, no reference genome exists, even knowing that it could inform conservation decisions or clarify their evolution and adaptation. As a pilot attempt to develop non-invasive sampling methods to develop a reference genome for Roseate Terns, we collected eggshell membranes from hatched eggshells. Creating such a protocol is challenging, because sufficient amounts of blood, egg white, or yolk would need to remain in the membranes to generate good-quality DNA; nonetheless, a successful extraction protocol would make it possible to conduct a variety of genetic analyses on these threatened birds, while minimizing disruption to sensitive populations. We adapted the Qiagen standard extraction protocol and measured the DNA concentrations on a NanoDrop microvolume spectrophotometer model ND-100 to verify the quality of the extractions. We performed three attempts to obtain high-quantity DNA from the eggshell membranes. We conclude that the approach is promising but requires refinement of collection and storage techniques. A reference genome for Roseate Terns remains an important goal for future work.

Phenological mismatch in the Florida Scrub-Jay (Aphelocoma coerulescens)

S. Barve, M. Heather, A. Tringali, N. Chen, J. Fitzpatrick, R. Bowman

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Birds use various environmental cues to initiate reproduction. With global change, many species are showing phenological mismatch, where the timing of breeding is discordant with the peak in resource abundance, leading to lower reproductive success or quality of offspring produced. Over the last 41 years, we found that Florida Scrub-Jays (FSJ) at Archbold Biological Station have advanced their nesting season (~10 days). We tested for a phenological mismatch by investigating whether birds that had their first nests early also produce fewer offspring and/or offspring of lower quality. Over the 41-year period, a warm January (mean daily maximum temperature) was correlated with an advanced initiation of first nesting attempts in FSJs. Early first nests had larger clutch sizes and overall greater fledging success, but the offspring produced in later first nests had significantly higher body mass and higher survival. Our results suggest that advances in FSJ reproductive phenology potentially driven by warmer winters are leading to lower quality offspring in early nesters suggesting a phenological mismatch. We discuss the consequences of this mismatch for the population dynamics of this federally Threatened habitat specialist.

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*The role of genomic architecture in determining species diversity in three monotypic passerines

J. Beam, D. Toews

Presenting author: **Johanna Beam**

Studying the mechanisms that drive the formation of new species (i.e., 'speciation') is crucial to identifying how biodiversity is generated and maintained. Genomic factors, such effective population size or genetic diversity, may lead to variation in diversification rates and thus different speciation rates. To date, most studies of lineages with exceptional diversification have focused on taxa with high speciation rates. However, we aim to explore systems at the other end of the speciation spectrum, specifically focusing on 'monotypic' lineages. Here we present genomic analyses of the Sapayoa, the Olive Warbler, and the Yellow-breasted Chat. We first obtained one reference-quality genome from each species. Using the Pairwise Sequentially Markovian Coalescent (PSMC) model, we modeled the effective population size and demographic history for each species. For the Yellow-breasted Chat, we also obtained population sampling to quantify geographic population structure. Our hope is that by comparing the genomic characteristics of these monotypic lineages to other, more diverse radiations, our research will determine whether there are genomic signatures that explain why a given lineage did not diversify as much as close relatives. Understanding why some lineages have a propensity to speciate, while others do not, may be key to understanding how and why bird species go extinct due to external factors such as a changing climate.

Ultraconserved elements resolve phylogenetic relationships of woodpeckers and allies (Picidae)

B. Benz, B. Smith

Presenting author: **Brett Benz**, University of Michigan Museum of Zoology, bwbenz@umich.edu

The woodpeckers and allies (Picidae) represent a diverse and near-global radiation of birds, encompassing 217 species in 33 genera. Although recent molecular phylogenetic studies have brought significant advances in understanding relationships among closely related woodpecker species, branching patterns and higher-level relationships among regional woodpecker clades remain poorly understood, owing to rapid lineage formation and short internodes across the woodpecker phylogeny backbone. In this study, we leverage sequence data collected from thousands of ultraconserved elements (UCEs) to infer the first genome-scale phylogeny of the woodpeckers and allies and re-examine broad-scale patterns of biogeography within the family. Using concatenated and species tree approaches, we recovered a well-resolved phylogeny that differs in several key aspects from recent molecular-based studies. Our results confirm a sister relationship between Sasia and Picumnus, and thus monophyly of the Picumninae, which clearly originated in the Old World. The enigmatic genera Nesoctites and Hemicircus comprise independent sequential branches that are in turn sister to the Picinae. Old and New World members of the Campephilini also form independent and sequential lineages, clarifying their Laurasian origins. Lastly, the monotypic Xiphidiopicus percussus was placed as sister to Melanerpes striatus, rendering Melanerpes paraphyletic. The results of this study provide a robust phylogenetic framework

crucial for future investigation of the key morphological and behavioral innovations that enabled the diversification of this unique radiation of birds.

A study of gender dynamics in territory acquisition strategy of the Florida Scrub-jay

S. Beres, S. Barve
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Territory acquisition reflects social hierarchy in Florida Scrub-Jays (Aphelocoma coerulescens or FSJ), a cooperatively breeding bird. About 25% of breeding adults acquire domain via territorial budding, a process by which a male helper expands its own natal territory and ultimately acquires both the area he helped obtain and a portion of his natal territory. It is generally accepted that males acquire territory by budding or replacement, where females disperse earlier and further. However, it is suspected that females bud or inherit territory more than previously thought. If this is true, it will rewrite territory acquisition and gender dynamics in FSJs. This project would investigate theories surrounding female budding, specifically if it is associated with lowered competition. I hypothesize that females, while significantly less likely to inherit territory, bud more than previously thought and these instances are coupled with a male-leaning sex ratio where females face less intrasexual competition and drive male dispersal.

Context-specific ‘silver-spoon' effects of wetlands, climate, and temperature on the fitness of tree swallows

L. Berzins, R. Dawson, R. Clark
Presenting author: **Lisha Berzins**

Changes in land use and climate are currently impacting numerous taxa and creating strongly contrasting early life environments for developing offspring. Understanding how early life conditions affect fitness may provide insights into the mechanisms underlying spatially-varying population trends of species across their range. We examined whether maternal effects and environmental conditions in the natal year affected the lifetime reproductive success (LRS; i.e., likelihood of producing a recruit) of locally recruited tree swallows at sites in Saskatchewan (SK; 1991-2017, n = 493) and British Columbia (BC; 2001-2017; n = 202), Canada. In SK, where wetlands are being lost due to agricultural land conversion, and drought is anticipated to increase with climate change, local recruits were more likely to produce a recruit themselves when natal wetland abundance was moderate compared to lower (odds ratio [OR] = 1.38, 95% CI [1.06, 1.94]) or higher (OR = 1.43 [0.98, 1.96]) abundances, and temperatures during development were warmer (OR = 1.17 [1.04, 1.32]). In BC, where precipitation is predicted to increase with climate change, local recruits were less likely to produce a recruit when soil moisture conditions were wetter in the natal year than moderate (OR = 1.97 [1.14, 3.52]) and drier (OR = 2.06 [1.0, 4.29]) conditions. No maternal effects were detected at either site. Thus, LRS of individuals within distinct populations is influenced by environmental conditions that vary locally; understanding such effects could be critically important for predicting the responses of regionally distinct populations to future changes in climate and land use.

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*Life in chaos: Nesting habitat preference of birds in urban-rural gradients in Kathmandu Valley

D. Bhusal, P. Ghimire
Presenting author: **Dinesh Bhusal**

Urban biodiversity is critical for human health and well-being yet less attention has been given to conserving it. Urbanization causes habitat degradation and fragmentation, pushing remaining patches of urban biodiversity toward jeopardy. Understanding how lives survive in such chaotic conditions is important to managing urban ecosystems. Birds are key components of an urban ecosystem, as their persistence is related to several urban environmental conditions. In this scenario, understanding an essential aspect of bird survival, i.e., nesting habitat preferences in cities compared to adjacent rural landscapes, provides us insights not only into urban avian ecology but also into the urban ecosystem and what key adaptations make it possible. Therefore, we study avian nesting ecology (habitat preferences

and nest substrate use) in the capital city of Nepal (Kathmandu) comparing with adjacent rural areas. We surveyed 6 road transects, each of 6 km in length (total of 36 km) in urban sites and rural areas. We found that nesting density is almost twice as high (9.94 nests/km) in urban sites compared to rural (4.2 nests/km). Only 9.5% of total nests in urban areas are found on the artificial substrate, indicating that birds prefer natural substrate over artificial even in urban areas. We found a significant association between sites (Urban and Rural) with the intensity of the use of artificial material (cigarette butts, wires, and plastics) as nest material (Ó¼2= 149.09, P =2.2e-16) but no significant differences in nests height. Our results indicate that urban birds rapidly utilize anthropogenic materials for their nesting in urban areas, suggesting a more plastic approach compared to the same birds in rural areas.

Small scale movements using node technology in a topographically complex landscape

M. Blake, M. Fylling, A. Noson
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Advancements in wildlife tracking are continually evolving, allowing us to use technology to answer questions that could not have been asked previously. The Motus Wildlife Tracking System across the world has allowed us to track long-distance movements of migratory birds but this collaborative network of receivers is not sufficient for documenting localized bird movements. More recent Motus technology has emerged allowing us to examine small scale movements of birds using nodes. Tracking localized movements of birds with arrays of nodes has had very little testing, especially in more complex topological landscapes. In this study we test proof of concept using node array to evaluate whether the Motus network could also provide insights into localized bird movements during the breeding season using lazuli buntings (Passerina amoena), spotted towhees (Pipilo maculatus), and brown-headed cowbirds (Molothrus ater). We attached solar-powered Motus transmitters to these three species over three years to evaluate movements throughout the spring and summer. Our study shows both the strengths and short comings of this technology, allowing insight into how to apply this technology on more complex landscapes.

Does timing of prescribed fire influence use of tallgrass prairie by migrating birds?

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Remnant tallgrass prairies provide critical habitat for many species of declining grassland birds. Fire is a crucial disturbance that maintains these grasslands and creates heterogeneity that benefits a variety of wildlife, but how fire management affects migrating birds is understudied. Most avian research in tallgrass prairies has focused on breeding and wintering habitat; less is known about how migrating birds use these prairies. We evaluated the effects of burn timing and time since fire on spring use of tallgrass prairies by migrating birds in the Flint Hills of Oklahoma. We conducted bird surveys from March-May in 2022-2023, periods throughout which prescribed fire was implemented in our study area, resulting in prairie patches that represented varying times since fire. Our results demonstrate that a diversity of spring burn timings create heterogeneous stopover habitat used by a broad suite of passage migrants, because different species have different migration schedules and use prairie patches with different times since fire. For example, different bird species of conservation concern were associated with varying times since fire, including American Golden-Plover, which primarily used blackened, recently burned patches (e.g., <2 weeks since fire) and Bobolink, which primarily used patches with fresh green growth (~1 month since fire). Our research provides further evidence that landscape heterogeneity created by spatially and temporally dynamic use of prescribed fire promotes wildlife diversity.

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*Relationships between environmental stressors and Cliff Swallow (Petrochelidon pyrrhonota) feather coloration and colony

S. Brandt, M. Ambardar
Presenting author: **Sonja Brandt**

Environmental stressors can strongly impact breeding birds. Cliff Swallows (Petrochelidon pyrrhonota) are aerial insectivores that experience mortality from car collisions, because they often nest and hunt under bridges and road culverts. Individual traits that may convey social information, such as body condition, or feather reflectance, may be associated with better coping around cars and other environmental stressors. Few studies have investigated relationships between reflectance and other environmental stressors such as water loss due to drought near the colony and foraging areas. Our objective was to determine if proximity to roads and water level were related to wing length, body condition, colony size, and feather coloration in Cliff Swallows. Our study took place in Barton and Ellis Counties, Kansas. This area is currently in a drought. We located Cliff Swallow colonies and captured adult Cliff Swallows with mist nets. We measured wing cord length, mass, tarsus length, and tail length. We collected feather samples from the back, the rump, and two areas on the breast for reflectance measurement using a spectrometer. We also measured the extent of water in the colony area, and the distance of the colony to roads. We expected that individuals with more colorful feathers and in better body condition would use colonies that are near areas with higher water levels and farther from roads. We discuss our results within the context of drought and climate change. Since Cliff Swallows are common and widespread in North America, they could be helpful ecosystem indicators, especially if this research suggests that they are affected by drought or other environmental stressors.

Linking foraging habitat quality to American Oystercatcher breeding productivity on two Virginia barrier islands

L. Brown, E. Nol

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The breeding population of American Oystercatchers has been strongly declining across the Virginia barrier islands since 2016. Here we explore potential causes for the decline in breeding success and number of breeding pairs on two Virginia barrier islands. We focus on how foraging habitat quality may be implicated in the decline. In 2022 and 2023, we combined observations of foraging and chick provisioning behaviors of oystercatchers with fine-scale GPS tracking data and environmental correlates, and relate this to breeding success.

Bird-window collisions in downtown Houston: methods, trends, and lessons learned

S. Brown, K. Biles, G. Durham

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Widow collisions are one of the leading causes of mortality for migratory birds, contributing to over 365 million bird deaths each year in the US. In 2017, after a tragic mass mortality collision event at a Galveston skyscraper, Houston Audubon developed a Lights Out program to help reduce such instances. As a part of this effort, we began systemic monitoring of 10 buildings in the downtown district of Houston, Texas, for bird-window collisions. We utilized community scientists to conduct daily surveys throughout both spring and fall migratory periods starting in the spring of 2021. Surveys included walking the full circumference of 10 selected buildings within 2 hours each morning, beginning at sunrise. The order in which we visited the buildings was rotated each day to reduce time-related biases. Five of our 10 buildings participate in our Lights Out program, meaning that they are committed to reducing their external lighting during migratory periods, while the other five do not. If an injured or dead bird is found, pictures are taken for identification before the bird is collected and either sent to a rehabilitation facility or to Harris County Public Health Mosquito & Vector Control Division to test for potential diseases. From 2021 through the end of 2022, we collected 255 birds. These consisted of birds from 16 families, representing both migratory and resident individuals. Data collection is still ongoing to increase our sample size, as we work to understand how the buildings themselves and the local weather patterns increase variability in the bird-window collision rate.

The timing of breeding influences fall migratory behavior of the Black-throated Blue Warbler

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Northern forests are exhibiting an elongation of the 'green' period due to climate change, with a progression of warmer, earlier springs and later autumns. Migratory birds have been shown to behaviorally respond to such changes in the spring, like migrating earlier and laying their eggs sooner. There may also be late season affects as migratory species could be taking advantage of higher arthropod abundance in the fall and extending their breeding. Prolonged breeding may cause a trade-off between fledging more offspring (increasing current fitness) and being physiologically less prepared for departure and migration (future fitness). The goal of this study was to identify if there are consequences to extending the breeding season, and if there are costs incurred on fall migratory behavior. To investigate this, we deployed radio transmitters on pairs of Black-throated Blue Warblers breeding at Hubbard Brook Experimental Forest in New Hampshire, US. We found that fall migratory departure between individuals varied, with males departing overall earlier than females. Individuals that conclude their breeding later depart later on average, however, this relationship is more evident in females than males. There is also variation in southward routes (coastal vs. inland) and initial migration rate as birds depart from the breeding grounds. Overall, longer, warmer green periods may negatively affect individual migratory birds by means of physiological trade-offs in the pre-migratory period. And further, there may be lasting costs associated with fledging young later in the breeding season that manifest as carry-over effects on condition and survival in subsequent stages of an individual's annual cycle.

Decision-making in obligate army ant following birds: patterns in foraging patch choice vary across coexisting species

E. Burns, S. Willson
Presenting author: **Emily Burns**

Obligate army-ant followers should evolve behavioral strategies that help them choose army-ant swarms that offer the highest payoff in foraging success. Each day, individual birds must choose which Eciton burchellii antswarm they will attend across those they track within their home range. Because species differ in ecological and behavioral factors including body size, morphology, home range size, and dominance interactions, we hypothesized that different species would have different strategies for choosing a foraging patch, in this case an army ant swarm. We collected data in lowland rainforest in Manu National Park, Madre de Diós, Peru, over 19 months from 1998-2007. All local E. burchellii colonies were tracked and followed daily, and birds were individually color-banded and observed daily. We measured army-ant swarm characters after observations of birds at each local swarm. A priori models were developed using parameters related to army ant swarm, temporal, and bird characteristics. We used AICc to rank models and assess their relative plausibility, and model averaging to assess the importance of parameters on the presence of a bird at an antswarm. Parameter estimates were then translated into odds ratios with 90% confidence intervals. Although antswarm choice strategies differed between the four bird species, the end result of any individual's choice may put it at the same antswarm as individuals from species with different choice strategies. Most, and particularly nomadic, E. burchelli antswarms were apt to have attendants from each of the species examined here. Differences in antswarm choice strategies may not be significant on a daily basis, but may be important during ecological bottleneck events.

The effects of light pollution on migratory animal behavior

C. Burt, J. Kelly, G. Trankina, C. Silva, A. Khalighifar, H. Jenkins-Smith, A. Fox, M. Leon-Corwin, C. Black, K. Fristrup, K. Horton
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Light pollution is a global threat to biodiversity, especially migratory organisms, some of which traverse hemispheric scales. Research on light pollution has grown significantly over the past decades, but our review on migratory organisms demonstrates gaps in our understanding, particularly beyond migratory birds. Research across spatial scales reveals the multifaceted effects of artificial light on migratory species, ranging from local scales through collisions with lit structures, at regional scales by altering stop-over sites and aerial connectivity of the night sky, and at macroscales through exposure to sky glow

and altered phenology. These threats extend beyond species active at night - broadening the scope of this threat. Emerging tools for measuring light pollution and its impacts, as well as ecological forecasting techniques, present new pathways for conservation, including transdisciplinary approaches.

Preliminary Winter Bird Community Data for Tracking Pine Savanna Restoration in the Mississippi Gulf Coast

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North American grassland bird populations have declined, due in part to the loss of suitable winter habitats, including the longleaf pine (Pinus palustris) savanna ecosystem, across the Southeastern United States. Longleaf pine savanna coverage has vastly declined across the Southeast region of the United States from approximately 23 million hectares prior to European colonization to less than 1.2 million hectares in most recent years due to habitat conversion, but perhaps most importantly, lack of fire. Several bird species of conservation concern are found during the winter in these longleaf pine savanna ecosystems along the Gulf of Mexico coast including Henslow's Sparrows (Ammodramus henslowii). Our objectives in this study are to (1) document changes in bird communities associated with habitat management activities (i.e., mechanical clearing, prescribed fire, etc.) and (2) determine the presence/absence and density of winter grassland birds, with a primary focus on Henslow's Sparrows, in relation to pine savanna restoration efforts. Initial avian surveys conducted December-March 2019-22, to establish baseline bird communities across sites to measure bird response to intensive land management actions indicate most of the restoration areas are dominated by species characteristics of shrub and forest. Preliminary data also showed a representative presence of grassland birds including Sedge Wren (Cistothoris stellaris) and Swamp Sparrow (Melospiza georgiana) and Henslow's Sparrow. One site in particular, a regularly managed area using prescribed fire, had a significant number of winter grassland birds including 37 Henslow's Sparrow, a Species of Greatest Conservation Need.

Causes and consequences of nest architecture variation in House Wrens (Troglodytes aedon aedon)

C. Carr, Z. Swanson, D. Reichard
Presenting author: **Chandler Carr**

Nest architecture and location are critical factors for protecting altricial young from predators, parasites, and the surrounding environment. However, nest structure, size, and materials vary substantially among individual parents and these traits do not always correlate with fitness. Here, we examined the causes and consequences of substantial variation in the nest architecture of House Wrens (Troglodytes aedon aedon), a cavity nesting songbird in which females are the suspected primary nest builder. To test whether nest building related to metrics of fitness, we observed whether multiple nest characteristics correlated with the day of the breeding season and number of offspring fledged for 109 nests. We also examined the repeatability of nest architecture between clutches based on female identity and box identity to test whether architecture is a product of the builder or the box and territory. We found that House Wren nests are highly variable throughout the breeding season despite fewer chances for reproduction later in the season, indicating that nest variability cannot be explained by shifting reproductive effort late in the year. Consistent with previous studies, no aspect of nest architecture correlated with the number of offspring fledged, suggesting that nest architecture and materials may play a limited role in nest success. The identity of the box proved to be a predictor of nest height variability while the identity of the female was a strong predictor of material variability in the cup. Our data suggest that selection on nest architecture is likely weak, and variation in House Wren nest architecture is best explained by differences in individual preferences and the presence of available nesting materials.

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*Are their barks bigger than their bites? Testing for correlation between song and bill morphology in the Song Sparrow

Z. Casteel
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Across the eight animal taxa known to possess learned vocalizations, geographic variation in these signals is nearly ubiquitous. Despite the critical role of language in human society, the mechanisms which lead to geographical divergence in learned vocal signals remain enigmatic. Song Sparrows (Melospiza melodia) provide an excellent model for testing hypotheses for why songs diverge between populations of a species. These Emberizine sparrows are geographically widespread, exhibit a range of morphologies, occur in a variety of habitats, and possess complex vocalizations which are learned from other individuals. My study seeks to test whether divergent morphology, as a consequence of local adaptation, is driving vocal divergence and to elucidate which aspects of morphology-body size, beak size, or beak shape-correlate with specific variables of sexually selected song in this species. In doing so I hope my results will shed light on the ways by which song diversifies on a continental scale, and on interactions between ecological selection and sexual selection in a potential case of incipient speciation.

Lack of evidence for discrete migration strategies in American woodcock suggests potential for species' resilience

S. Clements, L. Berigan, R. Darling, A. Fish, S. McWilliams, C. Slezak, A. Roth, E. Blomberg

Presenting author: **Sarah Clements**

Diversity in behavior is important for migratory species to respond to global change. We aimed to characterize migration strategies and identify behavioral mechanisms and individual drivers associated with migration strategy in American woodcock (Scolopax minor; hereafter woodcock), a migratory gamebird experiencing long-term population decline. Since 2017, the Eastern Woodcock Migration Research Cooperative has collected range-wide GPS movement data for >500 woodcock. We classified woodcock migratory movements based on a step-length threshold and calculated several characteristics of migration related to distance, path, and stopping events. We then used principal components analysis (PCA) to explore whether woodcock could be grouped into distinct strategies and identify behavioral characteristics that characterize migration strategy during spring (northbound) and fall (southbound) migration seasons. The PCA revealed that variation in woodcock migration strategy occurs along gradients rather than in clusters, and that the gradients are driven by a variety of migration metrics measuring migration route and stopping behavior. Subsequently, we used linear models to test whether individual body condition, age and sex class, and year influenced each behavioral characteristic. We found that body condition had positive relationships with migration distance, duration, and deviation from a straight line in the fall, but not spring. We observed an effect of sex and age class on distance to coast in the fall and stopping event duration in the spring. Our results suggest that the diverse migration strategies of woodcock will be an asset to the resilience of the species and effectiveness of management strategies.

Physiological conditions of barn owl nestlings as indicators of habitat quality in the Napa Valley wine-growing region

C. Cortez, M. Johnson

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The heterogeneous composition of Napa Valley includes a range of native habitats interspersed among cultivated lands that can be sustainably farmed for years to come. Nest boxes that attract barn owls (T. furcata and T. alba) to vineyards potentially provide a sustainable, cost-effective approach to protecting crops while minimizing the reliance on chemical pesticides. Because the environment of a site influences its suitability for reproduction and/or survival, theory holds that individuals will tend to occupy sites with attributes that are more favorable towards achieving these desired outcomes, known as the adaptive breeding-habitat hypothesis. This project will extend the line of questioning by examining variation in the physiological condition of offspring as a measure of habitat quality.

Male and female song comparison: Are males really more complex?

M. Costas-Sabatier, A. Rios-Franceschi

Presenting author: **Miguel Costas-Sabatier**

Birdsongs have been predominantly studied in male birds, however, recent studies have shown that female birdsong exists and is more common, especially in the tropical region. A species in which both males and females sing is the Antillean Euphonia (Chlorophonia musica sclateri). Although both species sing, we hypothesize that females will have a higher element rate and more elements in their songs due to intra-specific competition. For data collection, we used the eBird database to narrow down the geographical range for sampling When the bird was present and singing, the individual was recorded using a Zoom H-6 recorder with ssh-6 microphone capsule. Parameters such as frequency, duration, rate, and others were generated from 40 songs of both males (29 songs) and females (11 songs) using Raven Pro and analyzed in r. Preliminary results have shown that female songs have a significatively higher element delivery rate than males (p-value = 0.000001418), as well as a significatively higher number of elements(p-value = 0.00189) with a mean number of elements of 55.54 (Â± 11.17) elements per song, while males had a mean of 37.73 (Â±14.01) elements per song. However, female songs were significative shorter in time (p-value = 0.01927). Interestingly, the females have more elements and a higher element rate this is the first time this has been reported in a species from Puerto Rico. It's possible that the shorter song helps lower the risk of depredation, however, that should be tested in the future. This ongoing research needs more data to verify the preliminary results.

Effects of migratory strategy on flight muscle mitochondrial physiology in songbirds

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Migration is an energetically challenging life-history strategy for birds, so variation in migratory strategy may translate to variation in energetic requirements. Mitochondria supply a large proportion of the energy used for migration, yet how mitochondrial function varies with migratory strategy is unclear. We hypothesized that mitochondrial function varies with migratory strategy in birds and predicted greatest capacities for oxidative phosphorylation and lowest for reactive oxygen species emission in long-distance migrant species compared to short-distance migrants. We tested this hypothesis by comparing mitochondrial physiology between a short-distance migrant and a long-distance migrant species in six Nearctic passerine families. We classified species overwintering in North America as short-distance migrants, and species overwintering in South America as long-distance migrants. We captured birds during spring or autumn migration at Long Point, Ontario, Canada and transferred birds to short-term captivity at Western University prior to sampling. We then assayed mitochondrial function using mitochondria isolated from the flight muscle. We found similar capacities for oxidative phosphorylation between short- and long-distance migrants within five families. Similarly, we found little variation reactive oxygen species emission rates between short- and long-distance migrants in five families. Together, our data do not support our hypothesis and suggest limited variation in mitochondrial physiology with overall distance of migration. This lack of variation may reflect similarities in energetic requirements that are independent of migratory distance, or suggest that migratory songbirds converge in mitochondrial function.

Climate Effects on Female Reproductive Success of the Prothonotary Warbler

E. Cummings, L. Bulluck

Presenting author: **Emma Cummings**

Environmental conditions on both the breeding and non-breeding grounds can influence migratory birds' fitness. Analyzing long-term datasets is crucial to understanding how local weather during the breeding season interacts with global climate cycles to influence reproductive success. Prothonotary Warblers (Protonotaria citrea) breed in bottomland hardwood forests in the eastern United States and overwinter in mangrove forests in Central and northern South America; both of which are affected by rainfall. Because Prothonotary Warblers readily nest in boxes and have high site fidelity, they make an excellent study species for assessing the impact of climate change. Our study uses a 28-year data set (1995-2022) from eastern Virginia, USA, to assess how breeding season temperatures, breeding season precipitation and the El Niño Southern Oscillation (ENSO) during the winter months (Sept – March) affect female reproductive success (i.e., the number of young fledged per female per year). We found that more

precipitation during the early spring was positively associated with reproductive success except in El Niño years when it is negatively related to reproductive success. We also found that breeding grounds' maximum temperature 30-79 days prior to when the female lays her first egg leads to fewer young fledged in all years, regardless of ENSO. This study underscores the need to assess the impact of climate change on migratory species across the annual cycle to attain an improved understanding of the implication on their ecology and conservation. By taking a comprehensive approach, we can develop more effective conservation strategies promoting migratory species' long-term sustainability.

Vitelline warbler ecology and singing behavior

W. Cummings, M. Thomas, K. Singer, V. Moss, D. Goodman, C. Layne
Presenting author: **Wyatt Cummings**, Dartmouth College, wyattjcummings@gmail.com

The vitelline warbler (Setophaga vitellina), a restricted-range species endemic to the western Caribbean, has been understudied in ornithological research. Little is known beyond its phylogenetic relationship to other New World warblers, and particularly broad knowledge gaps exist regarding its ecology and vocalizations. In this study, we used island-wide surveys and song recordings to investigate the distribution, vocalizations, and ecology of vitelline warblers across a significant portion of their range on Little Cayman Island. We recorded 417 songs from 91 individuals and analyzed the length, frequency, and shape of various song components. We observed and characterized a high degree of variation in song composition and component frequency and shape. Other ecological insights from this study include the description of two types of call vocalization, observations of a reliance on gumbo limbo (Bursera simaruba) trees, and interactions with other bird species. Vitelline warblers warrant increased study in the future, as little is known about the threats facing them, and their singing behavior can offer new insights about warbler ecology.

Automated call box system to conduct playback experiments for songbird research and management.

V. Cupiche Herrera, B. McLaren
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Acoustic cues (e.g., vocalizations or 'calls' in wildlife) may effectively change behavioral patterns in certain species. There are very few published papers on how to create a device at a low cost that can automatically reproduce acoustic cues to carry on songbirds' playback experiments or management. We developed the Automated Call Box (ACB) based on an open-source Arduino-compatible microcontroller that attaches to a speaker system and costs less (<$200.00 USD) than the most common game caller used by researchers. The unit helps test the influence of social information on habitat choices and has other management applications. We field-tested six ACBs in 18 sites in Northwestern Ontario to assess the effect of conspecific vocalizations cues on the habitat settlement of Canada Warblers during the pre-breeding season. We successfully attracted seven individuals of Canada Warbler to different sites; we could observe the individual's approaches to the ACB during their deployment. The ACBs had a continuous deployment of 10 days without recharging; the sound can be heard >50m, the devices are reliable in broadcast time accuracy, and weather resistant (-2-28ÂºC, rain, and >20km wind). Our ACB allows researchers to conduct experiments on songbirds in inclement weather and complex environments, even in remote locations, with minimum or no necessity for the researcher to be present to reset the equipment.

American woodcock select for areas of increased night light during spring stopovers

R. Darling, S. Clements, L. Berigan, A. Fish, C. Slezak, S. McWilliams, A. Roth, E. Blomberg
Presenting author: **Rachel Darling**, University of Michigan, rachel.darling@maine.edu

American woodcock (Scolopax minor) is an upland migratory gamebird endemic to the eastern half of North America on the decline since at least the 1960s, likely due to loss and degradation of habitat. Woodcock migrate at lower altitudes, leave later in fall and earlier in spring than other landbird migrants,

and due to increased hours of darkness likely encounter relatively higher levels of anthropogenic night light on their nocturnal journeys. If, like many other birds, woodcock are drawn to brightly lit areas as they descend to stopover sites, night light may be negatively impacting their fitness and survival during migration. We leveraged a dataset of >500 GPS-tagged woodcock and the New World Atlas of Sky Brightness to examine the relationship between woodcock migratory stopover selection and night light. We ran step selection functions by migratory season and age-sex class and compared the approximate level of light each bird encountered as it initiated each stopover, with light levels at random steps distributed according to the bird's migration trajectory. Of the 4 age-sex classes, 3 selected for increased night light during spring migration, with the strongest effects in second-year males (0.89 Â±0.35), followed by after-second-year males and females (0.27 Â±0.06 and 0.18 Â±0.07 respectively). We found no significant relationships during fall migration. Our results suggest woodcock are consistently attracted to areas of higher illumination when choosing spring stopover locations. If woodcock experience greater threats to survival in brighter landscapes (e.g. building collisions, domestic cats), selection of these anthropogenically-altered habitats may have negative compounding effects on woodcock abundance.

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*Effects of forest reclamation and landscape features on avian occupancy, species richness, and abundance in Appalachia

R. Davenport, C. Barton, J. Cox, T. Fearer, J. Larkin, L. Sherman, S. Price
Presenting author: **Rebecca Davenport**, University of Kentucky, rebeccadavenportn@gmail.com

The Forestry Reclamation Approach (FRA) is a recently developed reclamation method that emphasizes best management practices in forestry, such as the planting of native trees and shrubs. Although the FRA is expected to benefit wildlife, no studies have empirically examined the effects of the FRA on avian species. Our study aimed to identify which reclamation approaches and/or landscape features promote breeding songbirds, particularly mature forest avian guilds and species of conservation need. We conducted point count surveys in high-elevation, red spruce-northern hardwood forests in the Appalachian Mountains of eastern West Virginia. We assessed differences in avian occupancy, species richness, species abundance, and community composition between four treatment types: 1) younger (< 9 years) FRA sites, 2) older (9-20 years) FRA sites, 3) non-FRA regenerated minelands, and 4) unmined, mature forests. Younger FRA sites were positively associated with the occupancy and species richness of the disturbed (shrubland/forest edge) and generalist breeding habitat guilds, but negatively associated with the occupancy and species richness of mature forest species. Treatment type had similar effects on species-specific abundance estimates, with mature forest species maintaining higher abundance in non-FRA and reference sites, and disturbed habitat species having higher abundance in younger and older FRA treatments. Furthermore, we found that both FRA treatments and reference sites supported numerous priority landbirds and species of greatest conservation need in the region. As the FRA becomes a more widespread reclamation approach in Appalachia, this study will inform future management based on considerations for native birds.

Signaling function of the female supercilium in the sexually dichromatic Black-throated Blue Warbler

A. Davidson-Onsgard, S. Kaiser
Presenting author: **August Davidson-Onsgard**

Ornaments are known to act as signals for attracting mates and competing against rivals in males and in females with sex role reversal. In birds, females often express less elaborate ornaments than males, largely assumed to be non-functional byproducts of genetic correlation. However, this hypothesis cannot explain the evolution of female-specific ornaments – a relatively rare phenomenon in birds with conventional sex roles. We hypothesized that female-specific plumage traits function as signals of mate quality and competitive ability under selection. We examined variation in the size of the supercilium and lower eye mark and associated variation in these traits with measures of mate quality and competitive ability in the sexually dichromatic Black-throated Blue Warbler (Setophaga caerulescens) at the Hubbard Brook Experimental Forest, New Hampshire. From May-Aug 2021-2022, we captured females and took standardized photos of the left and right sides of their face. We measured the size of the supercilium and lower eye mark using ImageJ. The size of the supercilium varied by 2.5 times between females with the

smallest and largest supercilium (mean Â± SE: 16.9213-18.31273 mm2; range: 10.8510-28.0985 mm2). Supercilium size was correlated with the size of the lower eye mark and both traits were symmetrical between the left and right sides of the face. Variation in the size of these traits were not associated with female age or their body size. We discuss how reproductive effort (mate quality) and territory quality (competitive ability) are associated with supercilium size.

Sanderling foraging ecology in relation to brine shrimp production at a managed saline lake in Saskatchewan

W. De SIlva, A. McKellar, C. Morrissey
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Chaplin Lake is a hyper-saline lake in Saskatchewan and a site of hemispheric importance for shorebirds as a staging area, where an active sodium sulfate mine manages water levels within multiple sub-basins where brine shrimp; a major prey of migrating Sanderling, are naturally abundant. This study assesses what physicochemical factors affect Sanderling (Calidris alba) and brine shrimp distribution during spring migration. Measurements of water quality parameters, abundance of Sanderlings and brine shrimps were recorded twice weekly from May to mid-June in each of 10 sub-basins. Sanderling abundance had a positive linear relationship with brine shrimp abundance (r = 0.26) and was predominantly observed in the terminal brining basins with the highest salinity (mean = 69.56 Â± 19.47 ppt). The emergence of brine shrimp coincided with the peak aggregation of Sanderlings in Chaplin Lake; which occurred in the last week of May. Sanderling (S) and brine shrimp (B) abundance were positively correlated to Water salinity (rS = 0.41, rB = 0.44), % Sodium sulfate (rS = 0.50, rB = 0.77), and density (rS = 0.50, rB = 0.79). We are currently analyzing stable isotopes in brine shrimp and blood samples and fecal DNA to identify the importance of brine shrimp for migrant sanderling during the period of rapid refueling. This information provides insight into the target time and environmental conditions for favorable brine shrimp production and thus Sanderling food availability. Therefore, the local salt mine at the lake plays a major role in maintaining Chaplin Lake as an optimum staging site for shorebirds. This information can be useful for conserving other lakes in the region as critical habitats for spring staging during migration.

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*Changes in bird diversity in response to a community-led ecological restoration program in Detroit.

C. Dennison, R. Buxton, A. Pearson
Presenting author: **Christopher Dennison**

Community-led ecological restoration of vacant lots or unmanaged parks can increase bird species diversity in cities while addressing issues of human health and environmental justice. However, understanding how bird communities respond to restoration, and how features of the urban environment affect these responses, is needed to support planning and policy that creates more effective biodiversity outcomes. Using acoustic recorders, we explored how the restoration of small inner-city parks to meadow grasslands affects bird species diversity in Detroit, based on features in surrounding neighborhoods. We compared Shannon diversity of birds at 10 recording sites around 4 restored parks versus 7 non-restored parks (n=110) in the summer during (2021) and one year after (2022) restoration. We used a generalized linear model approach to determine the moderating effect of variables including density of built structures, proximity to and density of roads, and Normalized Difference Vegetation Index (NDVI) on bird community space use. We found increased bird species diversity at ecologically restored parks compared to non-restored sites. Distance from built structures and higher vegetation indices within and around parks were both positively related to species diversity at restored and non-restored sites. Our results indicate habitat preference for ecologically restored sites by urban bird communities, and general preferential habitat selection for certain features of the urban environment. Understanding how urban bird communities respond to community-led ecological restoration programs can help inform more effective nature-based solutions and urban plans that address conservation, health, and social justice goals.

SNPfiltR: An R package for interactive and reproducible SNP filtering

D. DeRaad

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Appropriate quality filtering of SNP datasets is a highly important but often overlooked aspect of working with next generation DNA sequence datasets. SNPfiltR is a novel R package designed to make the process of optimizing SNP filtering parameters automated, fast, and reproducible, using the widely adopted R programming language. SNPfiltR extends existing SNP filtering functionalities by automating the visualization of key parameters such as sequencing depth, quality, and missing data proportion, allowing users to visually optimize and implement filtering thresholds within a single, cohesive R work session. Performance and accuracy benchmarking reveal that for moderately sized SNP data sets (up to 50 M genotypes, plus associated quality information), SNPfiltR performs with comparable accuracy and efficiency to current state of the art command-line-based programs. These results indicate that for most reduced-representation genomic data sets, SNPfiltR is an ideal choice for investigating, visualizing, and filtering SNPs as part of a user friendly bioinformatic pipeline. The package can be downloaded from CRAN with the command install.packages('SNPfiltR'), and the current development version is available from GitHub at: (github.com/DevonDeRaad/SNPfiltR). Thorough documentation for SNPfiltR, including multiple comprehensive vignettes detailing realistic use-cases, is available at the website: devonderaad.github.io/SNPfiltR/.

Age comparison of migratory movements of Blackpoll Warblers (Setophaga striata) during autumn.

M. Deutschlander, A. Patterson, M. Gianvecchio, M. Sutton
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Because of their trans-Atlantic, autumn migration to South America, Blackpoll Warbler (BLPW) migration has been well-studied at North Atlantic coastal sites, specifically near the Gulf of Maine. BLPWs studied near the Gulf of Maine show age-, date-, and population-related differences in local movement patterns (Brown and Taylor 2015, 2017). However, inland migratory behaviors of BLPWs are understudied. For example, whether age-related differences in movements observed near the Gulf of Maine are similar at inland locations is unknown. Using Motus technology, we examined stopover duration and local and regional movements of 16 adult (AHY) and 18 juvenile (HY) BLPWs captured at the Braddock Bay Bird Observatory (BBBO) during autumn of 2020 and 2021. There was no difference in stopover duration between AHYs and HYs (median duration = 7.5 & 8.5 days, respectively, U=122, p=0.46); most birds departed within 2 weeks. Departures times occurred during day (n=12) and night (n=22). Direction at departure was significantly different between ages (U2=0.207, p<0.05); HYs were primarily located to the south-southeast (163Â°, r=0.50, p<0.01) and AHYs were randomly distributed (p=0.86). Seventeen birds (11 HYs) were also detected by Motus receivers primarily located southeast of BBBO with coastal locations from Portsmouth, NH to Newport News, VA. HYs were more likely to be detected at Motus receivers along the south shore of Lake Ontario. These findings suggest that adults use lakeshore habitat to refuel, possibly displacing hatch-year birds further from shore. However, upon departure hatch-years may be more likely to follow the shoreline, possibly demonstrating exploratory behavior, prior to moving southeast towards the Atlantic coast.

Bird Banding Station at the National Botanical Garden of Havana, Cuba: preliminary results and perspectives

D. Ventura, L. Arañaburo Acosta, S. González Rosales, J. de Jongh González, M. Curbelo Cruz, L. Mugica Valdés, M. Acosta, K. Hobson
Presenting author: **Ana Maria Diaz**

The 2022 State of Birds Report warns about steep population declines of North American birds in virtually all habitats. Most of these species are shared by Cuba and other Caribbean islands. The lack of an effective monitoring system across the country and the region limits our ability to detect long-term population trends. Gaps in population estimates and natural history are even more significant in resident species. The permanent bird banding station of the National Botanical Garden in Havana, Cuba, aims at reducing those knowledge gaps. This work aims to present the preliminary results obtained at the station in the first semester of 2023, and future research perspectives. The banding pulses consist of monthly

visits of three days to the station facilities, and the set up of 3 to 4 mist nests when weather conditions allow. Birds are handled and processed by qualified professionals with necessary permits. During the banding pulses of January-March 2023, 106 birds of 21 species were captured for a total of 0,72 birds per net hour. More than half of the species captured were Neotropical migrants, including a species of conservation concern: the Swainson's Warbler. Of the resident species, three Cuban endemics and five other Caribbean endemics have been processed at the station. Three banded birds from the pilot banding surveys in 2022, were recaptured this year. Future deployment of Motus tags and analysis of stable isotope will contribute to studies of migratory connectivity of the migratory species wintering at the botanical garden. All these preliminary results envision a promising future for increasing our knowledge about the life-history traits of birds inhabiting the National Botanical Garden.

Propulsive contribution of the craniofacial hinge in climbing parrots

E. Dickinson, A. Schurr, M. Young, A. Wilken, M. Granatosky
Presenting author: **Edwin Dickinson**

Parrots exhibit numerous anatomical and behavioral adaptations unusual to other birds, including a highly mobile craniofacial hinge and a novel tripedal gait in which the head functions as a third limb. Here, the potential role of this craniofacial hinge during vertical climbing is examined within a model parrot species (Agapornis roseicollis) through an integrated approach combining high-speed cinematography and kinetics. Further, to test whether craniofacial joint movement during locomotion is distinct compared to forceful biting, we developed a custom-made bite force transducer using two mobile plates loaded with springs of known stiffness. Rosy-faced lovebirds were encouraged to bite the plates and angular excursion of the mandible and craniofacial hinge and linear displacement of the corresponding springs were measured from high-speed cinematography collected from a lateral view. During locomotion, the craniofacial hinge is extended at touchdown and steadily flexes throughout stance phase as the bird pulls itself upward, with excursion magnitudes that dwarf angular excursion during forceful biting and reported data in other avian lineages. Movements at the craniofacial hinge are geared toward propulsion and are positively correlated with both stride length and velocity. This clear propulsive role of the craniofacial hinge suggests that the anatomy of the parrot feeding system is likely shaped by both dietary and locomotor demands.

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*Window Collision Species Composition on a Large Midwestern College Campus

C. Dobson, E. Alexander, S. Tomczyk, H. Pollock, M. Ward
Presenting author: **Colin Dobson**, University of Illinois Urbana-Champaign, cdobson2@illinois.edu

Every year up to a billion birds are subject to mortality due to colliding with windows (Loss et al. 2014). Recent modern architecture and the societal appeal of buildings is slowly transitioning to designs with large, glass facades on buildings which is only making this issue more problematic. Although a wide diversity of bird species is affected by this phenomenon, migratory birds are the most directly affected by this issue (Basilio et al. 2020). This project was designed to survey bird collisions during the peak of migration in the fall and spring on the University of Illinois Urbana-Champaign campus to capture data sufficient to understand frequencies of collisions on campus among different species groups. The routes were ran twice a day during a designated five-week survey period during April and May and September and October in 2021 and 2022. Volunteers collect information on both deceased and alive stunned birds found along routes and record date, time, location, window face direction, and species to get a full scope of what species are striking the most and which spots are most prone to collisions. Over these seasons, 99% of the strikes found were migratory (n = 566) and 94% were passerines (n = 537). The most struck family was Parulidae (n = 350) and Tennessee Warbler was the most struck species (n = 89) followed by Nashville Warbler (n = 41), Ovenbird (n = 38), Bay-breasted Warbler (n = 37), and White-throated Sparrow (n = 33). Most importantly, we compared birds to their relative abundance and showed that Parulidae was over represented in strikes but common migrant families such as Tyrannidae, Vireonidae, Hirundindae, and Icteridae had much lower strike rates compared to to their relative abundance.

Keystone Effects of Black-tailed Prairie Dogs on Breeding Grassland Songbirds

A. Dreelin, A. Boyce, H. Jones

Presenting author: **Andrew Dreelin**, Northern Illinois University, randrew899@gmail.com

Bird communities on the Great Plains are structured by Black-tailed Prairie Dogs (Cynomys ludovicianus), a keystone species that grazes and burrows on large colonies, creating vegetative heterogeneity. However, prairie dog effects on songbird demography have only been assessed with artificial nests, which suggested negative effects on nest survival. To better inform Great Plains ecology & conservation, we are actively researching the keystone effects of prairie dogs on Horned Larks (Eremophila alpestris) & Chestnut-collared Longspurs (Calcarius ornatus). On public & Tribal land in central MT, we used quasi-random selection to establish 1100 x 300 m transects that span a prairie dog disturbance gradient, from active colonies (treatment) to surrounding grassland (control). Within transects, we systematically search for nests and monitor demographic parameters. Here we report preliminary results. Lark nest sites were skewed towards prairie dog towns (Î³1 = -1.06, mean = 106.9 m, n = 56), while longspur nest sites were normally distributed around prairie dog town edges (Î³1 = 0.31, mean = -105.7 m, n = 22). However, our logistic exposure model found that Horned Lark nest survival was not affected by distance to prairie dog town edge or vegetation characteristics. While preliminary, our results indicate that 1) grassland birds have species-specific nest site selection patterns around prairie dog towns and 2) prairie dogs may have neutral effects on nest survival for Horned Larks, which contrasts with findings from artificial nests. We will explore these patterns in more detail, test the mechanisms responsible, and provide practitioners with data to better integrate prairie dog effects into bird conservation planning.

A range-wide migratory network for Blackpoll Warblers (Setophaga striata)

J. Duali, R. Norris, B. DeLuca, S. Mackenzie, S. Haché, B. Drolet, R. Boardman, A. Roberto-Charron

Presenting author: **Jelany Duali**, University of Guelph, Jelanyduali@hotmail.com

Understanding when and to what degree individuals from different populations mix or remain spatially segregated during the annual cycle (i.e., migratory connectivity) is critical for developing effective conservation measures for migratory birds. In this study, we build and analyze a range-wide network to describe patterns of migratory connectivity in a declining songbird, the Blackpoll Warbler (Setophaga striata). Blackpolls breed across North America's boreal forest, overwinter in northern South America, and are famous for undertaking a non-stop flight over the Atlantic Ocean during fall migration. Here, we analyze year-round tracking data from 44 light-level geolocators deployed and recovered from Blackpolls between 2013-2020 at 10 locations across the breeding grounds to identify the key stopover and nonbreeding areas used by individuals from different breeding populations, then cluster these locations to form the nodes of a migratory network. We then combine geolocator data with relative abundance records from eBird to estimate the flow of individuals moving between nodes and use network metrics, including betweenness centrality and degree centrality, to identify key nodes for maintaining network connectivity. Finally, we assess the modularity of the network to quantify the degree to which different breeding populations mix during the annual cycle. Our results represent a first step towards understanding how environmental change in one part of the Blackpoll Warbler's range could affect population trends in other areas.

Colonization, competition, and niche breadth: a case study of rapid adaptation in an insular population of Song Sparrows

M. Duchesne, P. Arcese

Presenting author: **Megan Duchesne**

Climate and land use change facilitate substantial range shifts and novel competitive interactions among species; but case studies of the eco-evolutionary responses of native species remain rare. Grant & Grant (2006) reported rapid evolution in bill shape of native finches on Isle Daphne (Galapagos) in response to competition with colonist finches having similar preferences and abilities to exploit seeds, leading to divergence in morphology via natural selection. I will develop a parallel analysis, investigating temporal changes in traits affecting competitive ability in Song Sparrows (Melospiza melodia) resident on XOX DEL, BC, subject to increasing competition for seeds following colonization by Fox Sparrows (Passerella illiaca). I predict temporal variation in seed abundance and diversity, and competition, has caused rapid evolution in Song Sparrow bill shape with two possible outcomes (cf Abrams 1986). If niche breadth is

narrow, I expect bill dimensions to converge on those of Fox Sparrows, a socially dominant competitor, but nevertheless, drive declines in Song Sparrows. Alternatively, given a sufficiently broad feeding niche, natural selection may instead promote divergent evolution and facilitate coexistence. I will analyze selection using 48 years of morphology and fitness data for ~3,500 birds. I will conduct and compare vegetation surveys and estimate the rate of seed removal by increasingly abundant Fox Sparrows to demonstrate temporal changes in niche breadth on XOX DEL. My results will offer a novel test of theory and advance our understanding regarding the role of rapid evolution in the coexistence of a native species and new socially dominant competitor.

An experimental study of interspecific competition between Eastern Whip-poor-wills and Chuck-will's-widows

B. Dunnahoo, T. Boves
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Interspecific competition has long been considered a factor that can cause population declines and exclusion from optimal breeding habitat, and subsequently distributional shifts, for one or both species involved. However, detecting interspecific competition as a causal factor is often challenging, and it can be difficult to tease competition apart from other possible explanations (especially without the use of experimental studies). One hypothesized case of interspecific competition may occur between two rapidly declining nocturnal aerial insectivores, Chuck-will's-widows (Antrostomus carolinensis) and Eastern Whip-poor-wills (A. vociferus) in portions of their ranges where they overlap, such as in the Ozark Highland ecoregion of Arkansas and Missouri. Furthermore, due to breeding habitat degradation and changes in breeding ranges, Chuck-will's-widows and Eastern Whip-poor-wills may now interact with each other in many areas previously occupied by only one species. Thus, any interspecific competition between these two species could further accelerate population declines in regions where their breeding ranges currently, or in the future, will overlap. To assess this possibility, we conducted vocalization playback experiments (with two treatments and a control) across the Ozarks of northern Arkansas and southern Missouri to identify potential interspecific competition. In response to treatments and controls, we assessed agonistic behaviors that these two species exhibited, and tested for asymmetry in these agonistic behaviors. Preliminary data suggest that neither of these species recognize each other as direct competitors, but more experimentation is needed.

Winter foraging behavior of neotropical migrants and residents may reveal niche differentiation

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Niche partitioning is at the heart of interspecific competition. The Competitive Exclusion Principle states species must fill different niches to coexist, which is reflected in diet and foraging behavior. Wood-warblers (Parulidae) have been subject to intensive study on this topic since MacArthur's landmark study in 1958 on breeding grounds in the United States. However, competition on wood-warblers' wintering (non-breeding) grounds has received relatively little attention. We hypothesized that niche partitioning by foraging behavior would exist among insectivorous migrants and resident species at our study site in Punta Cana, Dominican Republic. We gathered standardized behavioral data on eight wintering migrant wood-warbler species as well as two resident insectivores, Broad-billed Tody (Todus subulatus) and Black-Whiskered Vireo (Vireo altiloquus). Our results suggest that these species are able to coexist through niche differentiation by a combination of prey procurement method, height, and foraging substrate. Groups of species fell into distinct foraging height classes, in which they remained regardless of prey procurement method. The residents differed from the migrants by eating berries or predominantly flycatching, while the migrants, which primarily gleaned, partitioned by foraging on different substrates. Neither resident species was regularly observed gleaning in the midstory, understory, or on the ground. This begs the question of whether these niches, filled by wood-warblers in the winter, remain unfilled by residents in the summer when migrants are absent.

Traveling with Eastern Towhees

M. Eshleman, L. Kiziuk, A. Coolman, A. Fetterman, J. Buler
Presenting author: **Michelle Eshleman**

Mortality for juvenile songbirds making their first migration is much greater than for adults. Even in adults, the migration phase is often where mortality is greatest and may drive population declines. However, much of what we know about immature migration patterns comes from larger birds and not passerines. Now, the Motus Wildlife Tracking System, a collaborative system of automated radio telemetry receiving towers, allows researchers to place radio tags weighing less than 0.5 grams on small species. Our study focuses on Eastern Towhees (Pipilo erythrophthalmus), a Species of Greatest Conservation Need in 11 states in the Northeastern United States. The migration pathways for this species are not well understood because no one has tracked individual towhees throughout the year. My study assess whether populations of Eastern Towhee in eastern PA are migratory or sedentary, the migration timing and pathways taken by adult and immature birds, and philopatry to breeding locations. During the breeding season of 2022, we tagged 12 juvenile birds and 17 adults in eastern PA. In January and February of 2023, we tagged five adults in the same region. We hypothesize that juveniles will be more attracted to artificial light than adults and that they will take more coastal pathways.

Can nesting in boxes help endangered Northern Atlantic roseate terns (Sterna dougallii) adjust to sea level rise?

J. Espinosa
Presenting author: **Jessica Espinosa**

Great Gull Island, located at the mouth of Long Island Sound, is home to one of the largest breeding colonies of federally endangered roseate terns in the Western Hemisphere. However, rising sea levels due to climate change threaten nest site loss, especially for those nests located in the rocky revetment surrounding the island. If roseate tern populations on the island are to persist, management actions will be needed to mitigate this loss. I examined rock nest vulnerability to sea level rise, finding that any nests under three meters above current sea level are potentially vulnerable by 2100. Most roseate tern nests (75%) were located either in the rocks or in artificial boxes, but despite their importance, the artificial boxes had low occupancy. Since many of these rock nests are vulnerable, I aimed to determine whether the birds will be able to maintain breeding success by switching to boxes should their nests in the rocky revetment be reduced. To determine if this is a viable strategy, I established how box characteristics relate to occupancy, finding that partially closed front boxes and wedge-shaped boxes, among others, were the most important factors in predicting occupancy. In addition, I banded A and B chicks in both rock and box nests and documented their survival throughout the season to determine whether boxes were sink habitats and whether certain box types led to higher chick survival. Rock nests and those box nests with some front coverage were more likely to fledge chicks, possibly due to lowered predation risk. These results suggest the use of certain box nests located in specific areas around the island may be part of a viable management strategy to combat roseate tern nest site loss.

American woodcock landscape use in New York State

K. Filkins, J. Straub, K. Malone, J. Stiller
Presenting author: **Kayleigh Filkins**

The American woodcock (Scolopax minor) is a migratory upland gamebird found across the Midwest and Eastern United States. Woodcock migration is challenging to study and previous efforts have focused on band recovery and localized movements using short-range radio telemetry. The large gap in migratory information led the Association of Fish and Wildlife Agencies to identify migration ecology as one of the greatest research needs for the American woodcock. This project is evaluating habitat preferences and resource selection of migratory and breeding woodcock in New York State. This is a collaborative project with the Eastern Woodcock Migration Research Cooperative (EWMRC), which includes 30+ organizations across the eastern United States that share data. Since 2017, there have been 568 unique birds tagged across 14 states and 3 Canadian provinces. Of these, 47 have been tagged in New York State. We established a 50km buffer around the NY state border-- 300 woodcock have at least one point tagged

within that buffer. In 2022, 10 additional transmitters were deployed on females in New York State. An additional 12 transmitters will be placed on females in April 2023. To date, we have estimated the home ranges of 9 birds in New York (one bird moved out of NY). Three of the birds have home ranges broken into two pieces after a significant movement (>10km). Average home ranges of these birds was 243 hectares (median = 73, max. = 1032, min.= 1.4). We aim to build a habitat and resource selection models using R . Woodcock are a target species for the New York Department of Environmental Conservation Young Forest Initiative Strategic Plan; therefore our project results will inform management of early successional habitats.

An analysis of hummingbird visitation to native, exotic, and artificial nectar sources across a landscaped terrain

J. Fisher, L. Rodriguez, C. Doan, D. Groom
Presenting author: **Jillian Fisher**

Hummingbird-flower interactions are a classic example of mutualism. Hummingbirds receive sugar-rich nectar stored in flowers, while hummingbird visitation allows for pollination. However, exotic plants and bird feeders introduced by horticulture can provide competition for native plants. This field study compares visitation rates among feeders, exotic plants, and native plants to identify hummingbird preferences in relation to their nectar properties on an urban landscape. We performed focal observation studies of the exotic Callistemon citrinus, Metrosideros excelsa, Agapanthus africanus, and Nicotiana tabacum, the native Gambelia speciosa, and hummingbird feeders at multiple sites. Nectar volumes and sugar concentrations from these specimens were also analyzed using microcapillary tubes and a Brix refractometer. In the summer, M. excelsa was visited most frequently by hummingbirds, followed by bird feeders and C. citrinus. An analysis of nectar stock and sugar concentration indicates that these three sources were the most energetically rewarding to visit. The native species G. speciosa was visited relatively infrequently, with the highest sugar concentration at 25.5 Â± 1.2%, yet a relatively low nectar volume. As such, the presence of exotic plants and feeders may reduce visitation to, and pollination of, native flora in urban areas. Preliminary results indicate that declining floral abundances in the fall, particularly of M. excelsa, result in higher visitation to C. citrinus and N. tabacum. This suggests a continued reliance on exotic plants throughout seasonal transitions.

Satellite-tracking technology reveals American Robins fly by night

K. Fraser, S. Bani Assadi, C. Turcotte-van de Rydt, K. Smith
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Investigating how migratory birds partition their movements over a diel scale can provide insight into the evolution of timing behaviours, migratory refueling strategies, and potential constraints with climate change. However, tracking within-day movements of smaller-bodied migratory birds has been challenging. We used new satellite-tracking technology to investigate the diel-scale movements of a migratory songbird, the American Robin (Turdus migratorius). We tagged robins (using ICARUS and PinPoint Argos75 units, n=58) intercepted during their fall migration through southern Manitoba, Canada. Average night flight distances were 137 km (range 5-590 km) whereas daytime flights were much shorter, averaging 22 km (range 5-119 km). Although robins are considered a primarily diurnal migrant, we found that nearly all migration flights (i.e. flights >50 km consistent with a migration direction) occurred during dark hours. Longer migratory flights were in the first half of the night, whereas flights during stopover, presumably between foraging locations, were concentrated in the morning hours. Our results indicate that the initiation and duration of migratory flights may be constrained by the hours of available darkness.

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*Examining impacts of climate change and habitat loss on the distribution and abundance of Long-billed Curlews

K. Freitag, A. McKellar, D. Bradley, S. Flemming, R. Torrenta, M. Shaikh, T. Luszcz, M. Reudink
Presenting author: **Kelsey Freitag**

Anthropogenic stressors including climate change and habitat loss have severe consequences for

ecological communities at a global scale. The impacts of these environmental pressures are amplified in grassland-dependent species because of lost and fragmented habitats. Grassland ecosystems are endangered in Canada, making up just one percent of land cover in British Columbia. The bird species reliant on these environments are experiencing declines, such as the Long-billed Curlew (Numenius americanus). The Long-billed Curlew is a grassland bird with a breeding range spanning western North America. They are listed on Schedule One of the Canadian Species at Risk Act due to population declines resulting from anthropogenic threats, such as agricultural conversion. Prior to 2022, a British Columbia-wide survey had not been conducted since the early 2000s, leaving a 20-year gap in our knowledge of curlew abundance and distribution in the province. During the recent survey conducted in 2022, we uncovered a distinct 85km northward shift in the breeding range of this species along with reduced detections in the southern populations. We examine how changes in land use and climate over the past two decades have driven this range shift. To accomplish this, historical and present curlew survey data were analyzed in relation to land use and climate data, and habitat occupancy models were developed to reflect present trends and predict future changes in distribution. This research will provide fundamental knowledge on how anthropogenic stressors impact grassland species. Understanding distribution and abundance patterns provide crucial knowledge for implementing critical habitat protections and developing up-to-date conservation plans.

Historical demography of northern seabirds: assessing responses to past climate changes

C. Boccia, V. Friesen
Presenting author: **Vicki Friesen**

Many northern seabird species are currently threatened or declining. Climate change is predicted to exacerbate these declines, as warming will proceed fastest at the poles. However, large fluctuations in climate have occurred throughout the Quaternary period and these historical glacial and interglacial periods provide an opportunity to assess seabirds' ability to cope with our current climate shift. Have seabirds, some of which are ice-edge associated, experienced large declines during previous warm spells? Knowledge of seabird species' vulnerabilities may allow us to take preemptive conservation actions. To answer this question, I will determine the effective population sizes of ten representative northern seabird species over the past roughly one million years. These time series will be reconstructed using sequentially Markovian coalescent methods (PSMC and MSMC) run on the genome assemblies available for these species. With these data in hand, I will be able to evaluate seabirds' population trends during times of major climate shifts; I will focus primarily on population sizes during the last glacial maximum and last interglacial period. Preliminary reconstructions show that many seabird species' population trends appear to have been unaffected by the last interglacial period and many appear to have experienced large declines that correspond to the last glacial maximum, perhaps due to the glaciation of nesting sites.

Birds, fire and the sixth extinction

C. Frost
Presenting author: **Cecil Frost**, Univ of North Carolina, cecil.frost@earthlink.net

All but a few pelagic birds have fire relations. We know more about them than any other taxonomic group, yet we know far less about the fire relations of birds than most other groups, including the widely studied fire relations of plants-a class that makes up the food supply and habitats for most birds. Had we the knowledge, we could rank all birds of North America on a continuum beginning with the most fire-dependent bird-perhaps the Kissimmee Prairie grasshopper sparrow, which only nests 'in the black', areas burned within the last two years. At the other extreme we find the most fire-refugial birds, species like the least tern that nests in sand, in a site with no fuel, and that feeds over open water. Viewed this way, at least half of all birds are fire dependent species. New definition: a fire dependent bird is any species which, deprived of fire needed to maintain an essential habitat, will decline and eventually go extinct. A bird that requires fire to maintain vertical structure of its habitat is a fire dependent bird. One whose post-nesting habitat needs fire to keep it open to produce seeds and insect protein for survival of its young, is a fire dependent species. A migrant whose last foraging habitat for refueling at its jumping-off

point on the edge of the Gulf of Mexico requires fire to maintain its thousand seed and berry-producing plant species and their ten thousand arthropod species, is a fire dependent bird. Because they can move from habitat to distant habitat, fire relations of birds are more complicated than any other major group. If we are not to relinquish at least half of all bird species in North America, the first step is to learn the position of every species on the fire frequency gradient.

Macro-demographic indices of recruitment and survival from ebird data

B. Galtbalt, J. Socolar, O. Robinson, F. La Sorte, K. Rosenberg, A. Johnston, A. Dokter
Presenting author: **Batbayar Galtbalt**, Cornell Lab of Ornithology, bg423@cornell.edu

To understand current bird declines, accurate estimates are required of the birth and death rates of birds across the vast geographic areas they visit. However, such information is currently time-intensive to collect and only available for select locations during short periods of the year. Here we present an analysis framework to estimate large-scale indices of recruitment and mortality from observational data of the citizen science project eBird. We present preliminary results for applying this framework to a set of common and widespread migratory species in North America. We aim to assess whether annual population fluctuations can be attributed primarily to variability in recruitment (tap-hypothesis) or to variability in survival (tub-hypothesis). We evaluate the spatial consistency of our demographic indices, discuss assumptions on detection and validation by independent data, and present a preliminary comparison of demographic patterns for species groups differing in their non-breeding areas.

Movement ecology of male and female golden-cheeked warblers (Setophaga chrysoparia)

M. Gamble, A. Long
Presenting author: **Michael Gamble**

Over 400 migratory bird species that occur in North America are experiencing population declines due to habitat loss and degradation. Identifying movement patterns and habitat associations is necessary to inform management and conservation decisions for these species. The golden-cheeked warbler (Setophaga chrysoparia) is a federally endangered, Neotropical migrant that breeds in oak-juniper woodlands in central Texas. The species is well-studied on the breeding grounds, but we lack accurate, fine-scale movement data throughout the breeding season that could provide important information on habitat use for both males and females. Recent improvements in tracking technology (e.g., increased battery life, smaller size) have enhanced our ability to study movements of smaller migratory species during the breeding period. We will present home range results (95% minimum convex polygons and 50% autocorrelated kernel densities) from our 2022 and 2023 field seasons using an automated radio-telemetry network and transmitters to investigate movement patterns and fine-scale habitat associations of male and female golden-cheeked warblers. Our research will fill a knowledge gap for golden-cheeked warblers and demonstrate the use of automated telemetry for research on small birds (<10 g) that occur in forested systems.

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*La Vie en Noise: Bird biodiversity and vocal behaviour in the urban noise of Paris

S. Gamboa, D. Mennill
Presenting author: **Stephanie Gamboa**

Many wild animals produce loud and conspicuous vocal signals that play an important role in territory defence and mate attraction. Increasingly, animal vocal signals are impaired by growing levels of anthropogenic sound, particularly in urban environments. Our understanding of animal ecology and conservation benefit from careful study of the influences of anthropogenic sound on bird diversity and animal vocal behaviour in urban settings. The Global Urban Bird Survey is a new initiative designed to quantify the biodiversity of birds living in large cities, using bioacoustic recordings to survey birds based on their vocalizations. The bioacoustic surveys of the Global Urban Bird Survey allow us to quantify the effects of anthropogenic noise on vocal behaviour of birds, at the same time that we quantify the effects of urbanization on bird diversity. We collected bioacoustic surveys of Paris France, as part of the Global

Urban Bird Survey, and we analyzed the effect of anthropogenic noise on both bird biodiversity and bird vocal behaviour in one of Earth's most highly modified urban environments. We sampled 35 points spread across downtown Paris, following a stratified, randomized sampling scheme. We found relationships between the intensity of anthropogenic noise and avian biodiversity: bird species richness was influenced by high noise levels. We also found relationships between the spectral properties of urban noise and the vocalizations produced by breeding birds. Our results help us to understand the influence of anthropogenic sounds in the urban environment on the ecology of birds, including both bird biodiversity and bird vocal behaviour.

Response of Neotropical migrants and resident birds to local habitat and landscape attributes in shade coffee farms

C. Gonzalez Prieto, P. Arcese, A. Rodewald, S. Wilson

Presenting author: **Catalina Gonzalez Prieto**, University of British Columbia, catag@student.ubc.ca

Agroforestry systems, such as shade-grown coffee, have received much attention for their potential to provide habitat for birds in regions that have undergone extensive forest loss. The quality of habitat within shade coffee farms has been shown to influence overall bird richness and the diversity of migrants in mixed-species flocks. However, less is known about the response of resident bird communities to shade coffee farm quality or whether migrants and residents respond differently to the landscape surrounding coffee farms. We assessed how local habitat and landscape attributes influence the richness of migratory and resident birds in 76 shade coffee farms in the Antioquia region of the Colombian Andes. Using generalized linear models, we determined how the richness of migratory and resident bird species was influenced by the structure and composition within shade-grown coffee farms (i.e., tree richness, abundance, and coffee intensification) and landscape variables surrounding the farms (i.e., amount of forest and forest-agriculture mosaics). The richness of both migratory and resident birds on coffee farms increased with greater forest-agriculture mosaic cover at the landscape scale, while richness of resident species was further influenced by tree abundance within coffee farms. These results indicate that the richness of resident birds is particularly sensitive to habitat at multiple spatial scales, perhaps because of the diversity of foraging and dietary guilds, which require a broad range of habitat to meet resident bird needs. Conservation strategies to support the diversity of migratory and resident bird communities together should thus consider both local scale quality and landscape scale context.

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*Vocal behavior during territory establishment of newly arrived and established male Ovenbirds (Seiurus aurocapilla)

A. Gouge, J. Foote

Presenting author: **Adam Gouge**, Algoma University, agouge@algomau.ca

During the breeding season many songbirds sing to secure a territory and a mate. Ovenbirds (Seiurus aurocappila) are wood warblers that migrate from their wintering locations in the neotropics to their breeding habitats in the northern parts of the United States and Southern Canada each spring. Upon arrival males begin singing emphatically in their prospective territories to establish boundaries and attract a mate, with the rate of singing decreasing following pairing and throughout the remainder of the breeding season. How the singing behaviors of male Ovenbirds with established territories are affected by the arrival of new males trying to establish an adjacent territory has not been described. Using autonomous recorders, we examined vocal behavior of new and established Ovenbirds when new males arrived. We predicted that song rate would be highest immediately following arrival and decline in the following days. We annotated spectrograms of daily recordings to count the number of songs produced by each bird within a 60-minute period starting 1 hour after sunrise for each of the first four days following a new arrival and used a linear-mixed effects model to determine whether song rate differed between days. New birds sang significantly more than established birds with no significant difference between days. Established birds sang at a significantly greater rate on day 1 compared to days 2-4. Our results suggest that established Ovenbirds quickly establish boundaries with late arriving birds. The sustained high song rate of new arrivals likely relates to both the effort required to acquire a territory and attract mate when arriving late on the breeding grounds.

Determining the origin habitat of Black-backed and the American Three-toed Woodpeckers by chemical oleoresin analysis

F. Grandmont, J. Tremblay, J. Ibarzabal, S. Lavoie
Presenting author: **François-Xavier Grandmont**

Fall dispersal of the Black-backed (Picoides arcticus) and American Three-toed (P. dorsalis) woodpeckersis a movement for which many unknowns persist. Although the summer range of these woodpeckers is located mainly in remote boreal regions, a study of the origin habitat of dispersing individuals could be done through certain specific analyzes carried out on the rectrices. The secretion of oleoresins on the surface of the trunks by conifers suggests that a large quantity of these substances accumulates at the end of the rectrices. Indeed, due to the continuous friction of these feathers with the trunks of trees during various activities, such as searching for food, certain specific compounds can accumulate there. The sampling was done by capturing the birds in mist net and dipping the rectrices in vials already containing hexane. It took place during the nesting season in the boreal forest north of Lac-St-Jean and also during the fall, this time at the banding station located at the Tadoussac dunes. With the quasi-monospecific composition of the coniferous forests characterizing the habitat of these woodpeckers, the oleoresins found on the rectrices can consequently testify of the origin habitat of the sampled woodpeckers. The preliminary results suggest chromatographic peaks corresponding to the chemical compounds found in the resins of conifers as well as a great similarity between the samples from woodpecker rectrices. Thus, an analysis of the oleoresins found on the tail feathers of these boreal woodpeckers opens the door to acquiring new knowledge about these dispersal movements.

Interactions between cavity-nesting species: are Carolina Wrens and Prothonotary Warblers competitors or mutualists?

S. Green, K. Miller, R. Pell, K. ONeil, E. Bowers
Presenting author: **Shelby Green**, University of Memphis, srgreen5@memphis.edu

Nesting in cavities yields several benefits, but also presents a significantly limiting resource over which individuals within and between species might be in competition. Conversely, increasing density of heterospecifics might confer an advantage in reducing the risk of nest depredation and parasitism, but these interactions have been understudied in wild populations. We examined the occupancy of nestboxes, clutch size, brood-parasitism rates, predation rates, and fledging success of sympatric Carolina Wrens (Thryothorus ludovicianus) and Prothonotary Warblers (Protonotaria citrea) over 7 years at the Meeman Biological Station in west TN. Wrens are year-round residents, while warblers are Neotropical migrants, but both species experience brood-parasitism by Brown-headed cowbirds (Molothrus ater) on their breeding grounds. Occupying similar ecological niches, density of each species varies inversely in space and time; thus, it seems likely that each species compete throughout the breeding season. When a harsh winter storm prior to the 2021 breeding season decimated the wren population, we expected an increase in subsequent warbler abundance. However, we found no significant change in breeding parameters in the absence of wrens, suggesting a lack of competition between these species. Thus, we hypothesize that warblers might derive some benefit, such as a reduction in brood parasitism by cowbirds, from heterospecific nest neighbors such as wrens, which are vocal, territorial, and physically aggressive to novel intruders. Rates of brood parasitism and nest depredation vary strongly by species in space and time within our study site, raising the question of whether warbler and wren neighbors cooperate over nest defense.

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*Does ‘pace of life' have a genomic basis in kittiwakes? A candidate gene approach

A. Green, C. Boccia, V. Friesen
Presenting author: **Alyssa Green**

'Pace of life' encompasses variation in lifespan, reproduction, and rate of development. Pace of life differences are common among closely related bird species, but little research has been done to untangle the genetic basis of these differences. We are exploring the genetic basis of pace of life in kittiwakes (Rissa spp.), which exhibit pace of life differences both across and within species. We compared whole

genome sequences from kittiwakes sampled throughout the Northern Hemisphere to test the hypothesis that variation in kittiwake genes underlies differences in pace of life. Our findings suggest that selection occurs on candidate genes related to pace of life in kittiwakes, specifically genes related to RNA polymerase, DNA polymerase, the thyroid, glucocorticoids, telomerase, and melanocortins. These findings identify a potential genomic basis for pace of life. Future research could test mechanisms by which genes alter specific pace of life traits. This will enable a deeper understanding of species' lifespans, reproduction, and rates of development, which are critical for species conservation and management.

Severe winter weather selected for longer extremities and duller plumage in Eastern Bluebirds

V. Rolland, S. Balenger, J. Grindstaff, L. Siefferman
Presenting author: **Jennifer Grindstaff**

Extreme cold events can revert the direction of organisms' responses to globally increasing temperatures. In February 2021, two record snowstorms swept the United States, causing bird die-offs that may have been associated with rapid natural selection. Our objective was to determine if the snowstorms caused natural selection on Eastern Bluebird morphology and plumage coloration. Larger individuals with smaller extremities are expected in colder climates and high-quality individuals (e.g., more symmetrical) should be more likely to survive, although a more-ornamented (costlier to maintain) plumage should be disadvantaged. We collected 163 fatalities and captured 68 survivors encountered in nest boxes at three sites in Arkansas, Mississippi, and Oklahoma. We measured 130 dead and all survivors for 10 morphological variables and six derived variables (e.g., asymmetry score). We extracted feathers from four body regions and obtained eight coloration variables using a reflectance spectrophotometer. Using generalized linear mixed models, we found that survival probability was not correlated with body size but surprisingly increased with a longer tarsus, and a wider, longer, and deeper beak. Although beak and tarsus are the primary areas through which birds lose heat, these longer extremities may have helped with foraging in snow. As expected, bluebirds with duller plumage were more likely to have survived, but asymmetry was not associated with a lower survival. Longer extremities, favored in extreme winter conditions, may persist as they present a thermoregulatory advantage in the increasingly warmer summer conditions. However, if natural and sexual selection act against each other, plumage ornamentation traits may stabilize.

Haemosporidian infections in Indiana populations of Cerulean Warbler (Setophaga cerulea): 2002 vs. 2022

J. Grudens, K. Islam
Presenting author: **Julian Grudens**, Ball State University, julian.grudens@bsu.edu

Avian blood parasites or avian malaria, are protists in the order Haemosporida, referred to as haemosporidians. Commonly studied genera include Haemoproteus, Plasmodium, and Leucocytozoon. These parasites infect terrestrial birds across the world, and infections can have negative consequences for the health and fitness of avian hosts. Two previous studies investigated haemosporidian infections in Cerulean Warblers (Setophaga cerulea), through microscopy of blood smear slides. One of these studies conducted in May of 2002 reported the prevalence of infection and median parasitemia for a sample of 19 Cerulean Warblers from Indiana. In the present study from Indiana, we used similar methods of light microscopy with 1000x magnification to quantify prevalence and parasitemia from blood samples of 20 male Cerulean Warblers obtained from 19 May - 19 June, 2022. We present preliminary results from this first field season of study. Infection sample statistics of overall haemosporidian prevalence and parasitemia were similar to those reported for the morphological species Haemoproteus paruli in the 2002 study. All infections detected in our sample can be attributed to the genus Haemoproteus. The similarity of infection statistics may suggest that environmental factors such as Dipteran vector abundance remain relatively constant in the region. Additionally, we expect to report genus specific identification and infection statistics from PCR based analyses currently in progress. These methods allow for more sensitive detection and provide haemosporidian genomic DNA for use in Sanger sequencing, allowing for identification to lineage level and comparison with previously documented lineages in the public database known as MalAvi.

Conservation of birds and their habitats in military camps

S. Guerrero
Presenting author: **Simón Guerrero**, Universidad AutÃ³noma de Santo Domingo, guerrero.simon@gmail.com

Bird conservation in military installations Guerrero, Simón,. Instituto Superior de Defensa (INSUDE), Ministry of Defense of the Dominican Republic. Dominican Rep. guerrero.simon@gmail.com 1+829-257-8988 I present preliminary data on an ongoing project whose general objective is the conservation of birds and their habitats in military camps through the ecological restoration of forested areas near said camps with native and endemic plants, mostly those that offer food and shelter to native and migratory birds. Trema micrantha, for example, is a tree whose fruits are eaten by local and migratory frugivorous such as the Cape May Warbler, Black-throated Blue Warbler, and Prothonotaria Warbler, among others. Hamelia patens (Firebush) is also very useful for wildlife: its flowers attract hummingbirds and butterflies, and its fruits are eaten by dozens of native birds and about 20 migratory ones. This project will also be implemented in the green areas of military compounds in urban areas, including schools belonging to the Ministry. Some of the chosen trees meet ethnobotanical criteria as well as ecological ones, either because they belonged to the Taino aborigine diet like Cecropia peltata, were sacred to them like Ceiba pentandra, or were linked to national wars like Muntingia calabura. A specific objective of the project is to affiliate our Ministry of Defense to the Partners in Flight program and request the cooperation of its US counterpart (DOD Partners in Flight). Let us hope that migratory birds, so wise that they ignore geopolitical boundaries, will serve as bridges to achieve greater rapprochement between our countries.

Bird conservation in military installations

S. Guerrero
Presenting author: **Simón Guerrero**, Universidad AutÃ³noma de Santo Domingo, guerrero.simon@gmail.com

I present preliminary data on an ongoing project whose general objective is the conservation of birds and their habitats in military camps through the ecological restoration of forested areas near them with native and endemic plants that provide food and shelter for native and migratory birds. Trema micrantha, for example, is a tree whose fruits are eaten by local frugivorous and also migratory ones such as the Cape May Warbler, Black-throated Blue Warbler and Prothonotaria Warbler, among others. Hamelia patens is also very useful for wildlife: its flowers attract hummingbirds and insects, and its fruits are eaten by dozens of native birds and about 20 migratory. This project will also be implemented in the green areas of military compounds in urban areas, including schools belonging to the Ministry. The project includes the installation of artificial nests and perches for educational, scientific and conservation purposes in gardens and schoolyards. Some trees also meet ethnobotanical criteria, since they belonged to the aboriginal diet (Cecropia peltata), were sacred trees (Ceiba pentandra) or are related to national wars (Muntingia calabura). A specific objective of the project is to affiliate our Ministry of Defense to the Partners in Flight program and establish contact with its US counterpart (DOD Partners in Flight). Migratory birds ignore geopolitical borders, serving as bridges to achieve a greater rapprochement between our countries.

Migratory connectivity and annual cycle contaminant exposure in Horned Grebe (Podiceps auritus) breeding in Canada.

C. Howell, K. Gurney, K. Kardynal, E. Reed
Presenting author: **Kirsty Gurney**

Over the course of their annual life cycles, migratory birds use a variety of habitats and are exposed to a wide range of environmental conditions, which can influence population demographics and species abundance in subsequent seasons. Identifying key habitats and potential sources of threats is essential for effective species management. Within Canada, some indicators suggest that breeding populations of Horned Grebe (Podiceps auritus) have significantly declined since 1970, yet factors influencing populations and reasons for the apparent declines remain unknown. This study aims to address these knowledge gaps by assessing (i) use of non-breeding areas and (ii) exposure to key contaminants

throughout the annual life cycle. Using two disparate breeding populations from Yellowknife, NT and St. Denis, SK, migratory connectivity will be assessed by assigning individuals to a wintering location using geolocators and stable isotope values (Î´13C, Î´15N, Î´34S) derived from feathers. To assess contaminant exposure, fecal samples will be analysed for current use insecticides, and egg samples will be analysed for persistent organic pollutants. The data gathered in this study will provide new insights on annual life cycle factors affecting breeding populations of Horned Grebe in Canada, which will inform conservation strategies for this species and their critical habitats.

Assessing waterbird conservation of alternative rice residue management in the Lower Mississippi Alluvial Valley

W. Guy, T. Boves

Presenting author: **William Guy**

Rice cultivation offers ample opportunity to address the problem of providing sufficient food for the world's continuously growing population while maintaining biodiversity and improving agricultural sustainability. Here, we aimed to specifically assess the conservation value for waterbirds of the timing of fallow-season flooding along with various other residue practices in production-sized rice fields in one of the most highly modified landscapes in the United States, the Lower Mississippi Alluvial Valley (LMAV). The effects of alternative rice management practices on waterfowl conservation have been studied in some regions; however, these conclusions do not necessarily extrapolate to all locations and the entire waterbird community. To fill these gaps, we conducted censuses of all waterbirds in fallow-season rice fields managed in various ways during the non-growing seasons for two years (2021-22 and 2022-23) in northeast Arkansas. We measured field-level habitat variables, including water depth and the percentage of rice residue left standing. We then constructed generalized linear mixed models that best described the variables related to variation in species richness (and eventually conservation value). In 2021-22, the top linear model explaining variation in species richness included water depth (positive) and the percentage of residue (negative) but did not include the timing of flooding. The timing of flooding may still be important, but in a more complicated way, potentially related to diversity bimodally. Ultimately, this research will provide information for developing conservation programs across the LMAV and foster a paradigm shift from waterfowl-centric conservation to an all-waterbird model.

The spatiotemporal effects of seasonal migration on avian community assembly

M. Hack, B. Winger

Presenting author: **Matthew Hack**

The relative importance of biotic and abiotic factors at different spatial scales in shaping species' geographic distributions represents a key issue at the nexus of macroevolution and macroecology. In order to understand the ecology and evolution of species distributions, it is critical to resolve the relative importance of these factors at different spatial scales, including the interplay of community interactions and occupancy. The phenomenon of seasonal migration further complicates these factors, as the movements of seasonal migrants regularly rearrange community assemblies and interactions. Migrants are exposed to different combinations of environmental conditions and species interactions over space and time, suggesting that patterns underlying their distributions during one season cannot necessarily be extrapolated to their entire annual cycle. However, the relationship between seasonal migration and community assembly remains poorly explored. To bridge this gap, we assess spatiotemporal variation in phylogenetic community structure in songbird communities as a consequence of seasonal turnover in community composition through migration. Using eBird species distributional models, we generate weekly estimates of the phylogenetic dispersion of passerine communities across the New World and throughout the annual cycle, which illuminates the variation in predominant assembly mechanisms in passerine communities through space and time. This framework allows for the comparison of community structuring mechanisms encountered by seasonal migrants throughout their annual cycle, where they contribute to seasonally shifting community assemblies by virtue of their biannual movements.

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*Comparing the effects of forest structure and management strategy on the

Olive-sided Flycatcher in the Sierra Nevada

B. Hack, S. Kahl, C. Wood
Presenting author: **Benjamin Hack**

In California's Sierra Nevada, the rise of megafires, a century of fire suppression, and logging of large trees on federally managed lands has resulted in forests that are highly departed from historical conditions. Due to different management strategies, these changes are more pronounced on lands managed by the U.S. Forest Service (USFS) than on lands managed by the National Park Service (NPS). Amidst ongoing declines of many western forest birds, evaluating contemporary habitat associations and how they relate to management strategies on federally administered lands could carry significant conservation implications. The Olive-sided Flycatcher (Contopus cooperi) is a declining songbird associated with tall, open forests in the Sierra Nevada, the core of its breeding range. We combined a landscape-scale passive acoustic monitoring program, the BirdNET animal sound identification algorithm, and single-season occupancy models to explore habitat associations of the Olive-sided Flycatcher in the Sierra Nevada and their relationships with land management. We found that Olive-sided Flycatcher site occupancy rates increased as canopy cover decreased relative to expected tree diameter, a finding that is consistent with their preference for older but open forests. There was no difference in site occupancy rates between lands managed by the NPS and USFS; however, the forest structure associated with Olive-sided Flycatcher was more prevalent on NPS-managed lands. Our results suggest management strategies for Olive-sided Flycatcher breeding habitat should prioritize the preservation of large trees, thinning of smaller trees, and restoration of historical fire patterns to create more open canopies.

Deciphering survival and habitat usage between the breeding and post-breeding periods for Kirtland's Warblers

H. Haradon, N. Cooper
Presenting author: **Haley Haradon**

The complicated annual cycles of migratory bird species have created formidable barriers to understanding the factors that limit their populations. For migratory birds, the post-breeding period is likely an important part of the annual cycle yet has received little attention. To fill this critical information gap, I will use a combination of handheld and automated telemetry to investigate the behavior and ecology of adult and juvenile Kirtland's Warblers (Setophaga kirtlandii). The specific goals of this proposal are to estimate the survival and habitat use of adult and juveniles during the breeding and post-breeding periods. The data from this research will fill important gaps in our understanding about the full annual cycle of songbirds and potentially provide information to develop new conservation and management strategies.

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*The Demographic, Environmental, and Genetic Forces Driving Blood Parasite Infections in the Florida Scrub-Jay

K. Hardy, S. Bol, F. Beaudry, R. Bowman, J. Fitzpatrick, A. Tringali, N. Chen
Presenting author: **Kristin Hardy**

Parasites can have important impacts on population dynamics and are responsible for the extinction of several wildlife species. It is therefore crucial to understand the factors that drive variation in parasite infections in natural populations. Microfilariae and trypanosomes are a common blood parasites that affects avian species. They are transmitted from infected individuals by flying insects and can lead to fatal diseases in several bird species including heart inflammation, tissue death, and immune response dysfunction. Here, we investigate the demographic, environmental, and genetic factors underlying variation in blood parasite prevalence and load in the Federally Threatened Florida Scrub-Jay (Aphelocoma coerulescens). We used generalized linear mixed models to estimate heritability of parasite infections and elucidate the major factors contributing to survival after the first year in the Florida Scrub-Jay over a 10 year period. We discovered age, humidity, equatorial southern oscillation index, and inbreeding to have the largest impact on blood parasite infections. The results of this project increases our understanding of blood parasite dynamics and fitness consequences in a natural avian population.

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*The long-term impacts of landscape configuration on an old-growth forest specialist in Alberta, over 25 years

T. Hart, E. Bayne, L. Leston
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Habitat fragmentation and loss resulting from natural resource extraction are major contributors to the ongoing decline of avian populations in Canada's boreal forest. The creation of linear features such as seismic lines, transmission lines, and roads generates large amounts of edge habitat, which can have particularly negative effects on interior species reliant on old-growth forests. One such species, the Black-throated Green Warbler (Setophaga virens), has been designated a Species of Special Concern in Alberta due to perceived population declines resulting from habitat loss and fragmentation. Despite its status, little is known about how this species responds to human footprint over a long time period. My research assessed the long-term impacts of forest fragmentation on Black-throated Green Warbler site occupancy and turnover at Calling Lake, Alberta over a 25-year period. Using multi-season occupancy models, I examined whether occupancy was predicted by distance to and amount of human footprint, stand age and composition, and treatment (connected, fragmented, or continuous forest patches). The main predictor of Black-throated Green Warbler occupancy was treatment, and there was an effect of harvest on extinction probability, but no effect of any other human footprint types. The fragmented and connected treatments had a negative influence on the probability of colonization and extinction. The continued population decline at Calling Lake, in controls and fragments, suggests regional or provincial-scale mechanisms for the decline.

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*Home range and resource use of a synanthropic predator in the Canadian mixed-grass prairies

V. Hartley-Cox, C. Somers, R. Fisher
Presenting author: **Victoria Hartley-Cox**, University of Regina, toryhartleycox@gmail.com

Since European settlement, the Great Horned Owl has steadily increased in abundance in the Canadian mixed-grass prairie, likely due to increases in woody vegetation (e.g., planted trees and shrubs) and anthropogenic structures suitable for owl nesting, roosting, and hunting. The increase of Great Horned Owls in the mixed grassland region could put them in conflict with other wildlife conservation efforts. My objective was to assess the nocturnal habitat use and territory size of breeding Great Horned Owls in grassland, cropland and mixed landscapes in southwest Saskatchewan. In 2022, nine owls (Cropland n=4, Mixed n=2, and Grassland n=3) were tracked using high-resolution satellite telemetry, yielding over 130,000 locations across the three landscape types. A subset of these locations (210 locations) were visited to determine perch and surrounding habitat characteristics. High-use areas were characterized by perches that were, on average, 4.7 m tall, 161 m from the nest and had greater vegetation height (mean 56 cm) when compared to medium, low or no-use sites. Great Horned Owls had larger territory sizes in native grassland (15 km2) compared to mixed (6 km2) and cropland landscapes (4 km2). These results provide insight into habitat use by a synanthropic predator that has been highly successful in an anthropogenic landscape.

Swainson's thrush autumnal migration in the Guanahacabibes Peninsula, Cuba.

A. Perez, A. Llanes Sosa, J. de la Cruz, H. Gonzalez
Presenting author: **Keith Hobson**

Swainson's thrush (Catharus ustulatus) was assumed to be a rare autumn migrant in Cuba. However, in the Guanahacabibes Peninsula, one of the principal Cuban migration flyways, we documented much more frequent occurrence of this species. Our constant-effort mist netting at this site provides an important baseline to investigate further their movement and stopover ecology. Captures were made with mist nets during September, October and November, 2015-2019. The species appears frequently in the area between September and the first half of November with maximum captures in October. Juveniles (HY) made up 52.8 % of the total of processed individuals (N = 315) and 89.8 % of birds had completely ossified skull. The average mass of the species was of 29.16 Â± 4.42 g. The highest capture rates were registered in semi-deciduous forest and were none were found in sandy coastal vegetation. Fat scores

averaged 1 for our migrant sample. We suggest a fundamental change of status for this species in the Cuban archipelago.

Connecting songbird migrants in Guanahacabibes, Cuba, to North American origins using stable isotopes

K. Hobson, J. Kusack, A. Llanes Sosa, A. Perez
Presenting author: **Keith Hobson**, Department of Biology, khobson6@uwo.ca

The Guanahacabibes Peninsula in northwestern Cuba is an important migratory corridor for Neotropical migrants, especially during the Fall months. This area has been the focus of constant-effort mistnetting operations by Alina Perez of ECOVIDA during 2018-2021. That work has provided new evidence of substantial movements of Swainson's Thrush (Catharus ustulatus), a species previously assumed to be an incidental migrant in Cuba and has established migrant and overwintering status of numerous other species. For a subset of birds captured in fall of 2020 and winter of 2021 and for fall of 2022, we performed stable hydrogen isotope analyses of rectrices and used Bayesian assignment methods to infer molt or natal origins of 301 individuals representing 16 species. We present assignment maps of a representative subgroup of species from this sample and speculate that a migratory corridor may exist between Guanahacabibes and the Yucatan Peninsula in Mexico. Our work demonstrates how the stable isotope approach can provide important coarse-scale information on migratory connectivity that is inexpensive and achieved through a single capture. We stress that this approach should be adopted broadly in the Caribbean and elsewhere as a means of quickly establishing connectivity through isotopic atlasing.

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*Variation of iris colour in Spotted Towhees (Pipilo maculatus) breeding in Metro Vancouver

T. Hohn, G. Karimpanal, E. Gow
Presenting author: **Triana Hohn**, University of Manitoba, trianahohn@gmail.com

Within passerines there is a range of iris colours. Within a species, there are several hypotheses suggesting iris colour may vary with geography, sex, age, physiological condition (breeding status, sexual hormones, condition, etc.), environment, and/or diet. One species with variation of iris colour are Spotted towhees (Pipilo maculatus). Juveniles have dark brown/grey eyes, but in adults eye colour can vary between pale yellow to dark maroon. Using digital photographs taken of spotted towhee eyes at four different study sites within urban greenspaces in the Lower Mainland of British Columbia, we tested several hypotheses about what factors influence iris colour in spotted towhees. Our results indicate that during the breeding season, iris colour is most strongly influenced by site and body condition but during the non-breeding season iris colour is influenced most strongly by sex in addition to site and body condition. Our findings indicate that iris colour can not be reliably used for aging between SYs and ASYs nor HYs and AHYs in the field and will help increase understanding of the physiological components involved in intraspecific iris colour variation.

Defining Critical Habitat: a case study of Least Flycatchers at Beaverhill Bird Observatory, Alberta

M. Van Brempt, G. Holroyd, G. Hvenegaard, J. Von Aragon
Presenting author: **Geoff Holroyd**, Beaverhill Bird Observatory, geoffholroyd@gmail.com

Critical Habitat is often defined by the last places that an endangered species occurs, not by its abundance and productivity in a particular habitat. Least Flycatchers Empidonax minimus, like most aerial insectivores, have declined rapidly over the last 50 years in North America, mostly due to the extensive use of insecticides. Since the Least Flycatcher is the most common species encountered at the Beaverhill Natural Area, likely due to the high insect densities, in 2022 we studied the productivity, nesting density, and habitat preferences of this species. We monitored 28 nests until fledging and found a higher success rate than other researchers have found for this species. Nesting density in our research area double that found in other studies. Interestingly, our study shows no evidence for any clustered breeding, a well-documented breeding behavior for Least Flycatchers. Least Flycatchers seem to have a preference

for nesting in Trembling Aspen, compared to Balsam Poplar trees. We suggest that high productivity and nesting density should be factors to help identify critical habitat and that the Beaverhill Natural Area be considered critical habitat for Least Flycatchers should that become necessary.

Investigating the Activity Pattern of Hudsonian Godwit Chicks Using an Automated Radio Telemetry Network

F. Huang, L. Puleo, N. Senner
Presenting author: **Feipeng Huang**

Animals vary their activity temporally at a daily and seasonal scale in response to body conditions and environmental factors. Logistical constraints have generally prevented traditional behavior observation and radio telemetry methods from providing an in-depth assessment of animal activity across the entire 24-h period. Recent technological advancements, however, allow animals to be tracked continuously throughout the day. In this study, we employed an automated radio telemetry network to track the fine-scale movement of Hudsonian Godwit (Limosa haemastica) chicks in Beluga, Alaska, to investigate the daily activity pattern of chicks and how it changes as chicks mature. In the summer of 2022, we tracked 19 chicks from hatch with radio transmitters that relayed radio signal strength (RSS) values every 9 seconds to an array of nodes. We then analyzed the derived locations of the chicks to determine how they allocate moving and resting times. The extended daylight hours of Alaska summer allow ample foraging time for chicks to meet their energetic demands for rapid growth, but any movement exposes them to predation risk. Our study will shed light on chick foraging efficiency and vulnerability to predation in a dynamic landscape.

Year-round bird-window collision monitoring at Simon Fraser University's Burnaby campus in British Columbia, Canada

V. Hum, D. Green, E. Gow
Presenting author: **Vanessa Hum**

In Canada, window collisions are responsible for approximately 16 – 42 million bird deaths a year, this is one of the main causes for anthropogenic bird population decline. Simon Fraser University's Burnaby campus provides critical information on seasonal variation in window collisions and mortality at a high elevation site surrounded by forest that provides habitat for many species breeding or migrating along the Pacific flyway. My research evaluates seasonal variability of collisions, evaluates species vulnerability due to collisions, determines what makes a building high-risk to collisions, and determines high-risk facades to later evaluate the efficacy of bird window deterrents. Collision surveys are performed year-round to monitor for collision evidence at random buildings stratified by size and surrounding vegetation over the course of five 45-day seasons, including the summer, fall, winter and two spring seasons. Additionally, scavenging and detection trials are performed to quantify for collision biases such as carcasses scavenging rates and survey detection efficiency. My preliminary results show the highest frequency of collision evidence in the spring season and lowest in the winter season. My research will provide an understanding of how collisions effect declining avian populations in western North America. The features of high-risk facades that I determine can be applied elsewhere to identify other facades that may be responsible for bird mortality, this prompting implementation of mitigation efforts such as policy development and bird-friendly films.

Determining the Origin of Birds Killed by Window Collision Using Hydrogen Stable Isotopes

L. Hurtado
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My study used stable isotopes of hydrogen to track the geographic range of birds that died because of a window collision on the campus of the University of Florida from 1997 to 2019. We collected the second secondary feathers from museum specimens of 38 cedar waxwings and 20 red-eyed vireos and compared the isotopic values of the feathers with a spatially explicit model of hydrogen isotopes in precipitation across North America to estimate the likely geographic origin of the feathers. We tested the

hypothesis that birds that collide with windows on campus originate from different regions and follow different migration routes depending on their species. The results showed that for the cedar waxwings, 50% of the birds molted their feathers in the Florida area, indicating a local origin, while for the vireos we had a contrasting pattern. Despite the fact that the species breeds in the area, only 10% had a local origin, while the rest of the individuals came from areas north of Florida. Our study demonstrates the potential of using hydrogen isotopes in feathers as a tool for studying the origin and movement patterns of migratory birds. We plan to continue working with more specimens from our museum (which includes several other migratory species such as Ovenbirds, Catbirds, Black-throated Blue Warblers, Baltimore Orioles, etc.) and inform the university of our results.

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*Post-fledging habitat use, movement, and survival of Black-throated Blue Warblers in high- and low-risk habitat

J. Hutchison, T. Jones, E. Woernley, S. Kaiser
Presenting author: **Jackson Hutchison**

Juvenile mortality of dependent offspring is a critical source of selection that shapes life histories. Predation risk is a major driver of post-fledging mortality likely influencing the movement and habitat use of juveniles that remain dependent on their parents for food and protection. However, few studies have examined habitat selection during the post-fledging period and how patterns of habitat use and movement may change with predation risk. We examined how predation risk influences post-fledging habitat use, movement, and survival of migratory black-throated blue warblers (Setophaga caerulescens) in high- and low-risk habitat at the Hubbard Brook Experimental Forest, NH. We found that fledglings nonrandomly selected habitat with denser vegetation in the shrub layer that offered greater concealment. Their habitat use differed from adult preferences for nest sites; fledglings used habitat that was less dense in the shrub layer but denser in the midstory than at nests. Post-fledging survival was lowest during the first day out of the nest (during which all mortality events occurred), increased over the breeding season, and was higher in low-risk habitat (low-risk = 0.833, high-risk = 0.429). However, variation in predator density and shrub stem density between habitats did not explain the survival disparity between low- and high-risk habitats. Our results indicate that post-fledging survival is highest in low-risk habitat at the end of the breeding season. Furthermore, habitat selection changes with age from dense vegetation in the shrub layer when they are most vulnerable to dense vegetation in the midstory as they gain mobility.

High-elevation bird response to shrub dominance on Yukon mountains

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This project examines the implications of increasing shrub dominance on high-elevation bird populations in the Yukon. Shrubs are among the taxa expanding their habitat ranges farther north and to higher elevations as a result of increasing global temperatures, and bird species that live and breed in sub-alpine and alpine-tundra habitats may be influenced by this increased shrubification. Thompson et al. (2016) examined the implications of increasing shrub dominance across a latitudinal gradient on bird species abundance in Alaska, and found varying non-linear relationships between each bird species abundance and different variables of shrub dominance. My project is based on similar concepts and methods, but will examine the relationships between shrub height, cover, and density and predicted bird abundance along an elevational gradient on mountains in the Yukon Territory. I hope to answer questions about which high-elevation bird species may be positively or negatively impacted by increasing shrub dominance, which components of shrub dominance may have the greatest effect on future distribution and abundance of high-elevation bird species, and compare whether relationships across a latitudinal gradient in Alaska align with relationships across an elevational gradient in the Yukon in similarly vegetated habitats.

Multiple aerodynamic functions of avian wing through variations in wingtip slots morphology

Y. Jiang, Y. Murayama, H. Liu, M. Murakami

Presenting author: **YAJUN JIANG**

Since the pivotal study by Trowbridge in 1906, wingtip slots of birds were recognized as the important aerodynamic traits of bird wing. Up to now, there are two main hypotheses about the aerodynamic function of the wingtip slots: one is the improvement of the efficiency of gliding flight by decreasing the induced drag; the other is the reduction of tip stall tendency. On the other hand, considerable variations are observed in the degree of wingtip slot among bird species. The proposal of emargination index by van Oorschot (2017) allow us to quantify the degree of wingtip slots among bird species in relation to their flight styles, e.g., gliding, flapping or soaring flights. We first accessed the shape of hand-wings for 91 species with different flight styles. Then according to this result, we choose 13 bird species for the wind-tunnel measurements with PIV (Particle Image Velocimetry). First, we found that gliding flight birds which have the lowest emargination index showed the decreasing values of vorticity from the arm-wing to wing tips. Second, the species with the flapping behavior of flight showed the lower values of vorticity under the steady uniform wind condition. Third, the wing of the species with high frequency flapping flight showed the function to stabilize the air turbulence under the disturbed unstable wind condition.

Anthropogenic debris as nesting material by tree nesting ardeidae birds in an urban heronry on the Southwest coast

S. John

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Increasing reports of incorporation of anthropogenic debris as nesting materials in nests of terrestrial and seabirds are pouring in year after year. As part of the Annual Heronry Nest Survey of Kerala, India, nesting survey is conducted in Kollam on the southwest coast of India from 2019. During regular survey activity, observation of unnatural materials in the nests piqued our interest. In Vaddy harbour area heronry, 972 nests of Little egrets (Egretta garzetta) and Indian pond herons (Ardeola grayii) was photographed from below using a Nikon D500 DSLR camera fitted with Sigma 150-600mm tele-lens during May 2022-February 2023. Presence of debris was visible in 797 nests. 37 nests of Little egrets and 14 nests of Indian pond herons, totalling 51 nests contained welded wire mesh along with other metallic and plastic debris. Here we present, nest incorporation of metallic (wire mesh, wires, cloth hangers) and plastic (fishing lines, net and ropes) in aredeidae nests. Shortage of natural nesting materials coupled with abundance of anthropogenic debris have been suggested the rationale behind the change in the nest building. Synthetic materials incorporated in nests can harm the occupants and negatively impact nesting and fledging success. We believe this is the first report of the incorporation of anthropogenic debris in ardeidae nests.

Bald eagle (Haliaeetus leucocephalus) reproductive success and avian influenza in Ohio, USA

L. Kearns

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Mortalities and decreased breeding productivity in Bald Eagle (Haliaeetus leucocephalus) populations during the 2022 breeding season have been connected to the avian influenza (HPAI) outbreak in the southeastern US. Ohio's nesting Bald Eagle population demonstrated similar patterns as the southeastern US in the spring of 2022. The Ohio Department of Natural Resources - Division of Wildlife has conducted annual nest monitoring of a sample of areas around the state from 2014-2022. HPAI was detected in Bald Eagles in the state beginning in March 2022, during the time when most eagles were incubating their nests. In 2022, average statewide nest success was much lower at 47.8% with an average brood size of 1.6 chicks per successful nest, compared to an average of 84.5% nest success and 1.85 chicks per successful nest from 2014-2021, suggesting a potential impact from HPAI. However, one region showed a contradictory trend. At Mosquito Lake (northeastern Ohio, Trumbull County), multiple breeding productivity measures were higher than in other regions of the state: the average nest success rate was 63.6%, which was only a 15% reduction in the average nest success rate from 2014-2021. In addition, the brood size was slightly higher (instead of lower) at Mosquito Lake (1.71 chicks/nest) compared to the average brood size from 2014-2021(1.66 chicks/nest). Although statewide trends suggest that HPAI had a substantial impact on Ohio's Bald Eagle population in 2022, breeding eagles at

Mosquito Lake seem to have avoided major impacts.

Evolution of carotenoid-based plumage in Australasian Robins (Family: Petroicidae)

S. Khalil, M. Rao, R. Koch, M. Toomey, J. Walsh, I. Lovette
Presenting author: **Sarah Khalil**, Tulane University, sarah.khalil93@gmail.com

Carotenoid pigments, which are responsible for many of the vivid red, orange, and yellow colors observed in vertebrates, are core components involved in the evolution of social signals. Despite the importance of carotenoids in avian behavior and evolution, identifying the underlying genetic basis of carotenoid coloration has been challenging because of the complex interplay of physiological processes that underlie the expression of this type of coloration. In this study, we leverage the family of Australasian Robins (Petroicidae) to investigate the genetic basis of carotenoid-based color evolution. The Australasian Robins offer a powerful system for the study of carotenoid-based color evolution, as this large family of birds have exhibited several independent transitions from largely melanin-based (black, grey, brown) to carotenoid-based plumage. Moreover, this group includes several species that differ in the type of carotenoid-based plumage that they express (yellow dietary carotenoids vs. orange/red metabolized carotenoids) as well as two species that exhibit pink plumage, which is an extremely understudied type of carotenoid-based coloration. We use whole-genome resequencing within a comparative framework, sequencing 13 species that exhibit yellow (n =4), red (n =3), pink (n =1), and melanic (n =5) plumage types. We combine genome scans and genotype-phenotype analyses, utilizing HPLC carotenoid feather pigment data to evaluate patterns of shared/repeated versus lineage-specific patterns of evolution. Our results will have broader implications for our understanding of evolutionary pathways underlying color diversification in avian systems.

Did wattles and other bare parts evolve exclusively via sexual selection in Galliformes?

M. Zhao, S. Kurtis, E. Humbel, E. Griffith, T. Liu, E. Braun, R. Buchholz, R. Kimball
Presenting author: **Rebecca Kimball**

A morphological trait can have multiple functions shaped by varying selective forces. Bare parts in birds, such as wattles, casques and combs, are known to function in both signaling and thermoregulation. Studies have demonstrated such structures are targets of sexual selection via female choice in several species of Galliformes (junglefowl, turkeys, quail and allies), though other studies have shown some role in thermoregulation. Here, we tested fundamental hypotheses regarding the evolution and maintenance of bare parts in Galliformes. Using a phylogeny that included nearly 90% of species in the order, we evaluated the role of both sexual and natural selection in shaping the function of bare parts across different clades. We found a combination of both environmental and putative sexually selected traits strongly predicted the variation of bare parts for both males and females across Galliformes. When the analysis is restricted to the largest family, Phasianidae (pheasants, junglefowl and allies), sexually selected traits were the primary predictors of bare parts. Our results suggest that bare parts are important for both thermoregulation and sexual signaling in Galliformes but are primarily under strong sexual selection within the Phasianidae.

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*Strength in unity?: Tradeoffs in the winter roosting behaviors of Eastern Bluebirds (Sialia sialis)

S. Kitchen, J. Mortensen
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Relatively small declines in common species can significantly and disproportionately alter ecosystem structure and function. One common songbird, the Eastern Bluebird (Sialia sialis), has a species history of suffering periodic population fluctuations and winter mortality events. However, few studies have examined their winter activities, including overnight communal roosting. Therefore, we investigated several tradeoffs in the winter roosting decisions of Eastern Bluebirds, focusing on how thermal properties, relatedness of roost-mates, and parasite avoidance influence nest box use and group

composition. During the 2022-2023 non-breeding season, 59 nest boxes across three sites in Northwest Arkansas were monitored twice weekly for roosting bluebirds. We used a blocked-site design to manipulate the parasitic conditions of boxes, including three treatment groups: cleaned boxes (no insulation, no parasites), boxes with old nests (insulation, parasites), and boxes with fumigated nests (insulation, no parasites). To determine the effect of ambient temperature on box occupancy and roost size, thermal probe data was recorded. Roosting birds were banded, measured (standard morphometrics), inspected for parasites, and sampled (feathers) for genotyping. By modelling these tradeoffs, we can better understand how winter weather influences Eastern Bluebird behaviors and survival strategies during the non-breeding season. We can also incorporate a full-annual cycle research approach to explore any carry-over effects on population growth over time. Moreover, these models will guide management decisions made by local and national bluebird societies, helping to reduce future mortality events and keep a common bird common.

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*Impacts of Backyard Habitat Creation for Birds at Single-Yard and City-Wide Scales

A. Krishnan, A. Ritz, J. Michaels
Presenting author: **Ananke Krishnan**

With urbanization on the rise, urban ecosystems are increasing in prevalence as viable spaces to conserve natural resources and biodiversity. We explore the potential of one such method, the implementation of 'backyard habitats', to enhance existing urban green space in backyards. We collaborated specifically with the Portland Audubon and Columbia Land Trust Backyard Habitat Certification Program (BHCP); based out of the Portland (Oregon, USA) Metro area, the BHCP spans over 6000 enrolled yards and helps urban gardeners build backyards that encourage and support local wildlife, providing valuable habitat and connecting people to the natural world. We examined this system both from the perspective of individual backyards as standalone habitat and aggregated backyards as habitat patches to promote city-wide connectivity. To do so, we surveyed bird community composition in backyard habitats across Portland and used this information to build least-cost path maps to identify habitat corridors for birds through the city. We were able to show that small-scale backyard restoration has the potential to strengthen structural habitat connectivity between parks on the fringes of the city of Portland, adding to the evidence that backyard habitats have immense potential as 'stepping stones' in urban ecosystems.

Understanding cholera immunity in common eiders (Somateria mollissima) in the Canadian Arctic using whole genome analysi

S. Kroeze, O. Love, M. Forbes, G. Gilchrist, V. Friesen
Presenting author: **Shayla Kroeze**

Conservation efforts are urgently needed for Arctic species which are now facing novel diseases. However, critical information on the genetics of disease resistance is lacking. The common eider (Somateria mollissima) is a colonial breeding sea duck that is an important source of fresh protein and feathers in northern communities and is an integral part of coastal and Indigenous culture. In 2006, avian cholera killed >30 % of hen eiders breeding at the largest colony in the eastern Arctic (Mitivik Island, Nunavut, Canada). We will use low coverage whole genome sequencing to test for a genetic basis for resistance to cholera in eiders. We hypothesize that genetic variants in some individuals conferred resistance to cholera, i.e., hens that died during the epidemic differed in identity of immunity-related genes (e.g., MHC Classes I and II genes, or toll-like receptor genes) compared to those that remained healthy. We also will test for genome-wide associations with cholera resistance controlling for related variables such as age, body condition, and arrival time. We will use an extensively archived time-series of DNA samples from the Mitivik Island eider colony to compare variation in identified genes before and after the cholera epidemic, as well as in populations that have and have not been exposed to cholera. Our work will provide valuable insight into the population genetics of disease resistance in wild populations, and the vulnerability of Arctic bird species to emerging infectious diseases.

Assigning harvested waterfowl to geographic origin using feather δ²H isoscapes: What is the best analytical approach?

J. Kusack, D. Tozer, K. Harvey, M. Schummer, K. Hobson
Presenting author: **Jackson Kusack**

Isotopic assignment methods rely on the use of predictable, established relationships between the isotopic composition of environmental hydrogen and that of the non-exchangeable hydrogen in animal tissues, often in the form of a calibration equation relating feather and precipitation stable-hydrogen values derived from known-origin individuals. The efficacy of assigning waterfowl to their geographic origin using stable isotopes depends on the accuracy of these relationships and their statistical uncertainty. Our objective was to critically evaluate current methods used to calibrate precipitation-hydrogen isoscapes to predicted feather stable-hydrogen values for waterfowl. Specifically, we evaluated the strength of the relationships between precipitation hydrogen-isotope values from three isoscapes and known-origin feather stable-hydrogen isotope values from four datasets. We then evaluated the performance of assignments using these calibrations by applying a cross-validation procedure. We concluded that it is not clear if any of the tested precipitation isoscapes better predict surface water inputs into food webs for foraging waterfowl. We found only marginal differences in the performance of the tested known-origin datasets, where the combined foraging-guild-specific datasets showed lower assignment precision and model fit compared to individual dabbling duck datasets. Thus, we recommend the use of the more conservative combined dabbling duck dataset to assign geographic origin for all dabbling duck species. Refining these relationships in this manner is important for improved waterfowl management and contributes to better understanding of the limitations of assignment methods when using the isotope approach.

Banding birds at the Guanahacabibes Peninsula, Cuba, 2015-2022

A. Llanes Sosa, A. Perez, J. de la Cruz, H. Gonzalez
Presenting author: **Jackson Kusack**

Guanahacabibes Peninsula, constitutes one of the principal migratory corridors in Cuba with potential movements to the Yucatan in Mexico depending on species. In recent years, through permanent banding during autumn, the phenology and composition of forest bird assemblages has been studied in depth. During 2015- 2022, 108 species were captured, 72 are migratory. A total of 9231 individuals were processed. Two new species and one subspecies were ringed for Cuba: Pyrocephalus rubinus, Empidonax traillii and Cardelina pusilla pileolata respectively. Individuals of Calcarius lapponicus were sighted, which constituted the second record in Cuba and the insular Caribbean, and Tyrannus forficatus, a new record for the Guanahacabibes Peninsula, with 11 other species. Four of the captured species are considered very rare in Cuba (Empidonax traillii, Empidonax minimus, Geothlypis hiladelphia and Cardellina pusilla) and another 19 Rare, but, based on our data, a change of category is now suggested for all of them. The incidence of meteorological variables in migration is assessed and the migratory phenology of each species is detailed. The Peninsula is a critical stopover site for migrants residing in and moving through Cuba and the ornithological potential of this site is one of the most important in the country.

Red-winged blackbirds nesting nearer to yellow warbler and conspecific nests experience less brood parasitism

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In referential communication systems, the signaler's message intended for a conspecific receiver may be intercepted and used by a heterospecific eavesdropper for its own benefit. For example, yellow warblers (Setophaga petechia) produce seet calls to warn conspecifics of nearby brood parasitic brown-headed cowbirds (Molothrus ater), and red-winged blackbirds (Agelaius phoeniceus) eavesdrop on and recruit to seet calls to mob the brood parasites. Prior work found that warblers nesting closer to blackbirds were less likely to be parasitized, suggesting that blackbirds may even be the target of warbler's seet calls to assist with antiparasitic defense. Here we discovered for the reverse to apply too: blackbirds nesting

closer to yellow warblers also experienced lower probability of brood parasitism. Concurrently, we also found that blackbirds nesting closer to other blackbirds also experience lower parasitism rates. Although these are strictly correlational results, they nonetheless suggest that blackbirds are better able to defend their nest against cowbirds when also listening to nearby warblers' referential alarm calls.

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*A bird's eye view of tree retention in timber harvests

I. Lebeuf-Taylor
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Every spring on their northern migration, songbirds arrive in Alberta to find an ever-changing landscape. Most of the change in the forested regions of the province are from logging. Addressing the decline of available habitat for migrating songbirds, forestry companies are taking an ecosystem-based management approach. A tool developed from this perspective is the creation of tree retention stands, where patches of live trees are left behind after logging. Whether these retention patches, which are often smaller than half a hectare, are useful for forest songbirds is a new investigation. Focusing on six mid-seral forest songbird species, the objective of my research is to assess whether each species' use of the regenerating harvest is affected by the presence of retention patches within it over time. The surveyed harvests were logged within the past 22 years across the forested regions of Alberta. Each species' intensity of use of the logged or retained trees is evaluated along a gradient of spruce, aspen, mixedwood, and pine dominant stands. Results estimate some species increase their use of the harvest as it regenerates, independent of the presence of retention stands. Two species are responding uniquely to harvests with retention patches over time, albeit in opposite ways. To further explore each species' response, I am integrating the amplitude of the detected songs to enhance the precision of the ecological answer. This approach will provide a more accurate measure of the time birds spend singing in retained trees relative to areas without retained trees or the adjacent unlogged forest. The results of this study will provide invaluable feedback to forestry managers on the value of retained patches in harvests.

Research for conservation of nesting grasshopper sparrows on farms in Ontario

Z. Lebrun-Southcott, A. Campomizzi
Presenting author: **Zoé Lebrun-Southcott**

Multiple grassland obligates are considered species at risk because of substantial long-term population declines across North America. The eastern grasshopper sparrow (Ammodramus savannarum pratensis) is listed as Special Concern in Canada and Ontario, where most of the population occurs in the country. However, few conservation efforts target this species. Additionally, most grassland in Ontario occurs in hayfields and pastures, making collaboration with farmers essential for conservation. In 2022, we began a multi-year project to improve our understanding of grasshopper sparrow nesting ecology in the province and the impact of stewardship actions on breeding success. We collaborated with 8 farms in southern Ontario to implement stewardship and monitored 28 breeding territories and 32 nests to assess breeding success. Sixty-three percent (n = 32) of nests impacted by various stewardship actions that avoided or minimized disturbance to agricultural grasslands during the breeding season fledged young. Based on our small sample size, extending the rest period between livestock grazing occasions in rotationally-grazed pastures is perhaps the stewardship action with the most potential for positive impacts on breeding success without severe limitations on agricultural activity. The long rest periods between grazing events in some fields (55 – 76 days) enabled grasshopper sparrows to complete their ~35-day cycle (from nest building to fledglings capable of sustained flight) and provided time for re-nesting after nest failure. More research is needed to assess breeding success across various rest period durations and impacts on forage production for livestock, as well as the efficacy of other stewardship actions.

True colors: Investigating coloration on hummingbirds underwings through the eyes of hummingbirds

N. Lee, K. Epperly, Y. Erritouni, R. Elting, V. Chhaya, D. Beltrán, A. Rico-Guevara
Presenting author: **Nora Lee**

Hummingbirds are known to use plumage color as communication signals in the contexts of courtship

display, territorial defense as well as camouflage. Past colorimetric studies on hummingbirds have focused on visually colorful (to humans) plumage patches such as gorgets, crowns, and chests, which might ignore the functions of other 'dull' patches that could be conspicuous in the eyes of hummingbirds. One such example is the ventral side of hummingbird wings, on which our project focuses. During territorial defense, we have observed that 1) some hummingbirds pause briefly during hovering flight with their underwings held in visible position towards another hummingbird and 2) when they perch on feeders they hold up their wing(s) and face the ventral side towards other approaching hummingbirds. We hypothesize that underwing coloration and pattern serve signaling functions in the context of territorial defense and are associated with dominance amongst individuals. To capture plumage coloration, we use a spectrophotometer and a full-spectrum (captures UV+visible light) camera separately to measure and to photograph spread wings specimens from Burke Museum of Natural History and Culture. Wings are measured and photographed at seven angles to account for angle-dependent characteristics of iridescent coloration that is commonly present in the hummingbird family. Data from spectrophotometry and camera are put into R and ImageJ (image analysis software) respectively to quantify and analyze plumage coloration and patterns through a hummingbird-specifc visual system. After this study, future research on the behavior of live hummingbirds may be warranted to further investigate the signaling functions of hummingbird underwings.

Overcoming fear of mistakes in efforts to Indigenize STEM teaching

K. Lefevre

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There is growing effort to Indigenize post-secondary teaching materials and approaches in Canada, in response to the Truth and Reconciliation Commission (TRC) Calls to Action that address education. For non-Indigenous instructors who wish to update their courses and teaching materials, there can be a level of hesitation stemming from an uncertainty of how to proceed, and/or a fear of making mistakes by being clumsy, inadvertently overlooking protocols, or misappropriating cultural knowledge. Efforts to make change inherently involve trial and error, and making mistakes is part of the learning process. Moreover, planning sincere, informed efforts can help to overcome the hesitation to avoid mistakes. This presentation will offer concrete suggestions for non-Indigenous faculty who are seeking ways to honour the Calls to Action in their teaching. It will share ideas and resources, framed around a real example of updating an upper-level zoology course to incorporate local Indigenous knowledge. The goal will be to empower instructors who are uncertain about how to begin this important process in their teaching.

Migratory pathways and stopover habitat use of Swainson's Thrush in Southeastern Ohio

G. Lindsey, S. Romer, H. Sutton, S. Countryman, K. Williams

Presenting author: **Gabriella Lindsey**

After breeding, many birds across North America, including Swainson's Thrush (Catharus ustulatus), migrate to spend the winter in Central or South America. Determining migratory routes and stopover habitats is critical for full annual cycle conservation planning. In the fall of 2021 and 2022, eleven Swainson's Thrush were fitted with Lotek nanotags (<3% body weight). We used manual and automated radio telemetry (Motus) to determine stopover habitat use and duration in Southeastern Ohio. Eight of the eleven Swainson's Thrush we tagged were detected by the Motus Wildlife Tracking System during migration, providing insight into the migratory routes used by these birds. Our work suggests that after leaving Ohio, these birds crossed the Appalachians to the Atlantic Coast of the Southeastern United States (South Carolina and Georgia) then flew to the Gulf Coast of Florida before departing to South American overwintering grounds. This study provides insight into habitat used by Swainson's Thrushes during fall migration stopover in Southeastern Ohio as well as individual migratory pathways used by these birds and highlights the need to conserve habitat and airspace through the Appalachians, the Atlantic Coast, and the Gulf Coasts.

How does sensory pollution and urban vegetation affect avian diversity and

nesting success?

A. Llamas, T. Jones, J. Phillips
Presenting author: **Alfredo Llamas**, Texas A&M University-San Antonio, apllamas2@gmail.com

Anthropogenic sensory pollution, such as light and noise, can have various effects on animal behavior, such as song structure and thus mate choice. Little is known about nest site selection in relation to these combined sensory pollutants. Nest visibility and begging calls can cue predators, which will determine the overall survival of a clutch , and vegetation characteristics and sensory pollution may determine whether migrants pass through urban habitat. Thus, understanding which specific characteristics of habitats, soundscapes, and lightscapes attract migratory and nesting birds is useful to urban land managers. We investigate how sensory pollution and vegetation affect avian diversity and nesting success across an urban-rural gradient in San Antonio, Texas. We measured received noise levels and light (lux) at nests and 18 point count locations using a Larson Davis 831 meter and a Minolta t-10A light meter, respectively. Using point intercept vegetation plots, we measured canopy cover percentage, diversity of flora, and height of foliage across 50-meter circular plots, around each nest and point count location. Results show that avian diversity increases with the presence of medium sweet hackberry trees but decreases with higher levels of noise. Additionally, overall clutch size for adult birds decreases in the presence of noise. Vegetation characteristics, such as the percentage of grasses, forbs, and the total number of extra-large trees, tend to increase fledgling success. However, total visibility of nests tends to decrease both clutch size and fledgling success. Finally, daily nest survival study revealed that nests located near sources of light and those with increased height have higher survival rates.

Song stereotypy in Grasshopper Sparrows (Ammodramus savannarum) increases with age

B. Lohr, M. Brown, M. Moyer, R. Hill
Presenting author: **Bernard Lohr**

Sexual selection may influence variation in song in several ways, exerting pressure on song features that include total song output, local song structure, song complexity, and vocal performance characteristics. Several studies have shown female preferences for high performance song features, including for songs that exhibit increased stereotypy. In birds that sing songs with repetitive notes having a similar structure (e.g. trills or buzzes), older individuals may sing songs with a higher level of note stereotypy, both within song and between songs. In most such species, singing involves movements of the bill and upper vocal tract that track the frequencies (pitches) of song notes. It is thought that neuromuscular control of the bill and upper vocal tract movements may be involved in setting performance limitations on song. In male grasshopper sparrows, note repetition rates are extremely high, and males do not track note frequencies with bill movements. We investigated whether grasshopper sparrows produce more stereotyped songs as they aged, despite a lack of bill movements during singing. First, we evaluated variation in several acoustic measurements of song in two different age groups within this cohort. Then, we used a cross-correlation algorithm to generate an index of similarity within and across songs. As males within our cohort went from an earlier age bin to a later age bin, they sang more consistent (less variable) songs, despite a lack of associated bill movements during singing.

Modeling patch dynamics of Bicknell's Thrush breeding habitat mosaics in harvested and non-harvested forests

J. Longo, A. Roth, P. Thomas
Presenting author: **James Longo**

The Bicknell's Thrush (Catharus bicknelli) is a migratory songbird species with breeding habitat consisting of stunted, high-elevation, coniferous forest in northeastern North America. Bicknell's Thrushes inhabit areas where timber harvesting of spruce-fir forest produces vigorous regeneration. These harvested areas tend to be at relatively lower elevations and presumably resemble their naturally occurring breeding habitat on mountain tops. While some breeding habitat characteristics, particularly tree composition and forest structure, are well described, the patch dynamics of the greater habitat mosaic are poorly understood. Determining the spatial and temporal patch dynamics of forests will provide a more complete

view of how breeding habitat has changed in past harvested and non-harvested areas. This study combines remotely-sensed data to model patch dynamics and radio-telemetry datasets of breeding Bicknell's Thrushes in Maine and New Brunswick. A better understanding of patch dynamics in non-harvested areas can inform forestry practices in harvested areas which can aid forest managers in their management of Bicknell's Thrush breeding habitat.

Nest site reuse and fidelity in two cavity-nesters in Argentina: The American Kestrel and the Blue-crowned Parakeet

F. López, I. Berkunsky, M. Rebollo, P. Orozco-Valor, J. Grande
Presenting author: **Fernando López**, Smithsonian Institution, ferlopez_87@yahoo.com.ar

Reuse and fidelity to nesting sites can be used to establish relationships with reproductive success in birds. We estimate the proportion of cavities used and reused by individuals of American kestrel (Falco sparverius) and Blue-crowned Parakeet (Thectocercus acuticaudatus) in the Caldén Forest, Argentina. Also, we made an approximation about the fidelity of the individuals to the nesting sites and the reuse of the cavities is analyzed based on the success and characteristics of the cavity (high, depth, and entrance area) and the supporting tree (high and DBH). During three consecutive austral breeding seasons (2016/17, 2017/18, and 2018/19), cavities were monitored in which the American kestrel (n=63) and the Blue-crowned Parakeet (n=91) tried to nest. The American kestrel reused 39% of the cavities. The Blue-crowned Parakeet reused 78%. Cavity fidelity was 23% for the raptor and 21% for the parakeet. In both species, success was higher in reused cavities than in non-reused ones, and in turn, the probability of reuse was higher if the nest had been successful the previous year. On the other hand, the highest cavities in higher trees and with greater DBH were the most reused for both species. The obtained results indicate that there could be a tendency to reuse cavities with characteristics associated with a high probability of reuse for both species. In addition, this information would be relevant to make management decisions within an evidence-based framework for the conservation of forests and their associated wildlife.

PIF Western Working Group Motus initiative: Expansion of Motus wildlife tracking network in western North America

P. Lorch, M. Whitfield, J. Garcia Walther, M. Webb, W. Blake, A. MacDonald
Presenting author: **Patrick Lorch**, Southern Sierra Research Station, plorch@southernsierraresearch.org

The Motus Wildlife Tracking System (https://motus.org/) is an international collaborative research network of automated radio-telemetry receiving stations coordinated by Bird Studies Canada. The network contains more than 1,474 receiver stations from throughout the world, operated by more than 1,752 collaborators. It facilitates landscape-scale research on the ecology and conservation of migratory animals. In 2018, the Partners In Flight Western Working Group (PIF WWG) began the Western Motus Initiative to fill significant gaps in knowledge about the ecology of migratory birds in western portions of North and South America. PIF WWG has promoted the expansion of the network to meet pressing information needs for western birds and other wildlife to inform conservation actions within the next decade. Due in part to the initiative's efforts, the network is expanding rapidly in the west, from roughly 35 stations in 2018 to around 400 stations by 2023. We will highlight recent Motus network expansion in California where close to 20 new stations have gone in in the last two years, and over 40 more will be added in the next 2 years. We will also highlight key steps for spurring network growth in other western states and in Central and South America. Regional coordination efforts will be listed to allow interested people to plug into existing efforts and connect with coordinators for help getting started.

Salmon Saving Shorebirds: Integrating shorebird and salmon conservation into coastal restoration in Oregon

S. Loredo, D. Williams, V. Loverti, S. Bonfield
Presenting author: **Stephanie Loredo**, Environment for the Americas, sloredo214@gmail.com

Estuaries across the Oregon coastline provide stopover habitat for migratory shorebirds. Important habitats for shorebirds such as mudflats and intertidal marshes have decreased by 70%-80% in Oregon

and overall shorebird populations have decreased by 33% in the last 40 years. To protect and enhance stopover habitats on the Oregon Coast, The Salmon Saving Shorebirds (SSS) program was created in 2022 to incorporate shorebird conservation into existing coastal restoration that has been primarily focused on enhancing habitats for salmon and other native fish populations. SSS is working to achieve this through 1) education of shorebird habitat requirements, important habitats, and restoration actions that benefit shorebirds, 2) outreach to organizations and partnerships involved in coastal restoration, and 3) pre-restoration monitoring of shorebirds and their prey at multiple estuaries in Oregon. Shorebird best management practices for the restoration of coastal habitats has been compiled and an assessment of their suitability and feasibility in Oregon is underway. Baseline data collection of shorebird attendance, foraging/resting behavior, and invertebrate prey availability at Tillamook, Sitka Sedge, Alsea, Yaquina, and Siuslaw estuaries will begin in 2024. Data will allow for the assessment of current conditions for shorebirds at these estuary sites and future analysis of shorebird response to restoration actions. This work fills knowledge gaps on shorebird estuary use as a stopover habitat and best management practices for shorebird conservation in Oregon. Incorporation of actions that benefit shorebirds into coastal restoration plans will improve stopover habitat and multi-species management.

Ghrelin levels reflect combined effects of endurance flight and energy balance in migratory warblers.

S. Lupi, D. Mann, H. Kaiya, C. Guglielmo, L. Fusani, S. MacDougall-Shackleton
Presenting author: **Scott MacDougall-Shackleton**

Migratory songbirds perform high-intensity exercise for hours, or even days, at a time. This exercise is fueled primarily by stored body fat that is deposited during hyperphagic periods prior to migration and during migratory stopovers. The gut hormone ghrelin is linked to metabolism and feeding in vertebrate animals. In poultry, ghrelin treatment inhibits feeding and increases fat catabolism. In migratory songbirds, ghrelin treatment affects food intake and migratory behaviour, and ghrelin is elevated in quails during migratory phase. Ghrelin may thus be linked to the use of fat as fuel during migratory flights. To determine how circulating ghrelin reflects flight exercise and energy expenditure we measured ghrelin in blackpoll warblers (Setophaga striata) flown in a wind tunnel for up to 6 hours or held in a cage for the same duration. We also quantified energy expenditure during the flight, or during the time held in a cage, by assessing body condition before and after each test using quantitative magnetic resonance. In birds held in a cage there was no relationship between body fat and ghrelin levels. However, in birds that flew in the wind tunnel, ghrelin was higher in birds that started the flight with less fat. This suggests that ghrelin is elevated during exercise if energy stores are low. To explore this, we examined the relationship between ghrelin levels and energy expended during the test whether in a holding cage or flying in the wind tunnel. Ghrelin was higher in birds that expended the most energy, but only in birds that had the least fat. Ghrelin may thus provide an integrated signal of energy balance combining energy expenditure with energy stores.

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*Occupancy of spruce budworm-linked warblers following biological insecticide application

M. MacIvor, R. Johns, F. Maika, J. Nocera
Presenting author: **Maria MacIvor**, University of New Brunswick, maria_macivor55@hotmail.com

Btk (Bacillus thuringiensis kurstaki) is an insecticide used to manage spruce budworm (Choristoneura fumiferana; hereafter 'SBW') in New Brunswick, Canada. No study has yet assessed Btk's impact on habitat occupancy by 'SBW-linked warblers' such as Bay-breasted (Setophaga castanea), Tennessee (Leiothlypis peregrina), and Cape May Warblers (S. tigrina). To control SBW populations, Btk is applied to 'hotspots' of increasing populations and in these locations, I studied how SBW-linked warblers respond numerically to Btk application. Using autonomous recording units (ARUs) and avian point count surveys, I found Cape May Warblers were the most prone to vacate Btk-treated territories, Bay-breasted Warblers vacated territories at a lesser rate, while Tennessee Warblers were the least numerically sensitive to Btk application.

The Impact Prescribed Burns have on Snake Predation on Grassland Bird Nests in Southern Illinois

C. Mackenzie, M. Eichholz
Presenting author: **Cullen Mackenzie**, Southern Illinois University, cullenmackenzie4@gmail.com

It's been well understood that decreases in natural disturbances, such as fires, has contributed to a decline in tall grass prairie ecosystems, and consequently grassland bird biodiversity. In Southern Illinois, another documented threat to grassland bird populations is snake predation. The relationship between these threats has important implications for grassland management but has not been well studied. I will investigate the impact prescribed burns have on grassland bird nesting success, as well as grassland snake biodiversity, nesting predation and habitat use at Burning Star State Management Area in Southern Illinois. To do this I will use a combination of methods including bird point count surveys, nest monitoring, cover boards for snakes and snake telemetry at recently burned, and unburned sites. This study will continue through the Summer of 2026, adding to five years of previously recorded data. I predict that recently burned sites (<1-3 years) will have a decrease in both grassland bird nest predation and snake abundance than unburned sites. This project is important for the conservation management for the most rapidly declining bird guild in North America incorporating both obligate and facultative grassland bird species, and the less studied grassland snake communities found in high grass prairie ecosystems.

Diet change in thick-billed murres (Uria lomvia) from the high Canadian Arctic

M. Maddox, J. Provencher, M. Mallory
Presenting author: **Mark Maddox**, Acadia University, markmaddox@acadiau.ca

Warming temperatures are causing a decrease in sea-ice cover across Arctic environments, leading to changes in the distribution and abundance of Arctic marine biota. Thick-billed-murres (Uria lomvia), an Arctic-breeding seabird, are an important sentinel species for monitoring changes throughout the Canadian Arctic. Our research objective was to examine the recent diet of thick-billed murres from Qikiqtarjuaq and Pond Inlet, Nunavut and compare this to 45 years of historical murre diet data across the Canadian Arctic. Murres were collected near their breeding colonies and the contents of the gastrointestinal tracts were analyzed for prey items. Thick-billed murres consumed principally Arctic cod (Boreogadus saida), a predominantly ice-associated species, consistent with results from earlier studies. We predict that thick-billed murres will shift their diet towards less ice-dependent species as sea-ice cover continues to decline, as seen across breeding colonies at lower latitudes, although we found little evidence that this shift has started in the high Arctic over the past few decades.

Wintering Common Loons (Gavia immer) exhibit shorter foraging times and dive durations when in larger groups.

J. Mager, J. Paruk, S. Abts, B. Wade
Presenting author: **Jay Mager**

In contrast to the breeding season, Common Loons vary in their degree of sociality during the nonbreeding season. Though larger groups may provide added vigilance and protection from predation, larger groups may also provide foraging benefits which may come at greater competitive costs to individuals. To examine such possibilities, we examined how foraging and agonistic activities varied with group size from the diurnal time-activity budgets of 121 Common Loons overwintering at a large freshwater reservoir lacking significant predators in northwest South Carolina from 2019-22. While we found that as a whole the amount of time focal individuals spent foraging averaged ~50% of their activity budgets, we also found that this time significantly decreased with group size as did the average duration of their foraging dives. We observed little to no overt aggression between individuals during the winter season, let alone changes in behaviors that would indicate greater interference competition with group size. Assuming shorter foraging periods and dive durations are beneficial to individuals, these findings strengthen the argument that sociality may indeed provide foraging benefits to loons, particularly to those that forage primarily upon large schools of foraging fish during the nonbreeding season.

Diversity of shorebirds (order: Charadriiformes) thriving in an altered wetland of

the Southern coast of Sri Lanka

V. Mendis, D. Mahaulpatha, D. Jayasekara, S. Sigera, C. Gunathilake
Presenting author: **Dharshani Mahaulpatha**, University of Sri Jayewardenepura, vinurimendis.tmp@sjp.ac.lk

Diversity and distribution of shorebirds and their habitat utilization within Kalametiya Sanctuary, a threatened wetland in Southern Sri Lanka were assessed from May 2022 to March 2023. Thirty point-count stations fixed along three transects in lagoon, grassland and mixed-mangrove habitats were surveyed during which 19 shorebird species (12 migrant and 7 resident species) belonging to 6 families were recorded, including globally Near Threatened Limosa limosa (Linnaeus, 1758) and Esacus recurvirostris (Cuvier, 1829). Shorebird diversity differed significantly between grassland and mixed-mangrove habitat (t= 2.61, df= 496) even though they accounted for many species in common (Jaccard Similarity Index = 0.58). Breeding residents Himantopus himantopus (Linnaeus, 1758) and Vanellus indicus (Boddaert, 1783) were highly abundant in all three habitats and data revealed that the study area was utilized by both species for nesting. Further studies are recommended to investigate the nest success rates with direct habitat variable fluctuations and human-induced disturbances within the Sanctuary. The lowest shorebirds abundance was recorded in the lagoon habitat, reflecting the effect of alteration of the site over the past decades following an irrigation development project. Habitat utilization data elaborated that migrant and resident shorebird species followed mixed flock feeding even while sharing the same feeding guilds. Results of the present study highlights the importance of Kalametiya Sanctuary as a habitat sustaining feeding and nesting grounds for shorebird species and conservation strategies that can minimize threats faced by inhabiting resident shorebirds and winter visitor species are proposed accordingly.

Gaming the system: change in nesting strategy following failure in Florida Scrub-Jays (Aphelocoma coerulescens)

K. Marthens, B. Cammarano, S. Barve
Presenting author: **Katherine Marthens**, Archbold Biological Station, kmarthens00@gmail.com

The Florida Scrub Jay (Aphelocoma coerulescens), designated as threatened at both state and federal levels, has a high depredation rate (>60%) and most breeding pairs require multiple nesting attempts within a season to succeed reproductively. This study examines how Florida Scrub-Jays change various nest site characteristics after failure due to predation. Using over fifty years of demographic data, I examine changes in nest height, nest tree species and height, edge distance, and nest cover across subsequent attempts within seasons. Differences between abandoned and predated nests will be compared to discuss the extent to which predation plays a role in changing nesting strategies as opposed to other reasons for failure. Correlations between initial and subsequent nest locations within the same season will also be discussed, examining whether earlier predated nests have a nonrandom effect on future attempts. This project offers insight into the extent to which Jays demonstrate plasticity in nest site choice and design in response to a particularly strong environmental cue.

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*Going cold turkey: Does microclimate influence winter roost trees used by Wild Turkeys (Meleagris gallopavo)?

K. Martin, G. Burness, J. Bowman
Presenting author: **Kayla Martin**

Wild Turkeys (Meleagris gallopavo) have increased energy expenditure in the cold and as a result may move to sheltered forest habitats to reduce energy demands during stormy winter weather. However, it is unknown the extent to which atmospheric factors (e.g., wind, temperature, and precipitation) influence habitat selection by turkeys at a much finer scale, such as selection of individual roost trees within a larger forest habitat. I assessed whether microclimate differs between roost trees used by turkeys in winter and nearby trees that are not known to be used for roosting. I hypothesized that turkeys reduce their energetic demand in winter by selecting roost trees that have favourable microclimates compared to other trees that are available. I identified winter roost trees used by turkeys within the Peterborough region of Ontario, Canada, and paired each tree with a nearby tree that was not used for roosting. I

measured air temperature, wind speed, and precipitation from December 2022 to March 2023 at each pair of roost and non-roost tree. My results will show whether air temperature, wind speed, and amount of precipitation are different at trees turkeys roosted in compared to nearby trees that turkeys did not roost in. If I identify differences in microclimate, it could suggest that turkeys select roost trees that help them thermoregulate during winter.

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*Can public lands safeguard grassland bird populations in the eastern US?

M. Massa, A. Johnson, E. Matthews, G. Shriver, E. Cohen
Presenting author: **Megan Massa**

In eastern North America, populations of grassland birds are under severe threat from habitat loss and agricultural intensification. Protected areas such as private lands and conservation easements are important tools to protect biodiversity, but their relative effectiveness for grassland birds in this region is less well known. To assess whether public lands safeguard grassland bird diversity, we combined data from two grassland bird monitoring programs: the National Park Service National Capital Region Inventory & Monitoring Network and the Smithsonian Conservation Biology Institute's Virginia Working Landscapes program. From point count surveys in Virginia, Maryland, and West Virginia, we compared richness, abundance, and diversity of 27 obligate and facultative grassland species among public protected areas, private conservation easements, and unprotected private lands. We found that richness did not differ among land ownership types, but diversity was highest on public lands. However, public lands had a lower abundance than private lands of grassland birds as a whole. Grassland points surveyed on public lands were also surrounded by more development and more isolated from surrounding protected cover than points on private lands. We did not find any community metric to be higher on unprotected private lands than on privately-owned easements. These results suggest that although grassland bird populations are diverse on public lands, partnerships between public and private lands will be key to conserving grassland birds.

Which biotic and abiotic factors influence dominance and vagrancy in hummingbird communities?

E. Mathiasen, L. Tell, S. English, D. Groom
Presenting author: **Elizabeth Mathiasen**, San Francisco State University, elizabethmathiasen@gmail.com

Dynamics of dominance hierarchies in hummingbird communities are complex and can rapidly change over short time scales. These changes are shaped by a variety of factors, including phenotypic traits, community composition (species and bird population at feeders), and environmental factors. We seek to explore what factors are related to changes in dominance over time, and how feeder displacement affects visitation at nearby feeders. We hypothesize that sex, age, plumage characteristics, and season will impact feeder dominance and vagrancy, with older and more male-like birds being more feeder dominant. We also hypothesize that an individual's displacement from one feeder will impact adjacent feeder visits. From 2016 to 2021, three species of hummingbirds(Calypte anna, Selaphorus sasin, and Archilochus alexandri) were tagged with passive integrated transponders at two sites in California and feeders were equipped with tag-readers. At time of capture, each bird was identified by species, sex, and age, and the proportion of plumage iridescence was scored. Dominant individuals were determined by the proportion of total visits to each feeder by each bird, with those not meeting the threshold considered vagrant. Preliminary results suggest that dominant birds have a higher proportion of iridescent feathers than more vagrant individuals; dominance in male Anna's hummingbirds was related to head iridescence, whereas dominance in females was related to gorget iridescence. Increased gorget iridescence in female birds may provide a competitive advantage by causing them to appear more male-like. Further work using this novel approach will examine additional factors that may influence dominance at feeder stations.

Calling dynamics of the Ruddy-breasted crake (Porzana fusca) in a fragmented landscape

S. Matsubayashi, F. Saito, R. Suzuki, K. Nakadai, H. Okuno

Presenting author: **Shiho Matsubayashi**

Monitoring nocturnal or crepuscular birds is difficult because of their secretive and elusive natures. We auditory monitored territorial calls of Ruddy-breasted crake (Porzana fusca) inhabiting a restored wetland consisting of a swamp and two small reed patches, in Nara, western Japan, using 8-channel microphone arrays and monaural recorders during the breeding season of 2022. We assessed spatio-temporal calling dynamics and breeding habitat use of the crakes, by first localizing the sound derived from directional microphones using open-sourced robot audition software, HARK (Honda Research Institute Japan, Audition for Robots with Kyoto University). We then estimated the location of the crakes in a two-dimensional space, by triangulating azimuth angles derived from two microphone arrays closest to the sound source. We further assessed spatio-temporal dynamics of their territorial defense to potential intruders. The birds' locational information combined with seasonal vocal activities derived from monaural microphones, revealed the numbers, population density, and territory size of the crakes within the study area. Preliminary analyses also show that our monitoring method is useful not only for better understanding territorial behaviors and microhabitat use of the crakes, but can also be extended to auditorily investigate other rare elusive birds in a non-invasive way. Results of this study, i.e., habitat use, habitat properties, and connectivity, are also useful for habitat restoration of this rare species.

Introduction to Motus Network in Venezuela: a call to new partners in Canada to support migratory bird studies

M. Matta

Presenting author: **Miguel Matta Pereira**, Environment for the Americas, mmatta@environmentamericas.org

Due to its geographical location in northern South America and the landscape attributes that this country protects, Venezuela represents a strategic area for the study and conservation of migratory birds in America. In 2022, the MOTUS Wildlife Monitoring System Network (MOTUSVEN) project began in Venezuela, in order to better describe the movements of resident and migratory birds that are stopover, wintering or transiting the country. The first receiver station was located at the Rancho Grande Biological Station, which is located near the Portachuelo Pass in the Henri Pittier National Park. Henri Pittier National Park is an Important Bird Area and an Alliance for Zero extinction site, and Portachuelo Pass is a low-lying point between the mountains that facilitates the migration of resident and migratory birds. As a result, during fall migration season of radio monitoring our receiver station detected a male of the Golden-winged Warbler (Vermivora chrysoptera) carrying a Nanotag while flying at night, this bird traveled from Tennessee (United State) to Rancho Grande. The MOTUSVEN project has valid permits and authorization to operate for scientific purposes and we hope to grow this network together with organizations with interest to increase the capacities of local researchers. MOTUSVEN with its first installation motivated other universities, NGOs, government institutions and civil society to get involved and expand the network with an installation plan of nine (9) receiving stations distributed in different venezuelan key bioregions between 2023-2025. We invite all Canadian ornithologist, organization and societies of researchers to join us in collaboration to fill gaps about the migrations paths across Venezuela.

How to engage more Indigenous students in ornithology

E. McKinnon

Presenting author: **Emily McKinnon**, University of Manitoba, emily.mckinnon@umanitoba.ca

Many universities are prioritizing the process of decolonization and focusing on increasing representation of and supports for Indigenous students. As ornithologists (and/or birders), how can we create pathways for diverse students to engage with birds and bird research? In my work as a post-secondary science instructor for the University of Manitoba Access Program, which supports Indigenous, low-income, northern-resident and newcomer students, I have used ornithology as a tool for engagement and outreach. In this presentation, I will outline several ways in which ornithologists can increase engagement with Indigenous students, and I give examples of specific strategies for connecting with students on campus, connecting with communities off campus, and supporting students conducting research on birds. Expanding our efforts to include targeted supports and outreach to underrepresented groups not only

benefits the students (with knock-on effects within their own community network), but also the field of ornithology itself, as diverse students bring their stories and perspectives to inform their approach to bird science and birding.

Breeding habitat selection of Eastern Population Sandhill Cranes

K. Lee, K. McLean, C. Sharp, C. Lepage, B. Fedy
Presenting author: **Kelly McLean**, University of Waterloo, kiaunna.lee@uwaterloo.ca

Breeding habitat constitutes a key resource for sandhill cranes (Antigone canadensis; 'cranes') and is important for regulating abundance and population persistence. Given the recent range expansion of Eastern Population (EP) cranes, our knowledge of crane breeding ecology remains limited, and research is required to understand spatiotemporal drivers of breeding territory selection for conservation planning. To address our knowledge gaps and ensure sustainable crane management, we monitored GPS-locations of 42 adult cranes equipped with GPS-GSM transmitters from 2020-2022 across Eastern Canada's boreal forest to estimate the size and distribution of breeding territories and identify patterns of habitat use. Arrival and departure dates to and from breeding territories were calculated using net-squared displacement and change point analysis, while home range sizes were estimated using 95% minimum convex polygons. Home range selection and habitat selection at the second and third order, respectively, will be assessed using resource selection functions. Cranes established breeding territories throughout the boreal forest in northern Ontario and Quebec. Mean arrival date to breeding territories occurred on April 21Â±8.3d, while mean departure date was August 28Â±13.9d, with cranes remaining on the territory for approximately four months. The size of the breeding territory varied per individual, with the median home range size being 8.06Â±26.4 km2. Understanding patterns of habitat use will allow for fine-scale analysis of factors that impact breeding ranges of cranes and advance our knowledge of crane conservation in increasingly human-modified landscapes.

New perspectives on the population and persistence of Gray-headed Chickadee in Canada

L. McLeod, C. Mahon, D. Iles, T. Booms
Presenting author: **Logan McLeod**

The Gray-headed Chickadee, one of Canada's most enigmatic resident songbirds, has a poorly understood status, with fewer than 20 documented observations in the country in the last century. Recent data from Alaska indicate that the species' distribution in North America has contracted, and its population has declined. In 2019, we deployed 23 ARUs at historical Gray-headed Chickadee locations and 66 ARUs at design-based survey locations in the Yukon, Canada. We used a combination of human listening and a recognizer built for Gray-headed Chickadee calls to process the recordings, but we failed to detect any Gray-headed Chickadees at the survey locations. Based on this information, we conducted a population size estimation exercise using Bayesian estimation with informed priors based on assumptions about detection and known biological parameters. Our results suggest that the Gray-headed Chickadee population in Canada is likely extremely small and may be under threat from changes to the arctic-boreal biome brought on by climate warming.

Minimally-invasive techniques to study the ecology and behavior of North America's rarest marsh bird, the Black Rail

S. McRae, B. Kephart, A. Neice
Presenting author: **Susan McRae**

The Black Rail Laterallus jamaicensis is the smallest of the secretive marsh birds found in North America. It is also the most rarely detected. Due to recent population declines, the Eastern subspecies is now federally listed as threatened in the United States. Auditory callback surveys that use standardized broadcasts of species-specific vocalizations and record responses are most commonly used to survey for Black Rails. However, frequent use of callback is potentially detrimental to their social organization, and its effectiveness subject to seasonal variation and habituation. Efforts to develop techniques to study Black Rails that minimize disturbance include the use of new technologies that can be deployed to detect

occupancy remotely. We have been piloting a series of methods including the use of autonomous recording units (ARUs) for passive recording of vocalizations. ARUs are practical and effective but data management, analysis and quality control require extensive time and effort. We have adopted the use of custom-focused, motion-triggered infrared trail cameras. The rate of detections is low due to the limited sampling range per unit, but images can provide valuable details about individuals and activities. Finally, we have developed a species-specific eDNA assay using water and soil samples. This technique is expensive and has a low detection rate, so will likely be most useful when applied in conjunction with habitat restoration efforts. Ultimately, we aim to move beyond simple detections to unveil circadian and seasonal patterns of Black Rail activity in coastal North Carolina.

Cosmopolitan metapopulations versus cryptic speciation: when do we elevate populations of a globally established species

E. Mendales, J. Dumbacher, J. Chaves

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Few species are found at a global scale. However, this is the scale at which biologists historically argue over species concepts. If a population in one part of the world shows no admixture with another, some may call them two separate species, other may point out their capacity to reproduce and call them subspecies within the same species, while many say it is not that simple. The Striated Heron (Butorides striata) is one such species complex that is found around the world, with wide ranging morphologies, 20-25 subspecific designations, however with little to no genetic assessment of their global representation. They are found in tropical to subtropical environments with continuous distribution on large expanses of land (eg. South America, Africa) as well as restricted distributions across large islands (eg. Borneo, Madagascar) and small archipelagos (eg. Chagos Islands, French Polynesia). Mate-pairs will maintain small territories for foraging and chick rearing. The most recognized subspecies within this group is the Galapagos Lava Heron (B. striata sundevalli) as its morphology is highly distinct. Deep coverage massive parallel sequencing of ultra-conserved regions of the genome are used to investigate the patterns of global radiation among three main biogeographic territories of the Striated Heron (the Americas, Africa, and Australasia). Genetic analysis of fine scale radiation patterns of the Lava Heron in Galapagos teaches us about colonizing patterns in a new territory. The genetic architecture along with a comprehensive morphological study through museum collections, allow us to answer when we can elevate certain populations of a globally established species.

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*Using a large citizen science dataset to understand patterns and drivers of altitudinal migration in the Himalayas

T. Menon, U. Srinivasan

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Among montane birds, altitudinal migration is a well described phenomenon. Yet, apart from mountain ranges in the Americas there is little information on the large-scale patterns and extent of altitudinal migration. While largely tropical in the foothills, high elevations in the Himalayas have tundra-like environments with harsh winters. In our study, we describe avian altitudinal migration across the Himalayas and examine its predictors based on a species' morphological and behavioral traits. Using a large citizen science dataset (eBird) we define elevation ranges of 303 bird species in their breeding and non-breeding season. We describe 5 altitudinal migration patterns and find that most high elevation breeders (67-76%) migrate downslope. Many are partial migrants which show intraspecific variation in migration propensity. By comparing species common to both the eastern and western Himalayas, we find that migration patterns for populations within a species differ across a temperature seasonality gradient. Specialized dietary guilds like insectivores and granivores were more likely to migrate downslope, potentially tracking resources while dietary generalists like omnivores were unlikely to migrate. Species found in open habitats were more likely to migrate downslope since they have a more variable microclimate. Commensal species are subsidized by human resources and were found to be less likely to migrate even when breeding at high elevations. We find that unlike long distance migrants, wing morphology does not constraint a species' ability migrate altitudinally. Our study thus provides new insights into the patterns of altitudinal migration at the scale of large avifaunal community in an

understudied mountain range.

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*Are domestic cattle exposing naÃ¯ve bird species to nest parasitism by brown-headed cowbirds?

S. Meyhoff, E. Bayne
Presenting author: **Sejer Meyhoff**

The brown-headed cowbird (Molothrus ater) (hereafter cowbird) is an obligate brood parasite (it lays its eggs in other birds' nests) that has the potential to significantly reduce the nest success of host birds. Historically, cowbirds associated with bison (Bison bison) as the presence of bison likely increased foraging opportunities by creating microhabitats for insects, increasing insect abundance, as well as flushing insects in their wake. Today, cowbirds are known to associate with domestic cattle, likely for the same reasons, and may be exposing naÃ¯ve bird species to nest parasitism in areas where bison were not historically present in large numbers. This study examines the association of cowbirds with cattle in Alberta, Canada, by using bioacoustic and camera trap data on a regional scale to determine if the presence of cattle is correlated with a higher than expected abundance of cowbirds. An index of association between cattle and cowbirds is estimated using an occupancy modeling approach and compared to a habitat suitability index for cowbirds derived by the Alberta Biodiversity Monitoring Institute (ABMI).

Using biogeochemical tracers to refine Arctic seabird trophic responses to environmental change

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Shifting sea ice dynamics may have unequal influences among Arctic seabird species due to varying dietary preferences and foraging styles. Analyzing seabird diets over time provides a robust indicator of shifts in food web structure and reveals important ecosystem changes in the Arctic marine environment. Past studies have found relationships between sea ice conditions and the diet of seabirds using nitrogen stable isotope analysis of their bulk (i.e., whole) tissues (Î´15Nbulk). However, these values incorporate both trophic dynamics and baseline biogeochemical variability, masking true trophic responses. Our goal is to provide a more accurate trophic position estimation to reveal trophic change in response to accelerating sea ice decline among four Arctic breeding seabirds with various diets and foraging strategies. We analyzed eggshells of thick-billed murres (Uria lomvia), northern fulmars (Fulmarus glacialis), black guillemots (Cepphus grylle), and glaucous gulls (Larus hyperboreus) collected from Prince Leopold Island, NU between 1987-2018 for compound-specific nitrogen stable isotopes of amino acids (CSIA-AA). Trophic position estimates were internally corrected for baseline variability using Î´15N values of source amino acids. CSIA-AA provides a more robust assessment of trophic position for understanding links between food webs and contaminants. In addition, Î´15N values of source amino acids are a reliable indicator of inshore/offshore foraging and baseline shifts in the biogeochemical cycling of the ocean. Results will present evidence on the resiliency or adaptability of each species to potentially irreversible changes to the Arctic marine ecosystem at all trophic levels.

Exploring Movement Ecology and Demographics of Female Cerulean Warblers (Setophaga cerulea) in the Ozarks and Appalachia

J. Miranda, J. Larkin, D. Raybuck, D. McNeil, T. Boves
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The Cerulean Warbler (Setophaga cerulea) is a Neotropical-Nearctic migratory songbird that breeds in mature forests of eastern North America and winters in the northern Andes Mountains. Over the past fifty years, Cerulean Warblers have experienced severe population declines and is now considered a species of conservation concern in much of the United States and Canada. In an effort to better understand this decline and identify their conservation needs, describing all parts of their annual cycle has become a major priority. The breeding biology of male Cerulean Warblers has been at the forefront of many studies; however, none have considered the biology of female Cerulean Warblers, leaving a crucial gap in our

knowledge, and potentially in our ability to effectively conserve them. We captured and used radio telemetry to track them on their breeding grounds in the Ozarks (SE Missouri) and Appalachians (SW Pennsylvania) to describe space use and habitat selection, as well as estimate apparent in-season survival. This study provides valuable biological information on female breeding ecology as well as necessary inputs for a full annual cycle model, which is in the process of being produced. Conservation of Cerulean Warblers will finally be able to incorporate the ecology of both sexes, thus likely producing more effective conservation plans.

Population structure and phylogeography of the Atlantic Forest endemic Dendrocincla turdina

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We investigated the population structure and phylogeography of Dendrocincla turdina (Dendrocolaptidae), an Atlantic forest endemic passerine. Nine molecular markers - one mitochondrial gene (ND2, 1011bp), one nuclear intron (FIB7, 822bp), and seven polymorphic species-specific microsatellites (SSRs) – were analyzed from 141 individuals. SSRs data did not reveal any population structure, but a recent bottleneck was detected. The haplotype networks based on ND2 and FIB7 corroborated the absence of structure, with the most frequent and central haplotypes found along all the taxon's range and their star-like shape indicated population expansion. The extended bayesian skyline plot based on ND2 and FIB7 suggested that its population expansion started in the last glacial maximum (LGM). These results suggested the presence of only one population that suffered a bottleneck followed by a demographic expansion. The results of approximate bayesian computation analysis were congruent with a bottleneck followed by population expansion until nowadays, and around 21k year ago (at the LGM) the population effective number was estimated as being two orders of magnitude lower than today. This pattern of absence of population structure along the Atlantic forest was reported for only other three passerine species and is in contrast with various other passerine species that present latitudinal differentiation. This suggests that idiosyncrasies of the species resulted in different responses to past changes in the Atlantic forest.

Solutions for a sustainable coexistence between people and aquatic birds in La Segua wetland, Ecuador

E. Montenegro, E. Fornasini, T. Santander

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La Segua wetland, located in the province of ManabÃ, has more than 1700 hectares that provide habitat for more than 126 species of resident and migratory birds. Despite being declared a wetland of international importance, it presents latent threats to its ecological integrity and biodiversity. The project 'Solutions for Sustainable Coexistence between Humans and aquatic birds in La Segua, Ecuador', supported by the Coastal Solutions Fellows Program of the Cornell University Lab of Ornithology, seeks to maintain the ecosystem functions of La Segua for the benefit of residents and migratory waterbird populations through the implementation of better production practices, systematic monitoring, and local capacity building. To date, the main achievements of the project include: 5 hectares of shrimp ponds intervened with landscape modifications, two shrimp ponds monitored in boreal migration months (October 2021 to February 2022), a native plant nursery for restoration activities, four workshops for local capacity building, monthly counts in four navigable routes covering the entire wetland, and one conservation easement signed with one shrimp farm owner to maintain habitat for migratory shorebirds in the next 20 years. The results showed that shrimp farms could be important habitats for migratory shorebirds such as Least Sandpipers, Semipalmated Sandpipers, Whimbrels, Greater Yellowlegs, and Lesser Yellowlegs, among others. The challenges are enormous. However, these results demonstrate that proper and sustainable management of shrimp farms could become effective actions and opportunities to conserve shorebirds throughout their migratory route in the Pacific.

Relationship among testosterone, antioxidant capacity and reproduction in male red-winged blackbird, a polygamous specie

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In male birds, testosterone is associated with mating effort and reproductive success. High testosterone can promote aggressiveness which can be an advantage during male-male competition, allowing acquisition of high quality territories and attracting more females. Despite these benefits, high testosterone may come with a cost, since is associated with increased metabolism. A by-product of metabolism, the reactive oxygen species (ROS), can cause oxidative damage to biomolecules. Therefore, testosterone could be involved in a trade-off between investment in reproduction and self-maintenance. However, individuals with higher capacity of acquiring resources could overcome the costs of sustaining high testosterone. For example, antioxidants, a defense mechanism against ROS, can be obtained from diet, and could minimize this potential trade-off. Our objective is to test the hypothesis that individuals with higher testosterone levels will acquire greater antioxidants from their high quality territories, allowing them to invest more in current reproduction, without suffering the costs of increased oxidative stress. We took a blood sample after injecting with gonadotropin releasing hormone (GnRH) to measure post-GnRH testosterone in male red-winged blackbirds (Agelaius phoeniceus). We will measure Trolox-equivalent antioxidant capacity from blood plasma. Nesting attempts were monitored to determine the harem size, nestling mass, and total fledglings. We predict males experiencing higher post-GnRH testosterone levels and antioxidant capacity will have higher harem size, heavier nestlings, and produce more fledglings. These data will contribute to our knowledge about influence of testosterone in mediating potential trade-offs.

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*Changing landscapes: Analysis of overwinter habitat use and movement ecology of Dark-eyed Juncos (Junco hyemalis)

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Landscapes across the United States are changing drastically because of human development and agricultural expansion, creating fragmented landscape matrices with a mix of forests, grasslands, agriculture, housing, and other anthropogenic land uses. Dark-eyed Juncos (Junco hyemalis) are short to medium distance migrants that use forests, forest edge and grassland habitat within the intermix of anthropogenic land use during the winter. Understanding habitat use and survival during the full annual cycle provides critical information for developing conservation plans, but less than 10% of ecology research incorporates multiple seasons, with overwintering periods being the least observed. Using automated (Motus) and manual radiotelemetry, we monitored the daily activity and habitat use of 24 Dark-eyed Juncos in southeastern Ohio to understand habitat use on the landscape. We also monitored bird feeders at a home within the rural landscape to identify color-marked juncos that visited each feeder and understand how these birds use feeding stations in relation to available habitats. Our study will provide data on how birds, like juncos, use habitats within the landscape during the winter, their overwinter survival, and their spring departure date, which can be used to provide local landowners with recommendations on how to improve overwinter habitat availability and quality.

Breeding season distribution of Cerulean Warblers (Setophaga cerulea) in Northwest Arkansas

J. Mortensen
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The Cerulean Warbler (Setophaga cerulea) is a small migratory songbird that breeds in mature deciduous forests of eastern North America. It is one of the species of highest conservation concern in its range owing to an estimated population decline of 74% in the last 50 years. Arkansas is at the southwest boundary of the species breeding range and less is known about its status in the state compared to other areas of breeding occupancy. Our goal was to determine Cerulean Warbler occupancy of forested areas in the southern Ozarks during the 2017-2021 breeding seasons. We found a pattern of high occupancy of forested sites in Devil's Eyebrow Focal Area north of Beaver Lake and parts of Devil's Den State Park, and zero to low occupancy at all other surveyed properties (n = 155 point count stations across 15 sites).

Cerulean Warbler encounters at point count stations were not consistent within or between breeding seasons, likely driven by the species' relatively low detection rate. Our results suggest that Cerulean Warblers in the Northwest Arkansas Ozarks have similar habitat associations as has been previously reported for the species elsewhere in its range. We found birds almost exclusively on ridgetops, in areas with steeper slopes and higher than average local elevation. They were found in areas with taller trees, with oaks, hickories, and maples the dominant species at occupied sites, and absent from areas with coniferous species. Our best habitat model indicated that vegetation cover was the most important variable in explaining variation in cerulean point count station occupancy, a result consistent with previous work showing the importance of well-developed under- and overstories.

Do Rangeland Management Practices Incentivized by California's Healthy Soils Program Confer Co-Benefits for Birds?

X. Moura, M. Johnson, M. Ybarra
Presenting author: **Ximena Moura**

Rangelands are important landscapes in California that support a robust cattle industry but also serve as vital grassland habitat for avian wildlife. Climate change is projected to impact rangeland systems, leading to economic and ecological deterioration. California is prioritizing climate-smart solutions to buffer and protect working lands through its Healthy Soil Program (HSP). While the HSP targets soil health and range conditions for domestic livestock, it also may benefit avian wildlife. Our project seeks to answer if range management practices incentivized by California's HSP, such as range seeding, soil amendments, silvopasture, and hedgerows, also make rangelands more suitable for birds. Using a newly described Bird-Friendliness Index (BFI), we evaluated the response of the bird community to these rangeland management practices. By using BFI to score rangelands, we evaluated how bird density, conservation status, and functional diversity are all influenced by the HSP. We predicted that, after accounting for other local and regional variables, ranches from Central to northern California that utilize numerous HSP practices for multiple years will have greater BFI scores than ranches just starting or with minimal HSP investment. Results of BFI on ranches are preliminarily discussed, with future predictions of how specific HSP practices might impact bird communities.

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*Survival and movement patterns of juvenile Savannah sparrows during the post-fledging period

S. Mueller, R. Norris
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Demographic information covering a species' full annual cycle is crucial to understanding population dynamics and identifying causes of decline. For migratory birds, relatively little is known about survival and behavior during the post-fledging period, after juveniles leave the nest but before their first migration. Inexperienced juveniles are particularly vulnerable to predation and starvation and often experience high mortality rates. We used radio-telemetry to examine multiple hypotheses to address the causes of variation in post-fledging survival rates and movement patterns in a population of Savannah sparrows (Passerculus sandwichensis) breeding on Kent Island, NB. From June to Sept. 2022, we deployed radio tags on 53 juveniles to track movement patterns and determine survival rates, locating each individual daily. Daily survival rates were lowest in the first three days post-fledging (< 0.950), then steadily increased as fledglings aged (> 0.965 after 20 days post-fledging). Only 41% of fledglings were still alive after eight weeks. Fledglings stayed relatively close to their natal nests in the first two weeks after fledging (mean 56 Â± SE 18 m on day 14 post-fledging). The average distance juveniles were from their natal nest increased steadily (~2.4 m per day) for the first month post-fledging, then leveled off (mean 133 Â± SE 28 m on day 28; mean 139 Â± 41 m on day 56). We also present results from models that examine the intrinsic and ecological causes of variation in survival rates and movement patterns.

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*Does the evolution of song and colour drive complexity in Tanagers?

L. Munoz, S. Mahoney, M. Reudink
Presenting author: **Lorena Munoz**

Tanagers are one of the largest families of passerine birds, and are well-known for their diverse and colourful plumage, striking songs, and wide variation in behaviour ecology. The independent evolution of song and colour has previously been demonstrated within this family, but we know little about the role that habitat use and diet potentially played in their evolution. By having a greater understanding about the role these factors have, we can test the sensory drive hypothesis, which claims that acoustic signals may be affected depending on the specific environment in question. Our research objective is to investigate whether habitat and diet, factors associated with song and colour evolution in other taxa, explain variation in song and colour within the family Thraupidae. We gathered song data from Demetry et al. 2021, colour scores from Dale et al. 2015, and diet and habitat data from the IUCN. Followed by a comparative phylogenetic analysis with our compiled data against a phylogeny tree of 318 species from within Thraupidae. Colour, song rates, and song frequency data were scored relative to three main habitat uses, open, forest, and generalist. Our results show that both song and colour are strongly associated with habitat. We found that tanagers using open habitats showed the lowest colour scores compared to those in generalist and forest habitats. For song rates, generalists scored the highest, followed by open and forest habitats. Lastly, for song frequency, open habitats scored the highest compared to generalist and forest. These results support the sensory drive hypothesis, and by studying the Thraupidae family, it helps us further understand the importance and effects of ornamentation on a larger scale.

A new Paleogene fossil and a new dataset for waterfowl (Aves: Anseriformes) clarify evolution at the K-Pg Boundary.

G. Musser, J. Clarke

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Despite making up one of the most ecologically diverse groups of living birds, comprising soaring, diving and giant flightless taxa, the evolutionary relationships and ecological evolution of Anseriformes (waterfowl) remain unresolved. Although Anseriformes have a comparatively rich, global Cretaceous and Paleogene fossil record, morphological datasets for this group that include extinct taxa report conflicting relationships for all known extinct taxa. Correct placement of extinct taxa is necessary to understand whether ancestral anseriform feeding ecology was more terrestrial or one of a set of diverse aquatic ecologies and to better understand avian evolution around the K-T boundary. Here, we present a new morphological dataset for Anseriformes that includes more extant and extinct taxa than any previous anseriform-focused dataset and describe a new anseriform species from the early Eocene Green River Formation of North America. The new taxon has a mediolaterally narrow bill which is not known in any previously described anseriform fossils other than portions of the pseudotoothed Pelagornithidae. The matrix created to assess the placement of this taxon comprises 41 taxa and 719 discrete morphological characters describing skeletal morphology, musculature, syringeal morphology, ecology, and behavior. We additionally combine the morphological dataset with published sequences using Bayesian methods and perform ancestral state reconstruction for ecological and behavioral characters. We recover the new Eocene taxon as a stem anseranatid across all analyses, and find that the new taxon represents a novel ecology within known Anseriformes and the Green River taxa.

Community-based monitoring: learning from birds and local communities in Río Claro, Colombia

N. Niño

Presenting author: **Nelsy Niño**

The RÃo Claro basin (Antioquia, Colombia) is home to many endemic and threatened species. Due to the wealth of calcareous material in this region, mining activities have been established that threaten the region's biological, geological, and cultural richness, which has motivated the development of conservation strategies. One strategy is the participatory monitoring of biodiversity done by researchers from the Humboldt Institute (Colombia) and the inhabitants of eight villages in the RÃo Claro watershed. Plants, bees, mammals, and birds are being monitored. Birds are being studied through passive monitoring with camera traps, direct observations during linear transects, and free sampling. The monitoring began in May 2021 and continues to be carried out in diverse habitats within the region. To date, 200 bird species belonging to 52 families and 168 genera have been recorded. Common bird

families are Tyrannidae (25 species), Thraupidae (23 species), and Trochilidae (9 species). The region is home to five endemic species at the regional and national level and four endangered species. Several environmental concerns across the eight villages exist, such as the decline of fauna and flora species in forests and waterways due to unsustainable use. Continued monitoring of the avifauna is important for understanding how species respond to anthropogenic impacts and the long-term conservation of biodiversity. Monitoring between researchers and inhabitants of the basin has allowed us to enhance and exchange knowledge on both sides and add value to ongoing nature tourism processes.

Effects of annual climatic variation on the sex ratios of nestling mountain chickadees

A. Nowicki, B. Sonnenberg, V. Pravosudov, C. Branch
Presenting author: **Alyssa Nowicki**

When encountering environmental stressors, sex allocation theory predicts that sexually dimorphic species should modify the sex ratio of their offspring to reflect differences in resource cost, fitness, and reproductive return between the sexes. Since brood sex ratios can vary from year to year, offspring sex allocation may represent an important adaptive strategy for bird species inhabiting environmentally unstable or evolving landscapes. Mountain chickadees are small, non-migratory passerines which breed yearly and are known to nest under a wide array of environmental conditions. Here, we will examine the sex ratios of mountain chickadee broods at two sites of differing elevations and climates in order to better understand the use of adaptive sex allocation in response to environmental variation in passerines. Additionally, we will investigate variance in brood sex ratios across breeding seasons at the same site in order to assess the plasticity of sex allocation as an adaptive strategy in the short term.

Bobolink (Dolichonyx oryzivorus) breeding and breeding dispersal patterns in the Wolastoq/Saint John River Valley

M. Oliver, J. Nocera
Presenting author: **Meghan Oliver**

Bobolinks (Dolichonyx oryzivorus) largely rely on habitat created from agriculture. However, this has resulted in population declines due to nest disruptions from haying. Delaying hay harvests can improve survival, but this incurs costs to farmers as hay quality decreases further into the summer. As such, it may be beneficial to explore other factors contributing to breeding success to make this management strategy more precise. Therefore, the purpose of this study is to assess the small- and large-scale environmental conditions that contribute to Bobolink nest success and failure, as well as determine the dispersal patterns of Bobolinks breeding in the Wolastoq/Saint John River Valley in New Brunswick, Canada. We used radio telemetry to collect movement data which revealed sites where Bobolinks remained throughout the breeding season and sites from which they dispersed, indicating high likelihoods of nest success and failure, respectively. These successes and failures were corroborated with nest monitoring efforts and point count surveys. This revealed changes in abundance in each field throughout the breeding season which can be viewed as a proxy of Bobolinks that undertake breeding dispersal. The results from this study will be used to determine 'critical habitat' (a legally required designation) based on site occupancy and nest success, which has not yet been identified in the region. Additionally, quantifying the proportion of Bobolinks that disperse will improve the accuracy of current population estimates which are largely based on point count surveys that do not account for dispersal rates of these birds. Ultimately, our findings will better inform conservation decisions for this threatened grassland bird.

Tracking the diel timing of spring migration in a fly-and-forage migrant

C. Olson-Brissaud, J. Ray, K. Fraser
Presenting author: **Clémence Olson-Brissaud**

The migratory behaviour of landbird species can be generally categorized based on whether they migrate diurnally or nocturnally. Despite being considered diurnal migrants, swallows can incorporate night flights when crossing barriers such as open ocean, which may save time and energy during suboptimal foraging conditions. However, owing to prior limitations in tracking diel-scale movements of small birds, little is

known about migratory birds' intervening flight behaviour, including the duration of flights and refueling strategies. To investigate daily flight timing and duration of purple martin (Progne subis), a diurnal, migratory swallow, we deployed and retrieved archival GPS units at a northern (MB) and southern (TX) breeding site. GPS units were programmed to record location data every two hours starting from the median date of spring migration. Using these fine-scale spatiotemporal data we are determining how martins partition daytime flight and refueling and whether martins exhibit different flight patterns over large water bodies, such as the Gulf of Mexico, as compared to overland flights.

Heat shock proteins as a physiological stress metric of migrating songbirds

G. Orfanides, S. Pagano

Presenting author: **Gabriella Orfanides**

Understanding what factors could cause birds to mount costly physiological stress responses during migration has important conservation implications. However, developing reliable methodology to assess chronic stress of songbirds remains a logistical challenge in ornithological research. Heat shock proteins (HSPs) are molecular chaperone proteins associated with the stress response of vertebrates, yet their use as a stress metric in avian migration research remains little explored. In this study, we measured HSPs in migrating Catharus thrushes and evaluated the utility of these proteins as a stress biomarker. Total protein was extracted from blood samples previously collected from migrant birds sampled at the Braddock Bay Bird Observatory during both spring and fall migration stopover. HSP60 was measured via western blotting and quantified using densitometric analysis of western blot images. Stopover refueling was assessed by circulating plasma triglyceride concentrations measured using spectrophotometric assays, and total leukocyte counts were derived as indices of immune status. Correlations of HSP abundance with body condition, immune status, and refueling rates were evaluated. Results provide novel insight into the importance of an underexplored stress metric and physiological tradeoffs that could occur due to chronic stress.

Comparing the genetics of spatial cognition in two species of food caching chickadee

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Food caching species are a powerful model to address questions about the evolution of cognition. Two species of food-caching birds, mountain chickadees (Poecile gambeli, MOCH) and black-capped chickadees (Poecile atricapillus, BCCH), coexist along an elevational gradient from Boulder, Colorado (1620 m elevation) to Ward, Colorado (2880 m elevation) – allowing for an investigation of the genetics of spatial cognition in two different species that occupy equivalent habitats. Previous studies have found that (1) selection acts on acts on spatial cognition in MOCH and (2) evidence that spatial cognition in MOCH has a genetic basis and is heritable. However, the genetic basis of cognition in BCCH remains unknown, hindering our ability to understand how spatial cognition evolves in chickadees more generally. To investigate this gap, we will utilize the unique overlap between MOCH and BCCH to ask: how similar is the genetic basis of spatial cognition in co-occurring MOCH and BCCH? We will develop a cognitive feeder array experimental system to measure the cognitive abilities of wild free-living MOCH and BCCH. We will use innovative field methods to determine if there is interspecific variation in spatial cognition between BCCH and MOCH, combined with whole genome sequencing and genome-wide association (GWAS) methods to assess the genetic architecture and degree of genetic similarity underlying cognition between two species.

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*Seasonal patterns of corticosterone responses in wild male and female black-capped chickadees (Poecile atricapillus)

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In many temperate songbirds, the activity of the hypothalamic-pituitary-adrenal (HPA) axis, including the

release of the glucocorticoid corticosterone (CORT), varies seasonally; both baseline and stress-induced CORT are generally higher during breeding season relative to the rest of the year. However, in parids, there is some evidence that CORT is also elevated in winter when birds are retrieving previously stored food caches. In food-storing birds, CORT levels interact with memory processes and may modulate changes in the brain necessary for increased memory demand in winter. However, these responses may also be modulated by laboratory captivity. Here, we examined seasonal differences in baseline and stress-induced plasma CORT (an acute measure) as well as feather CORT (a longer-term measure) in wild black-capped chickadees (Poecile atricapillus; N=48) captured in spring (Mar-Apr; pre-breeding), summer (Aug-Sep; post-moult), and winter (Dec-Jan; non-breeding). Blood was collected in the field within 3 min of capture and again before euthanasia, which occurred within ca. 1 hour of capture to minimize captivity effects on future brain measures. In adults, feather CORT was highest in spring (post-food storing, pre-moult) and lowest in summer (post-moult). While we found no seasonal differences in baseline CORT, there was seasonal variation in stress-induced CORT in sex-specific patterns: in females CORT was highest in spring and in males CORT was highest in summer. Overall, our data confirm that CORT responses in parids vary seasonally and also with sex, but in patterns different to most songbirds. However certain measures may be reflecting more short-term, acute HPA axis activity, rather than longer-term seasonal change.

Exploring the geographic consistency of the genetic basis of spatial cognition in mountain chickadees (Poecile gambeli)

A. Patel, S. Padula, G. Semenov, V. Heinen, B. Sonnenberg, C. Branch, E. Bridge, J. Welklin, V. Pravosudov, S. Taylor

Presenting author: **Ajay Patel**

The mountain chickadee (Poecile gambeli, MOCH) is a non-migratory, food-caching passerine common to the high elevation coniferous forests of Western North America. Phylogeographic studies have described two distinct populations east and west of the Sierra Nevada Mountains; having likely been isolated for between 610,000 and 1,530,000 years. Montane species are particularly vulnerable to climate change, primarily due to changes in habitat suitability and upslope movement which can lead to species extirpation. In Colorado, MOCH are likely to experience increased pressures ranging from loss of suitable habitat to encroachment of competing species, as climate change accelerates. Importantly, understanding how potentially adaptive alleles, like those involved in MOCH spatial cognition associated with food-caching, are distributed can help predict future species responses to changing conditions. A better understanding of intraspecific variation in the genetic basis of spatial cognition in MOCH, will allow us to determine how Colorado chickadees might adapt as our climate changes. Thus far, the genetic basis of spatial cognition in MOCH has been examined in a single geographic region with only one subspecies. Leveraging RFID-based feeder arrays to measure spatial cognitive performance, we seek to determine whether the genetic basis of spatial cognition in MOCH is geographically consistent between populations in the Colorado Rocky Mountains (P.g. gambeli) and the California Sierra Nevada Mountains (P.g. inyoensis). Answering this question will provide a unique opportunity to evaluate genetic parallelism in adaptive regions of the genome and help us understand the adaptive capacity of spatial cognition in MOCH in Colorado.

Dynamic measure of glucocorticoid hormones using feathers and plasma in the polymorphic White-throated Sparrow

R. Peck

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The White-throated Sparrow (Zonotrichia albicollis) is a polymorphic species with two distinct morphs with unique life-history strategies. They differ in such behaviors as paternal care, territorial defense, reproductive effort, promiscuity, and site selection. White morph males engage in less parental care than do tan morphs, and so this study seeks to learn how the contrasting life strategies and subsequent parental investment affect basal corticosterone (CORT) levels of offspring. It also seeks to answer the relationship between neighbor density and habitat selection with CORT. The study intends to do this via plasma CORT and also feather CORT, which is shown to accumulate CORT over the growth of the

feather. A recent study found little CORT in the feathers of five species; therefore, it is important to determine what is being detected in WTSP feather CORT assays, which this study intends to do, while also validating the methods of extracting and assaying CORT in White-throated Sparrow feathers.

Application of a monitoring protocol for Thrashers in the Sonoran Desert

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In the arid zones of North America, different bird species have shown a decline in their populations, especially the Bendire's Thrasher (Toxostoma bendirei), and Lecont's Thrasher (Toxostoma lecontei). Although it is not known with certainty, the decline in populations is attributed to habitat loss due to development and the use of pesticides. In Mexico there is not enough information to place these species in any risk category, so in this study, in order to generate information to develop management plans in favor of knowledge and conservation, the protocols proposed by the Desert Thrasher Working Group were carried out in different points of the state of Sonora during the months of May-November 2022, to search for the species and recognize the habitat. During the sampling, 418 protocols and 47 incidental observations were made in a total of 109 sites visited, where 140 adults of Toxostoma bendirei and 14 juveniles were recorded. This work is the largest effort that has been carried out in Mexico, which provided much information about its current situation in the State of Sonora. The records showed greater abundance of Short-billed Curassows in the sites located on the outskirts of Hermosillo during the month of May, recording 76 individuals in 20 sampling sites; while the following months were less productive despite monitoring in sites with similar habitat.

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*Is bigger better? Testing the assumptions of the group augmentation hypothesis in terms of group size and territory size

K. Rajput
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The group augmentation hypothesis rests on the assumption that living in larger groups provides benefits such as access to better quality territories, increased foraging efficiency, reduced predation pressure, and thereby better survival of group members. It is also expected that larger groups defend territories better, thereby reducing overlap with neighboring groups. However, how stable these trends remain across different reproductive phases is often not clear or even examined. We examined this in a cooperatively breeding paleotropical bird, Jungle Babbler, found commonly across lowland India. The study was conducted on eight habituated groups of Jungle Babblers across one breeding season (BS) and one nonbreeding season (NBS) for each group. We found that larger groups occupied bigger territories during NBS, however, this was not true during BS. Further, group size did not predict the habitat quality of the territory occupied in terms of resource density, either during BS or NBS. However, during NBS, larger groups were found to occupy territories with a higher proportion of closed-canopy habitats and a larger proportion of their territories having no overlap with neighboring groups, thereby indicating better territory defense. Taken together, this study provides a holistic understanding of the interactive effects of social (group size) and ecological factors (territory size, quality and competition) in relation to the assumptions of the group augmentation hypothesis.

Identifying trends in the spring phenology of the Prothonotary Warbler (Protonotaria citrea)

R. Ralston, C. Tonra
Presenting author: **Rebecca Ralston**

As climate change progresses, birds will have much of their migration ecology altered. In fact, a migratory bird's ability to adapt to climate change may depend greatly on whether it can advance its spring migration timing so it can continue to take advantage of a short but rich food supply for breeding. However, despite advances in the spring phenology of North American songbirds being well documented, the drivers of individual migration timing are understudied for many species. Here, we present initial

findings of trends in Prothonotary Warbler (Protonotaria citrea) spring phenology across their breeding range for the period of 2012-2022. Using community science observations reported to eBird, we evaluated arrival timing in 200km x 200km grid cells spanning core Prothonotary Warbler breeding and migratory ranges. We then identified phenological trends and assessed correlations between arrival timing and yearly environmental and climatic variation. This research expands our knowledge of phenology in Prothonotary Warblers, a declining species of conservation concern. Furthering our understanding of phenological trends may assist in predicting how bird species will adapt to climate change.

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*Assessing the novel use of a combinatorial referential alarm call to denote a brood parasite

K. Ray, K. Maurer, M. Hauber, S. Gill
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Diverse species use alarm calls to communicate threats. In some species, alarm calls are functionally referential and refer to specific stimuli; such calls can be single-note or a combination of calls. Combinatorial referential calls can communicate complex ideas, but few species are known to produce these calls, in part due to analytical challenges associated with identifying predictable call sequences. My research tests the hypothesis that red-winged blackbirds produce combinatorial referential alarm calls in response to different nest threats, including brood parasites. Red-winged blackbirds provide an excellent opportunity to explore this strategy as they recognize different predators, produce multiple alarm calls, and understand heterospecific referential alarm calls. I predict blackbirds combine calls into multi-element sequences to denote different predators. I recorded blackbirds as they responded to different taxidermic models of predators and used cluster analysis on frequency and temporal features (n = 319 calls) to identify the number of unique call types in predator contexts. Cluster results revealed three objectively distinct call types used during the model experiments (n = 72), with an average silhouette score of (Si = .57), indicating a good fit. Next, I will run newly developed collocation analysis on these unique calls to reveal any frequently used sequences within experimental recordings. Combinatorial referential calls within birds are poorly understood and my work will contribute to a growing body of evidence that this complex communication evolved in diverse lineages of species, including red-winged blackbirds.

The relationship of the endangered Yellow Cardinal and bird diversity with a forest treatment at central Argentina

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The Yellow Cardinal (YECA) inhabits South America and it is globally endangered. Their main threats are habitat loss and degradation habitat loss and degradation, along with illegal trapping. We evaluated YECA abundance, cover of plant stratums (herbs, shrubs/saplings and trees) and bird diversity (richness, abundance, dominance) in sites with (treatment) and without (control) a mechanical shrubs/saplings removal as a forest management action to reduce wood encroachment. The study site was in the Espinal ecoregion of La Pampa Province, Argentina. The treatment sites showed lower shrub/sapling cover, due to the management practice correctly done. YECA abundance was higher in treatment sites, and also YECA abundance was negatively related to shrub/sapling cover. However, bird diversity did not differ between treatment and control sites. Our results showed the mechanical wood encroachment removal as a forest treatment modified the habitat and was related positively with the abundance of the YECA in the Espinal. This scientific evidence could provide vital information for future forest management planning to conserve the endangered YECA.

Are Purple Finches (Haemorhous purpureus) the Next Host for a Mycoplasmal Conjunctivitis Epidemic?

M. Reinoso-Perez, K. Dhondt, A. Levitskiy, G. Dupont, E. Tulman, S. Geary, A. Dhondt

Presenting author: **Maria Teresa Reinoso-Perez**, Cornell University, mr833@cornell.edu

Ever since 1994, when the bacterial pathogen Mycoplasma gallisepticum jumped from poultry to wild birds, it has been assumed that the primary host species of this pathogen in wild North American birds was the house finch (Haemorhous mexicanus), in which disease prevalence was higher than in any other bird species. Here we tested two hypotheses to explain a recent increase in disease prevalence in purple finches (Haemorhous purpureus) around Ithaca, New York. Hypothesis 1 is that, as M. gallisepticum evolved and became more virulent, it has also become better adapted to other finches. If this is correct, early isolates of M. gallisepticum should cause less-severe eye lesions in purple finches than in house finches, while more-recent isolates should cause eye lesions of similar severity in the two species. Hypothesis 2 is that, as house finch abundance declined following the M. gallisepticum epidemic, purple finches around Ithaca increased in abundance relative to house finches and purple finches are thus more frequently exposed to M. gallisepticum-infected house finches. This would then lead to an increase in M. gallisepticum prevalence in purple finches. Following an experimental infection with an early and a more-recent M. gallisepticum isolates, eye lesions in purple finches were more severe than in house finches. This did not a support Hypothesis 1; similarly, an analysis of Project Feeder Watch data collected around Ithaca did not show differences in changes in purple and house finches' abundance since 2006, a result which is no support for Hypothesis 2. We conclude that purple finch populations will, unlike those of house finches, not suffer a severe decline because of a M. gallisepticum epidemic.

Exposure, repellency, and learned aversion to neonicotinoid-treated seeds in granivorous birds

S. Ren

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Neonicotinoid seed treatments are the most widely used insecticides that show significant toxicity to vertebrate wildlife, particularly granivorous birds. This study aims to evaluate 1) the exposure of neonicotinoid seed treatments on granivorous songbirds and 2) assess whether birds avoid or acquire learned aversion to treated seeds following exposure. Field experiments were conducted in spring 2022 on five pre-seeding crop fields to simulate clothianidin-treated seed spills and document visiting wildlife activities using camera traps, RFID PIT tags and nanotags. Three experimental phases were implemented for each site: capture and release (2 days), treatment phase 1 (1 week), and treatment phase 2 (1 week). During treatment phase 1, 2 stations per site were baited with clothianidin-treated wheat seeds and 2 had untreated wheat seeds. During treatment phase 2, the assigned treated or untreated seeds were reversed for all sites. A total of 7 mammalian species and 17 avian species were recorded by camera traps visiting the simulated seed spills, but the RFID and nanotags were not effective. Average consumption durations were higher at untreated stations than treated stations and the number of species occurrences declined after first exposure. Further statistical analysis will be conducted to quantify the consumption duration and number of seeds consumed at each station by species and treatment. This study will be repeated in spring 2023 to increase sample size and number of sites and test the effect of different seed colourants on avian detection and consumption. This study's findings will inform the regulation and use of neonicotinoid insecticides and contribute to the conservation of wild granivorous bird populations.

An analysis of variation in Magnolia Warbler (Setophaga magnolia) flight calls

E. Ress, B. Van Doren, A. Farnsworth

Presenting author: **Elliott Ress**

Effective communication is critical for the survival, reproduction, foraging, and successful migration of birds. Flight calls are short vocalizations frequently associated with migratory behavior and may contribute to maintaining flock structure, signaling individual identity, and facilitating interspecific communication. To determine if signaler traits are encoded in flight calls, I analyzed various acoustic characteristics from the calls of a nocturnally migrating songbird, the Magnolia Warbler (Setophaga magnolia). I evaluated flight calls recorded from temporarily captured birds at Powdermill Avian Research Center and Braddock Bay Bird Observatory to look for variation attributable to individual identity, sex, age, seasonality, and recording location. Calls from the same individual were significantly more similar to one another than to

calls of other individuals. Seasonality and recording location were significantly associated with call characteristics, while calls did not vary significantly by age and sex. These findings suggest that Magnolia Warbler flight calls may encode individual identity and seasonality. Further, flight call variations attributed to recording location may be a result of environmental factors (time of day, atmospheric conditions) or a variance in experimental conditions or methodology.

Global patterns of plumage colour evolution in island-living Passeriform birds

M. Reudink, S. Mahoney, C. Pageau, M. Oud, J. Briskie
Presenting author: **Matthew Reudink**

Plumage coloration is an important trait involved communication and is shaped by a variety of ecological pressures. Island residency has the potential to change the evolutionary trajectory of plumage colour by differences in habitat and resources, or by altering predation pressure and social selection intensity. Latitude, island size, and isolation may further influence colour evolution by biasing colonization. Therefore, general patterns of plumage evolution are difficult to disentangle. We used phylogenetically controlled analyses to assess the influence of island residency on plumage colouration, by calculating chromaticity values from red, blue, green scores extracted from photos of Order Passeriformes birds. Importantly, we controlled for ecological factors hypothesized to influence colour evolution and assessed family-level effects. We found 1) colour varied between islands and mainlands in females, but not males, and both sexes were affected by several ecological factors; 2) patterns of colour evolution varied among families; 3) island size and distance to the mainland and other islands significantly influenced colour; and 4) interactions between ecological factors and latitude were consistently influenced colour, supporting a latitudinal gradient hypothesis. Our results indicate although island residency influences female colour evolution, a myriad of ecological factors drive plumage colour and the patterns vary among families.

Roads and railroads: Impacts on behavior and reproductive success in Florida Scrub-Jays (Aphelocoma coerulescens)

F. Riand, S. Barve
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Florida Scrub-Jays (Aphelocoma coerulescens) are a federally threatened species suffering significant population declines. Roads and railroads, two types of land transport associated with urbanization, contribute to habitat loss and degradation. Previous research has found that jays residing in roadside territories suffer high mortality from direct traffic collisions but do not have impacted nest success. However, these studies did not focus on roads with high traffic levels, where higher sound pollution may be more likely to impact nest success. Furthermore, no research to date has examined how railroads affect Florida Scrub-Jay behavior and nest success, despite railroads traversing through several populations in Florida. This study aims to fill this gap by conducting focal watches at railroads and analyzing a long-term dataset on metrics of reproductive success near roads and railroads. The results of the focal watches show the temporal impacts of passing trains on normal jay behavior, and how distance from a railroad affects recovery time. Additionally, our analyses of previous data reveal how proximity to a road or railroad affects clutch size, nestling condition, nestling survival, and nest predation rates. Since interruptions in daily activities and lowered reproductive success can have significant detrimental effects on jay populations, understanding the impacts of growing road and railroad networks is critical for the conservation of this species.

Population transcriptomics studies in geographically distant species of North American songbirds

I. Ricchetti, S. Lamichhaney
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We are using tools of population transcriptomics to study geographically distant populations (from Ravenna, Ohio and Petersham, Massachusetts) of two North American songbirds, Poecile atricapillus, the black-capped chickadee, and Spinus tristis, the American goldfinch. Our goal is to examine their local signatures of gene expression. We have collected samples by mist-netting in winter 2018 and 2022.

Tissues were harvested from these birds and RNA was extracted from their brains and livers. This RNA was sequenced using next-generation Illumina sequencing. A de novo reference transcriptome was built for each species, which was used to quantify transcript abundance and identify differentially expressed genes among these populations. The annotated reference transcriptome will be used to further characterize their enriched gene functions and regulatory pathways. Our results indicate that two distinct populations of Black-capped chickadees possess unique profiles of gene expression. Potentially, this could be due to non-migratory behavior of these species, allowing them to remain geographically isolated year-round to develop a local adaptive response to the unique environmental pressures in both locations. Beyond natural variation in gene expression, we intend to identify single-nucleotide polymorphisms, insertions, and deletions in their protein-coding DNA to explore genomic regulation underlying this phenotypic plasticity.

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*Description of mangrove bird assemblage in the Cienaga grande de Santa Marta

S. Mendivil Rivas, D. Tamaris Turizo, A. Ayala Viloria
Presenting author: **Sergio Mendivil Rivas**

The Cienega Grande de Santa Marta mangrove ecosystem is a fundamental resource for birds. Many studies and monitoring have been conducted at these sites over time, however, the measure of diversity has been analyzed with old indices. Using the true diversity method to estimate the alpha diversity in the mangrove bird assemblage, data were taken by line transects in 4 sampled sites, during 28 days between 2 climatic epochs and migratory seasons. The order Pelecaniformes represented 42.67% of the total number of individuals and the presence of the endemic species Chrysuronia lilliae was reported as unique in the entire sample. The sites with the highest species richness were Aguas Negras and Rinconada (q0= 65 and 56). The Luna station had the highest number of equally abundant species (q1 = 22) and both Luna and Rinconada had higher records of dominant species (q2 = 14 and 10). The pattern suggests that the assemblages present a high richness in natural and conserved sites such as Aguas Negras, so it is recommended to monitor the estimated diversity for future comparisons and conservation decisions.

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*Experience the Afrotropics: Virtual reality cameras capture novel behavior in ant-following birds

P. Rodrigues, L. Powell, H. Pollock, G. Rhyne, P. Stouffer
Presenting author: **Patricia Rodrigues**

Neotropical ant-following birds display a unique behavior called bivouac-checking, which allows them to keep track of, and thus specialize, on nomadic Eciton army ants. Bivouac-checking birds visit known army ant nests, or bivouacs, daily to check on the ant's activity. In the Afrotropics, birds follow Dorylus driver ants, but are assumed to not be specialized or display analogous behavioral adaptations such as bivouac-checking. Here, we use 360Â° cameras to document nest-checking behavior in Afroptropical ant-following birds for the first time. At our site in Oyala, Equatorial Guinea, we placed 360Â° GoPro cameras at active Dorylus driver ant nests (n=10); over 100 hours of footage revealed that multiple species of ant-following birds regularly check nests. Putative specialists-those hypothesized to be more dependent on ants-typically appeared first at nests and often arrived only minutes after first light, suggesting prior information on the location of nests. If Afrotropical ant-following birds share this specialized behavior with their Neotropical ant-following counterparts, they are likely more specialized than previously thought. Additionally, we hope that allowing viewers to experience this novel behavior in virtual reality will help garner a newfound appreciation for these underrated birds, allow the opportunity for an otherwise inaccessible experience, and inspire further use of 360Â° cameras to bridge the gap between science research and the public.

Health status of the overwintering endangered species Calamospiza melanocorys (Lark bunting) in the Mexican high plateau

C. Rodriguez Licea, L. Chapa-Vargas
Presenting author: **Citlali Rodriguez Licea**

Many grassland birds, such as the endangered Lark bunting (Calamospiza melanocorys), currently face significant declines of their populations due to anthropogenic activity. Land use change which results in key habitat degradation and fragmentation is one of the main drivers of this phenomenon, but climate change may also have important effects. Although birds can adapt to some degree of degradation, negative impacts on their populations are increasingly becoming more evident and such effects need to be understood. Health evaluations can be implemented for conservation assessments through the analysis of various avian health indicators such as parasite prevalence and abundance, body mass, fat and muscle indices. Together, these indicators can provide an overview of population conditions during the overwintering season. We conducted in situ measuring and obtained blood smears from individuals captured. Smears will be analyzed through microscopy to detect haemoparasites. Considering the access to data from previous and future studies yet to be done, coming to a total of four overwintering seasons monitored on the same site, a comprehensive comparison will be done to assess health status fluctuations through time, considering predictors such as degree of habitat degradation and climate variation among years. This study aims to fill the gaps in knowledge regarding C. melanocorys' health status outside of their reproductive season, and currently is on the phase of field data acquisition and analysis from the third overwintering season, as of now we've encountered some intraspecific variations on body condition whose drivers will be analyzed at the end of the project.

Does immune function trade off against refueling rate during stopover in migrating Catharus thrushes?

E. Rogers, A. Gerson

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Migrating birds experience conflicting demands during flight and stopover that may influence how energy is optimally allocated among physiological systems. For example, the immune system is vital for defense against disease, but is costly to maintain and activate. Migratory animals in particular may benefit from a strong immune system as they likely encounter a greater abundance and/or diversity of pathogens throughout their annual cycle. However, endurance flight is energetically and physiologically demanding and may negatively impact immune function. Despite evidence that birds may suppress or cease maintaining certain components of the immune system during migration, some have been shown to rapidly recover immune function at stopover. Stopover itself incurs costs associated with thermoregulating, rebuilding tissues, and replenishing fat. Previous studies have shown that the strength of immune defenses in migrating birds at stopover relates positively to individual body condition and stopover duration, but it is unknown whether recovery of immune function trades off against other stopover costs. We aimed to investigate immune function in migrating Swainson's Thrush and Hermit Thrush at stopover to determine whether the strength of immune defenses relates to refueling rate, and whether this relationship varies seasonally or between long-distance and short-distance migrants. To quantify innate and acquired immune function, we conducted a bacteria killing assay against E. coli and an IgY ELISA, respectively. We estimated refueling rate by measuring plasma triglycerides and uric acid. The results of this project will provide novel insight into the mechanisms influencing immune function dynamics during migration.

Comparative genomic analyses reveal variation in avian microchromosomes

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Avian genomes are distinct amongst vertebrates for their highly conserved karyotype. Classically, bird chromosomes are divided into ~10 pairs of macrochromosomes and ~30 pairs of microchromosomes based on broad differences in size and content. Due to their nearly-identical morphology and small size, microchromosomes have been difficult to observe and identify. However, with new advances in genome assembly techniques, we can now examine this important component of the avian karyotype with unprecedented resolution. Recent work in chickens showed the presence of 'dot' chromosomes that are distinct from other microchromosomes in their miniscule size (2-6 Mb) and high GC and repetitive content. However, the fine-scale variation in microchromosomes across bird species remains relatively

unexplored. Here we examined variation in genetic content and structure across 8 species of birds using publicly available genome assemblies and spatial genomic information. For each species, we characterized size, GC and gene content, recombination rate, repeat content, CpG islands, nucleotide divergence, and inter-chromosomal interactions for each chromosome. Cluster analysis using these features results in three distinct groupings of chromosomes. Chromosomes 1-9 and the Z chromosome fall into one group, recovering the traditional macrochromosome category. However, similar to recent results from chickens, the remaining microchromosomes segregate into two groups. We also find that certain genomic features, such as abundance of certain transposable element classes and inter-chromosomal interactions, contribute the most to group separation. Our results suggest that microchromosomal variation extends across a wide variety of bird species.

Behavioural consequences of conspecific density: a systematic literature review of the effects of neighbours on birdsong

N. Sánchez, D. Mennill

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Among territorial birds, the number of conspecific neighbours sets the social context for communication. There have been many investigations of vocal behaviour and its important role in territory defense and female attraction in birds; however, the effect of the density of neighbours on avian communication has received little attention. In this study, we reviewed the literature on the influence of density on vocal communication in songbirds, exploring how the number of neighbours influences the vocal behaviour of territorial birds. We found twelve studies of birds that included data of vocal behaviour in relation to the density of conspecific neighbours. The majority (9 of 12) showed that conspecific density influences avian vocal behaviour. Overall, these studies revealed an effect of density on song rate. Other vocal behaviours that were shown to vary with density were: song-type switching, song duration, peak frequency, and song variation. Most focused on temperate-zone species where males are the predominant singers. Our results reveal a bias towards the study of male songs in the context of neighbourhood density, with very few studies on female song; this corresponds with a historical geographical focus towards birds in temperate zones. We present suggestions for future investigations, and we argue that research on vocal communication will benefit from further study of the influence of conspecific density on avian vocal behaviour.

Occupancy of the migratory bird Wood Thrush (Hylocichla mustelina), in the North Caribbean of Area de Conservación Guana

I. Vargas-Valverde, G. Avalos, N. Sánchez

Presenting author: **Natalie Sánchez**

Occupancy models are commonly used to investigate the distribution of migratory birds and their habitats. Non-breeding sites for Neotropical migratory birds are less studied and we know little about their preferred habitats in Central America. In this study, we conducted acoustic surveys to detect Wood Thrush (Hylocichla mustelina) in forested areas in the North Caribbean of Guanacaste, Costa Rica. Additionally, to the acoustic data, we measured forest structure variables to describe the variation in forest structure that could explain patterns of Wood Thrush occupancy. This project includes 10 sites (northernmost site 11Â°01'56.14'N, 85Â°31'39.94'W and the southernmost site 10Â°45'52.74'N, 85Â°18'11.70'W) ranging from dry forest, wet forest, and cloud forest at different elevations (135 to 700masl). At each site, we deployed six stations, for a total of 60 stations. An autonomous recording unit was located at each station, recording from 5:00 a.m. to 7:30 a.m. for three consecutive days. Vegetation structure was quantified using hemispherical photos to measure leaf area index and canopy opening values. We performed a single-season occupancy model using the detection history of the species and forest structural variables. Our preliminary results showed that Wood Thrush occupancy increased with forest complexity. Dryer habitats seem to be less occupied by this species in Northern Costa Rica. The study highlights the need to understand the importance of protected areas and forest characteristics for the Wood Thrush in Central America.

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*Become the hummingbird: Using games to engage with underrepresented groups in science

A. Sargent, J. Pen, R. Canaday, A. Rockwood, A. Clark, C. Stockham, A. Rico-Guevara
Presenting author: **Alyssa Sargent**

As environmental conditions and conflicts worsen, the need for effective outreach programs increases. Given the extreme losses amongst bird and pollinator populations in recent decades, we face a worrying combination of humans' relative lack of empathy for birds and paltry media attention for the pollinator population crisis. However, creative communication approaches, spanning socioeconomic and neurodivergent divides, can combat misinformation while simultaneously promoting science equity. Though traditional lectures may be limited in their capacity to facilitate learning, interactive instruction can immerse students who process information differently, particularly those who gravitate toward tactile and kinesthetic learning. Games are especially effective for imparting complex scientific knowledge-including trade-offs pertaining to wildlife. To explore this approach, I have conceived and developed 'Hummingbird Sugar Rush': a game-based STEM curriculum that we will direct with middle schoolers from underrepresented groups, in which students embody hummingbirds with different strengths and weaknesses (depending on their real-life foraging strategies) and race to collect the most nectar.

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*Assessing heavy metal bioaccumulations in migratory birds of prey

T. Schubarg, Q. Aldrich, M. Barata, N. Baer
Presenting author: **Timothy Schubarg**

Increasing levels of heavy metals such as mercury, lead, and cadmium in our environment pose a threat to not only the animals present in the environment, but to human health as well. Mercury is a known neurotoxin, lead is known to lower IQ, and cadmium can lead to kidney, bone, and lung disease. Utilizing migratory birds of prey, this study aims to understand how heavy metals travel through terrestrial environments and work their way up terrestrial trophic levels through bioaccumulation and biomagnification. This study collected and tested feathers and flat flies from many different species of migratory birds of prey from 2021 to 2022. For the 2021 data, we found feeding at different trophic levels was not the only factor that determined heavy metal concentration in raptors. Species such as Cooper's Hawks and Sharp-shinned Hawks who share habitats and diets can have significantly different heavy metal concentrations.

Birdland: An exploration of connections between people and birds across the American landscape

J. Schuetz
Presenting author: **Justin Schuetz**

Birdland is a nascent exploration of relationships between people and birds across the United States. Intended as an open-ended investigation, the project promises to include a variety of visual, analytical, and narrative components over time. In this vignette, I use publicly available data to characterize how frequently the names of birds have been incorporated into the names of diverse man-made and natural features across America. Resulting maps and summary statistics provide geographic perspective on the cultural salience of different bird taxa. They also provoke fundamental questions about the web of causal relationships linking 'Nature' and 'Culture' in the United States. To what degree does adoption of bird names for man-made or natural features reflect underlying cultural values? To what degree might the use of bird names promote or reinforce connections with different taxa? Are bird names referenced in contexts representative of species' biological realities? Does it matter if they aren't? By interrogating relationships between people and birds from a variety of perspectives, using a diversity of methods, I hope that Birdland will promote further understanding of the dynamic cultural and biological processes that create and maintain meaningful connections between people and nature.

When every bird counts - Maximizing survey efforts for the elusive Black Swift

A. Seaman

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Black Swifts (Cypseloides niger) are an unusual Neotropical migrant bird that initiates nesting in Montana when most other birds are completing their breeding seasons (late June/early July). They are considered at high risk of extirpation, due to climate change, as they rely on perennial streams to create the waterfalls they nest behind or near. Biologists in Canada listed Black Swifts (BLSW) as endangered in 2015 due to significant population declines. In Montana, BLSW are a species of greatest conservation need (S1B) and a species of greatest inventory need. Prior to 2011, biologists surveyed for colonies mid-day or late evening, and only three known BLSW nesting colonies had been identified in Montana. Since 2012, we have collaborated with multiple agencies and organizations to identify as many colonies as possible using systematic late evening surveys. Then in 2019, after Canadian biologists saw higher success with morning surveys, we began to conduct both evening and morning surveys at each site and recorded the high count of BLSW observed at any point during the survey. We conducted 37 paired tests to compare whether there was a difference in evening and morning surveys. We counted significantly more birds in morning surveys. We will use the high-count morning numbers to monitor trends in occupancy and abundance over time. We discuss strategies for monitoring BLSW abundance and population trends, adaptations to the monitoring protocols, and share current maps of BLSW occupancy at Montana waterfalls.

Effects of diet shifts towards fruit on the condition of autumn migrant Catharus thrushes

Presenting author: **Chad Seewagen**

Functional connectivity of a Federally Threatened avian habitat specialist living in a fragmented habitat

S. Shah, D. Seidman, T. Nguyen, R. Bowman, J. Fitzpatrick, A. Tringali, N. Chen
Presenting author: **Shailee Shah**

In light of widespread, ongoing habitat loss and fragmentation, maintaining connectivity between discrete subpopulations of vulnerable species is a conservation priority. To maintain connectivity, management practices must facilitate effective dispersal-i.e., dispersal and subsequent reproduction-among populations. Yet, the factors governing dispersal remain poorly understood. In addition to geographical distance and patch size, dispersal between subpopulations can be affected by the composition and configuration of habitats in the intervening matrix as well as subpopulation attributes, such as density and sex ratio, that affect an individual's propensity to disperse. Here, we investigate the effect of these factors on functional connectivity in the Florida Scrub-Jay (Aphelocoma coerulescens), a Florida endemic restricted to xeric scrub habitat. We combine whole-genome resequencing data from 201 individuals across two time periods (2004-2009 and 2016-present) from nine subpopulations in central Florida with fine-scale land cover data, and 20 years of census data to examine the relative effects of subpopulation attributes and matrix habitat on levels of historical and recent gene flow. As the next five-year review of the Florida Scrub-Jay Recovery Plan approaches, this work provides timely insights for prioritizing functional connectivity between remaining population fragments of this Federally Threatened species.

Birds vs. cows: Impacts of regenerative grazing practices on grassland bird reproduction and habitat quality

J. Shamel, H. Grushon, S. Gilkey, N. Peck, J. Coon, W. Tori
Presenting author: **Jennifer Shamel**

Grassland birds are the most threatened avian group in North America, partially due to non-native grasses, which reduce habitat quality. Cattle grazing can be used to control invasive plants, but may negatively impact birds. We examined the effects of three grazing treatments (ungrazed, intensive-early stocking-IES, and season-long stocking-SLS) on obligate grassland bird abundance, reproduction, and

vegetation composition and structure. We surveyed birds and measured vegetation on 13 sites (2011-2022), and searched for nests (2022) on 6 sites in the Grand River Grasslands of Southern Iowa, yielding 73 nests among 6 species. Supporting our predictions, IES led to increased warm-season grass cover and decreased invasive grass cover compared to SLS, though ungrazed sites had the highest native and lowest invasive cover. We did not detect effects of grazing on reproduction, but fledgling production and nest abundance had a positive relationship with time-since-fire. Intensive grazing shows potential in reducing invasive grasses, but should be used with caution since there may be detrimental effects on birds.

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*Animal Real Estate: Do age, population density, and neighbours influence songbird territory size?

S. Sharma, S. Dobney, R. Norris, S. Doucet, A. Newman, D. Mennill
Presenting author: **Sarika Sharma**

The size of an animal's breeding territory can have important implications for survival and reproductive success. Territory size is a dynamic trait that can be influenced by diverse extrinsic factors. We explored variation in territory size in a long-term study population of Savannah Sparrows on Kent Island in New Brunswick, Canada. Using detailed field observations and geographic information system software, we measured the territory size for 258 males sampled over eleven years. We found substantial variation in territory size, with territories ranging from 1495 – 5727m2. We then compared territory size to the age of the male territorial holders, the number of birds in the study population (i.e. population density), and the number of immediate territorial neighbours (i.e. local density). Across eleven years, we found a relationship between male age and territory size, where older males tended to defend larger territories, and a negative relationship between population density and territory size. At the neighbourhood scale, we found no relationship between local density and territory size. When we included all these factors in a single model, we found that population density exerted the greatest influence on territory size, followed by male age. Our results suggest that older males with high site fidelity are likely dominant over younger males, however, conspecific pressure may restrict the expansion of territory size. Therefore, the territory size of male Savannah Sparrows exhibits plasticity and is contingent upon annual variation in male age and population density during the breeding season.

Assessing the Effect of American Kestrels on Small Mammal, Avian, and Insect Crop-pests of the Lower Mississippi Alluvia

T. Sharrow, T. Boves, V. Rolland, T. McKay
Presenting author: **Ty Sharrow**, Arkansas State University, tysharro@ptd.net

The ecosystem services (i.e., direct predation, perceived risk of predation) provided by native raptors are a potentially sustainable alternative to pesticides. The American Kestrel (Falco sparverius) is a declining generalist predator that may occupy agricultural landscapes where they consume potential invertebrate and vertebrate pests. However, removal of almost all woody vegetation (including snags) in agricultural regions such as the Lower Mississippi Alluvial Valley (LMAV) has eliminated most suitable nesting sites for kestrels and has likely resulted in low breeding densities of kestrels in this, and other agricultural, regions. Fortunately, kestrels can be attracted to otherwise suitable habitats by adding artificial nest boxes. In this study, we installed nest boxes adjacent to row crops (rice, cotton, corn, and soy) in the LMAV of northeastern Arkansas, USA, adjacent to row crops in an attempt to attract kestrels, and then assessed their impacts on small mammal, avian, and insect pest populations. We then conducted small mammal, avian, and insect surveys to assess pest abundances at both occupied and unoccupied nest boxes, and at random points, during the breeding/growing seasons in 2022 and 2023 (May – July). This project will provide information on kestrel nest site selection in northeastern Arkansas and data on the effectiveness of kestrels as pest control agents in a row-crop dominated landscape.

Allometric scaling in bones and feathers drives migration-associated wing variation in Song Sparrows (Melospiza melodia)

A. Sivakumar, S. Shakya, S. Edwards

Presenting author: **Ashwin Sivakumar**

The association of avian migration with wing lengthening and narrowing as quantified by hand-wing index is one of the most robust relationships in ecomorphology. Despite this, the specific integumentary and osteological components of the avian wing that drive this relationship remain unknown. In this study, we investigate how scaling in the individual flight feathers and bones of Song Sparrows (Melospiza melodia) determines variation in overall wing morphology between the species' many phylogenetically independent migratory and sedentary populations. We integrate traditional hand measurement with micro-CT scanning, including a novel method for extracting feather lengths from these scans, to analyze museum study skins and skeletal specimens and characterize hand-wing index, primary and secondary feather lengths, and the morphology of the ulna, radius, carpometacarpus and phalanges across the geographic distribution of this diverse species. We verify dramatic intraspecific variation in hand-wing index associated with migratory behavior, and, for the first time, build a granular map of the specific skeletal and plumage elements that are most strongly associated with this variation, demonstrating how adaptation in a macroscale morphological trait is structured by complex allometry between differentially conserved components.

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*Exploring Mimicry and Visual Communication in Woodpeckers: A Field Study Utilizing 3D-Printed Models

L. Smith, G. Leighton

Presenting author: **Lauren Smith**, SUNY Buffalo State University, laurenms18@gmail.com

The evolution of similar phenotypes poses an interesting challenge in evolutionary biology. While divergent ecologies may drive divergent morphology, physiology, or behavior, similar phenotypes are often due to similar ecology or selection for mimicry. One prominent case of mimetic phenotypes is found in hairy and downy woodpeckers. While several hypotheses might explain the hairy-downy mimicry complex, we aimed to test the idea that downy woodpeckers benefit from resembling hairy woodpeckers. To test this hypothesis, we used 3D-printed models of various woodpecker species in the field. These models were painted with colors that match the reflectance of their feathers, as measured by a spectrophotometer. We intended to test a couple of hypotheses of woodpecker behavior and visualization of different species using the 3D-printed models. The controls for this experiment were the 3D models of the hairy and downy woodpeckers, while the experimental subjects were a red-bellied woodpecker the size of a downy, and a regular-sized white-headed woodpecker. We conducted these experiments in several environments, including rural, urban, and suburban locations across multiple seasons. Our results emphasize the differences in interactions between plumage and woodpecker size in relation to other woodpeckers and third-party species. The results of this work underscore the complex interactions between mimicry and visual communication in woodpeckers and suggest future experiments to further demarcate the benefits of mimicry in woodpecker mimicry complexes.

Drivers of reproductive success in Florida Scrub Jay (Aphelocoma coerulescens) breeding pairs without helpers

O. Smith, S. Barve

Presenting author: **Olivia Smith**

Cooperative breeding is a unique system in which 'helpers' assist with the rearing of others' young. The reasoning behind this strategy has been explored by numerous researchers and continues to be under debate. I aim to use a long-studied population of Florida Scrub Jays (Aphelocoma coerulescens) at Archbold Biological Station as a model system for exploring the evolution of this behavior. To examine heritable variation in length of time spent as a helper, pedigrees will be reconstructed using 298 breeding individuals over four generations (from 2000-2008). To investigate environmental influence on productivity amongst different behavioral phenotypes, I will compare the breeding success of pairs with and without helpers regarding inter-annual changes in acorn abundance (proxy for food availability). From 2000 to 2008, the mean number of acorns annually was 10241 (ranging from 3400 to 18602). How food abundance impacts the productivity of differently sized family groups can provide insight into how breeding behavior in this species may be altered as a result of climate change. This study would not only offer a genetic perspective on cooperative breeding (which is not well represented in the literature), but it

would also aid the conservation of a threatened species through the enhanced knowledge of their breeding ecology.

Dynamic in situ nest warming induces developmental plasticity in six North American passerines

I. Smith, B. Weeks
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Increased temperatures during development can have significant effects on morphology in songbirds, often including developmental plasticity-driven declines in size. Although experimental work has often focused on individual species, consistent warming-driven size reductions across hundreds of bird species from a range of systems suggest this temperature-size relationship may be underlying a widespread climate change-associated mechanism. However, in birds, the relationship between size during development is complex: increases in temperature can stimulate growth when ambient temperatures are low, while inhibiting growth when temperatures are high. This can be described as a game of thermal optima; if birds develop at temperatures above their optimum, they will be smaller at fledge, and vice versa. Much of the evidence related to temperature effects on development come from poultry studies. Comparative work in natural settings is needed to understand variation in temperature impacts on development in non-model species, and to test whether variation in optimal development temperatures may explain variation in temperature-size relationships in the wild. We developed a microcontroller-driven dynamic warming device to accurately maintain cup nests 2Â°C above environmental temperature for the duration of incubation and development. We then measured the effects of the warming on body size, wing length, and rate of development as compared to unheated control nests in 6 passerine species.

Mallard (Anas platyrhynchos) migration chronology and seasonal survival in the Atlantic Flyway

D. Sparks, J. Straub, J. Stiller, N. Huck, M. Weegman, J. Coluccy
Presenting author: **Daria Sparks**, SUNY Brockport, dspar2@brockport.edu

The mallard (Anas platyrhynchos) is the most common duck in the world however, the breeding population in eastern Canada and the northeastern United States declined by 26% (r2 = 0.97) from 1999-2019. The population of breeding mallards in the northeastern US is declining rapidly (-36% over the past 20 years, r2 = 0.98), while the population in eastern Canada and Maine remains relatively stable (-5%, r2 = 0.07). Significant evidence to support one or more causes of population decline is lacking. We initiated a multi-year (2022-2026) study to capture female mallards then affix â‰¤20 g Ornitela GPS/GSM communication transmitters to better understand demographic rates, migration chronology, and habitat use differences. We will compare mallards that breed in Canada and Maine and those that breed in the Atlantic Flyway Breeding Waterfowl Survey area throughout the annual cycle. In year one, we marked 338 mallards in January - March of 2022 from New Brunswick to South Carolina. We plan to mark >750 over the next three years. Results forthcoming include migration and breeding movement distances, departure dates, estimated number of nest attempts, and seasonal survival. We will compare these variables relative to age and location of breeding range (i.e., US vs. Canada). Results and parameters from these preliminary analyses will inform larger project objectives related to building a comprehensive picture of the full annual cycle for mallards in eastern North America. Understanding demographic rates of eastern mallards and potential differences between populations in eastern Canada and eastern U.S. is imperative for managers to effectively model population dynamics and subsequent harvest strategies.

Assessing the impact of wind on avian spring migration: a multi-sensor approach

A. Strand, E. Bridge, J. Kelly, P. Stepanian, D. Bodine, J. Soto
Presenting author: **Alva Strand**

The challenges of studying avian migrants have spurred the development of a variety of remote-sensing technologies to track the movements of these highly mobile animals. While these technologies have revolutionized our ability to study avian migration, large gaps remain in our understanding of this complex biological phenomenon that could be filled by integrating data from multiple technologies. We designed a

proof-of-concept multi-sensor array consisting of a NEXRAD weather surveillance radar (WSR), a mobile WSR, an autonomous moon-watching sensor capable of detecting birds flying in front of the moon, and an autonomous recording unit (ARU) capable of recording avian nocturnal flight calls. We deployed this array at a field site in central Oklahoma on select nights in the spring of 2021 and integrated data from this array with wind data to assess the impact of this abiotic variable on the movements of spring migrants aloft. We found that avian migration intensity was negatively correlated with wind velocity, suggesting that spring migrants favor weaker winds; surprisingly, the highest migration intensities were associated with weak, northerly winds. Furthermore, we found that when faced with strong, southerly winds, migrants took advantage of these conditions by matching their flight directions with those of those winds. Importantly, we found that most of the migration intensities detected by the sensors were intercorrelated, except when this correlation could not be ascertained because we lacked the sample size to do so. This study demonstrates the potential for multi-sensor arrays to provide a more comprehensive picture of the ways in which avian migrants move in response to changing atmospheric conditions aloft.

Grassland bird stopover habitat preferences: site size, vegetation, and surrounding landscape

N. Suckow, M. Ward

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Grassland birds are the fastest declining guild of birds, largely due to habitat loss. While this has led to more research on grassland habitat use of breeding birds, their habitat preferences during migration remain understudied. By analyzing transect survey data collected in 2022 from grassland sites throughout Illinois, we determined which grassland qualities were most preferred and likely to better support grassland species during this period of heightened energy demands. We evaluated the relationships between grassland bird abundance and occupancy with habitat features such as the grassland size, vegetation composition, and the surrounding landscape. Preliminary results suggest that the relative importance of any one of these features varies among our focal species. We then compare highest ranked models between species and seasons. Determining which features have the most significant additive effects on overall grassland bird abundance will inform future grassland management, and ideally lead to higher-quality stopover sites and conservation efforts for grassland birds.

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*The prey-predator network between migratory shorebirds and invertebrate community in a stopover tidal flat in Japan

M. Tatani, J. Hosoya, Y. Takeda, O. Kagawa, S. Chiba

Presenting author: **Masanori Tatani**, Graduate School of Life Sciences, Tohoku University, masanoritatani@gmail.com

Shorebirds have often been the subject of studies on niche partitioning and multi-species coexistence as they assemblage in flat environments, such as tidal flats. However, among the studies that have examined food niche partitioning, the results have not always been consistent, with both cases of food niche partitioning and cases of no food niche partitioning being reported. In addition, the mechanism of multi-species coexistence at stopover sites was not fully known, despite the fact that 60% of the species migrate long distances annually and significantly change their habitats. The Torinoumi tidal flat in Miyagi, Japan is a stopover site for shorebirds, where multiple species coexist temporarily in the same area in spring and fall. We captured 631 individuals of 29 species of shorebirds in spring and fall from 2019 to 2022, and collected 273 fecal samples for detailed dietary analysis using DNA metabarcoding. Shorebirds in Torinoumi fed on a wide range of invertebrate taxa, including annelids, mollusks, and arthropods, and their food community composition varied significantly among species, indicating a food niche partitioning. However, this trend was significant in fall but not spring, suggesting that the community networks between shorebirds and invertebrates differed between spring and fall. The mechanism by which the multi-species coexistence of shorebirds is achieved may be due not only to the previously postulated specialization of bill morphology to prey items, but also to the bottom-up effects of the prey community dynamics.

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*Character displacement of mountain chickadee song where they co-occur with

black-capped chickadees

O. Taylor, K. Grabenstein, A. Theodosopoulos, H. Leeson, S. Taylor, C. Branch
Presenting author: **Olivia Taylor**

Mechanisms for species recognition are important when closely related species overlap in their ranges because hybridization (i.e., the interbreeding between two species) can be costly. Hybridization is maladaptive when it results in wasted reproductive effort, inviable offspring, or offspring with reduced fitness. When hybridization is costly, the characters used for species recognition may diverge where species co-occur. In passerine birds, song is an important mechanism of species recognition. The black-capped chickadee (Poecile atricapillus) and the mountain chickadee (Poecile gambeli) are two closely related species with both geographically isolated (i.e., allopatric) and geographically overlapping (i.e., sympatric) populations; in the latter, hybridization has been observed on numerous occasions. In this study, we compared songs of allopatric and sympatric populations of black-capped and mountain chickadees. We tested whether song divergence is greater in sympatry compared to allopatry given the potential selective pressures for species to avoid hybridization. As such, we predicted that songs of sympatric black-capped and mountain chickadee populations would be more divergent from each other than those of allopatric populations. We found that sympatric mountain chickadees produced more notes per song and were more likely to include an extra introductory note compared to allopatric mountain chickadees. Our findings support our predictions of character displacement in avoiding maladaptive hybridization.

Quantifying fertility and embryonic mortality in an aerial insectivore, the tree swallow (Tachycineta bicolor)

H. Tench, R.D. Dawson
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Aerial insectivores in North America have rapidly declined over the past half-century, and factors contributing to these declines are still poorly understood. Egg development is a crucial stage in the life cycle of a bird, and up to 15% of eggs laid in aerial insectivorous species may remain unhatched under otherwise normal conditions. An unhatched egg is either infertile or contains a dead embryo. Methods to distinguish between the two types of unhatched eggs, however, have been underused by researchers due to the difficulty of confirming fertility when evaluating unhatched eggs in the field. Aerial insectivores that use nest boxes, such as tree swallows (Tachycineta bicolor), are an ideal study species in which to investigate hatching failure, as nesting behaviour can be monitored closely throughout the season. In 2022, I monitored 475 eggs from 78 occupied nest boxes at two tree swallow populations breeding near Prince George, British Columbia. Using fluorescence microscopy, I determined almost all eggs were fertile, and thus most cases of unhatched eggs were due to embryonic mortality. Embryonic mortality was most likely to occur either during early incubation before development was macroscopically visible, or during late incubation as the embryo prepared for hatch. In future work, I will be examining the influence of weather and the age and condition of females on rates of fertility and embryonic mortality to identify potential factors constraining egg viability in the species. This study is the first to quantify fertility and developmental stages of embryonic mortality in tree swallows and will provide opportunity for further investigation into factors contributing to hatching failure in aerial insectivores.

Oxidative costs and constraints of territory quality on reproductive effort in male black-throated blue warblers

B. Thomson, S. Kaiser
Presenting author: **Braeden Thomson**

Life-history evolution is constrained by reproductive costs, as indicated by trade-offs between investing in current reproduction and future reproduction and survival. The physiological mechanisms underlying these trade-offs, however, are not well understood. Oxidative stress is a strong candidate mechanism for mediating the costs of reproduction. Yet, few studies have focused on links between oxidative stress and reproductive effort. We tested the hypotheses that reproductive effort generates oxidative stress (oxidative-cost hypothesis) and that oxidative stress restricts reproductive effort to mitigate the costs of

reproduction (oxidative-constraints hypothesis). We examined oxidative costs and constraints of maintaining territories that differ in size and quality on male reproductive effort in the migratory Black-throated Blue Warbler (Setophaga caerulescens) across a habitat quality gradient at the Hubbard Brook Experimental Forest, NH. From May-Aug 2021-2023, we collected plasma from breeding males early and late in the breeding season and measured oxidative status (ratio of pro-oxidants to antioxidants), and estimated territory sizes of color-banded males using kernel estimation, territory quality using caterpillar biomass indices, territorial defense effort over the breeding season, provisioning effort from nest videos, and total male reproductive success (within-pair and extra-pair young) using molecular parentage analysis. We discuss how territory size, quality, and defense and reproductive effort are associated with early- and late-season oxidative status. Our work provides insight into the physiological mechanisms that mediate the cost of reproduction that are key to understanding life history evolution.

Examining micro-geographic variation in ‘Apapane (Himatione sanguinea) vocalization and motif usage

A. Lopardo, M. Edwards, B. Thomson, P. Hart, P. Ditzel, B. Gottesman
Presenting author: **Braeden Thomson**

The repertoire of the 'Apapane (Himatione sanguinea), a honeycreeper endemic to the Hawaiian Islands, consists of several hundred memes whose frequency and structure change spatiotemporally across isolated habitats. The diversity of dialects may drive insights into biological and ecological factors of fractured ecosystems, applicable to a wide range of endangered sparse avian populations. At Hakalau National Wildlife Refuge, HI, we observed a distinct 'Apapane motif that only appeared near the border between restored and primary forest. We hypothesize that 'Apapane can exhibit extreme micro-geographic variation in their motifs, potentially to mediate interactions between two subpopulations: short-term, opportunistic feeders and long-term residents. To quantitatively test for this micro-geographic variation, we established a 750-meter transect. Every 150-m, we collected focal recordings, deployed passive acoustic recorders that continuously recorded for 3 days, and conducted point counts to determine the ratio between this distinct motif and the total number of 'Apapane songs. We then created a deep learning model to automatically detect occurrences of this motif across the passive acoustic dataset. Our point count survey and deep learning model suggest a unimodal distribution of motif call density across the transect. Results from the deep learning model will describe more accurately the extent of this variation, including its daily temporal patterns. Dialect shifts at this scale are a rarely documented phenomenon in avian acoustic ecology. This study is applicable to a variety of conservation implications such as endangered endemic Hawaiian honeycreepers, deforestation, and habitat fragmentation.

Factors influencing spatial and temporal patterns of Loggerhead Shrike occupancy at a grassland-sagebrush ecotone

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The Loggerhead Shrike is a predatory songbird that has experienced a severe population decline throughout its range since the 1940s, due primarily to habitat loss and fragmentation. Having raptorial behavior, this species occupies large territories consisting of open habitat with interspersed trees and shrubs for nesting and perching, and heterogeneous groundcover that provides hunting and foraging opportunities. While Loggerhead Shrike habitat preferences during breeding and non-breeding seasons are generally well-known, few studies have assessed factors driving local occupancy. As large-scale habitat connectivity and landscape-level characteristics affect Loggerhead Shrike occurrence, changes in local occupancy may be an indicator of habitat quality as land cover composition changes or becomes fragmented. We addressed this knowledge gap by analyzing 8 years of Loggerhead Shrike presence/absence data collected during breeding bird point count surveys at a grassland-sagebrush ecotone in northeast Wyoming. We quantified Loggerhead Shrike detection and occupancy probability using a multi-season dynamic occupancy modeling framework. Using remotely-sensed land cover data from the Rangeland Analysis Platform, we evaluated how initial occupancy and subsequent colonization and local persistence are influenced by land cover composition and change. Furthermore, we used meteorological data to assess the influence of weather (e.g., temperature) on detection probability. Our

results provide insight into factors driving local occupancy of Loggerhead Shrike in a grassland-sagebrush ecosystem, information that will be useful for designing and implementing management and conservation strategies for this declining species.

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*The Impact of Lights Out Campaigns on Artificial Light at Night and Migratory Bird Fatalities

G. Trankina, K. Horton, C. Burt, A. Khalighifar, C. Silva, H. Jenkins-Smith, A. Fox, M. Leon-Corwin, J. Kelly

Presenting author: **Grace Trankina**, University of Oklahoma, gtrankina@ou.edu

Fatal bird collisions are the second largest source of avian mortality, resulting in upwards of one billion individuals annually across the United States. Artificial light at night (ALAN) exacerbates collisions by attracting and disorienting birds. In attempts to reduce bird collisions, Texas city governments resolved to reduce ALAN from 11pm to 6am during peak bird migration. The effect of this resolution is untested. If the Lights Out, Texas program is effective, I have two hypotheses; (1) that the Lights Out, Texas campaign will result in measurable light reduction; and (2) that higher levels of ALAN during migration season will be a significant predictor of the number of bird collisions observed during the lights out period. I gathered sky brightness data in magnitudes per square arcsecond (MSAS) using 12 sky quality meters at Lights Out participant buildings in Dallas and Houston. Volunteers conducted bird collision surveys to document fatalities during Lights Out. To address the effects of the campaign on ALAN, I created calibration curves to adjust for moon phase and angle to isolate the change of artificial light sources and analyzed the difference in MSAS using a mixed effects model. To address my second hypothesis, the nightly total fatality occurrence surveys are compared against the citywide calibrated MSAS and other covariates that may influence fatalities such as weather and migration intensity. This analysis assesses the importance of ALAN as a predictor in the number of collision mortalities during lights out. Together, these two findings allow us to connect city-level policy proclamations to concrete conservation outcomes, and illustrate a path forward to protect migratory birds across the country.

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*Social Transmission of Predator Information Through Referential Alarm Calls Within and Across Species

C. Trebac

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Animals can encode information about a predator's size, identity, or threat through alarm calls. This can provide referential information that can be used by individuals within and across species receiving the information. Referential alarm calls can encode information through changes in structure or rate of the call, and these variances in their call can elicit different responses, such as fleeing or mobbing. We investigated whether white-breasted nuthatch alarm calls can encode referential information and elicit different responses from conspecifics. A related species of nuthatch varies their call rate in the presence of direct predators and mob more aggressively to heterospecific referential alarm calls, but no studies have evaluated if the varied calls of nuthatches subsequently elicit more aggressive mobbing behavior in conspecifics. Our study evaluated the mobbing behavior of white-breasted nuthatches in response to a high-rate conspecific alarm call, a low-rate conspecific alarm call, and a control. The high and low rate treatment alarm calls, made by playing referential black-capped chickadee alarm calls to white-breasted nuthatches, were played to conspecifics in forested locations. White-breasted nuthatches elicited mobbing behavior in response to high and low rate alarm calls through horizontally approaching the speaker from which the alarm call played. However, the nuthatches' mobbing behavior was not statistically significant between the high and low rate conspecific alarm calls. This study gives insight into the propagation of predator information through species commonly associated with each other and the potential implications of eavesdropping and responding to alarm calls within and across species.

Increasing diversity and inclusion in ornithological societies

L. Grieves, L. Howes, E. Gow, R. Chicalo, C. Estevo, A. McKellar, J. Ng, J. Reynolds, H. Tench, A. Westwood, z nanji, M. Triana, N. Koper

Presenting author: **Maria Triana**

Members of minoritized groups are underrepresented in professional societies across North America. In response to this, the Society of Canadian Ornithologists started its first EDI committee three years ago. Since then, we have introduced a number of programs to change our systems, policies, and actions to increase inclusiveness. Actions have included demographic surveys, free memberships to members of underrepresented groups, fundraisings events, virtual monthly social groups for members of underrepresented groups, webinar series of career development, a mentorship program, and an inclusivity-oriented free-registration virtual meeting focused on the work done by students and early-career researchers, and on amplifying voices from the Global South. We attribute the positive outcomes to our society, including increases in number and diversity of members, to several principles: 1) the EDI committee was primarily composed of members from groups that have been historically marginalized (underrepresented groups), to ensure these experts hold the primary power for directing change; and 2) Council members from outside the EDI committee implemented recommendations, to help ease the overburden that EDI work entails (very high rates of burn-out on EDI committees), and for allies, can result in transformative learning and feelings of being part of the solution. We believe that EDI work and skills and career development programs benefit all members of societies while decreasing equity gaps by ensuring that members from historically minoritized groups experience increased feelings of belonging, competence, confidence, collegiality, and of identifying as a professional or member of a discipline.

The impact of energy extraction noise on two grassland songbirds in the Mixed Grasslands of Alberta

M. Triana, N. Koper
Presenting author: **Maria Triana**

Biodiversity in North American grasslands is increasingly threatened due to habitat conversion resulting from human land use activities. Grassland songbirds, for instance, have experienced significant declines over recent decades. This study examines the impact of anthropogenic noise on habitat use on two declining grassland species, the Chestnut-collared Longspur (Calcarius ornatus) and the Savannah Sparrow (Passerculus sandwichensis), which are adversely affected by activities causing habitat loss and fragmentation such as agriculture and energy extraction (oil and gas). Beyond direct habitat alteration, energy extraction generates noise that can render landscapes less suitable for these species. In fact, energy extraction noise influences the abundance, nesting success, and adult and nestling body condition of both Chestnut-collared Longspurs and Savannah Sparrows. Utilizing previously calculated ecological footprints of energy extraction noise on the species' ecological responses, this study aims to estimate the proportion of habitat in the Mixed Grassland ecoregion of Alberta that is impacted by noise, as well as identify locations that could be prioritized for protection based on low impact from energy extraction noise and high bird density. The area of interest is characterized by one of the highest energy extraction densities in Canada and contains a substantial portion of the total Chestnut-collared Longspur population, a species at risk. Consequently, this project may reveal that the habitat quality for these bird species is lower than initially anticipated, underscoring the need for targeted conservation efforts.

Inferring habitat preferences for an Endangered grassland bird using within breeding season movements

A. Tringali, E. Abraham, G. Thompson, R. Bowman
Presenting author: **Angela Tringali**, Archbold Biological Station, atringali@archbold-station.org

The Florida Grasshopper Sparrow is Endangered, with fewer than 300 individuals existing in the wild. Florida Grasshopper Sparrows have higher abundance and reproductive success in recently burned prairie, but the associated habitat structure and sparrow preferences remain poorly understood. We studied an individually-banded population of Florida Grasshopper Sparrows occupying two contiguous prairies burned in alternate years. We conducted point count surveys, searched for and monitored nests, and assessed habitat during the breeding season. Then, we used within breeding season movements and differences in habitat structure to infer habitat preferences. We discuss preferred habitat characteristics and the use of prescribed fire as a management tool. Our results are used to improve

habitat management for this imperiled bird.

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*Taxonomic revision and phylogenetics of the Vireolanius leucotis complex reveals complex evolutionary history

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The Amazon forest of Brazil contains one of the most diverse avian assemblages in the world, providing essential ecosystem services to communities of other animals, plants, and local inhabitants. However, the avian diversity of the region is not very well understood, limiting our understanding of evolutionary history in the region as well as the effectiveness of conservation. Vireolanius leucotis is a canopy-dwelling shrike-vireo in the family Vireonidae with a disjunct range across northern South America. Molecular phylogenetics has revealed that Vireonidae has an Old World origin and diversified in the New World following a single colonization event . The genus Vireolanius is one of the earliest-branching clades of New World Vireonidae, meaning that understanding the mechanisms by which the clade radiated could provide valuable insight into early drivers of speciation following a founder event. However, to date, no subspecies-level phylogeny has been created for Vireolanius leucotis and the history of diversification in the genus is poorly understood. Based on reduced representation genomics, audio recording analysis, and morphological inspection of museum specimens, here we provide the first phylogenetic trees, population structure assessment, and taxonomic review of the Vireolanius leucotis complex. Our results suggest a restructuring of the taxonomy of the entire genus, and the presence of one undescribed cryptic taxon in Central Amazonia, which is vocally distinct from all other birds in the complex. Our results indicate a complex and dynamic relationship between Vireolanius leucotis subspecies and Amazonian river barriers, suggesting a putative contact zone between two taxa at the Sucunduri River headwaters.

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*Evaluation and application of a deep neural network, BirdNET, for bird sound detection

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Spatiotemporal variation of avian biodiversity is a commonly used indicator of environmental change. Conventionally, such information was derived with human observers, while passive acoustic monitoring (PAM) with autonomous recording units (ARU) is rapidly emerging as an alternative survey method. Given the large amount of acoustic data PAM can potentially collect, effort has been made to develop algorithms to automatically classify acoustic data. One of the most successful attempts is the recent development of a deep neural network, BirdNET, that can identify 984 North American and European bird species by their sound. However, systematic evaluation of this neural network is lacking. In this study, we aimed to evaluate the accuracy of BirdNET for detecting bird species in western Canada. A total of 66 ARUs were set up in John Prince Research Forest, BC Canada during May - July 2020 and 2021, resulting in about 67,000 one-minute recordings (about 1,000 hours) of acoustic data. We applied BirdNET to the dataset and assessed the accuracy in detecting 20 common local species that vary in their level of vocal activity. For each species, we selected 180 three-second sound segments identified by BirdNET, and compared the observed detection (by human listener) with predicted detection (BirdNET detection confidence). Our results indicate that BirdNET had fairly strong detection accuracy, but did vary slightly between species and habitats. This study provides a foundation for future studies that requires application of automatic detection in avian biodiversity monitoring using PAM techniques.

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*Evaluating the influence of overwintering conditions on prealternate moult phenology in Neotropical migratory warblers

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Despite the importance of moult for flight, thermoregulation, and social signalling, it remains one of the least understood events in the annual cycle of migratory birds. Prealternate moult has received far less attention than prebasic moult because it occurs during one of the least-studied periods of the annual

cycle: overwintering. Understanding the factors that shape prealternate moult phenology is critical for understanding the evolution of this moult strategy and its potential importance to social signalling and breeding success. Here, we provide a detailed description of the timing, prevalence, and intensity of prealternate moult in six common Neotropical migrants during the overwintering period in southwestern Jamaica. We investigated the role of winter habitat quality in influencing patterns of prealternate moult to better understand the nonbreeding implications of habitat quality on individual moult. We captured birds in two distinct habitats that varied in quality. Upon capture, we visually scored the extent of moulting contour feathers in each of 17 patches across the head and body and then estimated body condition as a scaled mass index. We predicted that population-level peak moult intensity will be delayed in low-quality habitat, and individual moult intensity is correlated with body condition. Initial results demonstrate that moult commenced earlier than expected (late Jan to mid-Feb) in five of six focal species and exhibited substantial intra- and inter-specific variation. Ultimately, these results advance our understanding of prealternate moult in Neotropical migrants and will serve as a foundation for examining the role of moult in carry-over effects from winter to migration in our study population.

Movement ecology and health of urban wildlife: from herbivores to raptors.

S. Uiterwaal, S. Blake, A. Dell, J. Meshach, S. Deem

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Movement is fundamental to ecological interactions as it underlies the rate of encounter, a necessary condition for most interactions between animals. All animals move at some time in their lives to both access resources and avoid risks. Yet despite the integral role movement plays in structuring species interactions, most studies focus on a single species or a small group of closely related species. Furthermore, despite a growing body of literature describing impacts of cities on wildlife and the increasing importance of urban parks for wildlife conservation, scientists currently lack an understanding of community-level effects of urbanization. Lastly, with emerging infectious diseases at the human/non-human animal interface gaining importance for public health, we must better understand the ecology of these diseases, including the movement of hosts and pathogens. To address these gaps and better understand the movement of biodiversity in an urban food web, we are fitting GPS trackers on trophically and phylogenetically diverse species in Forest Park, a spectacular urban park in the heart of St. Louis. In addition, we are quantifying baseline health parameters and infectious and non-infectious disease prevalence for the species we track, linking movement with disease dynamics in an urban setting. To date, we have GPS tagged ~40 individuals of different species representing a diversity of taxa and trophic levels. With a focus on the avian species in our study (including Great Horned Owl (Bubo virginianus) and Mallard (Anas platyrhynchos)), I will present preliminary results on how species interactions and human impacts structure movement within ecological communities.

Effects of captivity on the cloacal microbiome of Dark-eyed Juncos (Junco hymenalis)

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The microbiome plays a significant role in the overall health and normal function of organisms, but microbiome studies are still relatively new in avian species. We have previously published our study of the uropygial gland microbiome of dark-eyed juncos (Junco hymenalis) and found that microbiome composition differed between migratory and resident juncos and decreased in diversity over time in captivity but did not significantly alter preen oil composition. For this study, we are characterizing the cloacal microbiome of the same birds. Using DNA extracted from cloacal swabs, we sequenced the V4 region of the 16S rRNA gene. We used QIIME2 to denoise the sequences, remove any phiX or chimeric reads, and assign taxonomy. The R package phyloseq was used to calculate alpha and beta diversity metrics. As with the uropygial gland microbiome, we found an overall decrease in alpha diversity over time in captivity. We also found that migratory females have a less diverse cloacal microbiome when compared to migratory males and resident females. Finally, we have seen that the overall community composition is significantly different at the various timepoints of the experiment. We plan to continue our analysis to identify which bacterial taxa are changing in prevalence and abundance when comparing the

various groups and whether the cloacal microbiome of individuals in mixed-sex pairs becomes similar over time. The data from this study will be useful in informing the scientific community how captivity can alter the microbiome and opens potential avenues for research into how these changes can affect the overall health of the captive host organism.

An elevational phylogeographic diversity gradient in Neotropical birds is decoupled from speciation rates

K. Wacker, B. Winger

Presenting author: **Kristen Wacker**

While speciation is fundamentally responsible for the incredible breadth of biodiversity in our world, the rate at which species form varies widely across space, time, and the tree of life. A key question about macroevolutionary speciation rates is whether they are controlled by microevolutionary processes operating at the population level. For example, does spatial variation in population genetic differentiation underlie geographical gradients in speciation rates? Previous work suggests speciation rates increase with elevation in Neotropical birds, but underlying population-level gradients remain unexplored. In this work, we characterize elevational phylogeographic diversity between montane and lowland birds in the megadiverse Andes-Amazonian system and assess its relationship to speciation rates to evaluate the link between population-level differentiation and species-level diversification. We aggregated and georeferenced nearly 7000 mitochondrial DNA sequences across 103 species or species complexes in the Andes and Amazonia and used these sequences to describe phylogeographic differentiation across both regions. Our results show increased levels of population structure in the mountains compared to the lowlands, but we find that higher rates of population differentiation do not predict higher rates of speciation. This suggests that most population structure is ephemeral across evolutionary time.

Assessing high migratory connectivity for the imperilled Newfoundland Gray-cheeked Thrush to a restricted winter range

I. Warkentin, D. Whitaker

Presenting author: **Ian Warkentin**

Migratory connectivity links breeding and wintering areas for avian populations such that declines seen at one should be mirrored at the other. The Newfoundland subspecies of Gray-cheeked Thrush (Catharus minimus minimus) has declined by ~95% since the 1980s and is now seldom encountered across most of its geographically-restricted historical breeding range. While the winter range of Gray-cheeked Thrush spans much of northern South America, museum specimens suggested that the Newfoundland subspecies may winter in a restricted area peripheral to the species' core range and centered on the Sierra Nevada de Santa Marta (SNSM) in northern Colombia. However, recent studies indicate that the species is now extremely rare in this region during winter. Data from three males fitted with archival GPS tags in western Newfoundland during a pilot study in 2016 reinforced perceptions of a more restricted nonbreeding range, as they wintered an average of 167 km from each other in the SNSM region or just across the border in Venezuela. A handful of locations recorded during fall migration suggested that they traveled south across or around the western Caribbean. During summer 2022, we fitted an additional 32 male Newfoundland Gray-cheeked Thrushes with updated GPS tags having greater data storage capacity, enabling us to collect more information on wintering areas as well as greater resolution on the routes traveled during southbound migration. Here we will present movement data from tags retrieved during summer 2023 to confirm whether the Newfoundland Gray-cheeked Thrush has high migratory connectivity between equally restricted breeding and wintering ranges, while also offering new information on the species' migration behaviour.

Prevalence of year-round breeding plumage in Australian Fairywrens on a continental scale

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Many bird species molt twice per year and exhibit distinct non-breeding and breeding season plumages.

In multiple species of Australian fairywrens, the timing of pre-alternate molt is a sexually-selected trait, with males that molt into breeding plumage early in the non-breeding season siring more extra-pair young than males who molt late. However, it is not uncommon for a few older males in a population to maintain ornamented breeding plumage year-round. Aside from one species where year-round breeding plumage has become a fixed trait, it is unclear how widespread this phenomenon is among the remaining fairywren species and whether its presence is related to climate. Here we present data on the prevalence of year-round breeding plumage in fairywren populations across Australia, collected through our citizen science project, the Fairywren Project. Using observations of fairywren plumage types collected through eBird, we compare the presence and absence of year-round breeding plumage to past and current climate conditions to better understand the abiotic environmental drivers of this phenomenon. Given that timing of molt is a sexually-selected trait, our findings may have important implications for variation in the strength of sexual selection among fairywren populations inhabiting different environments.

Using avian energetics and migration modeling to predict fates of sublethally oiled birds

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For birds, mortality and adverse health effects are common consequences of oil spills. Existing models allow for the estimation of the number of birds killed by an oil spill, but fewer efforts model the sublethal consequences of oiling and the time between oiling onset and death. Previous work by our research group showed the value of computer modeling in addressing these research gaps by combining data on increased thermoregulatory costs of oiling with a modified version of an existing temperature-influenced avian migration energetics model. This initial model examined the potential effects of oiling on general migration patterns, changes in energetic gains needed to compensate for oiling, and starvation. Using the mallard (Anas platyrhynchos) as the model organism, we predicted a delay in spring arrival to the breeding grounds of 32 days (median; 95% interquantile range = [20 to 44]), or a required energetic gain increase on stopovers of 20.3% [12.4 to 28.7%] so that a trace-oiled bird could arrive at the breeding grounds in the same body condition as an unoiled bird. Our current efforts aim to incorporate the components of this initial model into a spatially explicit, population scale model. We intend this model to estimate alterations in reproductive output and indirect mortality of sublethally oiled birds. In addition to thermoregulatory effects of oiling, we plan to incorporate toxic effects of oiling and increased flight costs caused by feather fouling. Knowledge generated using this model is meant to benefit incident managers by providing impact projections, providing scientifically-sound injury estimates, and aiding in wildlife monitoring and response activities.

Drivers of breeding Eastern Whip-poor-will (Antrostomus vociferus) prey selection and availability in the Midwestern US

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Despite the nostalgia associated with the familiar song of the Eastern Whip-poor-will (Antrostomus vociferus) across its breeding range, the species remains a relatively understudied member of the aerial insectivore feeding guild, a taxonomically diverse group that has experienced alarming declines across North America. Recent research has demonstrated whip-poor-will's dependence on night-flying insects, particularly medium- to large-sized moths, as a food source. Given increasingly well-documented declines across a wide range of insect taxa, this reliance has raised concerns about food availability for breeding whip-poor-wills. To inform these concerns, we conducted hundreds of hours of insect trapping using ultraviolet-light traps on whip-poor-will breeding grounds in central Illinois. Insect traps were distributed across forests, grasslands, and edges and lit during one of three 90-minute time blocks (dusk, midnight, and dawn) to assess spatiotemporal activity patterns of potential prey. We also collected over 100 fecal samples from breeding whip-poor-wills at these sites, on which DNA metabarcoding was conducted to determine the species consumed. We compared this metabarcoding evidence with our insect trap samples to determine the shared attributes of the prey selected by whip-poor-wills, including body size, taxonomic classification, nutritional content, and patterns of spatiotemporal abundance. These insights

into the foraging ecology of this cryptic species could provide crucial clues to the drivers of their declines and illuminate promising future directions for conservation efforts.

Improving pileated woodpecker modeling: optimizing acoustic data and evaluating habitat use metrics

A. Zeller, E. Bayne, C. Mahon
Presenting author: **Austin Zeller**

Modern songbird surveys often fall short in properly detecting pileated woodpecker's (Dryocopus pileatus) breeding behaviors and can lead to inadequate modeling. We investigated the temporal variation of pileated woodpecker drumming behavior using autonomous recording units (ARUs) in Alberta, Canada. Results revealed a significant relationship between pileated woodpecker drumming behavior and day of year, with a peak in activity during early spring/late winter. We also revealed a significant relationship between pileated woodpecker drumming and time of day, with the highest activity observed around sunrise and a secondary peak in the evening. We recommend future sampling to take place around the first week of April and to focus on the time period of one hour after sunrise for the highest probability of detection. Using these results we were able to build two habitat models using different indices of habitat use: intensity of use and occupancy. It is our belief that occupancy does not fully describe how an animal is using the landscape. By exploring intensity of use, we hope to better explain pileated woodpecker habitat relationships. The findings provide insights into the temporal dynamics of pileated woodpecker drumming behavior, along with the species habitat associations, and can inform conservation and management efforts for the species, as well as serve as a tool for studying the pileated woodpecker.

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*Phylogenomics of the genus Rhegmatorhina

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Amazonia represents a natural laboratory for the study of avian speciation, with rivers carving barriers to gene exchange and creating centers of endemism full of examples of recently-diverged allopatric species. The antbird genus Rhegmatorhina represents a classic case in Amazonian biogeography, in which rivers and tributaries serve as barriers for individual movement and gene flow. However, the current inferences of evolutionary history of Rhegmatorhina are solely based on phylogenetic trees obtained from few mitochondrial and nuclear markers, leaving some relationships unresolved. Here we use Rhegmatorhina genomic sequences (ultraconserved elements - UCEs) and full mitochondrial genomes from 57 museum specimens to investigate the phylogenetic relationships within the genus. Our results suggest fundamental differences between phylogenetic trees built with UCEs and mitochondrial genes, like R. cristata as sister of all other species of Rhegmatorhina, as opposed to forming a clade with R. melanosticta. In the UCE phylogeny, we also find no clear relationship between the two clades of R. hoffmansi (A and B) supported by mitochondrial markers, which could indicate how the disparities between mitochondria and nuclear markers, mutation rates, introgression and inheritance patterns can act as confounding factors when inferring the evolutionary history of Amazonian birds. Further studies are necessary to clarify whether mitochondrial relationships reveal the history of lineages which no longer exist due to introgression and recombination in the nuclear genome.
