ORAL PRESENTATION ABSTRACTS

NADS 8
NORTH AMERICAN DUCK SYMPOSIUM
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A.1-2: Progress in Understanding Stakeholder and Public Preferences for Waterfowl Hunting, Viewing, and Conservation

Presented by: Nicholas Cole (ncole@contractor.usgs.gov)

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Beginning in 2012, the North American Waterfowl Management Plan called for a fundamental shift in perspective by seeking to explicitly addressing the connections between ecological and social systems within broad scale management of waterfowl and wetlands in North America. Beginning with a series of workshops, hunters (n = 9,144), bird watchers (n = 36,908), and the public (n = 1,030) were surveyed in the U.S. and Canada with the objective of informing strategic approaches to strengthen connections to, and support for, waterfowl and wetland conservation. Each survey integrated theory-driven approaches assessing attitudes and behaviors, identity, social networks, and preferences for participation among outdoor recreation. Although the initial descriptive reporting is complete (https://nawmp.org/documents), analysis continues with the intention of testing the applied theoretical models and informing potential approaches to nurture positive wetland-related conservation behavior and grow participation in waterfowl-related activities like hunting and birdwatching. One such approach was the use of discrete-choice experiments, parameterized by the initial workshops, to quantify the preferences and expected behavior of hunters and birdwatchers. Though it is valid to consider hunters and birdwatchers as homogenous population segments, previous research suggests it is important to account for potential heterogeneity that may exist in the perceptions of those population segments. Latent class analysis allows for the within-group heterogeneity to be accounted for within the discrete-choice experiment, and for the most appropriate groupings to be identified. This deeper dive into the surveys provides results that are important to future strategic plans designed to meet the goals of the North American Waterfowl Management Plan, and in turn, an example of how human dimensions information can be successfully applied within a wildlife management.

A.1-3: America's Shifting Wildlife Values, Attitudes, and Wildlife Management in the U.S.

Presented by: David C. Fulton (dcfulton@umn.edu)

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Wildlife management agencies are facing increasing social conflict and unprecedented scrutiny. The agencies are challenged by issues such as decline in hunting participation, public controversy with management actions and policies, disagreement about wildlife-human conflict, declining environmental conditions, and diminishing funding. We use the results from the America's Wildlife study to help explain how these issues have emerged as a result of the shifting social context within the United States. We draw from finding of three studies including the 2018 national survey wildlife values survey (n = 43,949 respondents, 50 states) and the 2018 agency culture survey (n = 9,770 respondents, 28 states). We use a systems model perspective to examine the rise of mutualist values and a shift away from more traditional utilitarian values toward wildlife. The consequences of this shift are critical for public attitudes toward wildlife-related issues and, we propose, will ultimately have an effect on fundamental aspects of wildlife agencies. This presentation will provide an overview of the theory social value change: current composition of wildlife values in the U.S. and effects on attitudes; longitudinal trends of value shift; and the apparent effect of value shift on agency culture.

A.2-1: Spatial Integration of Biological and Social Objectives to Identify Priority Landscapes for Waterfowl Habitat Conservation

Presented by: Anastasia Krainyk (akrainyk@usgs.gov)

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Waterfowl population management and habitat conservation compose one of the oldest and most successful adaptive management frameworks in the world. Since its inception, NAWMP has emphasized strategically targeted conservation investments in regions that most affect waterfowl population dynamics. By 2012, regional conservation had become more science-based and strategic: many migratory bird partnerships had ongoing projects on mapping and modeling waterfowl distribution and abundances using geospatial techniques. However, when developing a map depicting "Areas of Greatest Continental Significance to North American Ducks, Geese, and Swans" for the 2012 NAWMP Revision, waterfowl professionals articulated the need for improved decision frameworks and use of consistent datasets for refining large-scale spatial products depicting priority areas for waterfowl and people. We describe a framework for developing a spatial value model to support the identification of North American geographies of importance to waterfowl during the breeding and non-breeding periods and to resource users who could potentially support waterfowl habitat conservation. Objectives used to identify priority geographies were determined through a collaborative process of the Priority Landscapes Committee (PLC), and other experts in the fields of waterfowl ecology and human dimensions. ArcGIS Desktop was used as the platform for analyzing the spatial data as well as producing new data through spatial analysis functions. Thirty-eight spatial layers were developed, and several composite spatially explicit were produced based on PLC recommendations. The composite products have extensive similarities to the 2012 NAWMP map depicting areas of greatest continental significance to North American waterfowl.

The structured decision-making framework application in this study is discussed, and the appropriate use of the products and their limitations are outlined. Options for future improvements are presented by identifying gaps in data collection, waterfowl-habitat association assumptions, and uncertainties related to social objectives. These spatial products are intended for use by national, regional, and province/state level wildlife professionals to aid decisions about waterfowl habitat conservation.

A.2-2: Balancing waterfowl hunting opportunity and quality to recruit, retain, and reactivate

Presented by: Michael L. Schummer (mlschumm@esf.edu)

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Waterfowl hunter numbers and waterfowl populations were closely correlated until the past two decades when hunter numbers declined despite near record duck breeding population estimates in North America. This apparent decoupling of waterfowl numbers and hunter participation has raised concerns about the future of the hunting tradition and more importantly, the sustainability of the North American hunter-funded game conservation model. As a result, efforts to recruit, retain, and reactivate waterfowl hunters (R3) have been promoted by the North American Waterfowl Management Plan community and many state and federal agencies and non-profit conservation organizations continent-wide. Currently, it appears that increasing access and opportunity for hunting is a primary R3 strategy being used across North America by agencies and other non-governmental organizations and this is reflected within many state-level R3 plans and recent U.S. Fish and Wildlife Service actions. However, we hypothesize that R3 for waterfowl hunters is substantially driven by hunt quality and that quality and quantity of opportunity may be somewhat mutually exclusive. Therefore, providing abundant access and opportunity to hunt waterfowl alone, especially if it comes at the expense of hunting quality, will be inadequate and possibly detrimental to retaining, recruiting, and reactivating waterfowl hunters. We advocate for a better understanding of factors motivating R3 among market segments of the waterfowl hunting community, to develop R3 strategies specifically focused on identifying and providing those key factors, and to utilize adaptive feedback to evaluate the success and/or failures of R3 initiatives at achieving stated goals.

A.2-3: Closing thoughts: building momentum through adaptive learning

Presented by: David W. Howerter (d_howerter@ducks.ca)

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The 2012 revision of the North American Waterfowl Management Plan (NAWMP) and subsequent 2018 update confirmed that waterfowl management is now striving explicitly to affect social-ecological systems, not just ducks and wetland habitat. This stems from a growing recognition that meaningful progress in conservation requires both consideration of shifting human values and affecting human behaviors. This shift to formally integrate people into waterfowl conservation has led to rapid progress in efforts to better understand what motivates a variety of constituent groups to engage in waterfowl conservation activities.

Adaptive management (AM) approaches have proven helpful for learning and improving waterfowl habitat and harvest management, and it seems logical to look at our new people-focused initiatives through a similar lens. Interest has increased lately in hunter recruitment, retention and re-activation (R3) programs. Likewise, research, public education and public policy initiatives around the ecological goods and services (EGS) enhanced by wetland/grassland/watershed conservation are multiplying. Evaluations of the efficacy of such efforts have lagged, however.

As with any AM problem, we need to ensure that our human dimension initiatives have clear objectives and verifiable outcomes. If they are viewed as means objectives, are the initiatives resulting in gains for the fundamental objectives to which they relate? A related challenge is understanding how results of attitudinal surveys translate into observable behavior, specifically, how efforts to affect people's attitude actually affect meaningful behavioral choices. We challenge the waterfowl management community to collaboratively engage with social scientists and other human dimensions specialists to apply adaptive approaches for these expanding HD investments.

B.1-1: Who Will Mind the Marsh? Participants, Professionals and Partners in the 21st Century.

Presented by: John M. Eadie (jmeadie@ucdavis.edu)

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Agriculture and protection of natural resources were paramount in the vision of the Morrill Act of 1862 and many of the nations top wildlife programs were hatched in those land-grant institutions. Our constitutional responsibility is to prepare our nations youth, and to open the doors to all to manage our resources wisely. Now, over 150 years later, we must ask have we kept that trust? The waterfowl profession faces challenging times. We have experienced record populations of ducks and geese, but declining numbers of hunters coupled with an increasingly urban population disconnected with nature. The 2012 NAWMP Revision and 2018 Update highlight these concerns and the need to engage a broader constituency. To date, much attention has focused on R3 efforts to enhance hunter Recruitment, Retention and Reactivation. Our planning must go beyond this to a broader framework we refer to as P3 Participants, Professional and Partners. Participants, of course, include hunters the original minders of the marsh and the most enduring source of support. But we must also increase engagement of a broader sector of society at a grass roots level to ensure that wetland and waterfowl remain priorities. Likewise, we have agonized over what to do and where to do it, but have we forgotten to ask WHO will do it? Our capacity to train the next generation of Professionals (managers, researchers and educators) approaches a tipping point with an aging constituency and the erosion of college waterfowl programs. Finally, we must consider retention of our Partners the NGOs, state and federal agencies, and the private sector who make many of the investments in wetland conservation. Will waterfowl remain a priority for these partners, and how will we recruit the next generation of private individuals willing to invest substantial funds in wetland restoration and enhancement? This Special Section is dedicated to a dialogue on these issues. In this talk, we develop the framework, outline the concerns, and point to some possible paths forward.

B.1-2: Who will mind the marsh? Welcoming and diversifying new participants in waterfowl and wetlands conservation

Presented by: J. Drew Lanham (lanhamj@clemson.edu)

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The mainstream conservation movement in North America, of which waterfowl and wetlands were original foci, has attracted primarily white male professionals and participants. While female involvement is increasing in the wildlife profession, racial and ethnic diversity remains low. Further, demographic shifts of the populous from rural to urban areas are causing human disconnects with nature. This limited integration of societal members constrains growth of waterfowl, wetlands, and natural resources conservation. Indeed, countless people outside mainstream traditional conservation (e.g., hunters, fishers, birders) care deeply about the Earth and thus can help support conservation. Many under-represented constituenciesincluding low income communities, indigenous people, and communities of colorhave a long history of stewarding habitat. The more that mainstream conservation engages culturally diverse people, their history, and future trends, the more relevant, inclusive, and impactful future conservation will be. Diversifying humanity in waterfowl and wetlands conservation is more than recruiting people from various socio-demographic backgrounds. It also means understanding how all people relate to, engage with, fund, and care about the environment. All people may not need ducks, but all need clean air and water and other natural resources that are provisioned significantly through conservation. We believe by promoting convergences of culture and conservation in policy and practice, a more diverse base of funding and professional support can accrue for waterfowl and nature. We will discuss the past and future trends in socio-demographic and cultural makeup of North American society. Further, we will discuss ways waterfowl and wetland conservation can increase its competence through growth of cultural diversity and interaction, university matriculation and engagement of people of diverse cultures and values, develop appropriate methods of communicating across cultures, and peerless new ways to support conservation by a diversity of contributors.

B.1-3: Education and training of future waterfowl professionals

Presented by: Kevin M. Ringelman (kringelman@agcenter.lsu.edu)

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Perpetuation and advancement of North American waterfowl research and conservation require continual recruitment of new scientists and managers. However, our education and training capacity of waterfowl professionals at the university level is threatened. Despite establishment of seven university endowed chairs in waterfowl, we face about a 40% decline in waterfowl faculty from 1990 levels, with nearly half of remaining faculty set to retire within the next decade. Regardless of how many of those positions remain waterfowl-centric, future faculty will need to reach an increasingly large number of students simply to maintain current training capacity and the need for waterfowl and wetlands specialists. This challenge arises against a backdrop of shifting cultural backgrounds of undergraduate wildlife students, who are increasingly from urban and suburban areas, often entering the program without practical field skills that typically are not included in university curricula but are highly desired by employers. Here, we describe how online courses can broaden the effective reach of existing and future faculty, as well as reach underrepresented constituencies, non-traditional students (e.g., working professionals), and increase workforce diversity. Additionally, we present research results from a survey of wildlife employers, describing how past graduates compare to more recent graduates, what skills are most desired, and who should be responsible for teaching those skills. We also show results from a survey of recent graduates highlighting the skills that they find most-used in their jobs post-graduation. Finally, we make recommendations for changes and additions to university curricula, detailing the success of field-intensive courses and internship programs, and providing an overview of the ongoing development of university hunting programs across the country.

B.1-4: Development and Assessment of an Online University Course in Waterfowl Ecology and Management

Presented by: Lauren H.R. Senn (lhsenn@g.clemson.edu)

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Online courses offer an opportunity for students who are unable to take an on campus course to gain knowledge in a topic or meet an academic requirement. Clemson University is, to our knowledge the only US institution offering an online course in Waterfowl Ecology and Management. Such a course is needed by wildlife students and professionals unable to matriculate to a campus where this type of course remains offered. After converting a Waterfowl Ecology and Management course from traditional lecture and laboratory to online presentation, we are evaluating the transition and students evaluations of the new online course. The course has been offered in fall semesters since 2017 as an elective in Clemson Universitys online Masters degree in Wildlife and Fisheries Biology and for upper division undergraduates. The format of the course includes 30 video lectures with paired audio transcriptions, and is split into nine modules, each of which includes lecture videos, readings, class discussion, and a quiz. To determine the effectiveness of the online format, the course was assessed using a pre, mid and post course assessment, and a pre- and post-course knowledge assessment. Since 2017, 83 students have completed the course. The Fall 2018 post-course survey had a response rate of 86% (50/58 students). Results indicated that 98% of responding students believed the course increased their knowledge and appreciation of waterfowl, and 94% would recommend the course to others. A paired t-test of students pre- and post-knowledge assessment scores revealed a significant increase in score from the start to the end of the course (pre-test x = 41.6%, post-test x = 66.6%; t54= 9.97; P < 0.0001). Survey analysis will continue in 2019 and annually thereafter. Results from the 2017-2019 classes will provide insight on students perceptions of the new online course, how this course compares to in-person classes, and aid in the development of best practices for future similar wildlife courses.

B.1-5: Can partnerships help preserve the future for professional waterfowl/wetland education?

Presented by: Karla Guyn (k_guyn@ducks.ca)

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Since the 1930s and the emergence of waterfowl management as a profession, non-profits, government and academic institutions have partnered to advance its success. Initially these partnerships often focused on basic waterfowl life history then followed by growing interest in factors limiting populations. More recently, corporations and foundations began helping us better understand the multiple ecological benefits from wetlands, grasslands and other waterfowl habitats. These efforts emerged as we found zones of overlap between corporate business interests and our interests in habitat conservation. We believe these diverse ecological values will prove increasingly important for broadening public support for habitat conservation. An area of more recent concern has been the decline in waterfowl and wetland professorships at universities. Organizations have raised fears about the source of future skilled employees and leadership for directed research, teaching, outreach and conservation. We will discuss novel partnerships that have supported waterfowl/wetland research, potential partnerships in the future from new kinds of partners and the role partnership can have in securing university endowments. Much has been discussed in the media about the growing disconnect between youth/public and the natural world. To ensure we continue to have a pipeline of students entering in the profession, effort is needed to build these connections. Unique partnerships have emerged with primary schools, NGOs, corporations, governments and private donors. Growing these partnerships requires a broad network and innovative approaches to education and experiential learning.

B.2-1: Temporal Trends in Body Condition of Midcontinent Arctic Geese Wintering in the Mississippi Alluvial Valley

Presented by: Ethan R. Massey (emassey@ducks.org)

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Midcontinent winter populations of arctic nesting geese Anser sp. (hereafter, arctic geese), specifically greater white-fronted geese Anser albifrons frontalis, lesser snow geese Anser caerulescens caerulescens, and Ross's geese Anser rossii have increased in abundance and shifted their winter distribution. Consequently, the number of geese wintering in the Mississippi Alluvial Valley (MAV) has increased since the 1980's. Stored endogenous nutrients are critically important to the life cycle of arctic geese as they are used to complete long-distance migrations, survive harsh winters, and supplement nutrients needed for reproduction. This study tracked temporal changes in body condition of arctic geese during the wintering period. Arctic geese were collected during October – February, 2015–2016 and 2016–2017 in eastern Arkansas. Proximate analysis was used to determine size of lipid and protein stores as an index of body condition. Protein stores remain constant over the winter for all species. Mean lipid stores were dynamic and the highest values occurred in November while the lowest occurred in February. White-fronted geese arrived earliest to the MAV and demonstrated a greater increase in endogenous lipid stores relative to snow and Ross's geese during early winter when high-energy food resources were most abundant. Snow and Ross's geese arrived later and did not appear to increase their lipid stores in the agricultural landscape of the Arkansas MAV. All three species experienced a decline in stored lipids as winter progressed; the decline may be driven by numerous factors such as resource depletion, a shift in diet, physiological factors, hunting pressure, and increased energetic demands. An improved understanding of the role that wintering grounds play on the nutrient dynamics of arctic geese may indicate the importance of stored nutrients to winter survival and also aid in the management of growing populations.

B.2-2: Using plasma-lipid metabilites to index mass changes in birds: are triglycerides more indicative of energy income or lipid deposition?

Presented by: Heath M. Hagy (heath_hagy@fws.gov)

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Energy acquisition and storage are important during resource-limited periods for survival, migration, and subsequent physiological events of migratory birds. Plasma-lipid metabolites (i.e. triglyceride [TRIG], -hydroxybutyrate [BOHB]) have been used to index changes in lipid reserves and, thus, have utility for assessing foraging habitat quality during migration. However, such an index may be affected by energetic maintenance costs, diet, and other factors, and further validation under experimental conditions is needed to understand potential sources of variation and verify existing indices. We evaluated a plasma-lipid metabolite index using 30 female and 30 male wild Lesser Scaup (Aythya affinis; hereafter scaup) held in short-term captivity (approximately 24 hr.) during spring migration. Our model explained 68% of variation in mass change; -hydroxybutyrate was negatively associated and TRIG was positively associated mass change. -hydroxybutyrate estimates were nearly identical to those published on free-living scaup. TRIG estimates differed from free-living scaup and varied by sex, with females having a greater slope than captive and free-living males. Our results suggested TRIG is a better measure of energy income than deposition because TRIG slopes appear to be sensitive to energetic maintenance costs. Further, BOHB appears to be a reliable predictor of negative mass change. Despite differences in TRIG slopes between sexes and captive and wild birds, our model comparison process using z-standardized predictions within groups corresponded well and had no directional bias (r2 = 0.79). The sexual differences in apparent lipid deposition rates warrant further research before a generalizable model is advisable for comparing mass change predictions across studies. However, if predictions are standardized it appears this technique is generally robust to variations in energy income vs. deposition across sexes. Accordingly, our evaluation provides verification for the utility of plasma-lipid metabolites as an indicator of mass change and as a potential index of foraging habitat quality during migration.

B.2-3: Using plasma lipid metabolite indices to evaluate stopover habitat for spring-migrating canvasbacks

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Wetland loss and degradation on stopover areas for migratory waterfowl can lead to food shortages and reduced refueling efficiency. The spring condition hypothesis states that migratory stopover areas are vital for acquiring nutrients necessary for survival and reproduction. Lipid metabolite concentrations of blood plasma can provide a useful index of daily mass change (DMC) in wild birds and can be used to assess quality of stopover sites for refueling during migration. We first validated a lipid metabolites index as a tool for assessing stopover habitat quality, and then we used that tool to evaluate habitat quality for Canvasbacks (Aythya valisineria) across the Upper Midwest. We measured plasma lipid metabolite concentration relative to DMC of 60 wild Canvasbacks held in short-term captivity and subjected to feeding (n = 30) and fasting treatments (n = 30). Respectively, triglyceride (TRIG) and hydroxybutyrate (BOHB) concentrations were positively and negatively related to mass change (R2 = 0.58; DMC*|DMC| = 9724 + 4609[TRIG] 10419[BOHBln]). Canvasbacks collected experimentally across the Upper Midwest had positive index values suggesting sufficient forage resources to allow lipid acquisition during spring migration. However, predicted DMC was greater at upper Pools of the Mississippi River (Pools 7, 8, and 13) compared to Pool 19 of the Mississippi River and the Illinois River Valley, which was likely due in part to more abundant submersed aquatic vegetation (e.g., Vallisneria americana) in those upper Pools. Our results confirm that lipid metabolites are useful indicators of foraging habitat quality and may be useful for prioritizing wetland conservation. While our results suggest positive energy balance for Canvasbacks in most of the region, lower predicted DMC at Pool 19 is concerning because that area is considered a critically important spring stopover area for migratory diving ducks.

B.2-4: Can lipid metabolites of ducks index habitat conditions?

Presented by: Michael J. Anteau (manteau@usgs.gov)

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With mounting concerns over wetland habitat loss and degradation is the need to understand those impacts on duck populations. However, concerns about habitat quality often manifest at small spatial scales and population dynamics are a lagging indicator of habitat conditions compounded through time and space. Moreover, great variation in habitat conditions at migratory stopover sites of species using large geographic ranges adds substantial uncertainty in using vital rates as an index of local or regional conditions. Nutrient and energy reserves of lethally collected ducks have often been used to inform suitability of habitat conditions, but reserves are also a lagging indicator and problematic for characterizing dynamic habitat conditions. Moreover, for portions of the ducks annual cycle when they are mobile nutrient and energy reserves represent habitat conditions at both unknown spatial and temporal scales. Over the past 20 years, avian researchers have been investigating lipid metabolite concentrations to index habitat conditions in real-time and at small scales. Lipid metabolites are isolated from blood plasma and can be assayed to determine levels of short-term lipid deposition or catabolism depending on concentrations. Here, we review published research along with our recently conducted research on several duck species during spring migration with the goal of communicating the role lipid metabolites may play in helping to evaluate habitat conditions. We will explore how metabolite concentrations vary in response to species, time, diet, and sex and discuss important assumptions of using this technique and common mistakes that can be avoided when collecting these types of data.

B.2-5: Behavioral multipliers to resting metabolic rate in black ducks and lesser scaup

Presented by: Jacob McPherson (jmcpherson@ducks.org)

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American black duck (Anas rubripes) and lesser scaup (Aythya affinis) are species of concern within North American Waterfowl Management Plan goals. Historic declines in these populations may be the result of multiple factors including resource availability on migration and wintering landscapes. Bioenergetics modeling is used to calculate the carrying capacity of a landscape by estimating energy demand and energy supply. Estimates for physiologic parameters required in calculating energetic demand (i.e. resting metabolic rates [RMR] and behavioral specific multipliers) have relied on limited research. The primary objective of this project is to produce estimates of behavior specific multipliers to RMR to improve estimates of daily energy requirements in black ducks and lesser scaup. We used open-flow respirometry techniques to estimate RMR and to isolate behavior specific factorial increases to RMR in each of these species. RMR and behavioral multipliers estimated in this study were different from those reported in previous studies. Further, we found that multiplier estimates for certain behaviors in each species were similar enough to one another to justify combining behaviors into homogenous groups representing high, medium, and low energy behavior classes. As expected, the following covariates were found to have significant effects on energy expenditure associated with certain behaviors in one or both species: weight of bird, sex of bird, water temperature, time of day, presence of food, and presence of other birds. Results from this study technologically improve past estimates and simplify the underlying calculations required for bioenergetics modeling by combining behaviors with statistically similar energetic demands and will help improve the accuracy of landscape carrying capacity estimates resulting from those models.

B.3-1: Deterring gillnet bycatch: determining sea duck underwater hearing thresholds

Presented by: Alicia Wells-Berlin (aberlin@usgs.gov)

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As diving foragers, sea ducks are vulnerable to underwater anthropogenic activities, including naval sonar activity and gillnet fisheries. Bycatch in gillnets is a principle driver of mortality for sea ducks, killing hundreds of thousands of seabirds annually. To avoid this, we proposed studying underwater hearing in affected species. Understanding hearing in diving birds can be directly applied to mitigation strategies for reducing gillnet bycatch through the use of acoustic deterrent devices. Additionally, knowledge of underwater acoustic sensitivity is important to current regulatory and management priorities in order to evaluate the impact of noise pollution. In order to determine underwater hearing sensitivities for sea ducks vulnerable to bycatch, we used psychoacoustic techniques to train captive ducks to respond to sound stimuli. We raised long-tailed duck (Clangula hyemalis), surf scoter (Melanitta perspicillata), and common eider (Somateria mollissima) ducklings at Patuxent Wildlife Research Center's breeding facility and trained ducklings to participate in underwater hearing tests in the center's dive tanks. Underwater threshold data obtained from two years of duckling cohorts suggest that these species share a common region of greatest sensitivity, from 1.0 to 3.0 kHz. An existing 3.0 kHz whale pinger may be successful in deterring the more acoustically sensitive species, though field testing and further product development is necessary. Additionally, based on the results of this study, sea duck underwater hearing sensitivities are within range of high intensity noise pollution generated from mid-frequency sonar, small vessel activity, and offshore drilling. The consequences of the overlap between sea duck sensitivity and multiple sources of underwater noise pollution are unknown, but could include disruption of normal biological behavior, masking, and physiological stress.

B.3-2: Assessment of Predator Reduction on Nest Success of Over-water Nesting Ducks

Presented by: Michael K. Johnson (joh07575@umn.edu)

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Although numerous studies have demonstrated that lethal predator management improves nesting success of upland nesting waterfowl, less is known about its potential effect on over-water nesting species. We assessed daily nest survival rates of over-water nesting ducks in the Prairie-Parkland region of southwestern Manitoba during 2015-2017. Professional trappers removed known waterfowl nest predators in addition to focused efforts targeting raccoon (Procyon lotor), American mink (Neovison vison), and corvids (Corvus corax, Corvus brachyrhynchos, Pica hudsonia), between the months of March and July when local breeding occurs. Three 65-km2 study sites were subjected to intensive trapping whereas three equally-sized but untrapped sites served as controls. We located and monitored 504 canvasback (Aythya valiseneria), 422 American redhead (Aythya americana) nests, and 747 over-water nests of other species, including lesser scaup (Aythya affinnis), ring-necked duck (Aythya collaris), ruddy duck (Oxyura jamaicensis), and mallard (Anas platyrhynchos). We compared daily survival rates, estimated using Shaffers logistic-exposure method, between treatment and control sites to assess the effect of predator reduction on nest success. We found no biologically significant effect of trapping when nest success was compared between treatment and control sites. Temporal effects such as initiation date and nest age were important predictors of daily survival rates, and the installment of infrared trail-cameras at nest-sites to identify predators had a positive effect on daily survival rates, which waned as nest age increased. Failure to document a treatment effect on nest success was unexpected and indicates that in comparison to upland systems, targeted trapping efforts were ineffective at removing the most detrimental predator species for the over-water nesting guild.

B.3-3: Northern Pintail Duckling Survival in Agricultural Landscapes and Benefits of Fall-Seeded Cereals

Presented by: David Johns (david.johns@usask.ca)

David Johns – Department of Biology, University of Saskatchewan, Saskatoon, Saskatchewan
Jim Devries – Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, Manitoba
Bob Clark – Prairie and Northern Wildlife Research Centre, Environment and Climate Change Canada, Saskatoon, Saskatchewan

Northern pintail populations continue to remain below management objectives despite favorable habitat conditions in the Prairie Pothole Region; a result of low reproductive success due to agricultural intensification and higher nest predation in modified upland habitats. Fall-seeded cereal crops such as winter wheat are promoted to increase nest success in cropland-dominated landscapes; however, the benefits of higher nesting success in fall-seeded crops may be lost if duckling survival in cropland-dominated landscapes is reduced. We compared pintail duckling survival rates across 12 study sites within southern Saskatchewan across a landscape gradient and examined the influences of perennial cover and winter wheat on duckling survival rates in agricultural landscapes. A total of 87 broods provided survival estimates over two years. Cumulative duckling survival rates in grassland-dominated landscapes were almost twice that of agricultural areas, where survival rates were similar between fall-seeded cropland and perennial cover and double the estimates of spring-seeded uplands. At local scales, the abundance and configuration of wetlands and amount of perennial cover had positive effects on duckling survival. Results from this study highlight the gains in pintail productivity that may result from enhanced deployment of fall-seeded crops into areas with suitable brood-rearing habitats.

B.3-4: Evaluating fall-seeded cover crops for nesting waterfowl in eastern South Dakota

Presented by: Charles W. Gallman - (charles.gallman@sdstate.edu)

Charles W. Gallman – Department of Natural Resource Management, South Dakota State University, Brookings, South Dakota, USA
Eric S. Michel – Division of Fish and Wildlife, Minnesota Department of Natural Resources, Saint Paul, Minnesota, USA
Joshua D. Stafford – South Dakota Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, South Dakota State University, Brookings, South Dakota, USA

The Prairie Pothole Region is the primary breeding ground for North American waterfowl. This landscape was historically dominated by mixed and tallgrass prairies interspersed with wetlands, but >70% of native grassland area has been lost due to widespread conversion to croplands, which may threaten waterfowl production. Cover cropping is a re-emerging farming technique that may provide suitable nesting cover for grassland nesting waterfowl on active farmlands. My research objectives are to: (1) evaluate the utility of fall-seeded cover crops to breeding waterfowl compared to perennial cover; (2) determine if cover crops in rotation with row crops can successfully support grassland nesting waterfowl, and; (3) assess landscape scale, agricultural practice, and vegetation structure factors that may influence nest survival. In 2018 and 2019 we searched cover cropped fields and perennial cover fields for waterfowl nests, collected vegetation measurements, analyzed landscape characteristics, documented farming techniques, and estimated nest survival. In 2018 we found 50 nests in cover crops and 118 nests in perennial cover. Estimated daily nest survival was 0.908 for cover crops and 0.962 for perennial cover, equating to seasonal nest survival rates of 3.8% (95% CI =1.19.9%) and 27.2% (95% CI = 19.236.5%) in cover crops and perennial cover, respectively. The 2019 field season is in progress and we intend to analyze and present results from both study years. As of mid-June 2019 we have found an additional 70 nests in cover crops and 167 nests in perennial fields. Potential exists for large acreages of lands with fall-seeded cover crops in the Northern Great Plains and our results will help managers understand if cover crops provide suitable waterfowl nesting cover, develop best management practices to maximize waterfowl nest survival in cover crops, and identify new research objectives.

B.3-5: Cost-effective Farming Practices for Wintering Waterfowl in the Southeastern United States

Presented by: Jacob Gross (jacob_gross@fws.gov)

Jacob Gross – Department of the Interior, US Fish and Wildlife Service, Sam D. Hamilton Noxubee National Wildlife Refuge, Brooksville, MS
Hunter Edmundson – Department of the Interior, US Fish and Wildlife Service, Sam D. Hamilton Noxubee National Wildlife Refuge, Brooksville, MS

Agricultural crops provide key energy resources for millions of wintering waterfowl on National Wildlife Refuges (NWR) in the southern part of the Mississippi Flyway. Commercial rice, corn, and milo are the main crops produced on NWRs through cooperative partnerships with private farmers because of their high-energy values. Cooperative farming on NWRs has declined substantially over the last 10 years, due to policy restrictions, changing farming practices, and other factors. National Wildlife Refuges must now rely on their staff to grow crops and moist-soil plants to meet waterfowl foraging objectives utilizing conventional farming methods. Staff at Sam D. Hamilton Noxubee National Wildlife Refuge have been experimenting with new, cost-effective rice farming methods to produce high yields but at a much lower cost compared to conventional methods. Two weeks before broadcasting rice in June we utilized drum rollers in flooded fields to aggressively disturb the soil and remove late successional vegetation. Field preparation methods greatly reduced the use of herbicides, aided in the prevention of fall armyworms (Spodoptera frugiperda) without insecticides, and shortened the gap between plant maturity and waterfowl use in late November. Total rice production costs were approximately $40/acre (~25,000 DED/acre) compared to approximately $500/acre (~38,000 DED/acre) for conventional farming methods. The drawdown progression we followed for rice farming in June also coincides with the optimal emergence dates of desirable moist-soil plants such as jungle rice (Echinochloa colona), fall panicum (Panicum dichotomiflorum) and Amazon sprangletop (Leptochloa panicoides). Our results should provide waterfowl managers insight on identifying affordable alternatives to conventional farming, while maximizing both cereal grain and moist-soil seed yields for wintering waterfowl.

B.4-2: At-sea migration patterns and behavior across a suite of waterfowl species.

Presented by: Cory Overton (coverton@usgs.gov)

Cory Overton – Western Ecological Research Center, U.S. Geological Survey, Dixon, CA
Michael Casazza – Western Ecological Research Center, U.S. Geological Survey, Dixon, CA
Andrea Mott – Western Ecological Research Center, U.S. Geological Survey, Dixon, CA
Cliff Feldheim – Suisun Marsh Branch, California Department of Water Resources, West Sacramento, CA

Migration, both spring and fall, are arguably the most crucial periods during the annual cycle of waterfowl. Migration results in the redistribution of most waterfowl across the continent and conditions along migration routes may incur carry-over effects to other life history stages due to the increased energy expenditure and energy gain at staging areas. Staging areas are considered particularly influential to waterfowl due to the high number of individuals concentrated at them combined with their irreplaceability within the landscape and have therefore been the focus of much research. Many waterfowl, however, migrate along coastal routes or over the open ocean. Until recently it has been impractical to accurately monitor at-sea migration strategies. We use a database containing 950 individuals of 10 species with 218 individual migration tracks to describe a variety of oceanic and coastal migration patterns. At-sea migration varied with Rosss and Snow Geese (except the Wrangel Island population), Wigeon, and Mallards demonstrating few to no flights over the ocean. Moderate numbers of Pintail, Blue-winged Teal, and Shoveler flew coastal or oceanic routes. All Tule and Greater White Fronted Geese flew over the ocean with stoppage at sea common among both species. A single Wrangle Snow goose stopped twice on the water during a 41+ hour fall crossing of the Gulf of Alaska during gale-force winds and 20-foot waves. Total time spent floating in the ocean for all geese ranged from 4 to 48 hours with 1 to 7 individual stops on the water during a single migration. At-sea stoppage by pintail was likely but could not be confirmed due to a longer GPS interval and occurrence closer to the coastline. The prevalence, and consequence, of at-sea migration behaviors for some species/populations may be substantial and warrant additional investigation.

B.4-3: Network analysis reveals multi-species annual-cycle movement patterns of sea ducks

Presented by: Juliet Lamb (jslamb@uri.edu)

Juliet Lamb – University of Rhode Island and Rhode Island Department of Environmental Management, Kingston, RI, USA
Peter Paton – University of Rhode Island, Kingston, RI, USA
Jay Osenkowski – Rhode Island Department of Environmental Management, Kingston, RI, USA
Scott McWilliams – University of Rhode Island, Kingston, RI, USA

Conservation and management of long-distance migratory species, in general, and of the many species of waterfowl that breed in the Canadian arctic and winter in the lower 48 U.S. states, specifically, poses unique challenges. Migratory connectivitythat is, the extent to which groupings of individuals at breeding sites are maintained in wintering areasis frequently used to evaluate population structure and assess use of key habitat areas. However, for species with complex or variable annual-cycle movements, this traditional bimodal framework of migratory connectivity may be overly simplistic. Like many other waterfowl, sea ducks often travel to specific pre- and post-breeding sites outside their nesting and wintering areas to prepare for migration and, in some cases, molt their flight feathers. These additional molt migrations may play a key role in population structure, but are not included in traditional models of migratory connectivity. Network analysis, which applies graph theory to assess landscape connectivity, offers a powerful tool for quantitatively assessing the contributions of different sites used throughout the annual cycle to complex spatial networks. We collected satellite telemetry data on annual cycle movements of over 500 individual sea ducks of five species from throughout eastern North America and the Great Lakes. From these data, we constructed a multi-species network model of migratory patterns and site use over the course of the breeding, molting, wintering, and migration periods. Our results highlight inter- and intra-specific differences in the patterns and complexity of annual-cycle movement patterns, including the central importance of staging and molting sites in James Bay and the St. Lawrence River to multi-species habitat connectivity. We also discuss potential applications of network migration models to conservation prioritization, identification of population units, and integrating different data streams.

B.4-4: Population dynamics of King Eiders: ecological links to winter and breeding grounds

Presented by: Ray T. Alisauskas (ray.alisauskas@canada.ca)

Ray T. Alisauskas – Enviornment and Climate Change Canada, Wildlife Research Division, Saskatoon, Saskatchdewan
Dana K. Kellett – Enviornment and Climate Change Canada, Wildlife Research Division, Saskatoon, Saskatchdewan

We report on our long-term (1995-2016) mark-recapture study of female King Eiders nesting at Karrak Lake, Nunavut, in Canadas central arctic. We drew inference from 687 nesting adults females captured 1786 times and individually marked over 21 breeding seasons. We used Pradels models for estimating annual survival, per-capita recruitment and rate of population change; we also used a canonical estimator of abundance, from knowledge of numbers captured and capture probability. Furthermore, we considered ecological covariates, including 3 sources of integrated climate data during winter and spring migration, and on the nesting area to partition annual variation in survival, and local conditions at Karrak Lake to understand drivers of local population change. The North Pacific Index during winter and spring migration as well as the North Atlantic Oscillation during winter, each accounted for 21%, 30%, and 20% respectively, of annual variation in survival. We inferred that these patterns held for North American King Eider females that shared winter areas in both the North Pacific and North Atlantic waters. Covariates for annual variation in recruitment rate at Karrak Lake included timing of ice break up (25%), number of nests (1%), and the North Pacific Index during spring migration (4%). Process variance of rate of population growth at Karrak Lake was 0.022, that of recruitment was 0.021 and that of survival was 0.002, showing that the main driver of population change at Karrak Lake was recruitment (r-square = 0.77) rather than survival (r-squared = 0.10). We use the strong links of recruitment and especially survival to integrated climate data to reconstruct and infer historical trends in relative population size for King Eiders that breed in North Americas arctic.

B.4-5: Annual cycle of White-winged Scoters in eastern North America

Presented by: Scott McWilliams (srmcwilliams@uri.edu)

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Understanding full annual cycle movements of long-distance migrants is essential for delineating populations, assessing connectivity, evaluating crossover effects between life stages, and informing management strategies for vulnerable or declining species. We used implanted satellite transmitters to track up to two years of annual cycle movements of 52 adult female White-winged Scoters (Melanitta fusca (L., 1758)) captured in the eastern United States and Canada. Most scoters wintered for more than half the year along the Atlantic coast from Nova Scotia to southern New England, with some on Lake Ontario. Scoters followed four migration routes to breeding areas from Quebec to the Northwest Territories. Principal post-breeding molting areas were in James Bay and the St. Lawrence River estuary. Scoters demonstrated overall weak to moderate connectivity among life stages, with molting to wintering connectivity the strongest, and for those that winter in eastern North America appear to constitute a single continuous population. Resource selection function models revealed that (a) scoters selected for areas with lower salinity, lower sea surface temperature, higher chlorophyll-a concentrations, and higher hard-bottom substrate probability, and (b) high probability of use areas included or immediately bordered ~420 km2 of proposed Wind Energy Area (WEA) lease blocks in southern New England. Future offshore wind energy developments in the region should avoid key habitats highlighted by this study and carefully consider the environmental characteristics selected by sea ducks when planning and siting future WEAs.

C.1-1: How does conservation of waterfowl habitat fit into agricultural sustainability discussions – perspectives from the Prairie Pothole Region

Presented by: Scott E. Stephens (s_stephens@ducks.ca)

Scott E. Stephens – Ducks Unlimited Canada, Stonewall, Manitoba

With a growing population of over 7.7 billion people, global demand for agriculture to produce food and fiber continues to increase. Coincidentally, landscapes critical to North American waterfowl populations are dominated by agriculture. Can world demand for agricultural products and continued conservation of waterfowl habitats both be achieved in key landscapes? To explore this question, we look to the Prairie Pothole Region of the U.S. and Canada.

Fortunately, the agricultural industry is recognizing that consumers demand food and fiber products that were produced in an environmentally-sustainable way. As a result, industry is striving to find sustainable ways of increasing agricultural production that maintain the long-term environmental health and productivity and the benefits provided by natural systems, such as wetlands and grasslands.

This session highlights industry visions for sustainable agriculture in the Prairie Pothole Region. Conservation interests must actively engage with industry to ensure that grassland and wetland habitats, which are critical to breeding waterfowl, are part of sustainable agriculture's future. Partnering with a diversity of agricultural industry groups is fundamental to ensuring that key landscapes continue to provide breeding habitat for waterfowl, along with other critical ecosystem services, while still meeting demand for agricultural products.

C.1-2: Healing the land with Regenerative Agriculture

Presented by: Brad Schmidt (bschmidt@ducks.org)

Brad Schmidt – Ducks Unlimited Inc., Great Plains Regional Office, Bismarck, ND 58503, USA

Agriculture has been at a crossroads around the world for many years. The struggles for farmers and ranchers to make a living has been taking its toll. Finding commonality among conservationists and Ag professionals has been a difficult task, not only in the PPR but around the globe. Through the struggles there is a bright light at the end of the tunnel. The past few years Farmers/Ranchers/Conservationist and many others have found common ground surrounded around the subject of Regenerative Agriculture. Brad will focus on the subject of Regenerative Agriculture. He will show how the principles of Soil Health applied to the landscape encompass a Systems Approach method to help solve the problems that are faced throughout the world in every aspect of life.

C.1-3: Drivers of land use change

Presented by: Brenna Grant (grantb@canfax.ca)

Brenna Grant – Canfax Research Services

The beef industry has been in the hot seat with regard to public perception on global environmental impacts in recent years. However, often these criticisms ignore the unique context and characteristics of Canada and other Prairie regions. Specifically, the Canadian beef industry provides an economic incentive to preserve critical grassland and wetland habitat needed for at risk species. Land-use change away from the livestock industry will further drive the loss of this valuable habitat.

The Canadian beef industry has made great strides and continues to strive for continuous improvement for beef and grassland sustainability. Brenna will describe the beef industry's future goals for sustainability and what the Prairie landscape could look like if beef producers are successful in achieving these objectives. She will bring ideas for how collaboration with conservation interests can advance the work of the beef industry to achieve mutual benefits on the landscape. Brenna will delve into improving industry standards, a world-class sustainability framework, a vision for the future of our agricultural landscape and how these things are inherently tied to forces like markets, prairie conservation and public trust.

C.1-4: Sustainable Canola Supply – Convergence of Genomics, Precision Agriculture, Integrated Pest Management and Ecosystem Services to Produce Healthy Oil and High Quality Protein (Canola)

Presented by: Curtis Rempel (rempelc@canolacouncil.org)

Curtis Rempel – Canola Council of Canada and Dept. of Food and Human Nutritional Sciences, Faculty of Agriculture and Food Sciences, University of Manitoba

Projections by various agencies place demand for Canadian canola at 26 mmt in 2025 for its healthy composition of polyunsaturated long-chain and monounsaturated fats. Demand for high quality plant protein with high bioavailability will likely push demand for Canadian canola further. In order to meet this global demand, the CCC has a strategic plan to increase yields to 52 bu/ac (from 34 bu/ac), with increased profitability, sustainability and reduced production risk, by 2025. This strategic plan is anchored on 5 pillars. This yield increase has the added benefit of increasing atmospheric C utilization / sequestration. Profitable, "sustainable" canola yield intensification requires genetic advancement, prediction pest modelling, more efficient fertilizer utilization and increasing populations of beneficial insects, including predators, wild and natural pollinators via habitat promotion through conservation and restoration of wetlands, vegetative zones, enriched field margins and low-production field areas.

Results from several research projects that focus on genomics, predictive pest modelling, 4 R nutrient management, valuation of ecosystem services on seed and oil yield and insect and avian diversity and abundance will be presented and discussed in the context of modern agriculture practices and "sustainable" yield intensification.

C.2-1: Delta's University Hunting Program: bringing the NA Wildlife Conservation Model to campus

Presented by: Joel Brice (jbrice@deltawaterfowl.org)

Joel Brice – Delta Waterfowl, Bismarck, ND
Stephen Sowell – Delta Waterfowl, Bismarck, ND

Delta Waterfowl was formed and focuses on waterfowl and wetlands because of just one reasonwaterfowl hunting. The NA Wildlife Conservation Model threads together people who love and use resources with wise management of those resources. Delta is an example of that principle in action. Waterfowl hunters support our work to identify and implement the best ways to manage and enhance waterfowl populations. In recent decades, it has become imperative that Delta focuses time and resources on the second component of waterfowlinghunters. If hunter numbers continue to decline, we fear that management, funding and advocacy for wetlands and waterfowl will wane without the fire of hunting to stoke interest in those precious resources. Equally alarming, a significant percentage of wildlife studentsfuture waterfowl management leaders have had neither exposure to hunting, nor first-hand experience of the role of hunting in wildlife management. Students lacking a first-hand understanding of hunting may implement policy and management decisions that do not sustain waterfowl and their required habitats. Through educational hunting programs, Delta will provide students without a hunting background with hands-on participation in the NA Wildlife Conservation model. Delta is advancing a continental programDelta Waterfowls University Hunting Program (UHP). Deltas ambitious goal is to establish a UHP at every NA University that offers a wildlife program. Each program includes four main components: hunter safety course, shooting skills day, weekend waterfowl hunt, and post-hunt meal. Delta utilizes three participant surveys to measure program effectiveness and drive program improvement. Pre- and post-event surveys provide data to measure program outcomes and outputs. A follow-up survey takes place three months after program completion to document post-course hunting activity or obtain information on barriers to continued participation. Targeted resources and information will be shared with each participant based upon their individual responses to the follow-up survey.

C.2-2: Professionals and Students Perceptions of Graduate Student Publication Practices

Presented by: Lauren H.R. Senn (lhsenn@g.clemson.edu)

Lauren H.R. Senn – Department of Forestry and Environmental Conservation, Clemson University, Clemson, SC
Richard M. Kaminski – Department of Forestry and Environmental Conservation, Clemson University, Clemson, SC
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Shari L. Rodriguez – Department of Forestry and Environmental Conservation, Clemson University, Clemson, SC

Within most academic fields, publishing peer-reviewed research is expected for dissemination of knowledge and is used as a measure of professional performance. However, few papers have been published on professionals and graduate students perceptions of student publication practices, how professionals encourage student publishing, and what types of publication barriers exist for graduate students. To address this dearth of knowledge, we conducted a survey of attendees of the 6th and 7th North American Duck Symposium (2013 and 2016, respectively). Our objectives were to 1) assess respondents perceptions of graduate student publication practices, including number of students that had published, number of publications, and time to publication; 2) determine respondent views on the importance of graduate student publishing; 3) determine what strategies are most often utilized or experienced by respondents to motivate graduate students to publish; and 4) determine what respondents consider barriers to publication for graduate students. Using email in March 2019, we surveyed 469 professionals and 98 students at the time of the respective symposia. A total of 196 respondents submitted the professionals survey and 44 respondents submitted the students survey, resulting in response rates of 42% and 45%, respectively. Fifty percent of professional respondents indicated they felt frustrated motivating their Ph.D. students to publish and 69% felt frustrated motivating their Masters students to publish. Of strategies used to motivate graduate student publishing, 79% of students ranked providing congenial encouragement as most effective in motivating their publishing, while 60% of professionals ranked played a major role in drafting and editing as most effective in motivating students to publish. Both professionals and students considered lack of time during and outside work hours as barriers to publishing graduate work. Information from this study adds to a limited body of knowledge on wildlife graduate student publishing practices and can be used to improve methods to increase graduate student publication rates in waterfowl and other wildlife arenas.

C.2-3: A Comparison of Email and Random Mail methodologies for the 2017-2018 Louisiana Game Harvest Survey

Presented by: Luke Laborde (llabor2@lsu.edu)

Luke Laborde – Louisiana State University
Larry Reynolds – Louisiana Department of Wildlife and Fisheries
Jeffery Duguay – Louisiana Department of Wildlife and Fisheries
Michael Kaller – Louisiana State University
Anna West – Louisiana State University

A post-season mail survey is conducted annually by the Louisiana Department of Wildlife and Fisheries (LDWF) to estimate hunter activity and harvest of all legal game species. Following the 2017-2018 season, LDWF conducted a single mailing delivered to 15,273 randomly-selected Louisiana licensed hunters. We developed an identical e-mail survey using Qualtrics survey software, obtained LSU AgCenter IRB approval (#HE17-6), and distributed the survey in 3 waves to all available emails (67,045) after exclusion of hunters selected in the random mail sample. Response rates to the e-mail and mail survey were 22.7% and 23.5% respectively. Importantly, 16.4% of email survey respondents and 37.9% of mail survey respondents did not hunt during the 2017-2018 season, and these responses were deleted from further analysis. The average age of valid respondents was different, 46.4 years and 54.7 years for the e-mail and mail surveys, respectively. Results for days-hunted and harvest were empirically similar for deer, turkey, waterfowl, and small game, but not for hog hunting. Despite the empirically similarities, binary logistic regression identifies significant (= .05) differences in the age classes and days hunted between e-mail and mail survey respondents. In addition, the e-mail results under-represented and the mail results over-represented hunters over the age of 55 in comparison to the population of 273,409 licensed Louisiana hunters (average age 50.0 years). Both survey methods provided good geographic representation of the Louisiana hunter population. The average cost per valid response was $1.26 and $6.37 for the e-mail and mail surveys, respectively. E-mail distribution provides the opportunity to inexpensively engage many more hunters, and e-mail respondents were more representative of the population of Louisiana licensed hunters. This study is being replicated, and consolidated analysis of data from the 2016-2017, 2017-2018, and 2018-2019 post season surveys will commence this fall.

C.2-4: Working Wetlands-A Novel Approach to Small Wetlands Conservation

Presented by: John Devney (jdevney@deltawaterfowl.org)

John Devney – Delta Waterfowl
Cheryl Wachenheim – North Dakota State University

Working Wetlands-A Novel Approach to Small Wetlands Conservation

Breeding duck carrying capacity within the Prairie Pothole Region is limited by the available amount of wetland habitat available on the landscape. The loss of small wetlands negatively impacts carrying capacity, and as such, activities targeted to conserving small temporary and seasonal wetlands has long been a focus for the regions waterfowl managers. Yet, pressures on the remaining wetland resources continue and managers are seeking new approaches to address the pressing need of small wetland conservation.

Delta undertook a comprehensive effort of working with the agricultural community in North Dakota, engaging key conservation partners in advancing a new approach to small wetland conservation. This effort catalyzed a North Dakota pilot project, inclusion in the 2018 Farm Bill and is in the process of being implemented by the Natural Resources Conservation Service (NRCS).

The presentation will detail the background and approaches used to advance the program from a mere concept through to its current status on the verge of being implemented as NRCS programming across the U.S. Prairie Pothole Region. The use of new scientific literature documenting the public benefits of wetlands, employing a real time feedback mechanism through research and surveys in collaboration with the University of North Dakota, and how that feedback played a role in both policy development and political support for the concept as well as survey results will be presented.

The experience with Working Wetlands can yield important information on addressing contentious policy and conservation delivery challenges and may yield insight to managers and conservation planners about a useful approach in utilizing collaboration and the best available science as a means to achieve on the ground conservation outcomes for the benefit of breeding ducks.

C.3-1: Annual Assessment of Winter Waterfowl Habitat on Inland Agricultural Lands of the U.S. Western Gulf Coast

Presented by: Michael G. Brasher (mbrasher@ducks.org)

Michael G. Brasher – Ducks Unlimited, Inc., Gulf Coast Joint Venture, Lafayette, LA
Bryn M. Allston – Allston Consulting at U.S. Geological Survey, Wetland and Aquatic Research Center, Lafayette, LA
Nicholas M. Enwright – U.S. Geological Survey Wetland and Aquatic Research Center, Lafayette, LA
Mark W. Parr – U.S. Fish and Wildlife Service, Gulf Coast Joint Venture, Lafayette, LA
Barry C. Wilson – U.S. Fish and Wildlife Service, Gulf Coast Joint Venture, Lafayette, LA

The U.S. Western Gulf Coast, which corresponds to the planning region for the Gulf Coast Joint Venture (GCJV), provides important habitat for migrating and wintering waterfowl. The GCJV uses bioenergetic models that incorporate species specific-population abundance objectives, temporal residency, energy demand of birds, and foraging values of habitats to translate autumnwinter waterfowl population targets into habitat objectives for this important region. These objectives are expected to represent landscape conditions needed to support waterfowl populations at levels that are aligned with continental objectives of the North American Waterfowl Management Plan (NAWMP). Periodic assessments of long-term trends and annual variation in landscape conditions are necessary for evaluating progress toward objectives and ensuring established conservation priorities remain appropriate. In 2010, the GCJV initiated an annual habitat monitoring program using remotely sensed imagery (e.g., Landsat) to quantify abundance of winter waterfowl habitat on inland agricultural lands of the U.S. Western Gulf Coast during three periods of its autumn-winter planning window. As of 2019, the GCJV has quantified winter habitat abundance from over 20 years (19982019), revealing significant inter- and intra-annual variation in habitat abundance within and among Initiative Area planning regions. These data shed important light on spatial and temporal variation in waterfowl habitat across the GCJV landscape, help elucidate the effects of human activities and environmental conditions on landscape-scale waterfowl habitat abundance, and offer a new context within which to examine and interpret progress toward NAWMP habitat objectives.

C.3-2: Foraging Ecology and Depredation Impact of Scaup on Commercial Baitfish and Sportfish Aquaculture Farms in Arkansas

Presented by: Brian Davis (brian.davis@msstate.edu)

Stephen A. Clements – Mississippi State University, Department of Wildlife, Fisheries, and Aquaculture, Mississippi State, MS
Brian Davis – Mississippi State University, Department of Wildlife, Fisheries, and Aquaculture, Mississippi State, MS
Brian S. Dorr – USDA Wildlife Services, National Wildlife Research Center, Starkville, MS
Katie C. Hanson-Dorr – USDA Wildlife Services, National Wildlife Research Center, Starkville, MS
Luke A. Roy – Auburn University, School of Fisheries, Aquaculture & Aquatic Sciences, Greensboro, AL
Carole Engle – Engle-Stone Aquatic$ LLC/VA Seafood AREC, Virginia Polytechnic Institute and State University, VA
Anita M. Kelly – Auburn University, School of Fisheries, Aquaculture & Aquatic Sciences, Greensboro, AL

Scaup (Aythya spp.) are collectively the most abundant diving duck in North America. While their typical diet is composed mainly of invertebrates, migrating populations within the Mississippi flyway have been reported consuming large quantities of bait- and sportfish produced at aquaculture facilities, particularly in Arkansas. However, it is not well understood how scaup use these relatively new habitats provided by aquaculture or to what extent human-wildlife conflict exists. The objectives of our study were to investigate the foraging ecology and abundance of scaup using aquaculture facilities in Arkansas, and to estimate the total amount of bait- and sportfish consumed annually. During winters 2016-2017 and 2017-2018, we collected 529 lesser scaup and 19 greater scaup foraging on aquaculture ponds used to produce a variety of fish species. Using permutational multivariate analyses of variance, we detected significant differences in lesser scaup diets between winters and weather temperature categories. Specifically, fish did not appear in lesser scaup diets in winter 2016-2017, whereas fish comprised 18% of their diet in the colder, 2017-2018, winter. Chironomidae was the most common prey item found in lesser scaup, comprising 71% of their diet in winter 2016-2017 and 40% in winter 2017-2018. Additionally, we conducted 1,458 individual pond surveys between the two winters and created abundance models using polynomial regression to calculate total scaup use-days (SUDs) within our survey area and estimated total fish loss. During winter 2017-2018, our model predicted approximately 875,000 SUDs, resulting in an estimated 59,700 kg of fish consumed by scaup. We suspect that scaup increasingly exploit fish in colder winters because of birds increased energy demands, prey availability and ease of capture, or some combination of these. Although we cannot fully reconcile these nutrition and behavioral mechanisms at this time, scaup can inflict substantial losses on producers in some instances.

C.3-3: Green-winged Teal Diet Composition and Selection During Spring Migration in the Illinois River Valley

Presented by: Samuel T Klimas (sklimas@illinois.edu)

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The Illinois River Valley is an important region for non-breeding waterfowl, especially during spring as migrating individuals replenish vital nutrients to complete migration and initiate nesting. Identification and management of preferred waterfowl forages helps ensure adequate body condition of spring migrating waterfowl which is essential for survival and subsequent nest success. Green-winged teal (Anas crecca; hereafter teal) specialize on natural plant and animal foods in shallow wetland environments which may be limiting during spring migration. To identify diet selection, we collected 166 foraging teal and three benthic and nektonic core samples from wetlands in the Alton, La Grange, and Peoria reaches of the Illinois River during FebruaryApril 20162018. We removed and sorted, dried, and weighed (0.1 mg) food items from the upper digestive tract (proventriculus and esophagus) of collected birds and core samples for comparison of use and availability with a multivariate analysis of variance. Seeds of early successional vegetation occurred in all teal diets, while invertebrates and vegetative material occurred in 67.4% and 25.8%, respectively. Teal consumed 85.8% (CI95 = 81.290.3%) plant material and 14.2% (CI95 = 9.618.7%) invertebrates based on aggregate dry biomass. We failed to find support for selection of plant and animal foods (t140 -0.7, P = 0.5), but at the taxa level teal selected Cyperus spp., Ammannia spp., Leptochloa spp., and Potamoageton spp. but avoided Amaranthus spp., Ipomea spp., Echinochloa spp., and Oligocheta. We found no support for a difference in selection ratios between sexes (F1,139 = 0.7, P = 0.7). Teal require a variety of early successional plant seeds and associated invertebrates which can be promoted by active moist-soil management at stopover locations. Managers should ensure shallowly flooded wetlands are available with diverse plant and invertebrate communities.

C.3-4: Habitat Patch Switching in Autumn by Mallards in a Food-Rich Landscape

Presented by: Matthew D. Palumbo (Matt.Palumbo@uwsp.edu)

Brendan Shirkey – Winous Point Marsh Conservancy
Dr. Matt Palumbo – University of Wisconsin-Stevens Point
John Simpson – Winous Point Marsh Conservancy

Autumn waterfowl habitat management often focuses on providing high energy food resources to attract and concentrate waterfowl for harvest. Similarly, many waterfowl conservation plans assume food resources are the primary, controllable limiting factor influencing waterfowl distribution during migration, however hunting-related disturbance also likely influences waterfowl distribution in autumn. We investigated factors influencing mallard (Anas platyrhynchos) movements in an intensively hunted and food-rich landscape. We used locations from female mallards equipped with GPS back-pack transmitters to 1) determine the probability of mallards switching habitat patch types based on seasonal and daily patterns of hunting disturbance and 2) determine the distances mallards moved between habitat patch types that offer refuge and those that offer food resources as evidence for or against food resource depletion during the hunting season. We found mallards switched habitat patch types to exploit food-rich but intensively hunted habitat patches nocturnally and that habitat patch switching during time periods subject to disturbance increased significantly from the early segment to the late segment of hunting season. We also found distances mallards moved between refuge habitat patches and food-rich habitat patches did not change over the duration of the study period. Our findings support that hunting disturbance is a key variable influencing autumn movements and distribution of mallards, and that mallards in a food-rich and intensively hunted landscape employ nocturnal foraging as a strategy to survive autumn migration. Continued investigation is needed to understand waterfowl movements and nocturnal foraging strategies in landscapes that may be less-heavily disturbed and/or provide significantly fewer food resources. Nocturnal foraging behavior has potentially significant and negative consequences for waterfowl managers tasked with providing quality waterfowl hunting opportunities as ducks that only forage nocturnally are largely unavailable to hunters.

C.4-1: Drivers of American black duck productivity on the breeding range

Presented by: Glen Brown (glen.brown@ontario.ca)

Glen Brown – Wildlife Research and Monitoring, Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario
Rod Brook – Wildlife Research and Monitoring, Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario
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Black ducks have been of management concern for decades due to a long-term declining trend. The cause of declines remains unclear and little is known about what factors affect population dynamics in the boreal forest of eastern Canada. We assembled several long-term data sets (spanning 30 + years) to clarify drivers of black duck productivity on the breeding range in Ontario, including the Acid Rain Biomonitoring Program (Environment and Climate Change Canada) and the Eastern Breeding Waterfowl Survey. The detailed breeding pair, brood count and wetland specific environmental data were used to characterize the relationship between black duck productivity and habitat on breeding range, including the relative contributions of waterfowl densities (black duck and mallard), spring weather conditions, land cover change, human landscape disturbance, acidification impacts and recovery and the associated effects on habitat quality. We used a hierarchical mixed modeling framework to assess trends and the relative importance of hypothesized covariates. Clarifying uncertainties in how these drivers affect annual variation or trends in productivity will improve the utility of adaptive management models employed by the Black Duck Joint Venture and better inform decisions regarding habitat management and harvest.

C.4-2: Land use alters climatic vulnerability of pintails

Presented by: Qing Zhao (whitelangur@gmail.com)

Qing Zhao – University of Missouri
Todd Arnold – University of Minnesota
James Devries – Ducks Unlimited Canada
David Howerter – Ducks Unlimited Canada
Robert Clark – Environment and Climate Change Canada
Mitch Weegman – University of Missouri

Knowledge of land use patterns that could affect animal population resiliency or vulnerability to environmental threats such as climate change is essential, yet the interactive effects of land use and climate on demography across space and time can be difficult to study. Unlike most North American migratory waterfowl, populations of northern pintails (Anas acuta; hereafter pintails) have not recovered since the 1980s despite increasing pond numbers. While pintails are similar to other ducks in their dependence on ponds, their extensive use of croplands for nesting differentiates them and makes them particularly vulnerable to changes in agricultural land use on prairie breeding grounds. Our intent was to quantify how changes in land use and ponds on breeding grounds have influenced pintail population dynamics by developing an integrated population model to analyze over five decades (19612014) of bandrecovery, breeding population survey, land use and pond count data. We focused especially on the interactive effects of pond counts and land use on pintail productivity, while accounting for density dependent processes. Productivity was positively correlated with pond count and negatively correlated with agricultural intensification. Further, a positive interaction between pond count and agricultural intensification was insufficient to overcome the strong negative effect of agricultural intensification on pintail productivity across nearly all pond counts. The interaction also indicated that pintail populations were more negatively impacted by the decrease in ponds associated with climate change under higher agricultural intensification. Our results indicate that pintail populations have become more vulnerable to climate change under intensified land use, which suggests that future conservation strategies must adapt to these altered relationships. The interactive effects of land use and climate on demography should be considered more frequently in animal ecology, and integrated population models provide an adaptable framework to understand vital rates and their drivers simultaneously.

C.4-3: Evaluating Landscape Changes and Breeding Waterfowl in California's Central Valley, 1998-2016

Presented by: Cliff Feldheim (Cliff.Feldheim@water.ca.gov)

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Fiona McDuie – USGS Western Ecological Research Station, Dixon Field Station, Dixon, CA
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Habitat loss poses the greatest threat to species across the world and is the most significant contributor to reductions in biodiversity and animal populations. Wetlands, among the most biodiverse and economically valuable ecosystems, have suffered some of the greatest losses due to urbanization and changes in agriculture and land use. In Californias Central Valley (Valley), substantial wetland losses coincide with significant population declines of locally breeding waterfowl. With this study we evaluated habitat loss through land-use changes across time (1998-2016) throughout the Valley, and its impact to breeding duck populations. With satellite imagery from 1998 and 2016, we classified habitat across 63 aerial transects from the Sacramento, Delta-Yolo, San Joaquin, and Tulare Basins within the Central Valley Joint Venture, into optimal (wetlands/rice), suboptimal (pasture/crops) and unusable (orchards/urban) waterfowl habitat. We estimated changes in breeding duck populations by averaging counts from the same transects, over two 5-year periods spanning the habitat assessments (1996-2000 and 2014-18). Duck populations exhibited large reductions across approximately 90% of the area, and despite land management plans focused on wetland restoration to benefit duck populations, only 1.8% of unusable habitat has been converted back to wetlands. Between 1998 and 2016, 13% of previously usable habitat (optimal/suboptimal) has been converted into non-usable orchards or urban areas. Our results suggest that appropriate management strategies could help slow population declines of locally nesting ducks if focused on the impacts of urbanization or agricultural land use conversion from rice to orchards.

C.4-4: Implications of Covariation in Demographic Rates for Lesser Scaup

Presented by: Kelsey Navarre (kelsey.navarre@colostate.edu)

Kelsey Navarre – Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO
Jeffrey Warren – US Fish and Wildlife Service, Lima, MT
David Koons – Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO

The continental population of scaup remains well below population objectives. Previous analyses of long-term demographic data have revealed recruitment as the likely driver of population decline. Recruitment is comprised of several potentially important vital rates, which are often assumed to be independent in population models. This assumption could be costly because covariation in vital rates can sometimes have a greater influence on population dynamics than variation in any vital rate on its own. Long-term monitoring of lesser scaup (Aythya affinis) at Red Rock Lakes National Wildlife Refuge allows us to study temporal covariation in vital rates. This unique study has collected data across the annual life cycle of lesser scaup, including breeding propensity, clutch size, nesting success, duckling survival, post-fledging juvenile survival, and seasonal survival of adults. We examined the effects of hydrological variation on variation and covariation of vital rates, and the consequences of such (co)variation on population dynamics of the local lesser scaup population. Our results provide key insights into the life-history responses of lesser scaup to changes in wetland habitat conditions. Given that both climate and land-use change can drastically alter wetland hydrology, our work could guide similar studies on wetland habitat management and landscape conservation for lesser scaup amidst ongoing global change.

D.1-1: Ecosystem Services and the Curious Case of Canadian Wetland Economics

Presented by: John K. Pattison-Williams (jk.pattisonwilliams@gmail.com)

John K. Pattison-Williams – Pattison Resource Consulting Ltd.

The degradation and loss of North American wetlands over the last century has had an impact on biodiversity— including waterfowl—across the continent. In Canada, such loss of wetlands has been a concern for provincial governments across the political spectrum. Diverse policy approaches for conservation across the Prairie Provinces of Canada have led to varied success to mitigate this trend. A common theme in wetland conservation approaches in the last two decades has been concept of ecosystem services. Using case studies, this presentation will review the economic feasibility of wetlands to address pressing environmental concerns in four Canadian provinces in a social return on investment framework. Results will be explained, limitations explored and the future of market-based instruments to enhance waterfowl and wetland conservation initiatives will be discussed.

D.1-2: Beyond waterfowl habitat: Valuing multiple ecosystem services in managed wetlands to inform conservation

Presented by: Tom O'Halloran (tohallo@clemson.edu)

Tom O'Halloran – Clemson University
Marzieh Motallebi – Clemson University
Rick Kaminski – Clemson University

In North America, there is a long history of managing wetlands for waterfowl habitat. The economic values of waterfowl hunting, wildlife viewing, fishing, and crustacean harvest have heretofore sustained conservation and management of these systems. However, climate change, land use change, and in the case of coastal ecosystems, sea level rise, are creating new dimensions to the economics of managing wetlands for waterfowl. Here, we outline a strategy for new research that would integrate regionally-specific ecosystem services in an economic framework that provides a quantitative assessment of the pros and cons of specific management strategies in existing impounded wetlands and new impoundments that may emerge inland with sea-level rise. Potential foci include: habitat provisioning for waterfowl and other wildlife, climate mitigation via carbon and greenhouse gas exchange, water purification and storage and the cultural preservation value of historic landscapes.

D.2-1: Emerging trends and programs for natural Infrastructure finance

Presented by: Geoff Gunn (ggunn@iisd.ca)

Dimple Roy – International Institute for Sustainable Development (IISD)

The International institute for Sustainable Development (IISD) has been a strong proponent for well-managed ecosystems based on the multitude of valuable benefits that they provide. In a report in 2019, IISD used it's sustainable asset valuation tool (SAVi) to demonstrate the long-term values associated with an engineered wetland in Manitoba. IISD convened a forum in 2018 on Advancing Natural Infrastructure in Canada, bringing together experts, three levels of government, insurance and banking sectors and others to discuss the means of accelerating the retention, restoration and building of natural systems for improved flood resilience and other benefits. IISD continues to work on collaborative natural infrastructure projects such as wetland restoration and water retention projects on, as well bioremediation systems for water quality on the prairies. In this session, Dimple Roy, Director of Water Management at IISD will highlight IISD's work on natural infrastructure, focussing on emerging options for financing natural infrastructure in Canada.

D.2-2: Why losing waterfowl habitat is a concern for all

Presented by: Pascal Badiou (p_badiou@ducks.ca)

Pascal Badiou – Ducks Unlimited Canada, Institute for Wetland and Waterfowl Research

Ducks Unlimited Canada and other conservation agencies have long espoused the values of wetlands for the numerous ecosystem services they provide society. However, for the most part, these values were historically extracted from global analyses, covering numerous wetland types, spanning tropical to arctic regions. As such, these estimates had little ability to influence regionally specific wetland policies. Our presentation will outline how generating regionally specific information on the ecosystem services associated with prairie wetlands, and more specifically integrating the impact of wetland loss into larger regional environmental concerns, can help expand support for the conservation and restoration of key waterfowl habitats.

D.2-3: Advancing Waterfowl Conservation Through Ecosystem Services

Presented by: J. Dale James (djames@ducks.org)

J. Dale James – Ducks Unlimited Inc.
Ellen R. Herbert – Ducks Unlimited Inc.

The mission of Ducks Unlimited Inc. (DUI) is to conserve, restore and manage wetlands and associated habitats for North America's waterfowl, while also realizing these habitats benefit other wildlife and society. To date DUI has conserved, restored or enhanced more than 6 million acres of habitat in the U.S, largely to support continental waterfowl populations and their habitat objectives defined through the North American Waterfowl Management Plan. In order to "maintain abundant and resilient waterfowl populations" in a time of shifting demographics and social change, achieving these goals requires broader support from societal segments that may have less interest in traditional waterfowl habitat conservation outcomes. We will discuss DUI's contemporary efforts to prioritize quantification and communication of a broad suite of ecosystem services outcomes from our projects in addition to waterfowl habitat, such as flood abatement, carbon sequestration, water quality improvement and economic return on investment. We will also discuss how quantifying and communicating this broader suite of outcomes can be leveraged to cultivate a larger base of support for waterfowl habitat conservation, including engaging corporate social responsibility programs. It is envisioned that this diversification of support will accelerate the delivery of DUI's habitat conservation at scales that will significantly impact wetlands ecosystems to benefit both waterfowl and the people that utilize them.

D.2-4: Implementing a Standardized Wetland Monitoring Protocol to Assess the Nutrient Retention Capacity of Newly Restored Wetlands in Southwestern Ontario

Presented by: Bryan Page (b_page@ducks.ca)

Bryan Page – Ducks Unlimited Canada - Institute for Wetland and Waterfowl Research

To address the eutrophication of Lake Erie, The Great Lakes Water Quality Agreement of 2012 requested the Lake Erie basin governments to develop a Domestic Action Plan to guide the achievement of phosphorus reduction targets. In February 2018, the Canada-Ontario Lake Erie Action Plan was released highlighting the importance of wetland restoration as a recommended strategy to help reduce phosphorus loads entering Lake Erie. Based on this recommendation, Ducks Unlimited Canada developed a standardized wetland monitoring protocol to assess the nutrient retention capacity of newly restored wetlands in southwestern Ontario. The protocol was implemented in 2018 on eight newly restored wetland basins across southwestern Ontario. Inflows and outflows of each basin were equipped with continuous flow meters while water quality samples were collected intensively during the spring freshet and periodically in the fall, late spring and summer. Water level recorders and basin storage curves were employed to monitor available storage when basins were below spill-elevation. Net nutrient retention (load in – load out) were calculated on a daily basis. Preliminary results from the first 10 months of this ecological goods and services study will be presented.

E.1-1: Relative Importance of Vital Rates to Population Dynamics of Wood Ducks

Presented by: Gary R Hepp (heppgar@auburn.edu)

Gary R Hepp – School of Forestry & Wildlife Sciences, Auburn University, Auburn, AL
Robert A. Gitzen – School of Forestry & Wildlife Sciences, Auburn University, Auburn, AL
Robert A. Kennamer – University of Georgia, Savannah River Ecology Laboratory, Aiken, SC

We know very little about how changes in vital rates influence population growth rate () of wood ducks (Aix sponsa). We used estimates of fertility and survival of female wood ducks from our long-term nest-box studies in South Carolina, Alabama, and Georgia to create a stage-based matrix population model. We conducted perturbation analyses and ranked sensitivity and elasticity values to examine the relative importance of 17 component vital rates to . Our previous research showed that female survival was influenced by nest success, so we recognized this female heterogeneity in our analyses. Four vital rates showed the greatest importance to . Analytic sensitivities were greatest for female recruitment, followed by breeding season survival of females that nested successfully, nest success, and nonbreeding survival of females that nested successfully. The order of importance changed for analytic elasticities; breeding and non-breeding season survival of females that nested successfully were now most important, followed by nest success and female recruitment. Next, we used process variation of vital rates and conducted life-stage simulation analyses (LSA) followed by variance decomposition to determine the amount of variation in explained by each vital rate. Female recruitment explained 57.5% of the variation in followed by nest success (11%), and breeding and non-breeding season survival of females that nested successfully (9% each). Together these four vital rates explained 86% of the variation in . Mean asymptotic population growth rate (= 0.8018 0.0783 SD) indicated that recruitment of females hatched from nest boxes was insufficient to sustain the population. However, including yearling (SY) females that were produced outside of nest boxes (i.e., immigrants) increased recruitment rates 1.5 to 2 times more than SY females recruited from nest boxes alone. Future studies that examine how emigration and immigration interact with survival and reproduction to influence local population dynamics will be important for identifying the value of nest-box programs to conservation and management of wood ducks.

E.1-2: PIT-tagging and RFID Tracking Provide New (and Surprising) Insights on Nest Site Use, Fidelity, Female Survival and Recruitment of Wood Ducks in California

Presented by: John M. Eadie (jmeadie@ucdavis.edu)

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Tez F. Stair – Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, CA
Ami C. Olson – California Department of Fish and Wildlife, Sacramento, CA,
Bruce E. Lyon – Department Ecology and Evolutionary Biology, University of California, Santa Cruz, CA
Eli S. Bridge – Oklahoma Biological Survey, University of Oklahoma, Norman, OK

Traditional methods to estimate survival, fidelity, and reproductive success of wood ducks typically involve analyses of banded females caught on the nest during incubation. Such analyses provide a strong foundation for management. However, might such analyses be incomplete or potentially biased? Females banded on the nest comprise only a subset that: initiate a nest, begin incubation, and do so for at least 1-3 weeks into incubation. This misses what may be a sizable fraction including: females that fail prior to capture, brood parasitic females that only lay eggs in other females nests, and young first-year recruits that prospect for nests but do not breed in their first year. Failure to include these females could lead to inaccurate estimates of several key demographic parameters. We followed 4 different populations of wood ducks in California since 1997 using traditional band capture/ recapture techniques. In 2014, we initiated studies to implant PIT tags in every female and all ducklings, install RFID readers on every nest box at each site, and genotype all females and ducklings at each population using 19 microsatellite markers. To date, we have amassed data comprising over 1,000,000 RFID reads on over 500 breeding females and over 5,000 PIT-tagged ducklings. Our emerging results provide unexpected insights, including: (1) females explore a wide variety nest sites, far exceeding the number based on band recapture patterns; (2) many females lay in multiple nests concurrently, and incubating females on a given nest may not be those that layed the most eggs in that nest; (3) many apparent non-breeders did in fact attempt to breed but failed, and we now can estimate how many and who those females are; and (4) a large number of females who survived, were present in the population, and were recorded on nests would have been missed entirely using traditional banding capture/recapture techniques. In addition, we recorded large numbers of ducklings that recruit, visit nest sites and sometimes laid eggs, but are never caught or banded. Our results suggest that previous analyses of wood duck demography may be missing several key components. New technologies such as PIT tagging may provide novel insight into important but under-studied population demographic processes.

E.1-3: Wood Duck Tree Cavity Selection and Use at Missisquoi National Wildlife Refuge

Presented by: J. Boomer Malanchuk (bmalanchuk@ksu.edu)

J. Boomer Malanchuk – Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University, Manhattan, KS
Jacob N. Straub – Department of Environmental Science & Ecology, The College at Brockport, State University of New York.

Previous research suggests > 90% of wood duck production occurs in naturally forming tree cavities but there has never been a cavity-nesting study in the Atlantic Flyway. Most wood duck nest-site selection and use has been studied in man-made nest boxes, mainly in the Midwest. There remains a need to understand nest-site selection and use in tree cavities. We aim to understand which environmental variables influence nest-site selection by wood ducks in an old-growth silver maple (Acer saccharinum) floodplain forest at Missisquoi National Wildlife Refuge in northern Vermont. We located available nesting tree cavities using two search methods (fixed-area plots [n = 40] and line-transects [n = 130]). We measured tree cavity dimensions with a remotely operated camera and in-tree via double-rope climbing technique. We used Akaike Information Criterion model selection to understand the effects of cavity height from ground, area of cavity opening, and DBH of tree on tree cavity selection. We monitored 47 tree cavities that met predetermined size and conditions for use (fixed-area plots = 8, line-transects = 30, and opportunistic encounters = 9). Wood ducks selected tree cavities higher from the ground and with smaller relative cavity opening dimensions. We did not detect any tree cavity use by waterfowl in 2015 from the 8 cavities monitored. In 2016, 12 of 47 identified cavities were occupied though none produced a successful clutch. Nest failures were attributed to predation (58%, n = 8) and abandonment (42%, n = 5). Predation, or perceived predation, was considered the main driver of nest-site selection. We simultaneously monitored nest boxes (n = 20) and observed high nest success (2015 = 61%, 2016 = 27%) and high nest parasitism (2015 = 75%, 2016 = 27%).

E.1-4: Trapping rates, survival, and habitat selection for wood ducks in central Wisconsin

Presented by: Kali Rush (krush@ducks.org)

Kali Rush – Ducks Unlimited, Dexter, MI, USA
Jacob Straub – The College at Brockport - State University of New York, Brockport, NY, USA

Although breeding ecology of wood ducks is well-studied, most research has involved captured birds from artificial nest boxes, where females and their offspring might be protected from predation. While this capture method is relatively easy and efficient, it inherently eliminates or reduces the probability of studying wood ducks that select natural tree cavities for nest sites. In addition to breeding parameters, most habitat selection studies on wood ducks have focused on individuals with confirmed nests. We captured female wood ducks prior to nest initiation, in decoy traps, and from artificial nest boxes, attached VHF transmitters to individuals, and tracked their location throughout the breeding season at Mead Wildlife Management Area (WMA) in central Wisconsin. Our sample of female wood ducks represented box-nesting (n=16), cavity-nesting (n=8), non-nesting (n=5) ducks, and those that we could not determine nests (n=14). We pooled data across years and estimated breeding season female survival at 0.343 (95% CI=0.192-0.613), and this did not vary by mass, trap type, nest attempt, or nest type. This survival estimate was the lowest published breeding season survival estimate we could find, indicating that Mead WMA might be a sink for wood duck populations, but additional years of monitoring would determine if female survival is consistently low at Mead WMA or if our estimates were a function of random environmental stochasticity. Breeding propensity was 0.44 for females captured pre-nesting but could be as high as 0.72 if unknown status wood ducks indeed initiated a nest. Not surprisingly, our sample of wood ducks selected for forested and scrub-shrub wetlands, but surprisingly, they also selected for five additional habitats, including those with less structural cover, suggesting managers should maintain diverse wetland complexes. Additional research that addresses survival and recruitment, especially for cavity-nesting individuals will serve to better understand and manage this species in Wisconsin.

E.1-5: Emerging trends and spatio-temporal differences in vital rates for wood ducks

Presented by: Jake Straub (straub.47@gmail.com)

Jacob Straub – The College at Brockport State University of New York
Matt Dyson – University of Waterloo
Boomer Malanchuk – Kansas State University
Kali Rush – Ducks Unlimited Great Lakes/Atlantic Regional Office

The Wood Duck (Aix sponsa) is an important waterfowl species in North America. It ranks as the fourth most harvested duck species in North America and, as a species, nests almost exclusively below the 49th parallel in North America. Not surprisingly it is also one of the most studied species in North America, especially during its breeding season. Historically, wood ducks were thought to be limited by tree cavity availability and, therefore, intensive nest box management programs had been established throughout their breeding range. Decades of nest box research has illuminated a tremendous amount of knowledge about wood duck ecology. However, contemporary wood duck research has revealed low recruitment and high inter- and intra-specific nest parasitism from many of these boxes, and very few studies have focused on tree cavity-using populations. Given the history and contemporary importance of wood ducks, we conducted a meta-analysis summarizing breeding season life history characteristics across the wood ducks broad temporal and spatial range. We summarized and will present factors including survival rates, clutch size, nest success, habitat type, nest types, field methods and geographic location (time and space) with the goal of recognizing pertinent knowledge gaps and determining which parameters have the greatest certainty and reliability. Researchers could use our summaries to help parameterize population models and prioritize what types of studies, and where, are needed in the future for the conservation and management of the wood duck.

E.2-1: Effects of commercial forest harvesting on the distribution of breeding black ducks in New Brunswick, Canada

Presented by: Kelly McLean (kmclean6@unb.ca)

Kelly McLean – University of New Brunswick
J. Bruce Pollard – Canadian Wildlife Service
Nic McLellan – Ducks Unlimited Canada
Joseph Nocera – University of New Brunswick

Breeding American back duck populations (black duck; Anas rubripes) have declined range-wide since the institution of systematic surveys in the 1990s; however, what may be driving this decline is at present unknown. Black ducks can be intolerant to disturbance and may be subject to local threats, such as those from commercial forest harvesting. To determine if breeding black duck distribution is affected by commercial forest harvesting, we overlaid breeding black duck observations with historic forest harvesting patterns and wetland characteristics in New Brunswick (NB), Canada. Data were obtained from an existing systematic helicopter survey conducted in eastern Canada for 785 wetlands surveyed on a rotational schedule from 1995-2017. We determined for each wetland the proportion of intact forest in 30m and 1000m, the distance to the closest forest harvest within 1000m, the year of forest harvest, and forest harvest method for the most recent ten and twenty year periods. We then created a series of candidate a priori generalized linear mixed effects models; top candidate models for both the ten- and twenty-year disturbance periods were selected using AIC values. The proportion of intact buffer within 30 or 1000m did not influence the presence of breeding black ducks. Breeding black ducks were more likely to be observed on smaller wetlands; increasing wetland size had a strong negative effect on black duck presence. Increasing time since harvest and all harvest methods had negative effects on breeding black duck presence. Results were similar for the 10-year and 20-year time periods but decreasing distance to the nearest harvest had a negative effect on black duck presence in the 20-year model. Commercial forestry may have positive effects on breeding black duck presence following harvest which decrease over time. This may be caused by increased vegetation growth in regenerating forests, creating better nesting habitat.

E.2-2: Forest harvesting emulates fire for some but not all boreal-breeding ducks

Presented by: Vanessa Harriman (v_harriman@ducks.ca)

Mark Bidwell – Department of Biology, University of Saskatchewan, Saskatoon, SK
Vanessa Harriman – National Boreal Program and Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB
Glenn Mack – Fish and Wildlife Policy Branch, Alberta Environment and Parks, Edmonton, AB
Llwellyn Armstrong – Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB
Stuart Slattery – Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB
Robert Clark – Environment and Climate Change Canada and University of Saskatchewan, Saskatoon, SK

Efforts to emulate natural disturbance in forest management rely on the effects of anthropogenic disturbance on wildlife populations approximating those of natural perturbations to which they are presumably adapted via natural selection. Whether this is true broadly, and for North American boreal-breeding ducks in particular, is unknown so we investigated how patterns of duck settling and productivity are related to forest fire and two types of forest harvesting. We conducted aerial surveys of duck pairs and broods on 3,314 wetlands in northeastern Alberta and northwestern Saskatchewan, Canada, in landscapes disturbed within five years by fire, salvage (i.e., post-fire) harvesting, or green harvesting. We used multinomial N-mixture models to investigate relationships between pair and brood abundance of three duck nesting guilds and type and amount of disturbance, while controlling for environmental variation in and around wetlands and adjusting counts for imperfect detection. Abundance of pairs of ground-nesting ducks declined strongly with increasing proportion of salvage harvest, declined moderately with burn and was not related to green harvest, while abundance of broods increased with green and salvage harvest but did not covary with burn. Pairs of cavity- and overwater-nesting ducks declined with increasing proportion of all disturbance irrespective of type; abundance of cavity-nesting broods was not related to disturbance type or amount but overwater-nesting broods were less abundant in areas with green and salvage harvesting than in burned ones. These patterns suggest that forest harvesting may approximate fire for cavity-nesting ducks. For settling in ground-nesters and brood production in overwater-nesters, however, patterns in harvested landscapes relative to fire could result in population or community level effects, if relationships are causal. Such effects could occur if harvesting practices shift towards post-fire salvage associated with anticipated increased fire frequency caused by climate change.

E.2-3: Duck Populations and the Petroleum Industry in Alberta

Presented by: Susan Witherly (s_witherly@ducks.ca)

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Joni Storie – University of Winnipeg, Winnipeg, MB
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The boreal forest of northern Alberta supports a large portion of North Americas breeding duck population and is an area of importance to the petroleum industry. Breeding duck surveys in the Boreal Plains ecozone show several ground nesting species are in decline while cavity and overwater nesters are showing both positive and negative population trends since the 1970s. Industry has been hypothesized as a limiting factor that may influence duck populations and species composition in the region, but there has been limited empirical research to test this assertion. Likewise, climate is an important influence on waterfowl population trends and is often used as a covariate when examining other hypotheses. However, while climate data has been aggregated in many ways, the impact of aggregation method on outcomes of hypotheses testing has not been assessed. To evaluate effects of seasonal classification and relationships between ducks and industry, we used mixed effects logistic regression models with a combination of climate, environmental, landscape, and industry variables. Monthly climate data aggregated into annual (one), two, four, and five seasonal classifications were used to generate predictions of duck densities across a gradient of industry measures. Industry variables retained in models varied by seasonal classification, although we observed similar direction and magnitude of trends for specific industrial variables where retained. Cavity and overwater nesting guilds were best modelled with a four-season aggregation, and the ground nesting guild was best modelled with the five-season aggregation. Based on these best aggregation models, results were consistent across nesting guilds, with a small, negative relationship between breeding pairs and cumulative areas of petroleum infrastructure, and a positive relationship between both cumulative infrastructure edge and industrial activity with breeding pairs. We recommend analyses of waterfowl population data include an assessment of the best aggregation of climate data by nesting guild.

E.2-4: Roads, Pipelines, and Seismic LinesWhat Do They Mean for Boreal Ducks?

Presented by: Stuart Slattery (s_slattery@ducks.ca)

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The Western Boreal Forest (WBF) has changed rapidly due to industrial development. Implications of these changes for waterfowl are unknown though landscape changes are hypothesized to alter food availability and/or predation rates with subsequent negative impacts on demography. Linear features (roads, seismic lines, and pipelines) have the second largest anthropogenic footprint in crown-owned portions the WBF. Our objective was to assess relationships between these features and waterfowl settling and productivity, and thereby test predictions of food vs. predation mechanistic hypotheses. Waterfowl surveys were conducted using helicopters to count pairs and broods on grids (2.5km x 2.5km, n = ~100 per year, 2013 - 2016) distributed across gradients of linear feature densities in north-central Alberta. We used a double observer and repeated visit methodology followed by multinomial N-mixture models to examine relationships with linear features while correcting for detection probability and habitat biases. In addition, we tested for interactions between anthropogenic and natural linear features (riparian edge density). Analyses were conducted at both the wetland and grid levels. Most relationships between waterfowl metrics and anthropogenic linear features were neutral or positive, and, where negative, patterns were generally not consistent across nesting guilds, spatial scales or linear feature type. However, we did observe several interactions between riparian edge density and road and pipeline density. In these cases, roads tended to have negative relationships at lower riparian edge density, while the pattern was opposite for pipelines. Our results provided limited support for either mechanistic hypothesis and are generally consistent with other studies. Boreal waterfowl appear to be resilient to landscape changes at current levels.

E.2-5: Impacts of oil and gas development on duck pair abundance

Presented by: Chuck Loesch (chuck_loesch@fws.gov)

Charles Loesch – US Fish and Wildlife Service
Kaylan Kemink – Ducks Unlimited
Ryann Cressey – Ducks Unlimited
Tanner Gue – Ducks Unlimited
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Mike Szymanski – North Dakota Game and Fish Department

The expansion and intensification of oil and gas development in the Bakken shale oil formation that began in 2004 raised several uncertainties for managers tasked with prioritizing wetland and grassland habitat for conservation in the region. Of specific concern due to substantial overlap of wetland resources within the developed areas is the potential impact on breeding duck pair abundance. To test for large-scale changes in breeding duck pair abundance, we conducted wetland-based surveys for five species of dabbling ducks during 2015-2017. We used zero-inflated Poisson models to model the count data. In addition to wetland size, class, and location covariates previously used to predict breeding duck abundance, we included a spatially and temporally explicit index of disturbance. Our analysis results were mixed and suggested that abundance of early nesting species were positively related to the disturbance index, while later nesting species were negatively related to the disturbance index. Regardless of the relationship, the effect size was small and we do not consider the effect of disturbance resulting from oil and gas development on breeding duck pairs to be biologically significant. Consequently, efforts to conserve wetland resources that provide important habitat for breeding duck pairs should continue within the overlap of the Prairie Pothole Region and Bakken oil field, irrespective of oil and gas development intensity.

E.3-1: Predicting spatiotemporal abundance of breeding waterfowl across Canada: opening the black box

Presented by: Antoine Adde (antoine.adde.1@ulaval.ca)

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Nicole Barker – Boreal Avian Modelling Project, University of Alberta, Edmonton, AB, Canada
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The Waterfowl Breeding Population and Habitat Survey (WBPHS) produces annual counts of breeding waterfowl to species over 30km segments. The survey area now covers much of Canada, excluding the Arctic. Nicole Barkers (2014) study remains the only use of WBPHS for waterfowl species abundance models at national extent. She used machine learning methods to model 15 year mean segment as a function of a large suite of environmental covariates. In the spirit of continuous improvement, we revisited this study to: (i) account for interannual variation; and (ii) improve model interpretability. Our response variables were annual counts of 18 waterfowl species on 2,227 segments over 26 years (19902015). We defined a panel of 128 spatial and 104 spatiotemporal environmental covariates in four categories: forest attributes (35), geoclimatic (92), hydrology (42), and land cover (63). Our analytical approach combined gradient boosting and hierarchical generalized linear models. The final models explained from 24% (Ruddy Duck) to 71% (Mallard and Scoters) of the variance in the data. A total of 53 distinct covariates were included in the 18 models, with a maximum of 9 per model. Forest attribute covariates were most frequently selected, relative to the categorys representation in the panel. The geoclimatic category was least selected. The two most frequently selected covariates were the proportional above-ground biomass of Trembling Aspen (Populus tremuloides) and of Balsam Poplar (P. balsamifera), selected in 11 and 7 of 18 models, respectively. Combined with a yearly grouping structure, spatiotemporal covariates accounted for some of the interannual variability in species counts, with NDVI-related covariates the most frequently selected. Our innovative analytical method overcomes the challenges of high dimensionality while producing parsimonious, interpretable models. We hope models derived from this work will allow more precise and reliable spatial targeting for habitat conservation and population management.

E.3-2: Local and landscape characteristics that influence waterbird wetland use during spring migration in Illinois

Presented by: Abigail G. Blake-Bradshaw (ablakebradshaw@gmail.com)

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Habitat conditions during migration likely influences body condition and subsequent recruitment of some waterbird species and during the breeding period. However, relatively little is known about relationships between habitat characteristics and waterbird use during spring migration, despite the implication that habitat during spring migration is likely limiting in the Midwest, USA. We used aerial surveys and ground assessments of polygons included in the National Wetland Inventory to identify species-habitat relationships of waterfowl in Illinois during spring migration 2016–2017. We mapped surface water inundation, visually estimated vegetation cover, and assessed wetland management and anthropogenic stressors of all NWI polygon area included in 100–120 25-ha plots each year. Local wetland hydrological and vegetation cover were the most important predictors of dabbling duck and other waterbird densities. Dabbling duck density increased 34.8% and other waterbird density increased 44.6% for every 10% increase in the proportion of wetland areas inundated by surface water. Furthermore, dabbling duck density increased 26.5% for every 10% increase in the proportion of shallow (<45 cm) surface water. Dabbling duck and other waterbird density was negatively related to woody vegetation cover, which could be due to multiple factors including perceived risk associated with more vegetated wetlands or potentially limited food availability. While many factors influence waterbird use and selection, this study emphasizes the importance of providing surface inundation and regions of shallow water during spring migration in Illinois. Restoration efforts should incorporate controllable hydrology and potentially avoid instances where hydrology is largely unregulated in large river floodplains.

E.3-3: Building a Predictive Model of Submerged Aquatic Vegetation for Atlantic Brant

Presented by: Chase Colmorgen (chaseco@udel.edu)

Chase Colmorgen – Department of Entomology and Wildlife Ecology, University of Delaware, Newark, Delaware
Christopher Williams – Department of Entomology and Wildlife Ecology, University of Delaware, Newark, Delaware

With a constantly changing environment, the ability to retain and protect submerged aquatic vegetation (SAV: eelgrass (Zostera marina), widgeongrass (Ruppia maritima), and macroalgae (Ulva sp., Entermorpha sp, Gracilaria tikvahiae, and assorted Rhodophyta) is becoming more important as they provide critical ecosystem functions. SAV has many benefits to organisms including the Atlantic brant (Branta bernicula hrota) which is a specialist on these food sources. For example, after a stark decrease in eelgrass in the early 1930s due to a wasting disease from the slime mold Labyrintha zosterae, the population of Atlantic brant also decreased due to lack of food availability. With eelgrass never fully recovering, the brant substituted macroalgae as an alternative food source within a few years. Today, brant populations are still fluctuating raising questions as to whether current food abundance is a factor in their population changes. Thus, building a predictive model of SAV abundance will aid in predicting the potential carrying capacity of wintering brant within the Atlantic flyway. We used Landsat 8 imagery to create a Normalized Difference Vegetation Index (NDVI) of SAV between Long Island and Southern New Jersey which coincides with the highest population wintering grounds for brant. We collected water depth, quality, turbidity, salinity, and SAV biomass at 257 1m2 quadrats across the study area including 174 predicted SAV points and 82 null points. All SAV samples were identified to species, cleaned, dried, and weighed to determine energy density availability. Predictive Akaike Information Criterion (AIC) models of eelgrass and macroalgae presence indicated turbidity, water depth, and NH3-N are significant drivers of SAV presence. The NDVI results revealed higher modeling accuracy for algae species than eelgrass, but also supports the theory of more algae abundance than eelgrass. These modeling results coupled with the sorted biomass values allow estimations for wintering brant carrying capacity across the Mid-Atlantic.

E.3-4: Habitat Use by Female Mallards During and After Waterfowl Hunting Season in Mississippi

Presented by: Joseph D. Lancaster (lancastj@illinois.edu)

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Recreational hunting harvest is a predatory force demonstrated to impart fear in surviving individuals. Survivors of near-predatory events may alter behavior and space use to avoid risky environments and events that could pose fitness costs via reduced energy income, survival, and breeding opportunities. We hypothesized that duck hunting and associated disturbances create a landscape of fear that shapes diel habitat use by mallards (Anas platyrhynchos) during winter in Mississippi. Specifically, we proposed that open habitats, such as flooded croplands and emergent wetlands, present increased anthropogenic predation risk over forested wetlands which provided greater physical isolation. We expected greater use of forested wetlands diurnally and flooded croplands and emergent wetlands nocturnally within hunting seasons, but diurnal use of flooded cropland and emergent wetlands would increase post-hunting season. We evaluated diel habitat use within and post-hunting seasons using 9,229 locations from 241 radiomarked female mallards during winters 2010-2012 and 2013-2015 in Mississippis Alluvial Valley. Supporting our prediction, mallards used forested wetlands 135% (77 211 [95% CI]) more diurnally than nocturnally within hunting seasons. However, flooded cropland and emergent wetlands were used 2% (23 35) and 53% (14 109) more diurnally than nocturnally within hunting seasons, respectively. Diurnal use of flooded cropland was 40% (14 71) greater following closure of hunting seasons, whereas emergent wetlands were used 8% (13 33) more during the hunting season. Mallards used complexes of flooded croplands and wetlands, but anthropogenic disturbance likely was confounded with other influences such as wetland management on inviolate sanctuaries, which may have influenced diel habitat use in the surrounding landscape. Restoration of forested wetlands at seasonally flooded elevations will provide long-term benefits to mallards in the region.

E.3-5: Black Scoter Habitat Use along the Southeastern Coast of the United States

Presented by: Hannah M Plumpton (hplumpt@clemson.edu)

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While the Atlantic coast of the United States and Canada is a major wintering area for sea ducks, habitat use and movement patterns of sea ducks, such as the black scoter (Melanitta americana), are relatively unknown and understudied. The lack of information in conjunction with a rise in human activity in and near the Atlantic Ocean has led to an increased effort for the conservation and management of sea ducks, while minimizing human conflicts. The objective of our study was to identify variables that had the most influence on black scoter distribution in the Atlantic Ocean, particularly along the southeastern coast of the United States. To identify the variables that were the most influential on black scoter distribution along the southeastern coast of the United States, we used aerial survey data from 2009 to 2012 provided by the U.S. Fish and Wildlife Service. We used Least Absolute Shrinkage and Selection Operator (LASSO), a variable selection method, to examine habitat use with broad- and fine-scale oceanographic and weather variables. The oceanographic variables bathymetry and ocean floor substrate, the weather variable of average time between waves, and the interactive effect of North Atlantic Oscillation and distance to shore had the greatest association with the distribution of wintering black scoters. Additionally, our results indicate that oceanographic variables have a stronger relationship with black scoter distribution than weather variables. The identification of key habitat variables provides valuable insight into identifying the areas of high quality wintering habitat and resources and enabling the protection of those areas through preservation and minimizing human conflicts.

E.4-1: Estimating offsets for waterfowl displacement effects of anthropogenic impacts

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Biodiversity offsetting, or compensatory mitigation, is increasingly being used in temperate grassland ecosystems to compensate for unavoidable environmental damage from anthropogenic developments such as transportation infrastructure, urbanization, and energy development. Pursuit of energy independence in the United States will expand domestic energy production. Concurrent with this increased growth is increased disruption to wildlife habitats, including avian displacement from suitable habitat. Studies conducted at energy-generation facilities have provided evidence for behavioral avoidance and thus reduced use of habitat by breeding waterfowl in the vicinity of energy infrastructure. To quantify and compensate for this loss in value of avian breeding habitat, it is necessary to determine a biologically-based currency so that the sufficiency of offsets in terms of biological equivalent value can be obtained. We describe a method for quantifying the amount of habitat needed to provide equivalent biological value for waterfowl and other avifauna displaced by energy and transportation infrastructure, based on the ability to define five metrics: impact distance, impact area, pre-impact density, percent displacement, and offset density. We demonstrate the applicability of our avian-impact offset method for breeding duck pairs using an example for wind-energy production. We developed a companion worksheet that informs potential users how to apply our method to their specific developments and a framework for developing decision-support tools aimed at achieving landscape-level conservation goals.

E.4-2: Does wetland management for waterfowl increase marsh bird occupancy?

Presented by: Auriel M.V. Fournier (auriel@illinois.edu)

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It is widely assumed that wetland management practices for waterfowl benefit a variety of wetland-dependent birds, but few studies have evaluated this assumption. Secretive marsh birds are a migratory guild of conservation concern and that use shallowly flooded wetlands with dense emergent vegetation and abundant seed and invertebrate food resources conditions frequently desired in wetlands managed for waterfowl. We assessed marsh bird occupancy in wetlands across Illinois to better understand how local wetland characteristics, surrounding landscape context, and management practices for waterfowl influenced marsh bird occupancy. From mid-April through mid-June 20152017, we conducted 1,033 call-back surveys following the North American Standardized Marsh Bird Survey Protocol at 53 focal sites (wetlands passively or actively management for waterfowl) and 107 reference sites selected from the National Wetland Inventory (NWI; n = 73) and Illinois Natural History Surveys Critical Trends Assessment Program (CTAP; n = 34). We detected 3,680 marsh birds representing 9 of 10 focal species. Odds of detection declined 6% per day during the survey season annually. The odds of marsh bird occupancy were 29 times greater in the most heterogeneous (i.e., 3 intermixed vegetation classes) than homogeneous wetland classes. Moreover, the odds of marsh bird occupancy were 0.8 and 5 times greater in wetlands managed for waterfowl than random NWI and CTAP wetlands, respectively. Wetland. communities for marsh birds were limited across most of Illinois. Wetland management practices (e.g., semi- permanent emergent marsh) that retained surface water during the growing season, encouraged perennial emergent plants (e.g., Typha sp.), and had increased wetland complexity provided habitat for waterfowl and marsh birds. Further, intense management practices such as early drainage, vegetation manipulation (e.g., disking), supplemental planting, and control of perennial emergent species were unfavorable to marsh bird occupancy and should be applied infrequently if pursuing multi-species management.

E.4-3: Evaluation of Integrated Waterbird Management and Monitoring Program Survey Techniques to Assess Waterbird Abundance

Presented by: Luke J. Malanchuk (luchuk18@illinois.edu)

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A variety of survey designs and protocols are used to monitor waterfowl and other wetland-dependent bird (collectively, waterbird) abundance during migration and winter (hereafter, non-breeding period). Biologists from state and federal agencies, non-government conservation organizations, and universities use waterbird monitoring data to track trends in site use over time, index local population sizes, provide outreach to the general public, and evaluate management and conservation actions. However, inconsistent methodologies and inadequate design relative to survey objectives often reduce the usefulness of waterbird monitoring data. The Integrated Waterbird Management and Monitoring Program (IWMM) represents a collaboration between partners to provide a framework for standardized data collection, data management, and manipulation of decision support tools through an interactive online portal to assist decision makers in non-breeding habitat conservation and delivery. We evaluated the IWMM waterbird monitoring protocol by comparing seasonal duck use-day estimates and peak abundances derived from ground surveys to estimates based on aerial surveys during 20102016 at portions of Clarence Cannon, Great River, and Two Rivers National Wildlife Refuges. Aerial surveys were conducted by the Illinois Natural History Survey and corrected for detection probability and count bias using results from an ongoing research project. Ground surveys were conducted during the same week as aerial surveys by the Fish and Wildlife Service or cooperators. The IWMM protocol tended to overestimate dabbling ducks (+91%, 19%) and total waterbirds (+88%, 18%) during the pilot phase from 20102013 (n=84), but a protocol change in 2014 increased the rigor of ground surveys, leading to estimates comparable to the corrected aerial estimates for dabbling ducks and total waterbirds (-5%, 13%; -10%, 11%, n=41). We will present results from this evaluation, model factors (e.g., observer, vegetation cover, weather conditions) affecting waterbird surveys, and make recommendations for future implementation of the IWMM survey protocol.

E.4-4: Antagonistic, Synergistic and Direct Effects of Land Use and Climate on Aquatic and Avian Communities: Ghosts of the Past or Present?

Presented by: Robert Clark (bob.clark@canada.ca)

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Dave Messmer – University of Saskatchewan
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Howard Wheater – Global Institute for Water Security
David Howerter – Ducks Unlimited Canada
Robert Clark – University of Saskatchewan and Environment and Climate Change Canada

Wetlands are being lost or degraded, threatening biodiversity to an extent greater than in most ecosystems. To develop science-supported responses, we require an understanding of interacting effects of land-use and climate change on wetland biodiversity. We evaluated how current climate, climate change and land-use (conversion of grassland to cropland, loss of natural habitats), and wetland-water quality affect aquatic macroinvertebrates and birds at sites in Alberta, Canada. Macroinvertebrate taxa richness (MTR) was negatively related to salinity, whereas total precipitation and total phosphorous negatively influenced chironomids and odonates, respectively. Abundances of chironomids were positively associated with cropland cover. Greater area of non-woody riparian vegetation reduced the negative effect of salinity on MTR. Higher cropland cover and dissolved organic carbon synergistically interacted with total precipitation to affect chironomids. Higher grassland cover also increased the negative impact of total phosphorous on odonates. Higher average rainfall and greater warming temperatures over time were key determinants of higher bird species richness (BSR) and abundances of several bird functional groups. Area of pasture and forages, shrubland, grassland, trees, and wetlands were positively associated with most bird groups and BSR. Warming temperatures over time ameliorated the negative effects of higher cropland or less shrubland on aerial insectivores, arboreal herbivores, arboreal insectivores, terrestrial herbivores, and terrestrial insectivores. Climate patterns and climate change were as important as local land-use pressures for biodiversity with stronger impacts on birds. Climate change as a ghost of the past was more influential than current climate and provided novel empirical evidence that progressively warmer, wetter conditions is benefiting some bird groups, including aerial insectivores, a group of conservation concern. Riparian vegetation ameliorated the negative impacts of climate and water quality gradients on MTR and could mitigate the consequences of global change in intensive agricultural systems.

E.4-5: Using Environmental DNA to Characterize Waterbird Communities in Central Arizona

Presented by: Catherine E. Benson (bensonc5@erau.edu)

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All organisms, from bacteria to humans, leave a genetic fingerprint in their environment, and recent advances in environmental DNA (eDNA) analyses are allowing scientists to detect these signals in samples of air, water, and soil. One such analysis, eDNA metabarcoding, can be used to target the DNA of entire taxonomic groups for species-level identification. Over the past year, we designed a 16S rRNA metabarcoding protocol that targets vertebrate species. Pilot studies conducted in Arizonas Verde River resulted in eDNA detections of species from all vertebrate groups, including a number of waterbirds. Given these results, we sought to determine if this technique could identify members of a more complex assemblage of waterbirds. During November 2018, we conducted traditional waterbird surveys and collected water samples for eDNA analysis at the Watson and Willow Lakes Important Bird Area, a waterfowl and shorebird concentration site in Prescott, Arizona. Traditional surveys consisted of a two-hour point count conducted by four teams at four points along the shoreline. Water samples for eDNA analysis were collected in triplicate at eight sites spanning littoral and limnetic lake zones. Traditional surveys resulted in the detection of 26 waterbird and wetland-associated species, of which, 16 were also detected using eDNA analysis. eDNA detections included 12 species of waterfowl, and the American Coot Fulica americana, Pied-billed Grebe Podilymbus podiceps, Great Blue Heron Ardea herodias, Double-crested Cormorant Phalacrocorax auritus, and Red-winged Blackbird Agelaius phoeniceus. One species, the Wood Duck Aix sponsa, was detected only by eDNA. Based on these results, we believe that eDNA metabarcoding is a valuable tool with applications for monitoring waterbirds in aquatic ecosystems.

F.1-1: Why we need more women in STEM leadership roles: innovations to overcome obstacles and identify solutions

Presented by: Lisa Webb (webbli@missouri.edu)

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Data suggest that involving women in leadership roles from Fortune-500 companies to small conservation groups result in greater innovation, increased productivity, and higher project success rates. Over the past three decades there have been directed efforts at increasing womens opportunities for leadership roles through various private and government-funded programs, particularly in the fields of science, technology, engineering, and math (STEM). Although the number of women graduating with undergraduate and graduate degrees in STEM fields has increased, this trajectory has not continued for women in leadership roles in these disciplines. The trend is particularly evident in the field of natural resource management of game species, including waterfowl ecology, where a limited number of women fill leadership roles and academic positions with agencies and institutions in the United States and Canada. Research indicates that women face bias and barriers in many aspects and stages of their scientific careers: we will discuss the specific and often unconscious nature of these biases and how they can potentially discourage women from pursuing leadership roles and academic careers, as well as limit their willingness and ability to remain in these careers. Unconscious gender bias has been documented among many of the criteria used as part of hiring and evaluation decisions, including publication and funding rates, teaching evaluations, as well as subtler measures such as visibility, impact and reputation. It is noteworthy that many of these gender biases occur among both male and female evaluators, indicating a systemic cultural issue and highlighting the importance of working collectively to recognize and proactively address structural gender bias in STEM. We will discuss strategies for fostering a broader recognition of gender bias, as well as addressing unconscious gender bias at both the institutional and individual levels.

F.1-2: Beginning a career in waterfowl ecology: Challenges and strategies

Presented by: Casey Marie Setash (csetash@rams.colostate.edu)

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The number of women in the ecology field has drastically increased over the last several decades. There is currently a large cohort of young women studying some aspect of gamebird, and specifically waterfowl, ecology at the undergraduate or graduate level that will soon be seeking permanent positions in the field. These women will face different challenges from their male peers when attempting to obtain jobs in the historically male-dominated field of waterfowl ecology. The transient nature of the demographics within the field means there are fewer women than men in leadership positions, which results in fewer female mentors for early-career women entering the field. In addition, early-career positions often require employees to move long distances, travel frequently, and conduct physically demanding work during the primary child-bearing years of a womans life. We will discuss strategies for beginning a career in waterfowl ecology and why its essential that the diversity within the realm of waterfowl management reflects the diversity of the stakeholders who consume and enjoy the resource.

F.1-3: Underemployment: A self-imposed opportunity gap

Presented by: Lindsay G. Carlson (lcarlson@gmri.org)

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Sally Yannuzzi – State of North Carolina Wildlife Resources Commission, Raleigh, NC
Cheyenne Beach – Western Illinois University, Macomb, IL

An often-cited statistic states that men will apply for positions where they meet 60% of the qualifications, but women will only apply if they meet 100% of the qualifications. Women may be missing out on career advancement opportunities by failing to pursue them. One hypothesis to explain the gender disparity in perceived ability and subsequent opportunity pursuit is the confidence gap. Women are less self-assured than men, and this confidence differential affects the opportunities women choose to pursue as well as the compensation they receive. College educated women are more likely (47%) than college educated men (37%) to be underemployed in their first position after graduation, regardless of major. Women in biological sciences and natural resources professions are 7% and 5% (respectively) more likely than men to be underemployed after 5 years. The underemployment trend and the gender-disparity in underemployment can have career-long financial implications: underemployed graduates tend to make 27% less than their appropriately employed peers. The goal of this study is to investigate the causes and effects of gender disparity in opportunity pursuit and associated compensation for technician and other entry-level positions in the waterfowl and wildlife fields. We used mixed methodology to include a combination of quantitative analyses of wage vs. experience disparity as well as semi-structured qualitative interviews to gather data. This special session presentation will quantify and describe the confidence gap for females in the waterfowl and wildlife science workforce specifically. The objectives are to 1) increase awareness of unique challenges female applicants face during the job-application process and 2) provide strategies to increase the number of females pursuing upper-level positions in the waterfowl and wildlife workforce.

F.1-4: Mentoring in the Waterfowl Profession: Challenges and Opportunities

Presented by: Susan Ellis-Felege (susan.felege@email.und.edu)

Susan N Ellis-Felege – Biology Department, University of North Dakota, Grand Forks, ND
Kaylan Kemink – Ducks Unlimited, Inc., Bismarck, ND

Mentoring plays a crucial role in both the educational and professional world of Science, Technology, Engineer, and Mathematics (STEM) disciplines, as it provides students and young employees with sponsorship and networking opportunities. Despite the importance of mentoring for recruiting and retaining bright and innovative individuals to STEM careers, few institutions provide formal training about best practices or even general guidelines. While research in this area is still relatively scarce, what does exist suggests that mentor and mentee identities (e.g. gender, hunter) play a large role in how a relationship forms and persists. Men seeking to mentor women entering the field of waterfowl ecology for example would need to structure their approach differently than if they sought to mentor another male. Understanding how these social relationships should be approached and managed has become more critical as the structure of STEM disciplines like waterfowl ecology shifts from male-dominated to a more balanced gender ratio. We hope to provide an opportunity for reflection and a springboard for future discussions about how to enhance conservation of the resources for the generations ahead and increase retention of students in the waterfowl profession.

F.1-5: Effective networking strategies for hunters and non-hunters

Presented by: Beth E Ross (bross5@clemson.edu)

Beth E Ross – U.S. Geological Survey, South Carolina Cooperative Research Unit, Clemson, SC
Caroline Brady – California Waterfowl, Roseville, CA
Susan Ellis-Felege – Dept. of Biology, University of North Dakota, Grand Forks, ND
Anne Mini – Lower Mississippi Valley Joint Venture, Ridgeland, MS

Waterfowl ecology has grown from a long tradition of hunting. While historically, many waterfowl ecologists would have entered the field with this background, our field is becoming increasingly diverse. Many early career professionals may have had limited experience with hunting, yet many of the networking and informal social discussions at professional conferences related to waterfowl ecology focus on hunting. These interactions may leave non-hunters feeling left out, increasing issues related to imposter syndrome and underrepresentation. The objective of our presentation is to provide insights into how to network and grow within the field of waterfowl ecology. We provide experiences and perspectives from women who hunt and do not hunt, and how this might influence our perspectives of scientific conferences. We specifically discuss opportunities to network with individuals who do not come from a hunting background. Our discussion includes suggestions for networking at scientific conferences as well as from an individuals home institution, and we provide examples for how to find common ground as a stepping stone for opening the door to more diverse backgrounds. We feel that by intentionally networking with a diversity of individuals, we will be able to develop and grow the field of waterfowl ecology.

F.2-1: Regional Examination of the Contribution of Nest Boxes to Wood Duck Recruitment in the Southeast United States: Pilot Study

Presented by: Beau Bauer (bbauer@nemourswildlife.org)

Beau Bauer – Nemours Wildlife Foundation, Yemassee, South Carolina
Ernie Wiggers – Nemors Wildlife Foundation, Yemassee, South Carolina
Richard Kaminski – James C. Kennedy Waterfowl and Wetlands Conservation Center, Clemson University, Georgetown, South Carolina
Gary Hepp – School of Forestry and Wildlife Sciences, Auburn University, Auburn, Alabama
Paul Schmidt – Nemours Wildife Foundation, Yemassee, South Carolina

Artificial nest boxes have played a pivotal role in recovery and management of wood ducks (Aix sponsa) in North America for over a century. Wood ducks now comprise a significant percentage of the annual waterfowl harvest in the Atlantic and Mississippi Flyways, and are an inclusive species for the recently adopted multi-stock adaptive harvest management protocol for the Atlantic Flyway. While numerous studies have addressed nest box use, hatching success, duckling production, and habitat characteristics, few studies have addressed female recruitment by box-nesting populations and such data are lacking on a regional-scale. This lack of critical population metrics resulted in biologists from the southern portion of the Atlantic Flyway to list the need for contemporary regional-scale estimates of wood duck reproductive success and female recruitment rates as a high priority. Subsequently, we have initiated a pilot study in 2019 to evaluate methodology and logistics required to conduct a multi-state female recruitment study throughout the southeastern United States for 3–5 years. To date, box use in our study site (Lake Moultrie, South Carolina) was 53% (n = 166). From these boxes, we banded adult female wood ducks (n =112) and web-tagged newly hatched ducklings (n = 278). We also measured abiotic and biotic variables at each box to evaluate proximate habitat effects on box selection. This pilot study is being conducted as a partnership among Nemours Wildlife Foundation, Clemson University's James C. Kennedy Waterfowl and Wetlands Conservation Center, South Carolina Department of Natural Resources, and the U.S. Fish and Wildlife Service. Our goal is to expand this study to multiple states in 2020 along the Atlantic Flyway from Delaware to Florida and into the lower Mississippi Flyway. If successful, this study could be a model for how other flyway level questions for waterfowl identified during a meeting of biologists in February 2018 at the Nemours Wildlife Foundation can be addressed through a unified public and private-sector collaboration.

F.2-2: Nest-box selection by wood ducks and black-bellied whistling ducks across coastal South Carolina

Presented by: Gillie D. Croft (gcroft@clemson.edu)

Gillie D. Croft – Nemours Wildlife Foundation, Yemassee, SC
Richard M. Kaminski – James C. Kennedy Waterfowl and Wetlands Conservation Center, Clemson University, Georgetown, SC
Ernie P. Wiggers – Nemours Wildlife Foundation, Yemassee, SC
Patrick D. Gerard – Department of Mathematical Science, Clemson University, Clemson, SC

We conducted surveys of nest-structure use and selection by wood ducks (Aix sponsa) and black-bellied whistling ducks (Dendrocygna autumnalis) across two coastal South Carolina regions during 20162017. For 364 and 354 nest boxes surveyed each year, 61% were used by wood ducks and 15% by black-bellied whistling ducks. Peak nesting for wood ducks was in March-April and June-August for black-bellied whistling ducks, suggesting limited overlap in nesting chronology and competition for nest boxes between species. Multiple logistic regression revealed the odds of nest-box use by wood ducks were 5.8% (P = 0.003) greater for every 1,000 cm3 decrease in internal box volume. However, odds of nest-box use by black-bellied whistling ducks were 19.6% (P < 0.001) greater for every 1,000 cm3 increase in internal volume. Odds of box use were 15.1% and 11.1% greater (0.001 P 0.024) for wood ducks and black-bellied whistling ducks, respectively, for every 10% decrease in percent canopy cover around boxes. Odds of nest-box use by black-bellied whistling ducks were 18.3% and 9.8% greater (0.004 P 0.005) for every 10-cm increase in distance from the base of boxes entrance vertically to ground or water surface and every 10-m decrease in distance between boxes, respectively. Our results suggest the conventional nest box described by F. C. Bellrose, with internal dimensions of 25 25 55 cm, accommodated both species and can be deployed where the species nest sympatrically. Additionally, we suggest nest-box entrance diameter be 13 cm to facilitate use by larger bodied black-bellied whistling ducks but maintain use by wood ducks. Lastly, we observed that both species of ducks used boxes in open canopy ponds, which often contained fish that prey on ducklings. We suggest avoidance of these wetlands for erection of nest structures.

F.2-3: Survival and resource selection of overwintering ring-necked ducks in the southern Atlantic Flyway.

Presented by: Tori Mezebish (tmezebish@gmail.com)

Tori Mezebish – University of Georgia
Mark McConnell – Mississippi State University

Overwintering is an important life history stage during which waterfowl in the southeastern United States build and maintain energy reserves for subsequent migration and breeding but are simultaneously subject to hunting. Ring-necked ducks (Aythya collaris) are one of the most abundant and highly harvested North American diving ducks. However, few studies have investigated their overwintering ecology and none have estimated overwintering survival. Therefore, we quantified the overwintering survival probability and wetland selection of transmitter-implanted female ring-necked ducks over two winters (2017-2018 and 2018-2019) in the southern Atlantic Flyway. We estimated overwintering survival probability using a known fates analysis of 87 female ring-necked ducks in central South Carolina and the Red Hills Region of southern Georgia and northern Florida. Overwintering survival probability was 0.94 (95% CI: 0.81 0.98) for Red Hills females but only 0.54 (95% CI: 0.24 0.75) for South Carolina females. We attribute the disparity in regional survival probabilities to differences in hunting pressure, quantified as density of flooded agriculture in each study area. Further studies should investigate the magnitude and spatial variability of harvest pressure in the Atlantic Flyway, its influence on ring-necked duck population dynamics, and its role in Adaptive Harvest Management. We further characterized ring-necked duck overwintering ecology by quantifying selection of wetland types (i.e. vegetated, flooded agriculture, and open water) for 42 females in the Red Hills Region. Individuals selected for vegetated wetlands (Selection Ratio: 1.31) but not flooded agriculture (Selection Ratio: 0.93) and open water (Selection Ratio: 0.11). Selection for vegetated wetlands reflects the importance of native and moist soil vegetation for foraging and roosting both during and after the waterfowl hunting season. Our estimates of overwintering survival and resource selection are crucial to establishing best management practices on the wintering grounds and understanding ring-necked duck annual ecology.

F.2-4: Southward departure of urban-wintering Canada geese from major metropolitan areas

Presented by: Ryan Askren (raskren2@illinois.edu)

Ryan Askren – Illinois Natural History Survey, Bellrose Waterfowl Research Center and Forbes Biological Station, Prairie Research Institute at the University of Illinois, Havana, IL 62644.
Christopher M. Sharp – Environment and Climate Change Canada, Ottawa, ON K1V 1C7.
Michael W. Eichholz – Cooperative Wildlife Research Laboratory, Center for Ecology, Department of Zoology, Southern Illinois University Carbondale, Mailcode 6504, Carbondale, IL 62901.
Michael P. Ward – University of Illinois at Urbana-Champaign, Department of Natural Resources and Environmental Sciences and Illinois Natural History Survey, 1102 S Goodwin Avenue, Urbana, IL, 61801.

Temperate-breeding Canada goose (Branta canadensis) abundances have increased while wintering distributions of both subarctic- and temperate-breeding Canada geese have shifted northward. Abundances of geese remaining north of traditional wintering areas and in urban areas has resulted in decreased hunting opportunities further south. These shifts are likely due to a combination of changing climate and adaptation to urban areas that provide necessary resources and safety during mild winters. However, severe weather events may push geese from these urban refugia to huntable areas, leading to increased harvest and hunter opportunity. Our goal is to better understand resources that facilitate wintering in urban areas and weather conditions that force geese from these areas by examining southward departure of Canada geese marked in the Chicago and Toronto Areas. We transmitter-marked 153 Canada geese in the Chicago and Toronto Areas between 2014 2018 and tracked geese until death or transmitter failure. We determined dates and weather conditions relative to departure of transmittered Canada geese from urban areas. We recorded 26 departures the Chicago Area (n = 132 birds/seasons) and 28 departures from the Toronto Area (n = 56). Mean departure was 13 January 22.3 days from the Chicago Area and 7 January 18.2 days from the Toronto Area. Minimum daily temperatures on days of departure were similar between Toronto and Chicago Areas (-11.41 C 10.34, -12.62 C 9.79 respectively). We are continuing to model the effects of weather, breeding status, and resource use in urban areas on southward departure. Examining the relationship between urban land uses, weather, and winter departure can improve management of goose abundances and harvest.

F.3-1: Waste Grain Availability in Post-harvest Rice and Corn Fields, California

Presented by: Luke Matthews (lmatthews@calrice.org)

Luke Matthews – California Rice Commission, Sacramento, California
Dr. Mark Petrie – Ducks Unlimited, Sacramento, California
Dr. John Eadie – Wildlife, Fish, and Conservation Biology, UC Davis, Davis, California

Rice and corn comprise 70% of the winter food supplies for waterfowl in the Central Valley. However, agricultural practices such as post-harvest treatments of rice and corn fields have been changing in the Central Valley. These changes are largely due to recurring drought conditions and shifting agricultural economics. Currently we lack data regarding how post-harvest treatments in rice and corn fields affects waste grain availability, yet these data are essential to determine the carrying capacity of agricultural lands for waterfowl during winter in the Central Valley. To address this knowledge gap, we estimated the abundance of available waste grain (lbs/ac.) using dry field transects and dry field soil cores, and flooded field (wet) soil cores in 84 rice fields and 47 corn fields in 2016 and 2017. Our results indicate that the available waste grain in rice fields varied significantly among post-harvest treatments. Fields that received no post-harvest treatment (stubble left standing; no incorporation of straw) had the greatest amounts of waste rice, whereas fields that were disced, disced and rolled, or burned provided the least amount of available waste rice. The mean abundance of waste rice grain in dry fields, across all treatments, was 286 lbs/acre. Estimates of waste rice in flooded fields averaged only 132 lbs/acre, significantly lower than in the same fields prior to flooding. Variation in available waste grain in corn fields was greater than rice fields. The abundance of available waste corn in fields that were not incorporated post-harvest averaged 228 lbs/acre, whereas fields that were incorporated contained only 52 lbs/acre. The average available waste corn, across all post-harvest treatments, was 164 lbs/acre. Our results clearly show that the availability of waste grain in rice and corn fields is affected by post-harvest practices. If these practices change, estimates of carrying capacity for wintering waterfowl will be impacted.

F.3-2: Rice and Natural Seed Biomass Estimates for Avian Habitat Conservation in Gulf Coast Prairie Croplands

Presented by: Joseph R. Marty (jmarty@wlf.la.gov)

Joseph R. Marty – Rockefeller Wildlife Refuge, Coastal and Nongame Resource Division, Louisiana Department of Wildlife and Fisheries, Grand Chenier, LA
J. Brian Davis – Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University, Starkville, Mississippi
Richard M. Kaminski – James C. Kennedy Waterfowl and Wetlands Conservation Center, Clemson University, Georgetown, South Carolina
Michael G. Brasher – Ducks Unlimited, Inc., Memphis, Tennessee

Forage biomass estimates at regional and other large spatial scales are fundamental to estimating habitat carrying capacity for migrating and wintering waterfowl. Hundreds of wetland bird species use rice fields in the Gulf Coast Prairie region of Louisiana and Texas. Rice and associated natural seeds in these fields are valuable sources of energy for these birds during migration and winter, providing as much as 42% of the estimated habitat carrying capacity for wintering waterfowl in this region. We conducted a four-year study of the spatial and temporal dynamics of seed abundance and use of fields by wetland birds. We modeled variation in rice and natural seed abundance among production and idled rice fields in southwestern Louisiana, southeastern Texas, and the Texas Mid-coast in August and November 20102014 relative to environmental variables and field-use classification. Rice biomass was greatest in November in fields with an unharvested second crop of rice (i.e., ratoon; 837.7 kg[dry]/ha; CV = 16.7%) and least in fields where no ratoon was grown (119.3 kg/ha; CV = 18.5%). Natural seed biomass was greatest in idled rice fields in October (477.3 kg/ha; CV = 24.8%) where soils and vegetation were disked and in idled fields with standing native vegetation in November (304.8 kg/ha; CV = 17.1%). Wetland bird species richness and abundance were greatest in shallowly flooded (115 cm) ricelands with sparse vertical vegetation (120 cm). Duck abundance was greatest in shallowintermediately (130 cm) flooded ricelands with short vegetation (115 cm). We encourage the production of ratoon rice crops and moist-soil plant communities in idled rice fields, and subsequent shallow flooding during autumnwinter which would significantly enhance food resources for waterfowl and other waterbirds in this continentally important landscape for North American avifauna.

F.3-3: Waterfowl forage characterization and carrying capacity estimates for stock ponds of the MT7 Ranch, Stevens County, Texas

Presented by: James R. Morel (james.morel@ttu.edu)

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The Oaks and Prairies Ecoregion of east-central Texas harbor numerous man-made stock ponds, which regionally are the dominant landscape water feature and collectively provide abundant habitat for wintering waterfowl. Recent Texas Parks and Wildlife Department Mid-Winter Waterfowl Surveys indicate that the Oaks and Prairies Ecoregion may harbor > 1/3 of all wintering waterfowl in Texas, with nearly half observed occurring on stock ponds. We quantified waterfowl forage on 10 stock ponds within the MT7 Ranch, Stephens County, Texas. Aquatic invertebrate samples (n = 980), seeding plant samples (n = 89), and submerged aquatic samples (n = 21) were collected monthly to quantify total waterfowl forage biomass between 1 September - 15 March (waterfowl migration and wintering period), 2016/2017. Invertebrate and vegetation biomass data were used to build waterfowl carrying capacity estimates which indicate high diversity and variability of forage characteristics, both temporally and spatially among all study ponds. Waterfowl duck-energy-days (DEDs) were variable throughout the study period and among ponds (range = 0 128, x = 16.2) and cumulatively among all ponds, (range = 30 190, x = 95.9) and appear to be influenced by pond size and depth, which presumably limits available space for forage production, as well as cyclical differences throughout migration and winter. Although total DEDs were relatively low for individual ponds, when extrapolated to the number of stock ponds 4 acres over the Texas portion of the ecoregion (n = 440,510), monthly DEDs ranged between 2.7 million and 5 million.

F.3-4: Linking LTRM Vegetation Data with Bioenergetics Needs of Waterfowl to Inform Wildlife Habitat Management

Presented by: Kirsten I Schmidt (kschm107@uwsp.edu)

Kirsten I Schmidt – Graduate Student, University of Wisconsin-Stevens Point, Stevens Point, WI
Jacob N Straub – Associate Professor, College of Natural Resources, University of Wisconsin-Stevens Point, Stevens Point, WI
Stephen L Winter – Wildlife Biologist, Upper Mississippi River National Wildlife and Fish Refuge, U.S. Fish and Wildlife Service, Winona, MN

The Upper Mississippi River is a large and diverse ecosystem known for its rich diversity of flora and fauna. Many areas of the Upper Mississippi River harbor vast areas ideally suited for the growth of aquatic vegetation, especially wild celery (Valisneria americana). Wild celery tubers are an excellent food source for migrating waterfowl, due to its high energy content some species like canvasbacks (Aythya valisineria) prefer wild celery. Since 1998 the Long Term Resource Monitoring (LTRM) element Upper Mississippi River Restoration Program has monitored aquatic vegetation. There are uncertainties however, on how data collected by the LTRM is related to waterfowl habitat quality and bioenergetics. This study aims to determine if LTRM rake scores can reliably predict winter bud biomass estimates from core samples in impounded areas of pools 4, 8, and 13 of the Mississippi River, compare the amount of wild celery buds in areas open and closed to waterfowl hunting after the fall migration, and estimate the kilocalories of energy provided by wild celery winter buds. Substrate cores were collected at the same locations as LTRM rake sample sites in pools 4, 8, and 13 and were distributed within areas open and closed to hunting. Cores were taken in fall 2018 and spring 2019 before the annual waterfowl migration. LTRM rake scores were positively related to wild celery winter bud counts for Pool 8 ($P < 0.05$, $R2 = 0.38$). Winter bud counts used with documented bud weight and caloric values can estimate the total kilocalories in the sampling areas. For the Pool 8 open area theres an estimated 457,871,385 kilocalories available compared to 1,165,800,695 kilocalories in the closed area to hunting. These numbers translate to 1,144,678 canvasbacks use-days in the open area, and 2,914,501 use-days in the closed area.

F.4-1: Obtaining an unknown goal: a critical review of sea duck harvest management using a prescribed take level framework

Presented by: Scott Gilliland (sgg64@mac.com)

Paul L. Flint – USGS, Anchorage, Alaska
Scott G. Gilliland – CWS, Sackville, NB
Robert F. Rockwell – American Museum of Natural History, New York, NY
Eric T. Reed – CWS, Yellowknife, NT

A Prescribed Take Level framework (PTL) was recently developed to assess sport harvest for North American sea duck populations. Under PTL, the predicted harvest rate that achieves maximum sustained yield (MSY) is entirely dependent on the estimate of the maximum intrinsic rate of population increase (rmax) and does not require estimation of carrying capacity (K). Published and unpublished data in combination with expert opinion was used to develop distributions for the demographic parameters required to estimate rmax. We argue that the demographic rates used in these models did not reflect optimal conditions and thus the output does not represent true rmax . We demonstrate the effect of bias in rmax on the resulting equilibrium population size relative to MSY and caution that the concept of MSY may not actually be sustainable for sea ducks. At MSY the resulting population level is approximately half of K and conditions allow birds to maintain high survival and productivity. However, this also implies that there is an excess of resources which inter-specific competitors could exploit, functionally reducing K. One key feature of PTL is the actual population size that meets the objective is unknown. Thus, management is directed towards manipulating the population to some unknown size. Because the objective population size is unknown, it is impossible to determine if the goal has actually been met. We believe the prescribed take level framework may be a useful starting point for sea duck harvest management but requires further development. We also recommend revising the target population size to be well above MSY. We recommend investments in monitoring to assess population, survival and productivity changes associated with harvest. We also suggest that work be directed at identifying and estimating additive sources of mortality and reductions in fecundity as these may be targets for management actions.

F.4-2: Long-tailed Duck Harvest Characteristics from Two Rivers, Wisconsin: Lake Michigan

Presented by: Luke Fara (lfara@usgs.gov)

Luke Fara – U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin and Southern Illinois University - Carbondale, Carbondale, Illinois
Brian Gray – U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin
Kevin Kenow – U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin
Michael Eichholz – Southern Illinois University - Carbondale, Carbondale, Illinois

An in-person hunter harvest survey was conducted at Two Rivers, Wisconsin, to determine how environmental variables might have influenced hunter participation and harvest of long-tailed ducks (LTDU; Clangula hyemalis), to estimate hunter harvest rates of LTDUs, and to gather hunter opinions on Lake Michigan waterfowl hunting regulations. Hunters were present on 15 (71%) of the 21 survey days and we received a 100% response rate on 127 attempted surveys. Results of the survey indicate that long-tailed ducks made up 97% of the total waterfowl harvest and that hunters averaged 3.8 LTDUs per day. Reported wounding loss was 11%. There were 62 hunting groups that completed the survey and 45 (73%) groups provided 67 comments on Lake Michigan waterfowl hunting. Most comments (24) involved season start dates or length, with hunters indicating preference for a later start date or longer season on Lake Michigan. Hunters expressed concern for LTDU populations, as four comments were related to concerns of overharvest and hunting pressure, 12 comments were related to reducing the LTDU daily bag limit, and six comments related to implementing a hen restriction on LTDUs. Estimated associations between environmental variables and hunter participation and harvest of long-tailed ducks will also be presented.

F.4-3: Spatiotemporal Dynamics in Winter Harvest Distribution of Mallards Banded in Arkansas

Presented by: Douglas C OSborne (osborne@uamont.edu)

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Lindsay G. Carlson – Gulf of Maine Research Institute, Portland, ME

Band encounter data has been used to draw inferences about dynamics in distribution patterns of mallards (Anas platyrhynchos) since the 1950s. Based on these data, others have documented shifts in wintering locations of mallards in the Pacific Flyway during the 1950s and Central Flyway during the 1960s. Despite well-known biases in band encounter data, inferences made about harvest distribution can be informative to management and policy personnel. We used encounter data from mallards banded in Arkansas during winter between the years 1950-2017 to describe short- and long-term patterns in the distribution of mallards. We used kernel density estimation to quantify the center of winter harvest distribution and found significant overlap between historical and present distributions. However, not all shifts were in a northernly direction; models suggest center of mallard harvest in September is now 3.5 degrees more southerly than in the 1960s. Inversely, center of mallard harvest in December and January are 1 degree and 0.5 degrees further north than historically. In the long term, it seems likely that extreme climate events are constricting migration behavior and constraining wintering habitat selection. In the short term, we observed extensive inter-annual variation in harvest distribution for Arkansas banded mallards. We present these data with the caveat that mallards banded in Arkansas may not be representative of the entire Mississippi Flyway population. A sample of mallards banded in other Mississippi Flyway states had a further northerly and easterly wintering distribution. However, because a large proportion of Mississippi Flyway mallards wintered in Arkansas historically, understanding distributional shifts may be important not only to local managers, but may help inform management throughout the flyway.

F.4-4: Municipal mallards: Movement ecology and harvest of urban ducks

Presented by: Ben O'Neal (BONEAL@FRANKLINCOLLEGE.EDU)

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Bradly Wehus-Tow – Biology Department, Franklin College, Franklin, IN
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TJ Benson – Illinois Natural History Survey, Champaign, IL
Heath Hagy – U.S. Fish and Wildlife Service, Stanton, TN
Adam Phelps – Indiana Department of Natural Resources, Bloomington, IN

Mallards (Anas platyrhynchos) have long been recognized for their importance to wetland ecology and hunting. In general, our management and conservation models for this important species have focused on traditional population segments such as those in the Prairie Pothole and Great Lakes Regions. Many of these traditional nesting regions face mounting pressure from land conversion, while more developed regions of the Midwest are experiencing increases in aquatic habitats, particularly in developed landscapes. Mallards have shown an affinity for these human-dominated landscapes; however, little attention has been given to these urban population segments in terms of research or management. During summers 2015-2018, we banded 2,238 mallards within the developed landscapes of Champaign-Urbana, Illinois, and greater Indianapolis, Indiana. To date, we have had 178 hunter-harvested band returns (8.0% recovery rate). In terms of distance travelled, 53% were harvested locally (<10 km), 30% regionally (10-100 km), and 17% at greater than 100 km (overall mean = 81 km; median = 8 km). Birds traveled in every direction and showed no significant directional affinity (Rayleighs $Z = 2.04$; $p = 0.13$); however, 56% of movements > 10 km in distance were in a direction with some northerly component. Our study birds were encountered in diverse habitat types (e.g., dry fields, wet fields, marshes, and ponds; public and private). They contributed to harvest in nine states and three provinces. Our results indicate that mallards inhabiting urban landscapes during the summer do, in fact, move outside of their human-dominated environments during the autumn and winter months. In addition, our findings also indicate that urban mallards are spending time in huntable areas and contributing to harvest at meaningful levels both locally and more broadly.

G.1-1: Ducks in a transforming landscape: implications of a changing climate

Presented by: Danny Blair (d.blair@uwinnipeg.ca)

Danny Blair – Prairie Climate Centre, Winnipeg

Climate change is well underway, and there is much more on the way. Winnipeg's Prairie Climate Centre is at the forefront of communicating the science, impacts and risks of climate change to all Canadians. This presentation will review what has happened so far in Canada and beyond and—using the Prairie Climate Centre's Climate Atlas of Canada—it will show what we are likely to see in the coming decades. The implications for ducks, and all other forms of life, are profound.

G.1-2: 2006-2018 Habitat changes in Interior BC: hydrological effects on waterfowl habitats.

Presented by: Andre Breault (andre.breault@canada.ca)

Breault, Andre – Canadian Wildlife Service, ECCC, Vancouver British Columbia
Harrison, Bruce – Ducks Unlimited Canada, Kamloops, British Columbia

Over 20 species of waterfowl breed in Central Interior Plateau of British Columbia (CIPBC), an area covering 11 million ha identified in the 2012 North American Waterfowl Management Plan as one of 43 waterfowl areas of greatest continental significance. This study quantifies CIPBC upland habitat changes since the initiation of annual landscape-level breeding waterfowl surveys in 2006. GIS datasets from the Province of British Columbia were used to document upland cover losses associated with the Mountain Pine Beetle (MPB) Dendroctonus ponderosae infestation, forest fires and commercial logging. Since 2006, 1 million ha (9%) has been logged, 1.4 million ha (13%) burned and the MBP infestation killed trees over 3.3 million ha (30%) as of 2018. More than 40% of the landscape was altered over the last 2-3 decades and changes occurred very fast, over 20% in the last 12 years alone. MPB, fires and logging alter hydrological processes. More water reaches the forest floor, resulting in increased peak flows, increased runoffs, earlier snowmelt, increased seasonal flooding, changes in water quality, changes in soil moisture, increased evaporation in late spring and summer. Overall, there is a net loss of watershed moisture. Hydrological professionals estimate it will take upwards of 30 years or more before water balance returns to pre-MPB level. Interactive effects with logging, forest fire and climate change (e.g. precipitation and temperature patterns) are compounding the magnitude, intensity and duration of the hydrological effects. Ongoing and incremental negative effects on waterfowl habitat will occur at the landscape level for decades to come. We use the 2006-2018 breeding population trends of generalist and specialist species to show waterfowl responses so far. From a management perspective, the assumption that landscape level processes and climate change effects are slow and gradual does not hold for the CIPBC, where changes have been massive and very fast. Studies of hydrological effects of landscape-level processes on waterfowl habitat, climate change modeling and understanding habitat-species relationships can assist with the development of effective waterfowl and wetland conservation programs. Habitat conservation programs need to be re-evaluated as to their ability to address this level of landscape change.

G.1-3: Where have all the eiders gone?

Presented by: Scott Gilliland (sgg64@mac.com)

Scott G. Gilliland – CWS, Sackville, NB

The American Common Eiders breeding range extends from ME to central Labrador and wintering range from insular Newfoundland to RI. Concerns for their status arose around 2005 when large wrecks of eiders tuned up on beaches in MA. About the same time in ME and NS, 10s of thousands of male eiders abandoned moulting sites and banders noted fewer females attending breeding colonies. In 2006, ~72,000 eiders wintered in the Maritimes and by 2019 fewer than 20,000 birds were detected. Analyses of survey and banding datasets suggested steep declines in breeding females at colonies in ME, NB and NS (Lambda~0.93), while colonies in QC (Lambda=1.01) and NL (Lambda=1.05) were stable or increasing. Information from harvest surveys suggested poor productivity maybe partially responsible for the declines and the initial reaction was to blame predation of ducklings by Great Black-backed Gulls. Wellfleet Bay virus, recovery of Bald Eagles, mink, otters and Double-crested Cormorants were also identified as potential factors. However, I speculate that global warming maybe responsible. The Gulf of Maine is warming faster than 99.9% of all other ocean regions on the planet which is having dramatic impacts across the food web, shifting distributions and affecting abundance everything from lobsters to right whales. In particular, blue mussels, the preferred prey for eiders, appear to be negatively impacted by recent warm water events. The loss of eiders wintering in the Maritimes may in part be explained by northern shift in their distribution as the number eiders wintering in the Gulf of St. Lawrence has doubled at the same time. In contrast to terrestrial species which appear to lag behind climate velocities, marine taxa follow climate velocities with surprising accuracy. We suggest the waterfowl community devote more attention to sea ducks and the potential effects of climate change on their distributions and population dynamics.

G.1-4: Impact of Climate Change on Wetland Density and Waterfowl Production in Prairie Canada

Presented by: Lauren Bortolotti (l_bortolotti@ducks.ca)

Lauren Bortolotti – Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB
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Prairie wetlands are important to breeding waterfowl in North America, but are expected to be sensitive to changes in temperature and precipitation, with anthropogenic climate change possibly altering wetland abundance and distribution. Together, wetland change and climate-driven land use change may have synergistic, antagonistic, or additive effects on waterfowl habitat/populations. To proactively consider actions that optimally counteract threats posed by climate change, we are undertaking a three-part research project. First, key to better understanding future wetland extent is having models that are capable of simulating the unique climatological and hydrological conditions in the Canadian prairies. However, the most cutting-edge regional climate models currently do not adequately capture prairie wetlands spatial extent or possible climatic feedbacks. We are developing a prairie wetland representation for a land surface model coupled with the Weather Research and Forecasting Model to be able to simulate future wetland extent. Second, future wetland abundance and distribution will be incorporated into Prairie Habitat Joint Venture waterfowl distribution and productivity models to forecast effects on waterfowl. Finally, wetland changes will be combined with and compared to previously generated econometric and climate-induced land use change estimates to produce spatially explicit estimates of possible changes in waterfowl productivity across the Canadian PPR. This work will improve our understanding of the interactions between climate and land use change, their effects on waterfowl, and allow for improved conservation planning.

G.2-1: Nonbreeding distribution dynamics of waterfowl: Are patterns changing in the 21st Century?

Presented by: Tom Moorman (tmoorman@ducks.org)

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Lisa B. Webb – University of Missouri

Most waterfowl species in North America are highly migratory, an adaption arising ultimately from pressures exerted by a seasonal climate resulting from annual changes in the tilt of the earths axis relative to latitude. Migration enables waterfowl to exploit spatially and temporally variable and highly heterogenous landscapes at large geographic scales.. While migratory behavior in birds is stimulated by annual changes in photoperiod, on an annual or seasonal basis, proximate factors interact to influence the timing, duration, and distance of migratory movements that ultimately shape the nonbreeding distribution of birds across the continent. Paramount among these proximate influences are weather, habitat quantity and quality, and disturbance. Enduring shifts or expansions in winter distribution are well documented for some species of waterfowl (e.g., Canada geese, greater white-fronted geese, snow geese), likely driven by the interacting effects of a warming climate, landscape-scale changes in habitat resources, and changing anthropogenic pressures (e.g., harvest). Evidence for long-term distributional shifts of other species is emerging at multiple scales and across continents, further exemplifying the remarkable adaptability of waterfowl to an ever-changing environment, but potentially also influenced by poorly understood differential demographics among populations or subpopulations. Long-term changes and interannual dynamics of nonbreeding waterfowl, with causes over which we have limited to no management control, have important consequences for North American Waterfowl Management Plan habitat, harvest and people objectives. Hence, a thorough understanding of long-term change and interannual variability in nonbreeding waterfowl distribution is central to the waterfowl conservation enterprise in North America. We examine known and probable changes in distribution of nonbreeding waterfowl, potential implications for the waterfowl conservation enterprise, and call for increased collaboration to address key uncertainties around these issues.

G.2-2: Incorporating climate science into conservation planning for waterfowl during the non-breeding period

Presented by: Michael L Schummer (mlschumm@esf.edu)

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John M. Coluccy – Ducks Unlimited Inc, Great Lakes/Atlantic Regional Office, Ann Arbor, MI
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Waterfowl are highly mobile during the non-breeding period with movements dictated by ultimate and proximate mechanisms. Evolution of movements are largely beyond control, whereas conservation planners can react to proximate mechanisms including changes in food resources, disturbance and refugia, and weather. Evidence suggests that reduced weather severity can and has led to change in timing of migrations and distributions of waterfowl during the non-breeding period. However, changes in distributions among waterfowl differ because of variability in how species react to proximate mechanisms influencing migration. Further, while the climate trends towards less severe winter weather (e.g., warmer temperatures, decreased snow depth), variability in weather continues, resulting in highly disparate non-breeding distributions of waterfowl among years. This variability makes the temporal and geographic distribution of conservation efforts during the non-breeding period difficult because these efforts encompass the majority of the annual cycle and geographically spans much of North America. During this period of waterfowl redistribution, climate science has advanced rapidly, with greater capacity to predict both seasonal and long-term climate. We will summarize our current state of knowledge of waterfowl redistribution during the non-breeding period, address implications for waterfowl conservation planning, describe potential impacts to hunter satisfaction, hunter numbers, license sales, rural economies, and conservation funding, provide an understanding of the intersection of waterfowl and climate science, and discuss paths forward towards increasing our capacity to proactively produce applied science to inform waterfowl conservation planning efforts.

G.2-3: What role do duck demographics play in duck harvest for southern and northern hunters in the Mississippi Flyway?

Presented by: Frank C. Rohwer (frohwer@deltawaterfowl.org)

M.D. Chouinard – Delta Waterfowl
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Hunters in some areas experienced poor waterfowl hunting and reported observing fewer ducks in recent years. Conspiracy theories re-emerged – NGOs (including Delta) and agencies were accused of nefarious dealings to change duck distribution. While complaints are not new, we think it reasonable to examine duck demography changes that may be altering duck distribution, availability for harvest, and vulnerability to harvest throughout the flyway. We address or speculate on the following hypotheses:

1) Breeding grounds productivity is a more important driver of hunter success in southern latitudes. We hypothesize that northern latitude hunters benefit from "opening day" effects that render all ducks naïve to harvest, but by late fall and winter, adult birds have become wary and only juveniles remain relatively naïve. We predict that correlations between harvest rates and BPOP will be stronger in the north, whereas correlations between harvest rates and fall flights will be stronger in the south.

2) Age and sex ratio changes (more male biased) over time have exacerbated hunter frustrations in the south more than the north.

3) The rich (in ducks) have gotten richer and the poor have gotten poorer in mid-latitude and southern states due to intensive habitat management and perhaps harvest management on hunting clubs.

4) Ducks in the winter show higher philopatry than expected based on apparent duck distributional shifts. This may exacerbate hypothesis 3.

5) Spinning wing decoys have contributed to the demise of more ducks, perhaps the most productive females, which has disproportionately impacted hunters in southern latitudes.

We acknowledge that waterfowl managers have a limited control over where and when ducks migrate and are available to hunters. However, understanding how duck production, fall flights, and sex ratios impact hunter harvest is requisite to understanding how management practices can impact hunters in different segments of the flyway.

G.2-4: Waterfowl Hunting and Harvest: Perceptions, Reality, and Somewhere In Between

Presented by: Dale Humburg (dhumburg@ducks.org)

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Jamie Feddersen – Tennessee Wildlife Resources Agency, Nashville, TN
Kevin Kraai – Texas Parks and Wildlife Department, Canyon, TX
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Waterfowl hunting and harvest continue to change. Long-term and large-scale landscape changes affecting habitat for birds as well as hunters are confounded by year-to-year variation in bird distribution and local habitat conditions. The result is continuing debate about changes in distribution, impacts on waterfowling traditions, and managers implied responsibility for maintaining traditional distribution of harvest. Expectations for stability are not consistent with annual variation in weather and habitat, long-term trends in landscape condition, and ultimately, climate change. Additionally, changing hunter demographics and participation, in the context of the latest electronic decoys and other innovations potentially affect hunting patterns, pressure, and ultimately, duck behavior. Hunters are affected by waterfowl status, habitat conditions, and social context. Habitat and hunter management in turn potentially affect waterfowl distribution and behavior. Waterfowl managers are caught in the crossfire, responsible for conservation and public use, balancing regulations to perpetuate populations while also providing opportunity for hunting and harvest. Conserving habitat sufficient for waterfowl production and survival is balanced against demands for perpetuating waterfowl hunting traditions. Hunters perceive managers as having the ability and mandate to directly affect distribution through regulations and habitat conservation, but managers and researchers alike share uncertainty about their actual management influence on waterfowl distribution, movement, and behavior. Managers are uncertain about how changes in hunting pressure and habitat management influence bird behavior, potentially impacting hunt quality or shifting harvest distribution. Further complicating contemporary waterfowl management, todays social media environment offers opportunity for expert opinion to be shared widely before managers have an opportunity to frame issues from a scientific perspective. Within this new and rapidly changing context, waterfowl managers must take a fresh look at ecological and social trends, sources of uncertainty, and potential intended and unintended consequences that arise from the interplay of harvest and habitat management.

H.1-1: Comparison between chain-drag and thermal unmanned aerial system as upland waterfowl nest searching method

Presented by: Roald Stander (roaldstander@gmail.com)

Roald Stander – Clayton H. Riddell Faculty of Environment, Earth, and Resources, University of Manitoba, Winnipeg, Manitoba.
David Walker – Clayton H. Riddell Faculty of Environment, Earth, and Resources, University of Manitoba, Winnipeg, Manitoba.

In less than 10 years since the release of the first commercially available Unmanned Aerial System (drone), their use has become widespread in wildlife research in both optical and thermal applications, but no published studies examine the use of a drone and thermal camera as a nest searching method for upland nesting waterfowl. Chain-drags are considered the traditional method for upland nest searching but are field intensive in terms of personnel, time and logistics, and on occasion can cause damage to the nest and possible adult mortality. We compare the efficacy and efficiency of a drone with a thermal camera as a new method for upland nest searching to the traditional chain-drag method in North Dakota. Using a drone we searched at night between 0205 h 20 min and 0519 h 53 min with semi-automated programming to survey 25 sites, totaling 247 hectares. Total time required to complete drone searches (n = 25) with ground verification (n = 24) averaged 26. 8.7 min/ha and chain drags (n = 25) averaged 13.1 7.3 min/ha. We found a total of 156 nests using both search methods, 80 were unique to the chain-drag (122 total nests), 34 were unique to the drone (76 total nests) and 42 were found by both methods. Detection rate for the chain-drag method were 55%, 95% CIs [0.44, 0.66] and 34%, 95% CIs [0.27, 0.43] for the drone method. Chain-drags resulted in one recorded hen mortality and seven incidents where a nest was partially or completely destroyed. Zero incidents were recorded during drone searches or ground verifications following those flights. Our research indicates that this specific drone system does not replace the chain-drag method, but can be utilized to conduct nest searches in habitats where ATV access is limited, or where the risk of mortality may be a concern.

H.1-2: Use of Unmanned Aerial Vehicles for Conducting Breeding Waterfowl Surveys in Manitoba

Presented by: Jacob Bushaw (jbusha1@lsu.edu)

Jacob Bushaw – Delta Waterfowl and Louisiana State University
Mike Johnson – Delta Waterfowl and University of Minnesota
Dr. Frank Rohwer – Delta Waterfowl
Dr. Kevin Ringelman – Louisiana State University

Duck pair counts, nest monitoring, and brood surveys are important for estimating abundance and productivity on the breeding grounds. These time-consuming surveys require substantial investments in personnel and are still prone to systematic non-detections. Recent advances in Unmanned Aerial Vehicles (UAVs) have made it possible to conduct aerial surveys for a variety of wildlife; here, we evaluated their utility for conducting breeding duck surveys in southern Manitoba. We conducted pair counts with a UAV equipped with visual and thermal cameras and located 237 breeding pairs. While UAV surveys were substantially faster than ground surveys, they located fewer pairs then the ground crew because it was difficult to distinguish social groupings from the air. We searched for overwater nests with the UAV on 48 quarter-sections: 24 were also searched by ground technicians and 24 were searched and monitored only with the UAV to test for ground observer effects on nest success. We located 40 nests on drone-only quarters and nest success was 24.3%, compared to 28.7% for nests monitored on other sites by ground technicians. We located 125 nests on sites where crews overlapped: 74 nests were located only by the ground technicians, 23 nests were located by the UAV and missed by ground technicians, and 28 nests were located by both crews. Thick vegetative cover impaired the ability of the UAV to locate nests, and it was difficult to find nests not being incubated. During the two rounds of brood surveys the UAV located 669 broods with a detection rate of ~56%, compared to 334 broods located by the ground technicians with a detection rate of ~27%. We conclude that UAVs are ineffective for pair surveys, show some promise for locating overwater nests, but are twice as effective as traditional brood surveys.

H.1-3: Geolocator use on multiple species of ducks in Nevada

Presented by: Chris Nicolai (chris_nicolai@fws.gov)

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Chris A. Nicolai – Region 8 Migratory Bird Program, US Fish and Wildlife Service, Reno, NV
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Geolocators are a relatively new, small, and cheap technology that uses light levels to assess animal movements and behavior, but have received little attention for waterfowl studies. We attached geolocators on wood ducks, mallards, and canvasbacks from 2014 through 2017. Geolocators are typically mounted on legbands or backpacks for birds, but we also fitted waterfowl with nasal saddle mounts as we were originally concerned with the recording of light levels on legbands. We used both recaptures and hunter kills to retrieve geolocators. For wood ducks, we marked both confirmed nest box breeders and birds with no history of nest box use. We were able to develop Bayesian mixture models to assign light levels to breeding behaviors for both nest box and natural cavity breeding birds to assess nest success for birds which survived until geolocators could be retrieved. We were able to designate each day as either nesting or non-nesting from geolocator data, enabling estimation of life-history traits such as nesting propensity, annual nesting attempts, incubation duration and nest success. We also attempted to distinguish among nest prospecting, laying, incubation, and brood-rearing behaviors using an unsupervised time-series clustering algorithm, and to further estimate clutch size and nest fate. Using artificial nest box monitoring as validation data, we confirmed the accuracy of geolocator-derived estimates of the number and timing of nesting attempts and nest success.

For canvasbacks, we retrieved a total of 8 geolocator devices which provided >9 months of movement and breeding propensity data. All females showed evidence of breeding in areas of either Alaska or prairie Canada. Three males used the Canadian prairies in the summer and one used southwestern Alaska. Our data was sufficient to show both rapid and slow movements across seasonal areas of use and provides information on movements for pacific flyway canvasbacks.

H.1-4: How much is too much? GPS interval trade-offs and bias

Presented by: Cory Overton (coverton@usgs.gov)

Cory Overton – Western Ecological Research Center, U.S. Geological Survey, Dixon, CA
Michael Casazza – Western Ecological Research Center, U.S. Geological Survey, Dixon, CA
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Advancements in technology are rapidly increasing the capacity for wildlife researchers to obtain high frequency data on ever smaller organisms and at less expense. This capability results in comparatively large datasets and include more individuals that provides counterpoints to relatively sparse data from decades past. Undoubtedly, these newer methods can provide more accurate estimation of important ecological processes such as space use, movements, and resource selection patterns along with better representation of within population variability. However, many approaches used to quantify animal movement or space use are not robust to differences in the cadence of relocations and comparisons to historical data may not account for methodological biases even when using the same technique. Additionally, data available for analyses can represent a trade-off between accurately estimating space or movements of an individual and inclusion of more individuals to adequately represent population variability. We leveraged a database containing over 925,000 locations on 451 individual mallard, pintail, and cinnamon teal to evaluate difference space use estimates under multiple scenarios of data collection cadence or interval. We quantified the area of space used across 20-day periods using 5 analytical techniques on waterfowl data collected at a 30-minute cadence and the amount of bias present in that data subset to 6 different data cadences (1-, 2-, 3-, 6-, 12-, and 24-hourly intervals). Relative bias in space use estimates tended to increase with larger data cadence through the 12-hourly interval before decreasing for most methods, reflecting both the impact of fewer relocations in higher cadences and the lack of circadian patterns of space use in the 24-hourly cadence dataset. Average absolute relative bias across all cadences ranged from 12% to 80% indicating that some space estimation methods, e.g. adaptive radius local convex hulls, can be robust to data collection interval when appropriately parameterized.

H.1-5: SWAMP: Updates on an agent-based modeling program to evaluate carrying capacity of winter and migrational habitats

Presented by: Robert Blenk (RHBLENK@UCDAVIS.EDU)

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Agent-based modeling (ABM) of waterfowl populations is an increasingly appealing approach for researchers and managers due to the ability to incorporate spatial dynamics, evaluate multiple metrics of waterfowl condition and survival, undertake scenario planning and evaluation, and a multitude of other advantages. The Spatially-explicit Waterbird Agent-based Modeling Program (SWAMP) is an ABM designed to estimate time budgets, energetics, foraging, and survival of wintering waterbird populations. Since its previous iterations, SWAMP has undergone developments and improvements designed to improve its accuracy, versatility, and ability to connect the dynamics of stopover and wintering habitat at a flyway scale. I will describe the functions, data needs, outputs, and utility of SWAMP as a decision-support tool for waterfowl managers and will provide an introduction to the development and use of the tools relating to the development of SWAMP model scenarios. Our goal is to make SWAMP generally available to researchers and managers to evaluate winter habitat management at local, regional, and flyway scales.

H.2-1: GPS tracking data reveals daily spatio-temporal movement patterns of waterfowl

Presented by: Michael L. Casazza (mike_casazza@usgs.gov)

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Spatio-temporal movement patterns characterize relationships between organisms and their surroundings, and improve understanding of species ecology, activity budgets, bioenergetics, and habitat resource management. Highly mobile waterfowl, which can exploit resources over large areas, are excellent models to understand relationships between movements and resource usage, landscape interactions and habitat needs. We tracked 3 species of dabbling ducks with GPS in 201517 to examine fine-scale movement patterns over 24h periods (30min intervals), dividing movement pathways into temporally continuous segments and spatially contiguous patches. We quantified distances moved, area used and daily time allocation, using linear and generalized linear mixed models, investigating behavior through relationships between variables. Movements and space-use were small, and varied by species, sex and season. Gadwall (Mareca strepera) had shortest forage flights (FFDs): 0.50.7km, but longer within-area movements produced larger foraging patches. Pintails (Anas acuta) moved most, with FFDs 0.81.1km, were more likely to fly >300m, had more segments and patches per day which they revisited more frequently, and longest daily total movements. Sexes differed only during the post-hunt season when females moved more. 23.6% of segments were short duration (12 locations), 1/3 more than would be expected if random, and were more dispersed in the landscape than longer segments. 30min distances moved shortened as segment duration increased, likely reflecting phases of non-movement within segments. That ducks used smaller foraging and resting areas than expected or previously reported, implies foraging areas may be highly localized, and nutrients obtainable from smaller areas. Reduced movement over time demonstrates behavioral adjustments representing divergent energetic demands, the detection of which is a key advantage of higher frequency data. Ducks likely use less energy than currently predicted and management including distribution/configuration of essential habitat, may require reconsideration. Our study illustrates how fine-scale movement data can inform various fields of research.

H.2-2: Joint use of location and acceleration data to quantify habitat use transitions in Arctic-nesting geese

Presented by: Jay A. VonBank (jay.vonbank@students.tamuk.edu)

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Throughout the 20th century, greater white-fronted geese (Anser albifrons frontalis) primarily wintered in Texas and Louisiana, but over the last two decades have shifted their main wintering distribution northeastward, primarily into the Mississippi Alluvial Valley. Changes in land use, climate, and resource availability are likely drivers of the distribution shift, yet little contemporary information exists regarding behavior and habitat requirements of wintering white-fronts. We used GPS and tri-axial accelerometer data from 56 adult white-fronted geese captured during winters 20152017 in Texas and Louisiana. We used GPS information to determine white-fronted goose habitat use patterns in space and time, and used accelerometer-derived behaviors for more detailed understanding of how individuals used habitats. We used a novel Bayesian Markov modelling approach to determine how time spent in specific behaviors affected transition rates among habitat types, allowing inference as to the effects of behavior and environmental covariates as drivers of habitat use by combining 53,502 GPS locations with 300,348 temporally-matched behaviors. Transition probabilities to rice and to grass/pasture were only significant across all habitat types when temperatures were warmer, and transition probabilities from grass/pasture to corn and to peanuts were significant when temperatures were colder. Transitions to open water were more probable during night hours, but transitions to woody and herbaceous wetlands, and unconsolidated shore habitats from all other habitat types were not influenced by diel period, indicating white-fronted geese use different wetland habitats for different functions. Foraging increased in early winter, decreased mid-winter, and increased again during late winter before commencement of spring migration. Our model of habitat transitions showed different rates of habitat transitions among regions, illustrating a need for region-specific habitat management considerations. Understanding the drivers of habitat use and patterns of behavior will aid in determining future management practices throughout the range of greater white-fronted geese.

H.2-3: An overview of isotopic methods and applications for estimating origins of migratory waterfowl

Presented by: Douglas C. Tozer (dtozer@birdscanada.org)

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Douglas C. Tozer – Long Point Waterfowl and Wetlands Research Program, Bird Studies Canada, Port Rowan, Ontario
Dariusz Wojtaszek – Western University, London, Ontario; and Long Point Waterfowl and Wetlands Research Program, Bird Studies Canada, Port Rowan, Ontario
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Ratios of naturally-occurring stable isotopes (e.g., 2H, 13C, 15N, 18O, 34S) in bird tissues such as claws or feathers are now routinely sampled to estimate migratory connectivity in a variety of bird species including waterfowl. The method takes advantage of variation in the spatial distribution of stable isotopes in the environment that are, in turn, incorporated into bird tissues during tissue growth. Metabolically inert tissues are especially useful because they lock in isotopic values associated with origins of individuals, to be estimated when birds are captured and tissues are sampled at later times and often very distant locations. This comes as a huge advantage for estimating migratory connectivity given that birds only need to be captured or sampled once, unlike other methods, such as banding, that require initial and subsequent captures. However, like any method, using stable isotopes to estimate migratory connectivity comes with limitations that are important to understand. In this talk, we will 1) overview methods for using stable isotopes to estimate origins of sampled waterfowl, 2) discuss some applications that are especially suitable to the method, 3) outline important gaps in waterfowl knowledge that can be filled using the method, and 4) illustrate the usefulness of the method with preliminary findings from some of our recent sampling of stable isotopes in harvested individuals of multiple migratory duck species mainly in the Great Lakes region. During the talk, we will answer the question: are stable isotopes any good for estimating origins of migratory waterfowl? The answer is yes, but as we will show, the answer is yes only for suitable questions asked at appropriate scales.

H.2-4: Origins of harvested Mallards from Lake St. Clair, Ontario: A Stable Isotope Approach.

Presented by: Douglas C. Tozer (dtozer@birdscanada.org)

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Douglas C. Tozer – Long Point Waterfowl and Wetlands Research Program, Bird Studies Canada, Port Rowan, Ontario, Canada
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Understanding migratory connections between breeding origins and point of harvest for waterfowl in North America is important for effective management and conservation. Long-term mark-recapture programs have provided most of these data but such methods are less suitable for species originating from broad (continental) regions where banding effort is uneven. The use of naturally occurring stable isotope ratios provide a means to help overcome these difficulties. We used stable-hydrogen isotope analyses of feathers (2Hf) from Mallards (Anas platyrhynchos) harvested during the 201415 and 201516 hunting seasons at Lake St. Clair (LSC), Ontario, Canada (n = 237 individuals). We created a feather isoscape and applied Bayesian assignment approaches to determine probability of origin. The proportion of hatch-year Mallards produced locally (i.e., at the same latitude as LSC) ranged from 13.1% to 22.0% with almost no difference by sex. The proportion of after-hatch-year (AHY) birds that molted locally ranged from 3.5% to 11.7%, with slightly fewer local AHY females compared to local AHY males. Nearly all birds that did not originate locally came from latitudes to the north of LSC, and only two from south of LSC. Harvest management strategies in the Great Lakes states try to reduce effects of hunting on local Mallards. Our observations suggest that in context of LSC, the protection of local Mallards may not be as effective as currently perceived due to large proportion of birds originating from outside of the region. Whether this pattern is representative of locations in the Great Lakes beyond our study area is unknown, but we are expanding our study with plans to examine isotope-based origins of Mallards and other harvested waterfowl species at locations throughout the Great Lakes region to inform harvest management.

H.2-5: Habitat use and movement of Canada geese nesting in the Greater Toronto Area

Presented by: Ryan Askren (ryanaskren@gmail.com)

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Increased abundances of temperate-breeding Canada geese (Branta canadensis) in urban areas have been associated with human-goose conflicts. These conflicts can pose human health risks and decrease the aesthetic value of recreational areas. In urban areas, the majority of conflicts occur during nesting or the post-breeding period when geese are nesting or concentrated to raise broods and molt. The goal of our study was to quantify distribution and habitat use changes during the breeding season to inform management and better understand the ecology of urban-nesting geese. We fitted 69 nesting and molting female geese with GPS transmitters in the Greater Toronto Area from 2014 2018. We classified nest site habitat and timing of incubation using location data. Utilization distributions were calculated using kernel density estimates and land use types classified for use locations to improve understanding of movement and land uses important to geese before, during, and after nesting. Geese used greenspaces at similar proportions from March July, while water habitats were used more in June and July, and decreased use of manmade habitats in June and July. Home range sizes were largest in March prior to nesting (16.1 4.3 km2), decreased in May when most geese were incubating (4.6 1.2 km2), increased again during June likely driven by failed breeders (10.1 2.7 km2), and decreased again in July when the majority underwent synchronous molt (2.9 0.5 km2). We are continuing to examine the effects of nesting success and land use surrounding nest sites on movement distances. The use of GPS telemetry to track fine scale movement of urban nesting Canada geese will improve our understanding of the scale and locations required for effective management designed to reduce goose related conflicts.

H.3-1: Modeling double-observer aerial survey count data of wintering waterfowl in South Carolina

Presented by: Nick Masto (nmasto@g.clemson.edu)

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Aerial surveys are efficient and effective strategies to estimate occurrence and abundance of wildlife populations especially in large and inaccessible landscapes. However, a fundamental concern is that animal detection is imperfect. Thus, accounting for imperfect detection is critical for accurate inference of abundance, population trends, and spatiotemporal distributions. We used two simultaneous aerial observers and analyzed data as replicated counts using N-mixture models to estimate detection, abundance, and species-habitat relationships. Specifically, we desired accurate (i.e., adjusted by detection probability) and precise (i.e., CV 1520%) estimates of abundance of dabbling and diving ducks in South Carolina, based on data in January and February 2018. Model-based inference using habitat covariates generally was precise for dabbling and diving ducks (11% CV 27%) compared to single-observer, design-based estimation (17% CV 36%). However, both observers exhibited low detection probabilities for dabbling and diving ducks (p = 11% and 8%, respectively) and detection probability varied among habitat types for duck taxa. Thus, we suggest using methods such as double or repeated sampling to minimize detection bias during aerial surveys for wintering waterfowl. Additionally, habitats influencing duck abundance varied between January and February 2018. Managed and non-managed historic rice fields influenced dabbling and diving duck abundances positively in January 2018 but not in February 2018. Complete drawdowns of managed tidal impoundments following waterfowl hunting in late January may have influenced duck-habitat relationships in February 2018. Additional analyses are in progress, but we provide first estimates of wintering waterfowl using N-mixture models with data collected from aerial surveys in South Carolina. Similar methods can be adopted to improve monitoring and estimation of wintering and breeding waterfowl populations.

H.3-2: A Double Dependent Observer Method to Estimate Detection Rate During Helicopter Waterfowl Surveys

Presented by: Christian Roy (christian.roy3@canada.ca)

Christian Roy – Canadian Wildlife Service
Scott Gilliland – Canadian Wildlife Service
Eric Reed – Canadian Wildlife Service
Christine Lepage – Canadian Wildlife Service
Megan Ross – Environment and Climate Change Canada
Matthew English – Canadian Wildlife Service
Cindy Wood – Canadian Wildlife Service

We evaluated double-dependent observer methods for helicopter surveys as a mean to adjust counts of waterfowl for incomplete detection. We tested our methodology during a sea duck survey in Labrador, eastern Canada, in 2009 and subsequently applied it to a larger sea duck monitoring project in the Northwest Territories and Manitoba, Canada, in 2017 and 2018. We used a hierarchical Bayesian model with a data augmentation scheme that allowed us to derive detection rates for birds, true bird abundance, group size, and group composition (i.e. male, female, and unknown). We estimated detection rates by crews, and within crews by observer position (front vs. rear) and experience. We used the output of the model to derive the predicted number of total indicated breeding pairs for the survey area. Detection rate was highest from the backseat of the helicopter despite a reduced field of vision and experienced observers had a slightly better detection rate. There were individual differences in detection with experienced observers tending to have higher detection probabilities than less experienced ones. Detection probabilities also varied among species with higher detection rates for sea ducks and divers and lower for dabblers and geese. Overall detection rate was generally high, but failing to correct counts for incomplete detection could lead to an underestimation of total indicated pairs by 5% for some species. We recommend that doubleobserver approaches be used in future helicopter surveys to reduce bias associated with observer turnover and allow a measure of detection probabilities.

H.3-3: Integrating counts from aerial and ground surveys to estimate densities of waterfowl

Presented by: Beth E Ross (bross5@clemson.edu)

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Wildlife monitoring data can be challenging to incorporate into models for statistical and ecological inference because spatio-temporal scales and data quality may vary. Surveys to monitor waterfowl are particularly challenging in that waterfowl are migratory and occur throughout multiple ecoregions during their life cycles. Given their mobile nature, waterfowl are typically monitored based on continent-wide monitoring or surveying efforts (e.g., Waterfowl Breeding Population and Habitat Survey). While useful for understanding population-level changes, supplemental monitoring is needed to understand habitat use, spatio-temporal distributions, and population dynamics of waterfowl during the non-breeding season at flyway, state, and local levels. Given methods for monitoring waterfowl at finer spatial scales, opportunities exist to combine multiple data sources to better inform population estimates and habitat relationships. Our goal was to combine count data from aerial surveys with ground-based surveys to better estimate abundance of waterfowl along the coastal plain of South Carolina. We conducted ground and aerial surveys at Tom Yawkey Wildlife Center, South Carolina in January and February 2018. Our data integration model provided more precise estimates of abundance while adjusting for detection probability. We also compare abundance estimates based on visibility correction factors between ground and aerial surveys with abundance estimates from our integrated model. Lastly, we describe how additional information from other data sources (e.g., banding data or nest monitoring) could be incorporated into the model for additional inference.

H.3-4: Comparison of unmanned aerial vehicle surveys and visual ground surveys of waterfowl on stock ponds in the Oaks and Prairies region of Texas

Presented by: James R. Morel (james.morel@ttu.edu)

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The Oaks and Prairies Ecoregion of east-central Texas harbor numerous man-made stock ponds, which regionally are the dominant landscape water feature and collectively provide abundant habitat for wintering waterfowl. Recent Texas Parks and Wildlife Department mid-winter waterfowl surveys indicate that the Oaks and Prairies Ecoregion may harbor > 1/3 of all wintering waterfowl in Texas, with nearly half observed occurring on stock ponds. To understand temporal trends of species-specific waterfowl-use of stock ponds, we conducted 1,186 visual ground surveys during two migration and wintering seasons on 94 ponds between October 1, 2014 and February 20, 2015 (n = 503), and between September 24, 2015 and March 7, 2016 (n = 683). Unmanned aerial vehicle (UAV) surveys were also conducted to explore the efficacy of identification and potential to limit flushing behavior, often caused by visual ground surveys. During the 2015/2016 season, 40 UAV flights were conducted simultaneously during corresponding visual pond surveys. A double-blind test, utilizing four professional waterfowl biologists, was conducted to examine observer concordance and species identification while also examining the occurrence of waterfowl flushing behavior relative to visual ground surveys. Waterfowl occurrence on stock ponds declined between the 2014/2015 season and 2015/2016 season, despite an increase in survey effort and duration of survey season. Visual ground surveys were more precise than UAV surveys regarding identification and enumeration (visual ground surveys assumed to be 100% correct, UAV enumeration success = 86%, identification success = 55%). However, the potential for flushing is greater during visual ground surveys (23%) relative to UAV surveys (3%).

H.3-5: Visibility Bias and Disturbance of Waterfowl During Aerial Surveys

Presented by: Andrew D. Gilbert (agilb849@illinois.edu)

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Wetland managers commonly use aerial surveys to monitor the distribution and abundance of waterbirds to aid in population management and habitat conservation. However, most existing surveys only provide abundance indices that are uncorrected for visibility bias, which may limit their utility in accurately assessing local population size. Moreover, excessive disturbance from low-altitude aerial surveys may cause waterfowl to increase energy expenditure and exposure to hunting mortality contrary to the management objectives of many surveyed sanctuaries. We used concurrent ground and aerial surveys to estimate visibility bias and disturbance during cruise-style waterfowl surveys from September through January 20142017 in the Midwest, USA. We found the aerial observer had high detection rates and low count bias across waterfowl guilds, resulting in low overall visibility bias of ducks (11% 5% [SE], n = 124), geese (8% 3%, n = 70), and swans (5% 3%, n = 37). Group size, species prevalence, cloud cover, and temperature influenced visibility bias, but the direction and magnitude of effects were variable among taxa. We found disturbance and abandonment probabilities of waterfowl (x = 14% 2 and x = 3% 1, respectively) and other waterbirds (x = 13% 2% and x = 2% 1%, respectively) during aerial surveys to be low. Among waterfowl taxa, the odds of aircraft disturbance was 2.26.2 times greater at wetlands closed to waterfowl hunting than open wetlands, but wind speed and cloud cover did not impact disturbance rates of any taxa. The odds of disturbance for geese decreased 4.6% for every 1 increase in temperature. Low visibility bias, disturbance, and abandonment probabilities for most guilds indicate that well-designed, cruise-style aerial surveys provide reliable estimates of population size and periodic surveys are compatible with objectives of providing sanctuary conditions for most waterfowl.

H.4-1: Wetland suitability for spring-migrating waterfowl in the Midwest

Presented by: Abigail G. Blake-Bradshaw (ablakebradshaw@gmail.com)

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Wetland-dependent bird populations may be limited by suitable habitat in regions where loss and degradation of wetlands is pervasive, such as in the midwestern United States. Suitability of stopover wetlands used by wetland-dependent birds during spring migration may be linked to survival, body condition, and recruitment during the subsequent breeding season. However, available spatial datasets, such as the National Wetlands Inventory (NWI), may overestimate habitat availability if total wetland areas include areas which are unsuitable for use by wetland-dependent species. During springs 2015–2017, we assessed proportional coverages of suitable wetland vegetation and inundation conditions relative to the NWI for waterfowl and other waterbirds in Illinois. We modeled vegetation and inundation cover as a function of local and landscape characteristics during spring migration for dabbling ducks. Suitable wetland conditions comprised a small portion of NWI polygons. Shallowly inundated wetlands (<45 cm) suitable for foraging by dabbling ducks comprised 29% of NWI area in Illinois during spring migration. Approximately 37% of emergent NWI wetland area was shallowly inundated, whereas only 25% of forested wetland area was shallowly inundated. Highly interspersed vegetation and open water (i.e., hemi-marsh) was <1% of wetland area surveyed. Wetlands with greater vegetation complexity and connectivity to other wetland types had the greatest suitable area. We recommend conservation planners consider adjusting their estimates of wetland availability from spatial databases, such as NWI, when used to evaluate wetland supply on the landscape since significant proportions of forested and emergent wetland area was not flooded, were flooded at unsuitable depths, and/or wetlands lacked vegetation resources to provide substantial food resources.

H.4-2: Developing spatiotemporally explicit wetland inundation models for Illinois

Presented by: John O'Connell (john.oconnell@siu.edu)

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Managing wetlands to meet bioenergetic demands of waterfowl or to provide ecosystem services requires reliable estimates of temporal variation in the extent of wetland inundation, but the commonly used National Wetland Inventory (NWI) is temporally static. We are estimating wetland inundation relative to NWI spatial classifications by utilizing ground survey, remote sensing, and readily available GIS data. During mid-February through April 2015-2017, we surveyed 5,104 ha of NWI wetlands across Illinois. The extent of wetland inundation varied greatly across sites and within the survey periods, but in general, approximately half of the spring-surveyed NWI area was inundated in any given year (50.1 1.5% s.e.). Lake and river polygons were mostly inundated (85.7 1.1%, 74.1 2.9%, respectively), but inundation in palustrine wetlands that are often the focus of wetland management for waterfowl was much lower (38.3 2.1%). High inundation rates for ponds (77.9 5.8%) accounted for much of that inundation, while forested wetland (32.9 2.6%) and emergent wetland (45.8 4.1%) polygons were drier. These results underscore the potential for substantial overestimation of inundated wetlands based on the NWI alone and emphasize the need for spatiotemporally explicit estimators. We are currently using the survey data to develop and test multiple machine-learning algorithms for their efficacy in predicting inundation of NWI wetlands with the goal of mapping estimated inundation statewide at weekly time steps. We will also employ similar machine-learning methods to model inundation based on remotely sensed data, which offer increased aerial extents compared to ground surveys and allow us to infer outside of NWI wetlands. This may become an efficient alternative approach following the planned launch of satellites with free data access within the United States, and similar methods could be utilized outside of Illinois in areas with similar landscapes.

H.4-3: Examining wetland use by spring migrating ducks in the Prairie Pothole Region of Iowa

Presented by: Derek C. Ballard (dcb@iastate.edu)

Derek Ballard – Iowa State University
Adam Janke – Iowa State University
Orrin Jones – Iowa Department of Natural Resources

Historically, approximately 3.08 million hectares of native prairie pothole complex were found in Iowa but by the 1980s, 95% to 99% of Iowas wetlands had been lost because of drainage. There has been an increasing recognition of the importance of remaining wetlands in the prairie pothole region for stopover habitat for spring-migrating waterfowl because the quality and quantity of stopover habitat can affect speed and success of migration. We conducted weekly surveys on 436 wetlands during the springs of 2018 and 2019 to examine factors affecting use of wetlands in the intensively modified southern PPR landscape to inform restoration and conservation strategies. We stratified survey effort to sample seasonal wetlands (n = 84), semi-permanent and permanent wetlands (n = 260), and cropland sheetwater wetlands (n = 90). During 2018, we counted over 70,000 ducks on mostly semi-permanent and permanent wetlands (97% of all ducks counted). Cropland sheetwater (2.8%) and seasonal (<0.5%) wetlands contributed little towards duck use, likely because a shortage and lack of consistency of water present throughout the season. During the spring of 2019, we counted over 55,000 ducks with semi-permanent and permanent wetlands (92%) contributing the most. Cropland sheetwater (5.2%) and seasonal (3%) wetlands contributed slightly more than during the 2018 field season potentially due to a longer presence of water after initial spring flooding. Our presentation will discuss our findings and their implications for addressing information gaps in understanding duck use of modern prairie wetland landscapes during spring migration.

H.4-4: Spring Migration Ecology of Green-winged Teal and Gadwall in Illinois

Presented by: Aaron P. Yetter (ayetter@illinois.edu)

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Millions of waterfowl rely on Illinois wetlands during autumn and spring migration. Harvest surveys show gadwall (Mareca strepera) and green-winged teal (Anas crecca) comprise approximately 15% of the ducks harvested in Illinois, and they are commonly in the top five duck species in the Illinois waterfowl harvest. Detailed information on spring distribution, habitat associations, food selection, and stopover duration for these species are lacking or antiquated. Therefore, we radiomarked green-winged teal (GWTE) and gadwall (GADW) during springs 20162018 using VHF transmitters. Our objectives were to determine home range size, estimate survival and stopover duration, describe daily movements, and evaluate wetland habitat use by GWTE and GADW during spring migration in the Illinois River Valley (IRV). Preliminary analyses suggest movement distance of GWTE from diurnal to nocturnal locations was 5,001 m (SE = 290) and 5,161 m (SE = 224) from nocturnal roosts to diurnal locations. Similarly, day-night and night-day movement distances for GADW were 5,650 m (SE = 374) and 5,463 m (SE = 356), respectively. Spring stopover duration was 14 days (CI95 = 1119 days) for GWTE and 27 days (CI95 = 1258 days) for GADW. Daily survival was less for second-year birds (x = 0.99, CI95 = 0.950.99) than after second-year birds (x = 1.00, CI95 = 0.991.00). We found that GWTE utilized emergent marsh (60%) most often while GADW utilized wooded wetlands (45%) most. Our estimates of home range size (95% MCP) for GWTE and GADW averaged 2,413 ha (SE = 591) and 2,791 ha (SE = 703), respectively. Greater than expected stopover duration and diurnal habitat switching suggested quality migration habitat may be limiting ducks in the IRV during spring.

H.4-5: Stopover Duration and Habitat Use of Spring Migrating Dabbling Ducks in the Wabash River Valley

Presented by: Benjamin R. Williams (brwilli3@illinois.edu)

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Spring migration is an important and often under-studied period of the waterfowl annual cycle. Stopover sites along migration routes contain habitats and resources required by waterfowl to rest and refuel before continuing north to the breeding grounds. The Wabash River Valley (WRV) in southeastern Illinois provides habitat for over 500,000 dabbling ducks each spring. Despite the heavy use of this region, information regarding stopover duration and habitat use of waterfowl is lacking. Stopover duration, or the length of time an individual spends in a distinct region, is an important metric for waterfowl managers to consider while planning for the needs and required resources of migrating birds. Stopover duration for mallards (Anas platyrhynchos) and green-winged teal (Anas crecca) was approximately 17 days (95% CI: 12.6–22.9 days). This is shorter than current estimates used by conservation planners and may shift objectives. Additionally, mallards and green-winged teal used emergent and woody wetland habitat at rates highly disproportional to the availability of those habitats on the landscape. Both species tended to avoid sites with greater amounts of agriculture in the surrounding landscape, while sites surrounded by greater amounts of open water, upland forest, and upland grassland were more likely to be used. There was also a considerable amount of use in areas under conservation easements, suggesting the importance of these easements in waterfowl management. All of this information will help land managers and conservation planners direct funding to the most important habitats in the WRV and ensure sufficient resources for waterfowl utilizing the region each spring.

I.1-1: Waterfowl Population Models: New Biological Findings and Harvest Management

Presented by: Jim Sediinger (jsedinger@cabnr.unr.edu)

James (Jim) S. Sedinger – University of Nevada Reno (retired)
Thomas V. Riecke – University of Nevada Reno
Benjamin S. Sedinger – University of Wisconsin Stevens Point

Population models used for harvest management are predominantly between 15 and 20 years old. New research results and new analytical approaches make it possible to assess a number of the assumptions incorporated into these models. We explore these issues with the goal of fostering discussion and thinking about models used for harvest management. Reliance on population estimates from the breeding population survey may introduce bias into population models because of uncertainty about key assumptions underlying population indices with implications for the relationship between harvest and population size. Existing models assume sex ratios are static, but new analyses indicate that sex ratios are highly dynamic, and the proportion of males has been steadily increasing over the past three decades due to increasing differences in sex-specific survival rates. Current models do not explicitly incorporate density dependent effects on survival, but rather assume such effects are manifest in compensatory harvest mortality models. Assessment of trends in mortality in several dabbling duck populations suggest that female annual survival is affected by population density. Analysis of pre- and post-season banding data suggests at least partial compensation for harvest mortality during the hunting season, and that natural mortality is strongly influenced by environmental conditions. Novel hierarchical spatial models have the potential to quantify previously unexplained variation in demographic rates, and improve existing inference, where researchers can examine variation in demographic rates across land-use and abundance gradients. Finally, some structural features of existing population models may also reduce the ability of these models to perform as expected. For example, existing models assume that survival rates are lower under compensation than additive harvest mortality across much of the range of harvest rate, which could skew assessments of whether harvest is additive versus compensatory. Overall, these findings suggest that harvest management could benefit from new thinking about model structures.

I.1-2: Some serious citizen science: Lincolns estimator for waterfowl abundance

Presented by: Ray T. Alisauskas (ray.alisauskas@canada.ca)

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Hunting has the potential to affect survival and population size of waterfowl. This notion motivates much effort in North America toward direct estimation of abundance, harvest and survival for a wide array of waterfowl species. Before aerial survey for counting waterfowl became institutionalized, Lincoln proposed an alternative method in the 1930s for range-wide population estimation; his idea was based on the integration of (i) data from band recoveries and (ii) estimation of total harvest, without ever counting free-ranging birds. Lincolns estimator relies on information voluntarily supplied by hunters to inform it, providing an early example of the role of citizen science for understanding wildlife population dynamics.

I review Lincolns method, the assumptions that must be satisfied for its use as a suitable estimator of abundance, and the additional inferences about population structure that it allows, which are not readily available from aerial survey data. I examine differences in the two estimation approaches (Lincoln vs. aerial counts). Lincolns method depends on reliable, in-hand identification of the species, age, and sex of both banded and harvested waterfowl. Abundance estimates pertain to the time that birds are marked so that much of the waterfowl banding in North America that occurs in late summer provides preseason population estimates of 4 sex-age cohorts; in a similar fashion, winter banded samples could be used to estimate winter abundances. A number of different waterfowl populations are used as examples to illustrate how past dynamics of abundance, recruitment and sex ratios can be reconstructed using Lincolns method. Additional tests of density dependence and the role of habitat conditions on annual recruitment at the population level are possible.

I.1-3: Abundance drives cause-specific teal mortality

Presented by: Thomas Riecke (triecke@cabnr.unr.edu)

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Benjamin S. Sedinger – University of Wisconsin-Stevens Point
Todd W. Arnold – University of Minnesota
Cliff L. Feldheim – California Department of Water Resources
David N. Koons – Colorado State University
Frank C. Rowher – Delta Waterfowl Foundation
Perry J. Williams – University of Nevada
James S. Sedinger – University of Nevada

Recent and previous research has addressed density-dependent effects on population growth rates of North American waterfowl populations. Critically, current management frameworks result in harvest regulations tracking the abundance of North American waterfowl species. Consequently, harvest is increased when the potential for density-dependent effects are high. Previous work showed that this relationship may confound our understanding of the effects of harvest on mortality. We use novel hierarchical approaches to directly examine these relationships in blue-winged teal (Spatula discors), an abundant North American dabbling duck. Our results indicate that minimal (0.02) changes in harvest rate paradoxically appear to have strong (> 0.15) impacts on survival rates of adult female blue-winged teal if other causal mechanisms are not considered. Survival rates of all age and sex classes decline dramatically following minor increases in harvest rate, and major increases in abundance. Process correlations () among harvest and natural mortality rates of adults appears to be additive or depensatory for both adult females (= 0.232, 95% CRI -0.055 0.440) and adult males (= 0.193, 95% CRI -0.114 0.461). However, we note that large increases in teal abundance were strongly correlated with natural mortality rates for adult females (= 0.565, 95% CRI 0.273 0.807), adult males (= 0.401, 95% CRI 0.094 0.663), juvenile females (= 0.599, 95% CRI 0.310 0.839), and juvenile males (= 0.565, 95% CRI 0.273 0.807), despite minor variation in harvest, putatively leading to the observed major changes in survival. These results indicate that it is critically important to consider multi-dimensional relationships among harvest, natural mortality, and abundance when assessing the effects of harvest on population growth rates. These findings have important implications for the management of populations of harvested species.

I.1-4: Cross-seasonal models reveal evidence for density-dependence, climate-mediated survival, and harvest compensation in mallards

Presented by: Benjamin S. Sedinger (Ben.Sedinger@uwsp.edu)

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Demographic studies and surveys of plant and animal populations are the foundation of conservation biology, wildlife and land management, and much of ecology and evolutionary biology. These studies are critically important for understanding the effects of climate, density-dependence and habitat, and direct anthropogenic impacts (e.g., harvest) on plant and animal populations. Further, species which experience direct anthropogenic impacts in the form of commercial or sport harvest might also be more susceptible to rapidly increasing anthropogenic impacts on the global environment. Given existing paradigms, managers often restrict or increase harvest to attempt to influence population trends. However, recent research has questioned the current paradigm of purely additive sport harvest, which posits that survival, population growth rates, and harvest are directly linked. As such, the use and further development of existing longitudinal datasets is of critical importance as researchers attempt to understand the effects of human impacts on populations of organisms, where existing datasets may provide clues to the management of under-studied species. North American waterfowl populations are among the most extensively surveyed and marked vertebrate organisms on the planet, where they serve as an excellent model system to examine the effects of anthropogenic impacts and climate on wild organisms. From 1961-2016, over 1.9 million mallards were released in the Pacific, Midcontinent, and Atlantic mallard populations both prior to and after the hunting season. We use recently developed Bayesian hierarchical model structures to examine seasonal, cause-specific mortality rates of three North American mallard (Anas platyrhynchos) populations. We show evidence for seasonal harvest compensation in three North American mallard populations, for both males and females. Additionally, our results indicate that harvest mortality is positively affected by abundance while natural mortality is mediated by climactic factors during both summer and winter seasons.

I.2-1: Life-history traits predict species-specific effects of global change on breeding waterfowl in the Prairie Pothole Region

Presented by: Frances E. Buderman (fbuderman@gmail.com)

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David N. Koons – Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO

The Prairie Pothole Region of North America is the primary breeding ground for many North American waterfowl species. Contemporary agricultural practices have resulted in the consolidation of wetlands into larger, deeper, less productive ponds, and conservation tillage has resulted in early spring crop fields that visually mimic the native short-grass prairie that species have adapted to use for nesting, but result in high nest destruction due to mechanical planting. In addition, species may be differentially affected by land cover and climate changes due to variation in life history characteristics. We used a hierarchical Bayesian model to separate the effects of land cover and climate predictors on both habitat selection and demographic processes for nine waterfowl species that use the PPR: American wigeon, blue-winged teal, gadwall, mallard, northern pintail, northern shoveler, canvasback, redhead, and ruddy duck. We then used a post-hoc analysis to determine which life history characteristics are the primary contributors to species-specific variation in the effect of land cover and climate changes on the distribution and demographic performance of waterfowl species across the PPR. We found that nesting chronology, nesting duration, and clutch size were the best predictors of a response to cropland at the demographic level. Early nesters, long nesting durations, and small clutch sizes corresponded to larger negative demographic responses to cropland. In terms of habitat selection, the distinction between diving ducks and dabbling ducks explained the majority of the relationship between habitat selection and pond counts, with diving ducks having higher effect sizes. Results from this work will be imperative in determining species-specific conservation management and predicting potential indirect results of management decisions on other species.

I.2-2: Spatiotemporal variation in waterfowl demography

Presented by: Madeleine Lohman (madeleinelohman@gmail.com)

Madeleine Lohman – University of Nevada, Reno
Thomas Riecke – University of Nevada, Reno; Program in Ecology, Evolution, and Conservation Biology
James Sedinger – University of Nevada, Reno
Perry Williams – University of Nevada, Reno

Spatial variation in abundance and growth rates is a fundamental tenet of population ecology. Waterfowl exhibit large spatial and temporal variation in abundance, which is correlated with wetland quantity. Yet, analyses explicitly examining spatial variation in waterfowl demography are relatively rare, despite having important implications for our understanding of relationships among harvest, survival, and abundance. Moreover, spatial and temporal covariation among survival, fecundity, and their environmental and anthropogenic drivers remains under-unexamined. We will examine density-dependent effects on juvenile survival, variation in survival rates among ecoregions as harvest pressure changes, density-dependent effects on adult female survival across environmental gradients, and the influence of land use on spatial distribution and population dynamics. Using aerial (BPOP) and ground (Four-Square-Mile) surveys from the Prairie Pothole Region in North America, we will implement hierarchical multivariate Bayesian spatio-temporal models to simultaneously estimate variation in fecundity and survival, and the covariance among demographic parameters, waterfowl density, and habitat conditions. To do so, we will incorporate publicly available capture-mark-recovery banding data for mallards, northern pintails, and blue-winged teals. While researching these questions related to the management of waterfowl, we hope to address basic ecological questions such as ideal-free distribution theory and variation in life-history strategies at landscape-level scales and create a better understanding of the ecological drivers underlying observed population trends.

I.2-3: Mathematics and Mallard Management II

Presented by: Todd Arnold (arnol065@umn.edu)

Todd Arnold – Fisheries, Wildlife and Conservation Biology, University of Minnesota, St. Paul, Minnesota

In 1979, Cowardin and Johnson published a seminal paper entitled "Mathematics and Mallard Management", in which they used existing data and simple population models to explore alternative options for harvest and habitat management. Forty years later, we have a wealth of additional data and increasingly sophisticated models and modeling tools, but still lack fundamental knowledge of what drives population dynamics of mallards and other duck species. In this symposium, we've critiqued some of the fundamental assumptions underlying adaptive harvest management models used to formulate harvest and habitat management decisions for mallards and other species, and also demonstrated some of the new tools and approaches that are available for better understanding population dynamics in these species. In this plenary, I begin the process of putting these pieces back together again in a way that might rectify recognized shortcomings in historical models, provide contemporary guidance for current decision makers, and lead to improved understanding of processes affecting waterfowl population dynamics for future efforts.

J.1-1: Population Genetics and Hybridization of Mallards and Mallard-Like Ducks in North America

Presented by: Philip Lavretsky (plavretsky@utep.edu)

Philip Lavretsky – Department of Biological Sciences, University of Texas at El Paso, El Paso, TX, 79668, USA

North America is home to five recently diverged, New World "mallards," a group of dabbling duck species characterized by diagnosable phenotypic differences but minimal genetic differentiation. I present genomic data used to characterize population structure within this group, estimate gene flow, as well as identify signatures of selection across their genomes. In contrast to previous studies, coupling landscape-level sampling efforts and the thousands of genetic markers assayed using ddRAD sequencing methods successfully assigned individuals to their respective taxon or hybrid class. First, I find limited evidence of contemporary gene flow between the dichromatic mallard and several monochromatic taxa, but find evidence for ancient gene flow between some monochromatic species pairs. Additional analyses focusing on mallards and American black ducks further supported that these two have always been closely related, and that American black ducks are not on their path to becoming a "hybrid swarm." Thus, despite recurring cases of hybridization in this group, I conclude that the overall genetic similarity of these taxa likely reflects retained ancestral polymorphism rather than recent and extensive gene flow. In fact, I report previously unknown outlier regions across the Z-chromosome and several autosomal chromosomes that may have been involved in the diversification of the New World Mallard clade. These results challenge the current dogma predicting the genetic extinction of the New World monochromatic dabbling ducks via introgressive hybridization with mallards. Conversely, I provide evidence from century-old (1842-1915) and contemporary (>2009) mallard comparisons that confirm that the intensive stocking practices of game-farm mallards conducted across the last century has fundamentally changed the genetic integrity of North America's wild mallard population, especially in eastern North America. It becomes of great interest to ask whether the iconic North American mallard is declining in the wild due to introgression of maladaptive traits from domesticated forms.

J.1-2: Population Genomics Reveals Low levels of Hybridization between Mallards and Mexican Ducks

Presented by: Joshua I. Brown (jibrown@miners.utep.edu)

Joshua I. Brown – Biological Sciences, University of Texas at El Paso, El Paso, TX
Philip Lavretsky – Biological Sciences, University of Texas at El Paso, El Paso, TX

Little is known about the evolutionary history of the Chihuahuan desert endemic Mexican duck (Anas platyrhynchos diazi), which is one of fourteen Mallard-like ducks within the Mallard Complex. Hybridization with mallards (A. platyrhynchos) was originally thought to be a major conservation concern for Mexican ducks, but recent molecular work suggests otherwise. Here, we use a landscape level approach to determine the extent of current hybridization between mallards and Mexican ducks. We collected a total of 266 Mexican ducks across their range, 70 mallards, as well as 62 domestic mallards, including feral Khaki Campbell and game-farm released mallards from three states. We sequenced ~3,500 ddRAD-seq nuclear loci across samples, and report that mallards and Mexican ducks are genetically structured, and that Mexican duck populations follow an isolation-by-distance pattern. Notably, despite previous estimates of wide-spread hybridization, we report that hybridization between Mexican ducks and mallards (wild or domestic) is generally rare (~3%), and lowest of all New World Mallard-like ducks. In fact, we propose that previous estimates of hybridization based on plumage alone were likely inaccurate because traits thought to indicate a hybrid were in fact ancestrally shared between Mexican ducks and mallards. Moreover, several genomic regions under the effects of divergent selection within either Mexican ducks or mallards were recovered, providing support for the possible evolution of isolating mechanisms between the two. Next, we find that Mexican duck populations established in the early 1990s, and now distributed throughout western coastal habitats of Sonora and Sinaloa, were founded by Mexican ducks from Chihuahua. Finally, despite the isolation-by-distance pattern within Mexican ducks that is likely due to high levels of regional fidelity and low or no long-distance dispersal, we report the first genetically vetted Mexican duck collected in California.

J.1-3: Survival and seasonal habitat use of mottled ducks in southwest Louisiana

Presented by: Elizabeth S. Bonczek (lizzi.bonczek@gmail.com)

Elizabeth S. Bonczek – Louisiana State University
Joseph R. Marty – Louisiana Department of Widlife and Fisheries
Samantha A. Collins – Louisiana Department of Wildlife and Fisheries
Michael G. Brasher – Ducks Unlimited Inc., Gulf Coast Joint Venture
Kevin M. Ringelman – Louisiana State University

Mottled ducks (Anas fulvigula) are endemic to the Gulf Coast of the United States, and are non-migratory throughout their range. Because of this, they rely on coastal marsh and associated habitat to fulfill their needs across the annual cycle. The Louisiana mottled duck population has declined over the last decade and the 2018 Louisiana breeding survey was the lowest on record. This decline may go hand-in-hand with the high rate of wetland loss and degradation, and agricultural shifts from rice to other crops. As the landscape changes, it is crucial to identify the times of the year when mottled ducks are most vulnerable to mortality, and which habitat types they use to better inform land conservation. We used the GPS locations of mottled ducks tracked between September 2017 and August 2018 to quantify adult female survival and evaluate home range and space use. We captured mottled ducks during molt and outfitted them with GPS-GSM transmitters to collect locations every two hours. We used the Known Fate procedure in program MARK to examine temporal variation in survival in reference to biological seasons and hunting periods. Our best-fitting survival model parsed the year by first and second hunting season splits. Weekly survival was lowest during the first hunting split (0.981) and highest during the second split (1.000), with overall annual survival estimated at 54.8%. Additionally, we created seasonal home ranges using dynamic Brownian bridge movement models to examine habitat use over the breeding, molting, and pairing periods. Mottled ducks used a variety of habitats, including rice and freshwater marsh, and there was substantial variation among individuals. They less frequently used neighborhood ponds and forested wetlands, which are not habitats typically associated with mottled ducks in Louisiana. By understanding seasonal habitat use, wildlife managers can implement targeted conservation and management strategies for the benefit of this flagship coastal marsh species.

J.1-4: Population genetics of American black ducks in coastal North Carolina

Presented by: Daniel M. Lawson (dlawso@udel.edu)

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Philip Lavretsky – Department of Biological Sciences, University of Texas, El Paso, El Paso, TX 79968, plavretsky@utep.edu

North Carolina represents the southern extent of the American black ducks (Anas rubripes, hereafter, black duck) breeding range. Due to the presence of mallards (Anas platyrhynchos) on the breeding grounds and observed hybridization between the two species, we assessed genetic integrity, hybridization rates, and population structure of this local breeding population. Genomic and mitochondrial DNA was extracted from chorioallantoic membranes and contour feathers found at monitored nests and prepared for analysis using high-throughput DNA sequencing methods (ddRADseq). First, we tested for parentage and sibship across 40 North Carolina black ducks with the program COLONY. Next, nuclear and mitochondrial population structure, genetic diversity, and differentiation was assessed across samples, and across 290 genetically vetted mallards, black ducks, and mallard-black duck hybrids that served as genetic references. Despite a high level of interrelatedness among our samples , nucleotide diversity remains high (~0.0074), suggesting sufficient gene flow from other black ducks and/or mallards into the breeding North Carolina population. Interestingly, we are also able to confirm that two black duck sisters nested within 10 meters from each other, suggesting natal philopatry. Finally, we report a hybridization level of 45% (N =18), covering three filial generations. Of identified hybrids, ~47% (N = 8) were the result of game-farm mallard X black duck pairings. Thus, we conclude that due to high rates of interspecific hybridization and successive backcrossing events, introgression from wild and game-farm mallards is occurring into this population of breeding black ducks.

J.1-5: Applications of sUAS in the Northeastern United States forested environment

Presented by: Gary Macy (gjmacy@syr.edu)

Gary Macy – Environmental and Forest Biology, State University of New York Environmental Science and Forestry, Syracuse, NY
Michael Schummer – Environmental and Forest Biology, State University of New York Environmental Science and Forestry, Syracuse, NY
Johnathan Cohen – Environmental and Forest Biology, State University of New York Environmental Science and Forestry, Syracuse, NY
John O'Connor – Bureau of Wildlife, New York State Department of Environmental Conservation, Ray Brook, NY
Joshua Stiller – Bureau of Wildlife, New York State Department of Environmental Conservation, Albany, NY

Small Unmanned Aerial Services (sUAS) offer great potential as a utility to survey waterfowl and their habitats. Benefits include increased observational angle and field of view from the aerial perspective, and resulting potential for increased detection. sUAS also offers increased survey area coverage where foot or boat travel is logistically difficult (e.g., bogs). Given the current visual line of sight (VLOS) rules in U.S. Federal Aviation Regulations part 107, forested wetlands may be the most challenging habitat to employ sUAS for waterfowl research. Trees can obstruct an sUAS operators VLOS with the aircraft (i.e., legal and safety issues), and requires surveys be conducted at elevations above treetops (~ 34 meters above ground level (AGL) in northern New York) which can reduce image clarity. Prior research suggests waterfowl react little to a rotary wing sUAS at elevations greater than 45 meters AGL. Until 2018, there were no consumer grade unmanned aircraft platform and sensor combinations capable of reliably detecting and identifying species and gender for waterfowl with similar coloration at these altitudes (e.g., American black duck [Anas rubripes] bill color between sexes). We aimed to use sUAS to survey beaver-modified wetlands for American black ducks and other waterfowl species that breed in and migrate through forested wetlands in eastern North America. We used basic photogrammetric formulas, ground-image resolution recommendations from prior research, product specifications, and testing of available lesser aircraft-sensor combinations to determine that recent (2018) advances in consumer grade sUAS technologies would be sufficient to detect and identify species and gender from greater than 34 meters AGL. Preliminary results from testing during the spring migration 2019 suggest our aircraft-sensor platform and approach method are capable of detecting and identifying species and gender for at least 14 species of waterfowl while still maintaining VLOS and with few apparent disturbance behaviors observed.

J.2-1: History and Accomplishments for the Texas Prairie Wetland Project

Presented by: Taylor Abshier (tabshier@ducks.org)

Taylor Abshier – Ducks Unlimited Inc. Richmond, Texas

The Texas Prairie Wetlands Project (TPWP) was created in 1991 to deliver waterfowl habitat on private lands to attain objectives set forth by the Gulf Coast Joint Venture (GCJV), with underlying premises of maintaining sufficient overwinter survival and adequate body condition prior to spring migration. This partnership program is driven by Texas Parks and Wildlife Department, US Fish and Wildlife Service, Ducks Unlimited, USDA Natural Resources Conservation Service, GCJV, and Private Landowners. Over the past 28 years the program has delivered over 85,000 acres of wetland restoration, enhancement, and creation on private land on the Texas Gulf Coast through activities on over 1,500 individual managed units. TPWP is driven by science with 1) a basis in population targets and bio-energetically derived habitat objectives, 2) monitoring support through the GCJVs annual Seasonal Surface Water Monitoring protocol to evaluate the available waterfowl habitat on the landscape, and 3) implementation guidance from the Mottled Duck Decision Support Tool (DST). Annual surface water monitoring is completed with satellite imagery from three periods [(early (16 Aug31 Oct), mid (1 Nov15 Jan), late (16 Jan31 Mar)]. The images are processed and classified using ERDAS IMAGINE software. Through this process the GCJV provides information on the landscape condition relative to objectives, flooding performance of TPWP management units, and the contribution of TPWP sites toward landscape-level habitat availability. Data from 2004/05 through 2017/18 show that TPWP projects on the Texas Mid-coast and Chenier Plain represent up to 23% of available wintering waterfowl habitat of the agricultural zone in those regions. Using the Mottled Duck DST TPWP can identify locations along the coast that have potential for Mottled Duck breeding season habitat. With ground truthing on site visits this tool has provided landscape perspective to spatially target quality MODU nesting and brood rearing habitat. With continued support, research, and funding TPWP will continue to deliver high quality nesting, brood rearing, and wintering habitat on the Texas Gulf Coast for years to come.

J.2-2: Assessing Grassland Distribution and Trends across the North American Great Plains to Inform Waterfowl Conservation Delivery

Presented by: Sean P. Fields (sean_fields@fws.gov)

Sean P. Fields – US Fish and Wildlife Service, Prairie Pothole Joint Venture, Great Falls, MT
Kevin W. Barnes – US Fish and Wildlife Service, Habitat and Population Evaluation Team, Great Falls, MT

North American temperate grasslands are among the most threatened ecosystems in the world. The North American Great Plains has sustained extensive grassland loss and degradation since the 1800s due to agricultural conversion and infrastructure development. Land use intensification and eroded ecosystem integrity has resulted in consistent declines in Great Plains plants and animals, most notably grassland-dependent birds. The North American Waterfowl Management Plan established Migratory Bird Joint Ventures as collaborative, regional public-private partnerships that implement landscape-scale conservation efforts for the benefit of priority bird species. In response to the continued grassland loss, a network of eight Joint Ventures across the Great Plains and Chihuahuan Desert initiated a multi-phase grassland conservation effort to benefit grassland-dependent migratory birds, including upland nesting waterfowl. In the first phase, we developed spatial decision support tools to prioritize land parcels for conservation actions across the study area. We used a combination of proprietary US Department of Agriculture data together with remote sensing techniques to identify areas of undisturbed grasslands across migratory bird annual cycles. Additionally, we assessed the rate of conservation gains against the rate of grassland losses in each Joint Venture geography to identify the regions with the greatest urgency for conservation action. Our results indicate 50% of all grasslands have been lost with only 8.5% of the remaining undisturbed habitat perpetually protected. The Prairie Pothole Region of Canada and the US continues to suffer the highest loss rates, with shrub encroachment a primary factor in degrading habitats in the southern Great Plains and Chihuahuan Desert. Now that we have a common understanding of grassland distribution and trends and how those vary across the central grasslands, we plan to expand our partnerships to achieve shared conservation goals to benefit priority migratory birds and rural communities across the landscape.

J.2-3: Coots, Lines of Credit and Conservation Easements- Innovative approaches to conservation in the PPR

Presented by: Scott Stephens (s_stephens@ducks.ca)

Scott Stephens – Ducks Unlimited Canada
Darwin Chambers – Ducks Unlimited Canada
Andrew Hak – Ducks Unlimited Canada
Mark Francis – Ducks Unlimited Canada

Approaches to conserving waterfowl habitat in the Prairie Pothole Region have been varied and diverse through time. There has typically been a trade-off between the cost of conservation and the length of security for the habitat despite the fact that the desired outcome is perpetual protection at broad scales. Ducks Unlimited Canada had traditionally approached perpetual conservation through fee-title acquisition starting in the mid-1980's with the advent of NAWMP programming and NAWCA funding. However, continuing appreciation of land values and ongoing costs of management/maintenance have limited the utility of this tool to achieve conservation impacts at scale. Enabling legislation for conservation easements happened across the three Prairie provinces in the early 1990s. Conservation easement costs are typically 1/3rd of the fee-title value of the land and thus offer a larger conservation footprint for the same dollars. However, interest in conservation easements had been limited. Starting in 2014, Ducks Unlimited Canada began using a revolving land conservation program (RLCP) approach using a line-of-credit to fund the capital purchase. Any required habitat restorations are completed on these properties and then perpetual conservation easements are attached as a requirement of the sale of the properties back into private ownership. This approach has proved to have utility and is also more socially acceptable amongst the agricultural community across the Canadian PPR than fee-title ownership by NGOs like DUC. This program has had the indirect benefit of instigating discussions with private landowners on how conservation easements function and how they can benefit landowners. As a result, DUC has seen a six-fold increase in the total acres impacted by conservation easements over the past 6 years.

J.2-4: Using waterfowl ecology and economics to estimate return on conservation investments in prairie Canada

Presented by: James H. Devries (j_devries@ducks.ca)

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Ducks Unlimited Canada (DUC) has been delivering wetland and waterfowl conservation programs that protect and restore wetland and upland habitats for over 80 years. Historically, DUCs conservation programs in prairie Canada were guided by decision support systems based on waterfowl population density and conservation impact on waterfowl abundance and/or productivity. However, efficiencies considering the spatial variation in conservation costs, program delivery options, and waterfowl outcomes across prairie Canada were lacking. Thus, to improve efficiency in conservation program delivery and outcomes, we incorporated economic principles such as opportunity cost and time value of money (TVM) with spatially varying costs of business, and waterfowl response to conservation actions, in a GIS-based planning environment. We use landscape composition, land value, interest rates, wetland and upland program delivery costs, risk of loss, and waterfowl response, to map the cost per incremental gain in waterfowl production. This model enables us to compare conservation delivery options across different geographies and facilitates efficient delivery of conservation with the highest return on investment.

J.2-5: Framing the 2018 NAWMP Update and Plan Committee priorities

Presented by: R. Joseph (Joe) Benedict, Jr. (joe.benedict@tn.gov)

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The 2018 North American Waterfowl Management Plan Update, Connecting People, Waterfowl, and Wetlands, was signed by the United States, Canada, and Mexico and released January 29, 2019. The NAWMP has a long and successful history of conserving North American waterfowl through Joint Venture partnerships, a commitment to science-based habitat conservation, and understanding population-management linkages. The 2012 NAWMP Revision and Action Plan sought to expand the base of supporters and challenged the NAWMP community to consider the intersection of waterfowl, habitat, and people in management decisions. The purpose of the 2018 Plan Update was to document the achievements under the 2012 Revision, lessons learned along the way, provide a fresh focus on what remains to be accomplished, and rekindle the professional passion and resilience needed to advance the NAWMP over the next five to ten years. While guidance on integrating management decisions continues to develop, the NAWMP Plan Committee (PC) is committed to making rapid progress and fostering timely communication of the results within the NAWMP community. Progress since 2012 will be highlighted, including extensive social science work aimed at better understanding how people value wetlands and waterfowl. Additionally, the PC recently identified a number of strategic priorities and addressed structural issues of the committee for implementing the 2018 Plan Update. PC priorities and proposed structural changes will be shared, as well as new communication efforts, including those around the 30th anniversary of the North American Wetland Conservation Act.

J.3-1: An Assessment of Waterfowl Use of Intensely Managed Areas in Michigan

Presented by: Trey McClinton (mcclin73@msu.edu)

Trey McClinton – Department of Fisheries and Wildlife, Michigan State University
Dave Luukkonen – Department of Fisheries and Wildlife, Michigan State University
Dan Hayes – Department of Fisheries and Wildlife, Michigan State University

Waterfowl provide significant economic, ecological, and social benefits, and management strives to provide adequate populations to support hunting and non-hunting benefits of these resources. Given their importance, there is a need to regularly evaluate waterfowl use of wetlands and to adapt management systems to changing conditions. In Michigan, public land managers conduct weekly counts to document waterfowl use. Data obtained from these counts is potentially too coarse spatially and temporally to guide management and may suffer from biases due to differing detection among habitats. As such, the objectives of this research were to: (1) evaluate waterfowl use of Michigans intensively managed waterfowl areas in response to local conditions and management regimes and (2) test camera trapping methodologies as a means to address identified shortcomings of visual counts. I maintained 80 Browning Strike Force 850 HD game cameras across 5 state operated Managed Waterfowl Hunt Areas and the Shiawassee National Wildlife Refuge, from September through December 2018. Cameras were set to a timelapse plus setting which captured a photo every ten minutes during daylight hours and allowed waterfowl to trigger the camera by motion day and night. Assessments indicate that usage during daylight hours was highest in units that were closed to hunting. Although usage varied among wetland types (e.g., flooded corn, moist soil, etc.), detections in units open to hunting showed a stronger shift from day to night as hunting pressure increased. These results indicate that, though management has commonly focused on maximizing available food for migrating waterfowl, disturbance is also an important factor driving their temporal and spatial distribution. Additionally, our work shows that game cameras are viable tools for overcoming certain limitations of other sampling methods.

J.3-2: Using the NAWMP to guide a state-wide waterfowl habitat management plan in Wisconsin

Presented by: Jake Straub (straub.47@gmail.com)

Jacob Straub – Unviersity of Wisconsin-Stevens Point
Matthew Palumbo – New York State Department of Environmental Conservation

The goals of the 2012 North American Waterfowl Management Plan target a combination of biological and social objectives that are prioritized regionally through Joint Venture (JV) partnerships. The Upper Mississippi River and Great Lakes (UMRGLR) JV developed a decision support tool (DST) to assist in implementing these objectives. The DST is based on spatially explicit model-based maps, each representing a biological or social objective weighted by input from decision makers. The DST depicts regions of relative value to meet objectives and therefore identifies areas for regional managers to target conservation for waterfowl and people. In 1992 Wisconsin Department of Natural Resources developed their own state-based conservation plan to achieve waterfowl population and habitat objectives. This WI Plan was based on a spatial hierarchy of priority regions, areas, and townships that were delineated from estimated waterfowl densities and habitat, geo-political boundaries, and expert opinion. Since 1992 managers have been working to implement conservation practices based on this system. However much has changed since this time thus, our objective was to revise the 92 WI Plan, now called the Wisconsin Waterfowl Habitat Conservation Strategy, and provide updated spatially-explicit data layers to assist waterfowl habitat conservation efforts. We developed a suite of spatial layers, representing conservation capital and opportunities, designed to meet objectives specific to Wisconsin. Our maps have allowed WI conservation managers to visualize how conservation practices would be prioritized under various ranks of biological and social values. The WI DST will assist state managers with redistributing priority regions based on eco-physiographic boundaries (watersheds) and quantitative ranking based on the underlying biological and social data of the tool. Our approach demonstrate the value of incorporating spatio-temporal variation of biological and social data for conservation managers to prioritize practices while implementing the North American Waterfowl Management Plan.

J.3-3: Hydrological management for submersed aquatic vegetation and invertebrates in South Carolina

Presented by: Beau Bauer (beau.a.bauer@gmail.com)

Beau Bauer – Nemours Wildlife Foundation, Yemassee, South Carolina
Richard Kaminski – Clemson University James C. Kennedy Waterfowl and Wetlands Conservation Center, Georgetown, SC
J. Drew Lanham – Clemson University, Clemson, SC
Patrick Gerard – Clemson University, Clemson, SC
Ernie Wiggers – Nemours Wildife Foundation, Yemassee, South Carolina

Widgeongrass (Ruppia maritima) and other native SAV are propagated in brackish managed tidal impoundments (MTIs) in coastal South Carolina to provide forage for waterfowl and other waterbirds and habitat for aquatic invertebrates. We conducted a field study to test effects of complete drawdown (CD) to dried substrates versus partial, shallow water (0-10 cm) drawdowns (PD) on widgeongrass and other SAV biomass and aquatic invertebrate biomass in MTIs in southern coastal South Carolina. This information was lacking to estimate foraging carrying capacity and inform managers of best practices to promote waterfowl and other waterbird forage. We sampled sediments and SAV in 20 MTIs (CD n = 8, PD n = 12) and 3 non-impounded natural tidal marsh sites (control) during August 2016, November 2016, January 2017, and April 2017. We used mixed model analysis of variance to test effects of drawdown on SAV and benthic invertebrate biomasses and mixed model analysis of covariance to test effects of drawdown and SAV biomass (covariate) on total invertebrate biomass (benthic and epifaunal combined). Partially drawndown MTIs contained greater SAV and invertebrate biomasses for sampling periods with detected drawdown effects with the exception of benthic invertebrate biomasses in both CD and PD being greater than unmanaged marsh in January 2017. We also detected a positive effect of SAV biomass on total and benthic invertebrate biomass for most sampling periods. Additionally, we determined that PD MTIs had about 3 times greater potential foraging capacity for dabbling ducks than completely drawndown impoundments. We recommend partial drawdowns to maximize invertebrate and SAV biomasses and foraging carrying capacities for ducks and other waterbirds in South Carolina MTIs and similar wetlands. Additionally, we encourage complete drawdowns when deemed necessary (e.g., 23 year cycle) to regulate predatory aquatic invertebrates and fish and consolidate flocculent soils detrimental to SAV rooting and retention.

J.3-4: Accounting for the effects of water depth on energy availability estimates for ducks in northeastern Colorado

Presented by: Adam Behney (adam.behney@state.co.us)

Adam C. Behney – Avian Research Section, Colorado Parks and Wildlife, Fort Collins, CO

Habitat management and planning strategies for nonbreeding ducks are focused on providing enough energy to support population goals. Therefore, regional estimates of energy availability are required to determine if sufficient habitat exists. I sampled duck food in six types of water features in northeastern Colorado during three sampling occasions throughout nonbreeding seasons, 2015-2016 and 2016-2017. I also estimated the percentage of each water feature that was shallow enough to facilitate feeding by dabbling ducks as a way to correct overall energy density to reflect availability to ducks. I found that emergent wetlands contained the greatest food (fall actively managed = 688 kg/ha, fall passively managed = 684 kg/ha) and energy density, followed by playas (189 kg/ha) and sloughs (186 kg/ha), and reservoirs contained little food or energy (large reservoirs = 16.1 kg/h, small reservoir 29.5 kg/ha). Fall depletion of food was greatest in actively managed emergent wetlands and spring depletion was greatest in sloughs and passively managed emergent wetlands. Mean percentage of passively managed emergent wetlands, actively managed emergent wetlands, small reservoirs, large reservoirs, and sloughs shallower than 50 cm was 37, 77, 10, 4, and 83%, respectively. These estimates can be directly incorporated into Joint Venture energetic carrying capacity model and will result in reduced estimates of energy availability for the region, potentially below what is needed to support population goals. Furthermore, my method of estimating and accounting for water depth can be used elsewhere to reduce bias in food availability estimates.

J.3-5: Ecological assessment of wetland management techniques on restored wetlands in the Montezuma Wetlands Complex

Presented by: Edward B. Farley (efarley@ducks.org)

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Wetland managers need to understand how wetland management techniques influence food availability for waterfowl to help meet regional conservation goals. However, there is an information deficit on ecological returns on post-construction management of restored wetlands. We assessed the response of vegetation (summer), invertebrates (summer), seeds and tubers (autumn), and waterfowl (autumn and spring) to three wetland hydrology regimes (full water drawdown, partial water drawdown, and passive) on thirty randomly selected wetlands in the Montezuma Wetlands Complex, 2016 - 2018. We detected 127% and 90% greater seed and tuber densities in full (3-year mean = 848.7126.0 [SE] kg/ha) and partial drawdowns (681.862.5 kg/ha) than passively managed wetlands (365.020.5 kg/ha), respectively. Results suggest seed and tuber densities in managed wetlands in the northeastern United States are comparable to or greater than other parts of North America and moist-soil management should be considered an important technique to meet regional Duck-Energy-Day goals. Partial drawdown wetlands had greater submerged aquatic vegetation densities (3-year mean = 1,754.4473.0 kg/ha) than passively managed wetlands (3-year mean = 1,201.1527.4 kg/ha) across all years of the study. Partial drawdowns (3-year mean = 1,489.39 macroinvertebrates/m2116.48) also had 243% greater summer density of macroinvertebrates than passive drawdowns (3-year mean = 785.97 macroinvertebrates/m250.94) during the brood rearing period. During fall migration, passive wetlands had 367% and 182% greater waterfowl density than full and partial drawdowns respectively. In spring, waterfowl abundance was 216% and 156% greater in full and partial drawdowns than passive wetlands, with diving duck use 153% greater in both full and partial drawdowns and dabbling duck use 335% and 225% greater than in passive wetlands, respectively. We think seasonal differences in waterfowl use result from dry autumn and wet spring flooding regimes. Results reinforce the need for varying management techniques on wetland complexes to meet waterfowl needs throughout their annual cycle.

J.4-1: Microhabitat nest-site selection of ducks in the western boreal forest

Presented by: Bradley Fedy (bfedy@uwaterloo.ca)

Matthew Dyson – University of Waterloo
Stuart Slattery – Ducks Unlimited Canada
Bradley Fedy – University of Waterloo

The boreal forest is one of North Americas most important breeding areas for ducks, but knowledge of duck nesting ecology in the region is limited. We collected microhabitat data related to vegetation structure and composition at 157 duck nests and paired-random available locations from 2016 2018 in the western boreal forest (WBF) of Alberta, Canada. We identified fine scale microhabitat features selected by ducks for all species, nesting guilds, and 5 individual species using conditional logistic regression. Boreal ground nesting ducks selected nest sites that provided greater overhead and graminoid cover, but selected for less forb cover. Upland and overwater nesting guilds selected similar features, with the differentiation of selection of greater shrub cover and less lateral concealment by upland nesting species and selection for less shrub cover by overwater nesting species. We also estimated species-specific microhabitat nest-site selection for American Wigeon, Blue-winged Teal, Green-winged Teal, Mallard, and Ring-necked Duck. We observed variation in selection of vegetation composition among species, which may facilitate species coexistence at a regional scale. In addition to quantifying nest site selection, we also used our data to evaluate support for the nest concealment hypothesis. The nest concealment hypothesis assumes that birds select nest sites surrounded by dense vegetation to avoid detection by predators, because avian species are under intense selective pressure in choosing a safe nest site, where predation is the primary cause of nest failure. Our results suggest a tradeoff is made by upland nesting species, where females might balance the need for concealment from aerial predators with the need for increased vigilance and escape from terrestrial predators. Subsequent alteration in vegetation heterogeneity or predator communities in the boreal caused by climate and land use change may affect nest-site selection strategies used by boreal ducks. Therefore, we recommend further investigation of nest-site selection and survival at multiple spatial scales for boreal conservation and management.

J.4-2: Identifying critical nesting habitat for ducks in Alberta's western boreal forest.

Presented by: Matthew Dyson (mdyson@uwaterloo.ca)

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Stuart Slattery – Ducks Unlimited Canada
Brad Fedy – University of Waterloo

The western boreal forest (WBF) is an important breeding area for North American ducks, second only to the Canadian Prairies. The WBF is under intensive industrial development, causing habitat loss and fragmentation. Land use change can have profound effects on predator-prey interactions and influence population dynamics. In most avian species, nest success is critical to population persistence. Therefore, species are under intense selective pressure in choosing a safe nest site. Currently, we have limited knowledge of duck nesting ecology in the WBF, including the influence of changing land use practices on how ducks select nest sites. We investigated nest-site selection of ground nesting ducks in the WBF of Alberta at multiple spatial scales using logistic regression-based resource selection functions. We located 167 duck nests of 8 different species between 2016 and 2018 by nest searching across a gradient of industrial development. We hypothesized nest-site selection strategies associated with habitat and land use variables would vary by species and with spatial scale. We also hypothesized that industrial development increased predation and expected ducks to avoid highly disturbed habitats. In addition to quantifying the nesting-ecology relationships for multiple species and scales, we spatially predicted our best models to identify nesting habitat for boreal ducks. These maps can help prioritize habitat conservation and represent the first step towards understanding the nesting ecology of ducks in this important region.

J.4-3: Did duck population trajectories change with anthropogenic disturbance in the Boreal Plains ecozone?

Presented by: Howard Singer (h_singer@ducks.ca)

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Stuart Slattery – IWWR, Ducks Unlimited Canada, Stonewall, MB, Canada
Susan Witherly – IWWR, Ducks Unlimited Canada, Stonewall, MB, Canada
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Anthropogenic disturbances in the boreal forest are hypothesized to negatively affect breeding ducks. We examined relationships between population trajectory of duck pairs and amount of anthropogenic disturbance in the Boreal Plains ecozone of western Canada. Population trends were compared to density of seismic lines, pipelines, roads, and well sites, and distance to agriculture. We also evaluated whether relative importance of these disturbances differed in agriculture encroached vs. unencroached landscapes; distance to agriculture was assessed in unencroached landscapes. Pair counts (1960 2007) from the Waterfowl Breeding Population and Habitat Survey were pooled into nesting guilds (cavity, ground, and overwater). Relationships between anthropogenic disturbance variables and population trajectory was assessed using linear mixed modeling and multi-step random coefficients models, which controlled for habitat and weather variables. Relative magnitude and direction of relationships with disturbances varied with landscape and nesting guild. Overall, majority of negative relationships occurred with seismic lines and pipelines, with lower population trends in four of six comparisons for both disturbance types, while trends increased closer to agriculture. We then examined cumulative effects by mapping spatial variation in predicted percent change in duck abundance. Population trends for ground nesters tended be most negative in regions with high seismic line and well pad density in agriculture encroached landscapes and in regions with high seismic line and pipeline density in unencroached landscapes. Cavity nester population trends were generally positive throughout the study area but were lowest in unencroached landscapes farthest from agriculture. Overwater nester trends were generally lowest in agriculture encroached landscapes with high densities of seismic lines, roads and well pads and in unencroached landscapes with high densities of seismic lines, pipelines and roads. While our work suggests that anthropogenic disturbances, particularly seismic and pipelines, may merit further consideration as foci for conservation, additional research is needed to quantify demographic implications.

J.4-4: The Boreal-Arctic transition zone of Canada: duck factory of the not-so-famous?

Presented by: Christian Roy (christian.roy3@canada.ca)

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Alice D. Domalik, Cindy Wood – Canadian Wildlife Service, Yellowknie NT
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Christian Roy – Canadian Wildlife Service, Gatineau QC
Scott Gilliland – Canadian Wildlife Service, Sackville NB

Concern over population status and the adequacy of operational breeding waterfowl surveys for sea duck and scaup populations persists. Large areas of the Boreal-Arctic transition zone of Canada (Taiga Plains and Shield ecoregions) are excluded from operational breeding waterfowl surveys. Recent experimental surveys and satellite telemetry have suggested its importance to breeding populations of these species but there remains uncertainty about the area's importance to continental waterfowl populations. We conducted experimental helicopter-based breeding waterfowl surveys at 6 sites (20,000km2 each) located from Northern Quebec to the Northwest Territories, between 2017 and 2019. A total of 20-26 plots (25 km2) were surveyed at each site. The surveys were timed to coincide with the pre-laying and early-laying period for scoters. A double-dependent observer approach was used, allowing observed densities to be corrected for detection. Densities of sea ducks and scaup in aggregate were high at all sites, ranging from 3.6/km2 to 5.6/km2, exceeding 10/km2 on some plots. The most abundant species were scoters and scaup: tundra-dominated sites had higher densities of Black scoters and Greater scaup, White-winged scoters and Lesser scaup were at higher densities at more forested sites, and Surf scoters were more evenly distributed across sites. Maximum densities for Black scoters were 1.35/km2 [95%CI: 1.33 - 1.38]; Surf scoter 0.89/km2 [0.89 – 0.90]; White-winged scoter 0.57/km2 [0.57 – 0.59]; Greater scaup 0.39/km2 [0.38 - 0.39]; Lesser scaup 1.29/km2 [1.29 – 1.29]; as well as pooled scoters 2.34/km2 [2.32 – 2.37] and scaup 3.40/km2 [3.40 – 3.41]. More than 90% of all observations were of indicated pairs showing that these sites were terminal breeding areas for these five species. We will explore inter-annual variation in densities with 2019 survey data. Observed densities are high for diving ducks and sea ducks and clearly show the importance of the Boreal-Arctic transition zone for waterfowl production.

J.4-5: Breeding habitat selection of scoters and scaup in the Boreal-Arctic transition zone

Presented by: Cindy Wood (cindy.wood@canada.ca)

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Several sea ducks and both scaup species nest in remote regions of the Taiga Shield and Taiga Plains ecoregions, an area that straddles the tree line from Labrador to Alaska. Recent satellite telemetry studies have shown that these regions encompass core-breeding areas for all three species of scoters, and are also important breeding areas for Lesser and Greater scaup. However, there is a paucity of information on breeding habitat use and selection of those sympatric species which limits our ability to predict their distribution across the landscape, evaluate potential impacts of climate change or determine effective conservation actions. We conducted aerial surveys at six sites (20,000 km2 each) distributed within the Taiga Shield and Taiga Plains ecoregions, in Québec, Manitoba and the Northwest Territories during the pre-laying and early-laying period from 2017 to 2019. We used Natural Resources Canada's CanVec database and DUC's Hybrid Wetland Layer to extract a set of explanatory variables for habitat selection analysis at the scale of the survey plot (25 km2). Our results indicate that each species selected for different landscape features. Predicted densities for a given set of habitat features also varied markedly across sites, indicating that factors in addition to landscape-scale habitat features influence species abundance and distribution. Finally, we will evaluate inter-annual variation in habitat selection to determine how it responds to annual environmental conditions. Results from habitat selection models will provide a better understanding of landscape features important for breeding site selection in scoters and scaup. Habitat selection models will also provide a foundation for stratification of a potential future breeding ground survey as well as allow more robust estimates of population size and trend.

K.1-1: Standardizing hybrid identification: Developing a genetically-vetted field key to distinguish between Mexican ducks, mallards, and their hybrids.

Presented by: Flor Hernandez (fbhernandez2@miners.utep.edu)

Flor Hernandez – University of Texas El Paso
Andrew Engilis Jr. – University of California, Davis
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Philip Lavretsky – Univeristy of Texas El Paso

Hybridization rates between the Mexican duck (Anas platyrhynchos diazi) and mallards (A. platyrhynchos) were previously based on plumage characteristics only. However, traits among Mallard-like ducks that appear to be indicative of a hybrid may, in fact, be ancestral. Thus, using phenotypic characters alone may be inaccurate for estimating hybridization rates. Instead, we outline steps and present the first genetically vetted phenotypic scoring key that can be used to accurately identify Mexican ducks and hybrids in the field. We documented 22 plumage characteristics for samples that are also genetically vetted as pure or hybrid for 398 Mexican ducks across their ranges in the US and Mexico, as well as mallards from North America. In short, samples are first genetically assigned as pure (i.e., 95% genetic assignment to one group) Mexican duck, pure mallard or hybrid (i.e., 10% genetic assignment to the interspecific group). Next, we perform a discriminant function analysis to determine which phenotypic characters best distinguish between genetically assigned pure Mexican ducks, pure mallards, and hybrids. Among sex-age classes, we report that first-year male Mexican ducks commonly exhibited mallard-like traits (e.g. green feathers on the head, black rump) not observed in adult males. Moreover, the expression of these traits in first-year male Mexican ducks decreased from their northern to the southern range. This finding may explain early reports of decreasing hybrid prevalence with the same clinal fashion. Additionally, we corroborate earlier reports that female Mexican ducks show subtle plumage traits that make them difficult to distinguish from hybrids. Though juvenile males and females may be problematic to separate from hybrids, the accuracy of the key increases with adult individuals. The developed key is currently being deployed in the southwestern US where scored birds are going to be genotyped as to determine whether further key refinement is necessary.

K.1-2: Mallards (Anas platyrhynchos) Regulate Stress Responsiveness According to Energetic Demands During the Fall and Winter

Presented by: Jerad Henson (jhenson2@cbu.edu)

Jerad Henson – Christian Brothers University
Christopher Sims – University of Arkansas at Monticello
Stephan Schoech – University of Memphis

Many bird species exhibit a seasonally variable glucocorticoid response to a standardized capture and handling protocol. Corticosterone (CORT), the primary avian glucocorticoid, is elevated in response to a wide-range of stressors to facilitate the mobilization of energetic resources. It is believed that the seasonal variation in CORT responsiveness aids the individual in coping with changing energetic demands while protecting valuable protein and lipid resources. Although this variation has been observed in many bird species, very few studies have examined this phenomenon in waterfowl. We examined whether mallards alter CORT response during the fall and winter and whether this was related to body condition. We sampled mallards during three periods at two locations: 1) fall, during pre-migration in North Dakota (n = 25), 2) fall and early winter, during migration in Arkansas (n =5), and 3) late winter, during the early spring migration in Arkansas (n = 13). Mallard CORT response and body condition were compared across sample periods. CORT response was reduced during fall migration and increased during the late winter when mallards complete breeding pair formation. However, body condition and CORT response were not correlated. These results are similar to other studies that found a reduced CORT response during migration and molt, and increased responsiveness associated with breeding behaviors.

K.1-3: Are Great Lakes mallards underperforming compared to the remainder of the Mid-continent population?

Presented by: Drew Fowler (drew.fowler@wisconsin.gov)

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Barbara Avers – Michigan Department of Natural Resources and Michigan State University
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Mallards are the most heavily harvested duck species in the Mississippi Flyway (MF), including the Great Lakes states and these birds help support over 2.5 million duck hunter-days in the MF annually. Harvests of mallards originating from breeding areas in the Great Lakes Region are managed as part of the Mid-continent mallard population via Adaptive Harvest Management and mallard harvests within Great Lakes states have been derived largely from birds breeding within the Great Lakes region. We studied historic patterns of mallard abundance in the Mid-continent mallard breeding area based on spring waterfowl breeding population and habitat surveys. Great Lakes mallard abundance increased over the long-term and breeding mallard abundance in the Great Lakes States historically followed trends of the remainder of the Midcontinent population; however, trends diverged when Great Lakes mallards failed to recover from low abundance in the mid-2000s. Studies of hunting regulations, harvest rates, and hunter participation failed to find links to reduced mallard abundance; also, mallard productivity appears to have been relatively stable over the long-term in the Great Lakes region. Survival models fit to band recovery data showed little evidence harvest was excessive or that survival declined. Mallard abundance in Michigan has been positively related to Great Lakes water levels and this relationship was believed to reflect regional changes in wetland hydrology and availability of breeding habitat. The relationship of mallard abundance with water levels weakened after 2007 and abundance has not recovered despite water level recovery. Waterfowl biologists in Michigan and other Great Lakes states are at a loss to explain the current low mallard abundance as apparently suitable habitat has gone unoccupied. It is possible breeding distribution of mallards in the MF has changed and we propose a study of philopatry, movements, survival, and productivity in relation to mallard habitat selection and genetics.

K.1-4: Influence of Agricultural Grains on Diets, Body Condition, and Stress in Black Ducks and Mallards Wintering on Long Island, New York

Presented by: Aidan Flores (aflore06@syr.edu)

Aidan J. Flores – SUNY College of Environmental Science and Forestry
Michael L. Schummer – SUNY College of Environmental Science and Forestry

Availability of winter habitat and forage for American black ducks (Anas rubripes; hereon black ducks) can be limiting. Increasing urbanization, sea level rise, and other stressors often make restoration of coastal marshes infeasible or logistically difficult. Agriculture fields may need to increasingly serve as winter foraging sites for black ducks. We determined if diets, body condition, and stress indices of black ducks and mallards (Anas platyrhynchos) differed between agricultural and coastal sites on Long Island, New York. We captured black ducks and mallards at agricultural sites and lethal collections at coastal marshes. Agricultural fields were used by mallards (61% of ducks) and black ducks (36% of ducks), but only black ducks were observed in coastal marshes. Black ducks had 14.8% greater 15C ratios at agricultural than coastal sites, whereas 15N ratio showed the opposite trend. Black duck and mallard 15C and 15N ratios were similar at agricultural sites. These results suggest that diets differed between cover types for black ducks, but not between species at agricultural sites. Adjusted body mass of black ducks at coastal (1,081.1 36.8 g) and agricultural (1,114.6 15.6 g) sites were similar, but mallards (1,180.7 26.0 g) were 5.9% heavier than black ducks at agricultural sites. Red blood cell percentages were greater at agricultural (53.1 0.9%) than coastal sites (40.6 2.3%) for black ducks, whereas there was no difference between black ducks and mallards (52.9 1.5%) at agricultural sites. There were no differences in heterophil/lymphocyte ratios by treatments or species. Our results do not suggest substantial benefits of corn supplements to black ducks wintering on eastern Long Island. However, black ducks feeding on corn were not in worse condition, suggesting that loss of coastal marshes could partially be offset by supplementing with agricultural grains during winter.

K.2-1: Individuals Versus Environments: Intrinsic and Extrinsic Influences on Waterfowl Reproductive Success

Presented by: David Johns (david.johns@usask.ca)

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Drivers of variation in waterfowl reproductive success can broadly be grouped as restraints by an individual (i.e., breeding decision), constraints imposed from within individuals (i.e., intrinsic quality/condition) or from the surrounding environment (i.e., extrinsic or environmental quality). The simultaneous contributions of both intrinsic and extrinsic factors across seasons complicates investigations interested in disentangling relative effects of reproductive or survival trade-offs for migratory waterfowl. We used a combination long-term mark-recapture datasets, hormone biomarkers and large-scale studies of mallard reproductive success across the Prairie-Parklands. We used structural equation modelling to evaluate how current and antecedent factors influenced reproductive success while simultaneously assessing contributing factors to individual reproductive performance (fledging success). Path analysis indicated that neither amount of grassland nor past energetic condition were important to determining reproductive decisions but above-average pond abundances attracted females with higher body mass, greater nesting propensity and reproductive investment. Females in areas with higher wetland abundance were more likely to breed and made larger investments in nesting but produced fewer fledged ducklings. Intrinsic female traits had opposing influences on nest investment and reproductive success with age related trade-offs between breeding likelihood and ultimate success. We found evidence that late-nesting (re-nesting) females were more likely to fledge duckling(s) but had smaller brood sizes relative to early nests and females that laid more eggs in a season indirectly fledged more offspring (i.e., through greater hatching success and brood size at hatch) and yet the negative direct path between egg production and fledging success implies a cost associated with investment. Simultaneous consideration of both intrinsic quality, reproductive investment and environmental constraints enables more detailed understanding of reproductive ecology and potential carry-over effects.

K.2-2: Energetic Carrying Capacity of Submersed Aquatic Vegetation in Semi-permanent Wetlands Important to Waterfowl in the Upper Midwest

Presented by: Joseph D. Lancaster (lancastj@illinois.edu)

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Intensification of land use practices and climate change has resulted in extensive wetland loss and declines of native submersed aquatic vegetation (SAV) from wetlands across North America. Although SAV is an important diet component of many species of waterfowl (e.g., gadwall [Mareca strepera]) and other waterbirds (e.g., American coot [Fulica americana]), it has been dismissed as an important contributor to energetic carrying capacity due to assumed low density and assimilable energy. Moreover, conservation planners currently are unable to accurately account for the energetic contribution of SAV in bioenergetics models because of a lack of biomass and energy estimates for semi-permanent wetlands. Following recent advancements in assimable energy estimates for many common SAV species, we estimated energetic carrying capacity of 21 semi-permanent wetlands containing SAV identified as important stopover locations for migrating waterfowl and other waterbirds in the Midwest, USA. Energy density of SAV (x = 813 257 EUD/ha) was generally less than managed wetland types, varied by National Wetland Inventory class, and had a great degree of annual (984,873 EUD/ha) and spatial variation (87,970 EUD/ha). Energetic carrying capacity was greatest for isolated wetlands (1,507,584 585,219 EUD), followed by wetlands connected to rivers (840,286 549,395 EUD) and lakes (205,516 59,903 EUD). We attempted to develop a visual rapid assessment index that would allow wetland managers or researchers to quickly estimate energy density from SAV, but correspondence was low (R2m = 0.43). Energetic carrying capacity estimates of wetlands containing SAV will allow conservation planners to more precisely estimate energy supply on the landscape for waterfowl and wetland managers to evaluate trade-offs among alternative management strategies. We suggest future research estimate energy density among randomly selected wetlands across the Midwest and collect additional information on the below-ground biomass of SAV and associated assimable energy.

K.2-3: True Metabolizable Energy of Submersed Aquatic Vegetation for Ducks

Presented by: Margaret Gross (margaret.gross@state.mn.us)

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Improving the accuracy of energetic models used to set and evaluate habitat objectives to meet dietary needs of waterfowl requires true metabolizable energy (TME) estimates for numerous diet items. While significant effort has been devoted to estimating TME of moist-soil seeds, hard mast, agricultural grains, and invertebrates, few TME values exist for submersed aquatic vegetation, despite its significance in the diets of many waterfowl species. We conducted 340 TME assays and estimated TME for 21 vegetation and duck species combinations using the foliage of eight submersed aquatic vegetation species (southern naiad [Najas guadalupensis], Canada waterweed [Elodea canadensis], coontail [Ceratophyllum demersum], wild celery [Vallisneria americana], sago pondweed [Stuckenia pectinata], widgeongrass [Ruppia maritima], hydrilla [Hydrilla verticillata] and Eurasian watermilfoil [Myriophyllum spicatum]) with four duck species (mallard [Anas platyrhynchos], ring-necked duck [Aythya collaris], wood duck [Aix sponsa], and gadwall [Mareca strepera]). True metabolizable energy among combinations ranged from 1.07 (sago pondweed foliage, gadwall) to 1.92 kcal/g (hydrilla foliage, ring-necked) with an overall mean of 0.63 0.18 kcal/g. Among duck species, TME was greatest for hydrilla (x = 1.56 kcal/g) followed by Canada waterweed (x = 1.18 kcal/g), coontail (x = 1.01 kcal/g), widgeongrass (x = 0.78 kcal/g), Eurasian watermilfoil (x = 0.41 kcal/g), southern naiad (x = 0.38 kcal/g), sago pondweed (x = 0.02 kcal/g), and wild celery (x = 0.08 kcal/g). Generally, mean TME for most submersed aquatic vegetation species was less than agricultural grains, but it was similar to ranges reported for moist-soil seeds and other natural wetland vegetation and aquatic macroinvertebrates. We recommend that conservation planners incorporate our TME estimates into energetic models used in wetland restoration and protection objectives because submersed aquatic vegetation provides significant energy for waterfowl.

K.2-4: Influence of vegetation richness on dabbling duck nesting productivity

Presented by: Mike Eichholz (eichholz@siu.edu)

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A common restoration practice aimed at waterfowl production involves the establishment of low-diversity (3 5 species) Dense Nesting Cover (DNC) areas seeded with a mixture of introduced grasses and forbs. While DNC provides secure duck nesting habitat, low-diversity seeding mixes have demonstrated vulnerability to invasive vegetation and may fail to meet habitat requirements of other grassland species. In attempts to develop more ecologically-stable and heterogeneous habitat, there is interest in shifting seeding practices towards species-rich native vegetation (SRNV) plantings of 16-32 species. In a previous study designed to evaluate the efficacy of DNC and SRNV restorations as duck nesting habitat, we found that ducks select SRNV at a level similar to DNC, but lower Daily Survival Rate (DSR) was observed at SNRV sites in a year of high skunk-abundance. We hypothesized that higher-diversity habitats may be capable of supporting a larger number and diversity of organisms, including increased abundance of co-existing prey and predators which can negatively impact breeding duck populations. In our current study, we compare dabbling duck nest success, meso-predator abundance, small mammal abundance, and arthropod abundance on 26, 20-ha experimental plots across south-eastern North Dakota and north-eastern South Dakota. Plots represented a species richness gradient ranging from low-richness stands of DNC to progressively more species-rich plots (8-34 species). In contrast to our previous study, we found DSR of duck nests increased with vegetation species richness. These results were unexpected, but subsequent analyses of other components of the grassland community including vegetation structure and small mammal abundance suggest the result is a direct relationship with vegetation richness, or a relationship mediated by abundance of predators and/or coexisting prey. We present results obtained during this study, and discuss their implications for grassland management and restoration for wildlife.

K.3-1: Quantifying the influence of weather conditions on behavioral contributions to reproductive attempts in birds of contrasting migration strategy

Presented by: Mitch D. Weegman (weegmanm@missouri.edu)

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Migratory birds often face substantial risk as they travel between breeding and wintering areas annually. Spring migration is particularly risky because individuals must store energy for migration and reproduction. Hence, individuals attempt to time movements to optimize energy acquisition relative to expenditure, and poor decisions could reduce the probability of a successful reproductive attempt. Weather conditions also impact probabilities of breeding; even the best decisions may be negatively influenced later by poor weather conditions. We used GPS/acceleration tracking devices to test whether variation in the proportion of time feeding during spring explained variation in reproductive attempt or deferral, and quantified the extent to which local weather conditions explained variation in the proportion of time feeding in two populations of greater white-fronted geese (Anser albifrons) that show opposite population trajectories and have substantially different migration strategies. Our data suggest seven individuals (64%) from the midcontinent population and 13 individuals (48%) from the Greenland population initiated a breeding attempt. Variation in the proportion of time feeding during spring migration explained substantial variation in reproductive attempt or deferral only during the final stage of migration in midcontinent birds. Greater variability in the proportion of time feeding throughout spring migration dramatically increased the probability of a breeding attempt in Greenland birds, whereas the relationship was positive but not as pronounced for North American birds. The relationship between the proportion of time feeding and temperature varied by time period, but was consistently positive for both populations. However, the relationship between the proportion of time feeding and precipitation was negative for Greenland birds but positive for midcontinent birds, primarily as birds approached breeding areas. These results suggest that differences in behavior and subsequent reproductive attempts between populations are in part explained by migration strategies but also constraining local weather conditions.

K.3-2: Behavioral Responses of Common Eiders to Drones Surveys

Presented by: Susan Ellis-Felege (susan.felege@email.und.edu)

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Drones are relatively new technologies gaining popularity among wildlife biologists. As with any new tool in wildlife science, operating protocols must be developed through rigorous impact testing to avoid potential biases. Some studies have quantified behavioral responses of birds to drone surveys and results suggest responses are species and context dependent. We evaluated drone-induced behavioral responses of nesting Common eiders (Somateria mollissima) in Wapusk National Park, Manitoba, Canada. Using a Trimble UX5 fixed wing aircraft in 2016, we monitored and recorded eider behaviors at 9 nests (7 with drone surveys and 2 controls) with miniature video cameras and an additional 16 with trail cameras (8 with drone surveys and 8 controls). Video was reviewed 30 minutes before a UAV flight, during a survey, and 30 minutes after landing to fully capture procedures associated with a drone survey period. We quantified behaviors as the proportion of time birds were on- or off-nest to determine general attendance patterns. We also examined the specific behaviors of birds (vigilant, sleeping, nest maintenance activities etc.) using the subset of nests which had video cameras, allowing for fine-scale behavioral assessments. Overall, we found no effect of drone flights on nest attendance (M = 0.53 recesses/day regardless of drone survey occurrence; M = 8.1 and 10.7 minutes on days with and without drone surveys, respectively). Specific behaviors from the video cameras suggest birds may notice the drone flying over, but this does not appear to influence rates of nest attendance or more importantly nest success. Results from this study can be used to inform best practices for drone surveys, and highlight the need for species-specific impact assessments before using a drone for wildlife research.

K.3-3: Lake Michigan Long-tailed Ducks: Migration Patterns and Habitat Use

Presented by: Luke Fara (lfara@usgs.gov)

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Kevin Kenow – U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin
Steven Houdek – U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin
Michael Eichholz – Southern Illinois University - Carbondale, Carbondale, Illinois
Dr. Scott Ford – Avian Specialty Veterinary Services, Milwaukee, Wisconsin

Previous studies suggest that long-tailed duck (LTDU; Clangula hyemalis) populations are in decline and further efforts have been made to better understand their population distributions. Long-tailed ducks rank high in priority with the Sea Duck Joint Venture and have been a focal species in large-scale wintering telemetry projects in eastern North America. However, LTDUs radiomarked on the Atlantic coast and Lake Ontario have shown very little use of Lake Michigan, where recent aerial surveys indicate a large overwintering population. To address information needs on the spatiotemporal patterns of migration, breeding ground affiliations, winter site fidelity, and habitat use of LTDUs wintering on Lake Michigan, we radiomarked 25 LTDUs and followed their movements. Of the 25 radiomarked LTDUs, 13 survived >60 days and provided information on habitat use and migration. Long-tailed ducks used relatively shallow waters closer to shore during daylight hours (average across all birds 22.3 m and 5.4 km, respectively) but moved to deeper waters well offshore at night (average across all birds 61.0 m and 11.9 km, respectively) while using the open water of Lake Michigan. Most LTDUs moved southward on Lake Michigan as winter progressed and then relocated to Green Bay and the northern third of Lake Michigan before spring departure. James Bay and Hudson Bay served as primary stopover sites during spring and fall migration, and the territory of Nunavut, Canada was used during the breeding season. Spring departure of radiomarked LTDUs from Lake Michigan occurred in mid-May and fall arrival occurred in late October and early November. Movement information will aid managers dealing with key conservation issues, such as delineating and managing the eastern population of LTDUs, site planning for future offshore wind energy development on Lake Michigan, and evaluation of food web links associated with avian botulism type E on the Great Lakes.

K.3-4: Time at High Altitude Dictates Evolutionary Response to Hypoxia

Presented by: Kevin G. McCracken (kevin.g.mccracken@gmail.com)

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Catherine Ivy – Department of Biology, McMaster University, Hamilton, ON
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Julia York – Department of Integrative Biology, University of Texas, Austin, TX

High-altitude species generally have evolved greatly increased capacities in the O2-transport cascade for ventilation, pulmonary diffusion, circulation and tissue diffusion, mitochondrial function, and metabolism. However, the extent of interspecific variation in control of processes dictating hypoxia responses remains largely unknown. Here we contrast waterfowl species, one migratory breeding on the Qinghai-Tibet Plateau, and the others lifelong residents of the Andean Plateau. Surprisingly, and likely by coincidence two iconic species, one Tibetan and one Andean, superficially resemble the high-altitude adapted human populations where they are co-located. However, in comparison across many species time elapsed since species first became established in the high-altitude environment can be a key causal factor dictating evolutionary outcomes and response to hypoxia.

K.4-1: Does proximity to roads affect pair density of canvasbacks and redheads?

Presented by: Michael G. Anderson (m_anderson@ducks.ca)

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Llwellyn M. Armstrong – Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB

Many waterfowl surveys in the prairie pothole region were established along grid roads, generally spaced a mile apart, where indicated pairs were counted for some set distance on either side of the roadway. Often this comprised a strip 0.25 miles wide. Depending on the survey, these estimates were made by observers on foot, in vehicles, or low-flying aircraft. A necessary assumption when extrapolating such estimates to larger landscapes is that pair densities encountered along these strips are representative of entire landscapes. In perched moraines like the area near Minnedosa, MB, where drains usually cannot convey water off farms, drainage instead tends to consolidate surface water along edges of fields (e.g., road ditches) or in larger interior wetlands. We used annually replicated walking surveys for canvasbacks and redheads designed to view every single wetland, on two 6-square-mile study areas from 1983-1990, to assess whether proximity to roads affected estimates of pair densities. Other variables evaluated were a wetness index, species, study block, overall pair densities and plausible interactions. Year was included as a random effect. Poisson mixed effects models were used for modeling density of indicated pairs. The best approximating model included location (near-road vs. interior), pair density, species and location x wetness and location x density interactions. Model-estimated pair counts were higher in near-road locations for all circumstances in our study. These differences were greatest when pair density and wetness index or both were lower. An important next step would be to assess temporal changes in the distribution of wetlands relative to roads, and therefore the possibility of directional temporal bias. For Minnedosa, there are aerial photos of some sections from 1948 through the 1990s, but additional sites should be sought across the Canadian and U.S. prairies.

K.4-2: Relating predator community composition and duck nest survival in eastern South Dakota

Presented by: Samantha Fino (samantha.fino@sdstate.edu)

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Dr. Joshua Stafford – USGS Cooperative Research Unit at South Dakota State University, Brookings, SD
Dr. Aaron Pearse – Dr. Aaron Pearse, USGS Northern Prairie Research Unit, Jamestown. ND
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Depredation is a major cause of nest failure. Understanding the predator community composition and predator movements, influenced by patch dynamics, is critical to explain predator-prey interactions, spatiotemporal habitat use, and foraging of nest predators. Similarly, it is important to understand how grassland patch dynamics indirectly influence nest survival of ducks, with predator behavior as the primary mechanism. Our study was conducted in Faulk and Hand counties, South Dakota, with the primary difference of one county being subject to coyote removal management for several years, and the other has not. Our main objective is to quantify the influence of patch dynamics on predator community composition, occupancy and use, and determine how that relates to duck nest survival. Prior to the nesting season, we radio marked raccoons, striped skunks, and coyotes (20 of each). Radio collars were programed to record a GPS point every 30 minutes from sunset to sunrise. Average home range size was 6.4 ± 1.5 km2 for raccoons and 9.4 ± 2.1 km2 for striped skunks, with a large portion of their GPS points overlapping developed areas and habitat edges. We nest searched 57 km2 and monitored 110 nests. Nest survival was significantly greater in Hand County, with weekly and seasonal survival at 78% and 37% respectively, than in Faulk County, with weekly and seasonal survival was 59% and 12% respectively (p-value = 0.002). Additionally, we conducted opportunistic raptor surveys, live trapping of small mammals, and predator surveys using camera traps to produce indices of abundance as covariates. We are currently using these data to explain variation in predator abundance, distribution and space use with respect to vegetation, patch and landscape characteristics as the mechanism behind nest survival. Results of this study will better assist state and federal agencies in developing recommendations that encourage upland game bird nest success.

K.4-3: Nesting ecology of American black ducks in coastal North Carolina

Presented by: Daniel M. Lawson (dlawso@udel.edu)

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North Carolina represents the southern extent of the American black ducks (Anas rubripes) breeding range; however, their breeding ecology in this region is not fully understood. We located and monitored 140 nesting black ducks over two years (2017-18) to assess nesting productivity and quantify nesting habitat within coastal North Carolina. Specifically, we quantified nest initiation, peak nesting dates, nest success rates, modeled causes of failure, and tested for significant differences in 4th order habitat selection in use versus non-use nesting sites. The average nest initiation date over the study was April 12 with a peak nesting date of April 26. Nest success rates varied from 34.18% (2017, CI=95%, SE=9.83) to 66.40% (2018, CI=95%, SE=7.27) and daily survival rates averaged 97.69% (CI=95%, 96.74, 98.37) over the two years of the study. We designed a priori and ranked 25 competing models of nest failure using program MCestimate. The top-ranking model was fail(MVI*YEAR) where MVI*YEAR= Mainland versus island nesting location interacting with year of the study. Our summed model weight was .67. Primary nest predators included crows (Corvidae), raccoons (Procyon lotor), American mink (Neovison vison), and bald eagles (Haliaeetus leucocephalus). To define 4th order nesting habitat we conducted a simple two-factor t-test of vegetation composition (% grass), density, and average height at the nest and at two random paired points within 50 meters of the nest. Additionally, we tested National Wetland Inventory Classification and elevation at the nest and at two randomly generated points within 50 meters of the nest. We found significant differences ($P<0.05$) in vegetation composition, density, and average height between use and non-use sites.

K.4-4: Inter-specific plasticity in timing of breeding among northern hemisphere female ducks

Presented by: Robert Clark (bob.clark@canada.ca)

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Hannu Pys – Natural Resources Institute, Finland
Ray Alisauskas – Environment & Climate Change Canada, Saskatoon, SK
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Relative timing and flexibility for breeding dates may influence a species population vulnerability to climate change via potential phenological mismatch with their environments. Despite high interest in climate-individual-population interactions, there have been remarkably few comparisons of how females of closely-related species respond to common phenology gradients. We used data for duck species spanning a wide gradient of average nest initiation dates from three long-term research sites and compared population- and individual-level plasticity to varying spring phenology and whether intraspecific variation in response exists. Early nesting species included common goldeneye (Bucephala clangula; n=1812 females with 2 between-year nesting attempts) and mallard (Anas platyrhynchos; n=185), mid-late-nesting gadwall (Mareca strepera; n=111), and late-nesting lesser scaup (Aythya affinis; n=73) and white-winged scoter (Melanitta fusca deglandi; n=544). Results obtained from mixed effects models indicated that there was strong evidence of plasticity to spring warmth among females of the earliest breeding duck species, whereas late-nesting scaup and scoter did not respond. Nonetheless, late-breeding species exhibited annual variation in mean breeding dates, suggesting other cues may be used to time breeding. Among species that did track spring phenology there was evidence that this could be accounted for by phenotypic plasticity in goldeneye and gadwall, but not in mallard. Finally, individual female goldeneye and gadwall varied in strength of plasticity to phenology this variation could be a source of adaptive potential to adjust for advancing spring phenology expected with climate change. Further research is needed about the fitness consequences of plasticity to spring phenology, including trophic mechanisms and population consequences.

POSTER PRESENTATION ABSTRACTS

NADS 8
NORTH AMERICAN DUCK SYMPOSIUM
WINNIPEG, MANITOBA – AUGUST 2019

P.1-01: Impacts of oil and gas development on duck brood abundance

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The extraction of oil and natural gas from reserves in the Bakken Formation has increased dramatically from 2004 to 2017 in North Dakota and northeast Montana, USA. High development areas overlap substantially with wetland and grassland habitat identified as high priority for waterfowl conservation in the Prairie Pothole Region. To test for anthropogenic disturbance on waterfowl brood abundance, we conducted repeat-visit waterfowl brood surveys during 2014-2017. We tested hypotheses about disturbance and brood abundance using hierarchical zero-inflated Poisson models and a spatially and temporally explicit disturbance index within three radii (0.32 km, 0.64 km, 1.51 km). Model selection supported detection and abundance parameters that were consistent with previous research and suggested that brood abundance was higher in landscapes with high densities of small, shallow wetlands. Our analysis also demonstrated a negative relationship between abundance and the disturbance index for the smallest spatial radius (0.32 km), however the effect size was small, and predictions suggested that <1% of the broods in the sample population were impacted. Considering this relatively weak negative relationship and the continued role of wetlands as the primary driver of brood abundance, we recommended that managers continue to focus conservation efforts in landscapes with high densities of small, unprotected wetlands, even in the presence of oil and gas development.

P.1-02: Effects of unconventional oil and gas development on duck nesting ecology

Presented by: Kevin M. Ringelman (kringelman@agcenter.lsu.edu)

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Kaylan M. Kemink – Ducks Unlimited Inc., Great Plains Regional Office, Bismarck, ND
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Over the past decade, the United States has seen a boom in petroleum extraction from unconventional sources, particularly the Bakken shale formation in northwestern North Dakota. The Bakken overlaps with the Prairie Pothole Region, the most critical habitat in North America for breeding ducks, where fracking has the potential to impact more than a million duck pairs in the United States alone. Here, we evaluated the effect of oil and gas development on nesting ducks from 20152018 across 5 counties in North Dakota. Using data from ~4,000 nests we found that nest survival was higher at sites composed of a higher percentage of grassland, and for nests found closer to major highways. We found no effect of any metric of oil and gas activity on duck nest survival. Using survival-corrected estimates of nest density, we found that sites surrounded by more oil wells within 1000–2500 m had lower nest densities. Given the average number of wells (3.15 wells) within 1500 m of a site, nest density was predicted to decline by 18% relative to sites with no development. However, within a nesting field, we found no evidence that ducks were avoiding infrastructure at smaller spatial scales. Our results add to a growing literature documenting the negative effects of unconventional oil extraction on breeding birds, and highlight additional research needs on other aspects of duck breeding ecology.

P.1-03: Black-bellied Whistling Duck Site Fidelity and Nest Box Use at the Northern Edge of Their Expanding Range

Presented by: Starla Phelps (sphelps1@cbu.edu)

Starla Phelps – Christian Brothers University, Memphis, TN
Dr. Jerad Henson – Christian Brothers University, Memphis, TN

Black-bellied Whistling Ducks (BBWD) (Dendrocygna autumnalis) historic North American range lies along the gulf coast. They are traditionally non-migratory but have expanded their breeding range north to take advantage of new resources and nest sites. According to Ebird records, a large number of BBWD started to use an area along the Mississippi River in SW Shelby County, TN in 2008, and this is now one of the largest northern breeding populations. Little is known about this population or about BBWD breeding this far north. Thus, this study had two primary aims: to determine if this is the same individuals returning year after year (i.e. site fidelity) or something else pushing new birds north every year (i.e. dominance displacement); and to determine nest box use of northern breeding BBWD. Site fidelity was assessed by implementing a mark and recapture protocol. During 2018, ducks were captured by net launcher (n=16). They then received a USGS leg band and a red colored tarsus band with a three-digit identification number. The following year, tarsus bands were identified providing a return rate of 31.25% (n=5). Nest box use was determined by 17 boxes placed at a wastewater treatment facility in SW Shelby County, TN. A total of 65 BBWD eggs were laid in 4 boxes, and 23 ducklings left the boxes. Additional broods at this site indicate that BBWD are also ground nesting. While this study is ongoing, results thus far indicate that BBWD show site fidelity to and will readily use nest boxes at northern breeding locations.

P.1-04: Breeding waterfowl productivity in a flood-irrigated agricultural system

Presented by: Casey M. Setash (csetash@rams.colostate.edu)

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Similar to agricultural production, the sustainable management of waterfowl populations across the western United States inherently depends on informed water management. Both endeavors are increasingly challenged by human demands for water, drought, and change in the seasonality of precipitation. Reminiscent of agricultural practices that were common 50-100 years ago, the North Platte Basin in Colorado is one of the last remaining agricultural areas in the region where producers do not use center-pivot irrigation, instead irrigating via flooding. Approximately 85% of all wetland habitats in the North Platte Basin are privately owned, a majority of which are irrigated pastures and hayfields. We will evaluate the effects of renovating irrigation infrastructure across private lands on breeding waterfowl. Specifically, we will conduct a before-after-control-impact (BACI) evaluation of waterfowl productivity and habitat use on working lands before and after irrigation infrastructure improvements. Measures of productivity will include nest survival, nest density, abundance during peak stopover and breeding periods, and brood movements will also be monitored. This research will be used to inform best management practices benefitting both agricultural producers and waterfowl managers across the region.

P.1-05: Comparison of brood composition and characteristics between the Coteau and glaciated plains of the Dakotas

Presented by: David A. Brandt (dbrandt@usgs.gov)

David A. Brandt – USGS Northern Prairie Wildlife Research Center
Gary L. Krapu – USGS Northern Prairie Wildlife Research Center
Aaron T. Pearse – USGS Northern Prairie Wildlife Research Center

The Prairie Pothole Region of the Dakotas is arguably the most important area for waterfowl production in the U.S. and includes two general physiographic regions that vary greatly in wetland and landscape characteristics. The Glaciated Plains located in the eastern third of the states is characterized by a land base devoted predominantly to crop agriculture with some remaining intact grasslands used for haying and grazing. Coteau regions west of the Glaciated Plains (Missouri Coteau) and in northeastern South Dakota (Prairie Coteau), vary more in magnitude of cropping intensity but generally have more perennial cover and intact grasslands with a slightly higher density of wetland basins. We hypothesized that given the different characteristics of these landscapes, factors which affect nest, brood, and duckling survival could also differ and may ultimately be reflected in characteristics of broods. We conducted brood surveys across Glaciated Plain and Coteau landscapes 19941998 to assess differences that may exist in broods originating from these areas. Size of broods older than 25 days did not vary between regions but average date of hatching varied by 3-9 days depending on species. We will discuss possible mechanisms responsible for differences and broader implications from a population standpoint as agriculture continues to intensify in this region.

P.1-06: Evaluating Brood Selection of Wetlands in Crop Dominated Landscapes within the Prairie Pothole Region

Presented by: Catrina V. Terry (cterry8@lsu.edu)

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Kevin M. Ringelman – Louisiana State University

Although the Prairie Pothole Region is responsible for producing the majority of North Americas dabbling ducks, more than two-thirds of the wetlands in this landscape are now surrounded by cropland. These wetlands are at high risk of conversion and may be subject to degradation through runoff from adjacent crops. However, they may still represent habitat capable of supporting broods during the summer. Brood surveys, when paired with wetland metrics can help determine characteristics of wetlands that may be valuable for duck productivity in highly altered agricultural systems. In 2019 we will survey wetlands embedded in cropland across eastern North Dakota, eastern South Dakota, Minnesota, and Iowa with an unmanned aerial vehicle (UAV) equipped with a thermal and visual imaging camera because of its proven effectiveness against traditional ground observers. We will investigate wetland metrics through assessment of invertebrate communities, wetland vegetation, and vegetative buffers between wetlands and cropland and determine the concentration of neonicotinoids, a heavily-used insecticide. With the UAV, we will create mosaics of the wetlands that can provide information on emergent vegetation structure, submerged vegetation, and the buffer between the wetland edge and agriculture. Our goal is to provide estimates of brood abundance on these highly altered wetlands and investigate mechanisms that may be driving brood use, which will help managers make better decisions on targeting wetlands embedded in croplands for conservation and restoration.

P.1-07: Investigating wing molt ecology of gadwall and mallards nesting in the Suisun Marsh of California

Presented by: Jeffrey Kohl (jkohl@usgs.gov)

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John M. Eadie – Wildlife, Fish, and Conservation Biology, University of California, Davis, CA

We monitored postbreeding movements of hen gadwall (Mareca strepera) and hen mallards (Anas platyrhynchos) nesting in the Suisun Marsh of California to determine wing molt chronology and molt site selection during 2015-2018. GPS-GSM backpacks were attached to hens nesting on Grizzly Island State Wildlife Area and private duck clubs within the Suisun Marsh and bird locations received daily via the GSM network. We were able to acquire molting chronology information for 49 gadwall and 77 mallards as well as determine molting sites for 52 gadwall and 111 mallards. Greater than 55% of the marked gadwall hens molted within two watershed basins during the study; the Lower Klamath (27%) and Upper Klamath Basin (31%) in northeastern California and southern Oregon, respectively. Mallards molted in primarily six basins in California and Oregon which included the Suisun Marsh (31%), Sacramento-San Joaquin Delta (10%), Butte Basin (12%), Colusa Basin (12%), Lower Klamath Basin (11%), and the Upper Klamath Basin (12%). Molt start date for gadwall ranged from July 10th Sept 23rd with a mean start date of August 26th (4.60). Molt start date for mallards ranged from June 16th October 8th with a mean start date of August 25th (4.11). Gadwall had a mean molting duration of 34.44 days (3.01) and mallards had a duration of 40.53 days (2.96). Gadwall and mallards predominantly used permanent marsh (90.38% and 63.06%, respectively) as their preferred molting habitat. Results suggest that these high-use molting areas utilized by California breeding hen gadwall and mallards could benefit from management actions meant to improve postbreeding survival and increase waterfowl populations breeding in California.

P.1-08: Long-term trends in dabbling duck breeding demography in Suisun Marsh, California

Presented by: Josh Ackerman (jackerman@usgs.gov)

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California produces the majority of mallard and gadwall that are harvested within the state, and as such is an important breeding area within the Pacific Flyway. As part of the Suisun Marsh Waterfowl Program, we have assessed long-term trends in mallard, gadwall, and cinnamon teal breeding demography and factors influencing nest survival and nest density. Nest survival has fluctuated substantially among years and has trended lower in the past decade. Predation was the major cause of nest failure, with raccoons (53% of egg depredations) and skunks (27% of egg depredations) being the most predominant egg predators. Hens tended to select taller vegetation than was available within upland nesting fields, but nest vegetation height had little effect on nest survival. GPS-marked predators typically foraged along canal and wetland margins, and other edge habitats, indicating the increased potential for egg depredations in these areas. Temperature dataloggers placed within nests demonstrated that hens took 1-2 nest breaks per day, with the morning recess occurring around sunrise (5:00-6:00) and the afternoon recess occurring 1-5 hrs before sunset (16:00-19:00). Hens departed nest sites with their ducklings during daylight hours (98%), with 81% of broods departing the nest the day after eggs began to hatch and 53% of broods departing the nest within 14 hr after dawn. Duckling survival was relatively low and wetland salinity levels approached concentrations that have been shown to impair growth. These results have important implications for upland and wetland habitat management for breeding waterfowl.

P.1-09: Phenology and Distribution of Waterfowl in the Boreal-Arctic Transition Zone

Presented by: Cindy J. Wood (cindy.wood@canada.ca)

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The Boreal-Arctic transition zone falls outside of the continental waterfowl breeding survey area and information on waterfowl in this region is lacking. During 2017-2019, we conducted experimental helicopter aerial surveys for breeding waterfowl at five 20,000km2 study areas and one 4,700km2 study area across the Taiga Plains and Taiga Shield ecozones, from Northern Quebec to the Northwest Territories. The surveys were conducted during early to mid-June to target later nesting species. A total of 24 species were detected, 16 of those occurred regularly. Scoters, scaup and American Green-winged Teal were most abundant. Densities of Long-tailed Duck, Northern Pintail, Mallard, American Green winged Teal, American Wigeon, Hooded Merganser, Common Merganser, Red-breasted Merganser, Bufflehead and Canada Goose varied across sites. A breeding phenology index varied by year and site for all species, but generally indicated that the survey was well timed to monitor breeding Long-tailed Ducks, Red-breasted Mergansers, Common Mergansers, Mallard and Northern Pintail at some sites, whereas Hooded Mergansers, Bufflehead, Mallard, Northern Pintail, American Green-winged Teal and Canada Geese were predominantly post-breeding at most sites. Overall densities of waterfowl observed at all sites identify the boreal-arctic transition zone as a key waterfowl breeding and moulting area.

P.1-10: Probability of Mottled Duck Pair Pond Use on the Chenier Plain, Texas

Presented by: J. Boomer Malanchuk (bmalanchuk@ksu.edu)

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Mottled duck (Anas fulvigula) pairs use pair ponds from as early as February through mid-incubation. Mottled ducks defend pair ponds as territories because they provide access to resources and safety from predators. Pair ponds are important post-breeding because they provide most of invertebrate and other food items necessary for reproduction and recruitment. Little is known about the characteristics of ponds that attract paired mottled ducks for breeding efforts. It is important for managers to identify priority use areas on the broad scale of the Chenier Plain of Texas. We examined mottled duck pair pond use through the following objectives, 1) determine characteristics of pair ponds that attract breeding mottled ducks, 2) predict pair pond selection by mottled ducks based on salinity, depth, area, grazing regime, burning regime, emergent vegetation, submergent vegetation, and vegetation height, and 3) provide management options based on the results of analysis. We evaluated habitat selection using resource selection functions with Akaike Information Criterion model selection to understand the effects of 8 explanatory variables on probability of pair pond use by mottled ducks in a stratified survey of 822 ponds. Top-ranked models were assessed for model weight and significance of beta coefficient. The top-ranked single variable model was pair pond area, which predicted pair pond use decreases with increasing area. Additionally, we tested additive and interaction models between uncorrelated variables, with preliminary results indicating mottled duck pairs select for small ponds with submerged aquatic vegetation. The future of mottled duck conservation on the Chenier Plain will rely on conserving small pair ponds with submerged aquatic vegetation while managing for other habitat types that may be limiting (i.e., nesting cover, brooding sites, and molting areas).

P.1-11: Sitting ducklings: Timing of hatch, nest departure, and predation risk for dabbling duck broods

Presented by: Joshua T. Ackerman (jackerman@usgs.gov)

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For ground-nesting waterfowl, the timing of egg hatch and duckling departure from the nest may be constrained by the time required for ducklings to dry, to be developmentally ready to leave the nest, and to imprint on the hen, and influenced by predation risk. We determined the timing of hatch, nest departure, and predation on dabbling duck broods using small video cameras placed at the nests of mallard (Anas platyrhynchos; n=26), gadwall (Mareca strepera; n=24), and cinnamon teal (Anas cyanoptera; n=5). The onset of hatch differed by species, with cinnamon teal and gadwall nests starting to hatch during daylight hours (mean 7.5 hours after dawn) and mallard nests starting to hatch during daylight and night hours. Among all species, broods left the nest during daylight (98%), typically within 14 hours after dawn (53%). For mallard and gadwall, we identified 3 strategies for the timing of nest departure: 1) 9% of broods left the nest the same day that eggs began to hatch (612 hours after), 2) 81% of broods left the nest the day after eggs began to hatch, and 3) 10% of broods waited 2 days to depart the nest after eggs started to hatch, leaving the nest just after the second dawn (2742 hours after). Overall, eggs were depredated at 10% of nests with cameras in the 2 days prior to hatch and ducklings were depredated at 15% of nests with cameras before leaving the nest. The presence of predators at a nest and the death of multiple ducklings usually did not cause hens to flee the nest immediately with their broods. Our results suggest that broods prefer an early morning departure from nests, which may best balance developmental constraints with predation risk both at the nest and en route to wetlands.

P.1-12: Two decades of nest survival in the Nebraska Sandhills: the southern Prairie Pothole Region?

Presented by: Aaron Pearse (apearse@usgs.gov)

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The Nebraska Sandhills can attract hundreds of thousands of nesting duck pairs annually. Yet, a limited number of studies conducted in this region have reported low recruitment potential. Biologists monitored duck nests at Crescent Lake National Wildlife Refuge in the southwestern Sandhills for >2 decades. We summarized this unique time series and modeled temporal variation in nest survival of upland-nesting ducks. Nests from 5 species were found, with blue-winged teal (Spatula discors) as the most common species. Annual variation in nest survival was considerable during 1991-2018, ranging between 2% and 22% and averaging 8% (SD=5). Annual variation correlated with temporally varying environmental factors such as changes in wetland conditions, comparable to results from studies in the Prairie Pothole Region. Average and maximum nest survival was lower than estimated in the PPR, with predator community differences the likely mechanism. Bullsnakes (Pituophis catenifer) are present and known to eat duck eggs; therefore, grassland management that reduces abundance of larger snakes could have a positive effect on nest survival in this region. Under certain conditions the Nebraska Sandhills can recruit ducks at rates comparable to the PPR with annual variation affected by similar environmental factors. These results further support the notion that annual fluctuations in precipitation patterns affect predator communities which, in turn, influences recruitment potential of upland-nesting ducks.

P.1-13: Use of next boxes by wood ducks and hooded mergansers at Noxubee and Yazoo National Wildlife Refuges in Mississippi

Presented by: J. Brian Davis (brian.davis@msstate.edu)

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Use of artificial nesting structures (hereafter, nest boxes) for wood ducks (Aix sponsa) have a storied history in North America. Nest boxes are often used by other species of cavity-nesting birds, including hooded mergansers (Lophodytes cucullatus). Previous experiments using conventional-sized and small experimental nest boxes (approximately half the size of conventional boxes) at two sites in Mississippi documented variable use and wood duck duckling survival relative to box size, study area, time of breeding season, and other factors. Herein, we report preliminary results for shared use of next boxes by wood ducks and hooded mergansers at Noxubee and Yazoo National Wildlife Refuges, monitoring them at both areas from 1994-1997.

At Noxubee we found 460 unique nests in 122 nest boxes, and 356 (77%) nests were successful. Of the successful nests, 87 (~25%) contained eggs of both duck species. At Yazoo, we found 423 nests in 77 nest boxes, and 259 nests (61%) were successful. Of the successful nests, 25 nests (~10%) contained eggs of both species. Pooled collectively across both box types, refuges, and years, the proportion of non-host eggs in a clutch being incubated by the host ranged from ca. 15-25% By modeling potential costs of being parasitized interspecifically with clutches of 12 and 14 host wood ducks eggs, and no hooded merganser eggs, 9.4 and 10.8 wood duck eggs hatched, respectively in those nests. When 1-5 hooded merganser eggs were present in those wood duck nests, hatching of wood duck eggs only declined by 1.3 and 1.5 eggs, respectively. When hooded mergansers were host and had a clutch of 15 eggs, and no wood duck eggs present, mergansers hatched 14.6 eggs. However, when 1-5 wood duck eggs were present in these nests, 5.3 and 10.3 fewer merganser eggs hatched across their range. Clearly, further work is needed to investigate causes of these potential declines, particularly the consequences to hooded mergansers upon being parasitized by wood ducks. These results are preliminary; however, the number of shared nests for these species in this four-year study represents some of the greatest reported in North America.

P.1-14: Variation in individual quality of lesser scaup (Aythya affinis) ducklings in relation to spring phenology and density dependence

Presented by: Kyla Bas (kyla.bas@usask.ca)

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Determining how biotic and abiotic factors affect individual quality is important for understanding population processes and can help to inform management decisions. However, whether spring phenology and density dependence affect components of reproductive success in ducks is not adequately understood. Therefore, our objective was to test the effects of spring phenology and conspecific density on lesser scaup duckling quality. We evaluated the effects of local ambient air temperature during the breeding season and the effects of local brood density on body mass and body condition index of pre-fledging scaup ducklings captured (n=5330, ranging 120 - 1179 individuals captured per year) at Red Rocks Lake, Montana, 2010-2018. Mixed effects models incorporating random effects of year indicated that measurements of duckling quality may be related to pre-nesting temperature but were unrelated to ice-out date. Duckling mass was negatively associated with ambient air temperature during brood rearing, presumably due to adverse effects of cold weather on food and(or) growth. Duckling mass was also inversely related to duckling density, perhaps reflecting competition for food or high-quality habitat. Both these effects were more pronounced for younger ducklings. A scaled mass index was derived to describe duckling mass in relation to structural size and serve as a body condition index. The results for duckling body condition were comparable to those observed for duckling mass. Results were not consistent with the hypothesis that early spring phenology reduced duckling body quality; however, body mass was lower during years of higher duckling density.

P.1-15: Whats driving Wood Duck nest box use and success in Delaware?

Presented by: Justyn R. Foth (justyn.foth@delaware.gov)

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Wood Ducks (Aix sponsa) select natural nesting cavities based on surrounding habitat types, cavity height, entrance dimensions, and other factors. If natural cavities are limiting, they readily use artificial nesting boxes. However, regional estimates of Wood Duck use of natural cavities and nest boxes is limited. Estimating Wood Duck use of boxes and identifying parameters that optimize use could have a considerable impact on efficiently managing a Wood Duck nest box program. Variable Wood Duck box monitoring efforts have been occurring in northern Delaware since 2004 on Delaware Wild Lands and Delaware Division of Fish & Wildlife properties. We monitored horizontal diameter of entrance (cm), orientation of entrance (degrees), height of entrance (cm), post placement (i.e., land or water), distance to the nearest box (m), distance to open water (m), average visual obstruction (cm), type of predator guard (sleeve vs. baffle), nest status (i.e., use, hatch or failure, and dump nesting), and tagged females and ducklings to estimate future recruitment. Using data from 20042017, we created a priori models using General Linear Modeling and Akaike Information Criteria to identify possible parameter effects on long term use of boxes and data from 20172019 on nest success. Nest box use has fluctuated between 2856% from 20042019, and in 2017 was positively correlated with increasing distance to neighboring box, distance to open water, and decreased visual obstruction. Nest success increased from 2017 (5.71%) to 2019 (70.83%). In 2019, tagging efforts began and we recaptured four previously banded females, deployed 45 new leg bands, and web-tagged 226 ducklings of either sex. These data along with ongoing Wood Duck monitoring by us and our partners (Nemours Wildlife Foundation, Clemson University, SC Department of Natural Resources, and Mississippi State University) may allow managers to select box locations to optimize Wood Duck production.

P.1-16: Box-nesting ecology of wood duck and black-bellied whistling duck in South Carolina

Presented by: Gillie D. Croft (gcroft@clemson.edu)

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We surveyed nest-structure use, duckling production, and other metrics of reproductive ecology of wood ducks (Aix sponsa), black-bellied whistling ducks (Dendrocygna autumnalis), and hooded mergansers (Lophodytes cucullatus) during a landscape-scale study across coastal South Carolina in 2016-2017. Wood ducks used the greatest proportion of >350 monitored boxes (61%), followed by black-bellied whistling ducks (15%) and hooded mergansers (<1%). Wood ducks began nesting in January, before most black-bellied whistling ducks did in May. Peak nesting for wood ducks occurred in March-April for wood ducks and June for black-bellied whistling ducks. Based on phenology by these species, we speculate little competition occurs for boxes between them. Additionally, average percent use, numbers of eggs laid, and number of ducklings exiting from boxes were greater for wood ducks than black-bellied whistling ducks, because the latter species is not breeding abundantly yet in South Carolina (61% vs. 15% box use, 8 vs. 2 eggs, 5 vs. 1 duckling[s]). Our results indicated size of the conventional nest-box described by F.C. Bellrose was used by both species and therefore can be deployed where these species co-exist. However, where black-bellied whistling ducks are becoming increasingly abundant, we suggest nest-box entrances should have 5-inch diameters to facilitate use by this larger duck species. Lastly, we assessed cost of female wood duck recruits from nest boxes, based on expenditures to fabricate boxes, annual maintenance, an assumed longevity of 20-years for an annually maintained box (total=$143.23/box[U.S.2018]), reproductive metrics from our study, and a wood duck female recruitment rate of 6%. The cost per female wood duck recruit was $59.68, which was 2.4 times less than the cost of the box, its mounting-structure, predator-shield, and maintenance over 20-years ($143). Therefore, nest boxes in our study areas seem cost-effective, but female recruitment rates should be estimated cross-flyways to determine if nest-box populations are self-sustaining and cost-justified.

P.2-01: Increasing Capture Efficiency of Long-tailed Ducks on Lake Michigan

Presented by: Luke Fara (lfara@usgs.gov)

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Locating and capturing long-tailed ducks (LTDU: Clangula hyemalis) and other pelagic waterbirds at night is difficult on large bodies of water, such as the Great Lakes, particularly when there is little knowledge of night-time distributions. To increase capture opportunities, two approaches were used to supplement our knowledge of LTDU distributions on Lake Michigan. Aerial thermal imagery was used at night and flight crews were able to guide capture crews on the water to large waterbird distributions. Additionally, a subset of satellite transmitters (n=5) programmed to transmit at noon and midnight, were surgically implanted in males to document locations and diel movements of associated flocks. Long-tailed duck capture rates increased with enhanced knowledge of nighttime distributions provided by both the aerial thermal imagery and radiomarked male long-tailed ducks.

P.2-02: Using Artificial Intelligence to Count and Identify Sea Ducks

Presented by: Luke Fara (lfara@usgs.gov)

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In collaboration with the Bureau of Ocean Energy and Management, U.S. Fish and Wildlife Service, and the Vision Group at the International Computer Science Institute at the University of California - Berkeley, U.S. Geological Survey scientists are developing deep learning algorithms and tools for the automatic detection, enumeration, and classification of sea ducks from digital aerial imagery. High resolution digital imagery collected during aerial surveys of the Atlantic Outer Continental Shelf will provide the data for algorithm development, as well as baseline information on wildlife distributions and abundance. Algorithms will likely operate in stages, with an initial stage developed to detect possible targets and sort images with and without targets, and subsequent stages to enumerate and classify targets. Labeled image datasets are being developed to train the algorithms. Sea ducks are manually identified and annotated from representative imagery. Annotation of targets will be commensurate with study objectives (initially species level classification) and capture the variability in appearance to maximize classification accuracy of deep learning algorithms. For this study, we are annotating to the lowest taxonomic level and incorporating information on age, gender, and activity when resolvable. Auxiliary information such as imagery metadata and georeferencing will support advanced analysis in the future. The project seeks to improve the efficiency, standardization, and accuracy of airborne waterfowl population surveys and aid in informing harvest and other regulatory decisions, environmental assessments, and impact analyses of potential wildlife exposure to offshore energy development projects in the U.S.

P.2-03: Phylogenomics and Evolution of Sea Ducks (Tribe Mergini)

Presented by: Philip Lavretsky (plavretsky@utep.edu)

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We reconstruct phylogenetic relationships within Tribe Mergini by sequencing ddRAD-seq markers (> 3000 loci) for 387 samples (N = 9-56 per taxon) across all North American sea ducks. Individual estimates of population ancestry recovered all major genera and expected relationships. However, a total of 14 samples were found to have mixed ancestry, which likely represent putative hybrids: Barrow's x Common Goldeneye (N = 1), Common Eider x Harlequin duck (N = 4), King Eider x Spectacled Eider (N = 1), Long-tailed Duck x Black Scoter (N = 1), Long-tailed Duck x Bufflehead (N = 2), Bufflehead x White-winged Scoter (N = 3), and Harlequin Duck x Common Merganser (N = 2). In addition, all Long-tailed duck samples showed similar levels of shared coancestry with the main Eider clade, and all Steller's Eider samples had equally high coancestry assignment to Long-tailed ducks and the main Eider clade. Species tree reconstruction recovered four well resolved major clades and was consistent with the mitochondrial-based phylogeny: (a) a sister relationship between Barrow's and Common Goldeneye, and Bufflehead as the outgroup, (b) three species of Merganser, with Hooded Mergansers as the outgroup, (c) three species of Scoters in which Surf Scoters and White-Winged Scoters as sister taxa, and (d) all four species of Eider and Long-tailed Duck. Relationships among Eiders recovered a main, true Eider clade with a sister relationships among Common Eiders, Spectacled Eiders, and King Eiders, and a more distant relationship to Steller's Eider. Moreover, in addition to the ancestry assignments, phylogenetic reconstructions provide additional evidence that the lineage leading to Steller's Eiders likely had substantial genetic contribution from the Eider/Long-tailed Duck lineage, and may represent a species of hybrid origin.

P.2-04: A Meta-analysis of Band Reporting Probability for North American Waterfowl

Presented by: Todd Arnold (arnol065@umn.edu)

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Knowledge of band reporting is important for converting band encounter data into estimates of harvest probabilities, which can then be used to assess harvest management goals or estimate population size and other vital rates. Historical estimates of band reporting probabilities have come from reward band studies or joint analysis of band recovery and harvest survey data, but there are long gaps between estimates, and most studies have focused exclusively on mallards (Anas platyrhynchos). We compiled 337 published estimates of band reporting for North American waterfowl and conducted a Bayesian state-space analysis to provide a continuous time series of estimated band reporting probability from 1948 to 2010. Band reporting probability increased sharply between 1996 and 2000 when toll-free phone numbers were added to band inscriptions and agencies implemented electronic methods for band reporting, but our analysis also identified gradual long-term trends in reporting probability throughout the time series. We found little evidence for among-species variation in reporting probability, but species that are widely regarded as trophies by waterfowl hunters (e.g., certain diving ducks, Aythya spp., and northern pintails, Anas acuta) had higher reporting probabilities than mallards. We also found little evidence of geographic variation in reporting probabilities, although we confirmed lower reporting probabilities for eastern Canada. We recommend using our estimates of band reporting probabilities and their variances as informed priors in future analyses of band recovery data to fully embrace uncertainty about how this parameter affects estimates of other population parameters. Retrospective studies using parts collection data are needed to explore potential among-species differences in reporting probabilities during recent decades.

P.2-05: A Redesign Approach for Improving the Mottled Duck Breeding Population Survey in Western Gulf Coast

Presented by: Vijayan Sundararaj (Vijayan.Sundararaj@tamuk.edu)

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Estimating animal abundance through surveys plays a crucial role in understanding population dynamics for species of wildlife, particularly game species. The Western Gulf Coast (WGC) Mottled Duck population has shown a general decline over the last 4 decades. The primary reasons attributed to this decline are habitat loss and degradation due to human activity, hunting and drought conditions. The conservation partners within the WGC have stressed the need to develop a spatially and statistically improved range-wide survey for the WGC population of mottled ducks. The primary goals of the newer approach are to provide population trends and abundance for the entire WGC population and facilitate population estimation at state-level boundaries. In our redesigned survey analysis, we plan to analyze the historical data to identify factors that contribute to the high variance in the population estimates, evaluate visibility correction factors and re-evaluate the delineation of strata throughout the survey area to improve our ability to estimate the WGC population. These analyses will allow us to identify gaps in knowledge and help guide future research or survey modifications. Further, we also plan to evaluate the potential to extend the mottled duck survey to a lesser-known but a unique area of the South Texas Brush Country where recent anecdotal evidence suggests that this region may support a much higher population of mottled ducks then previously documented. We believe that a redesigned approach to estimating the mottled duck population in the WGC will reduce variation in its population estimate and be beneficial to wildlife survey practitioners and wildlife managers

P.2-06: Aerial transect surveys for monitoring fall-winter waterfowl abundance and distribution in South Carolina

Presented by: Nick Masto (nmasto@g.clemson.edu)

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Aerial surveys are effective and cost-efficient for quantifying waterfowl and other waterbird populations and habitat use across vast and especially inaccessible landscapes. Due to to cessation of the Midwinter Waterfowl Survey in 2016 and need for reliable surveys of wintering waterfowl populations in South Carolina, we conducted fixed-wing, 250-m wide aerial strip-transect surveys during falls 2016 winters 2019. We revised survey strata following 2016–2017 surveys reducing surveyed area by 38% while retaining 95% of waterfowl and other waterbird detections. We used design-based analyses to estimate population indices (; abundance not corrected for detection bias) of dabbling ducks, diving ducks, total ducks, and geese and swans with predetermined goals of precision (CV 1520%). Our January 2018–2019 estimates for total ducks (74,504 102,421) were similar to estimates reported for the 2012–2015 Midwinter Waterfowl Surveys; however, we did not achieve targeted precision for waterfowl during most surveys. Thus, we computed a theoretical survey effort to achieve CV = 20%. Increasing survey effort three-fold (i.e., ~66 flight hours = 7.5 days) should provide desired precision for waterfowl but likely would not be affordable. Instead, we suggest additional survey stratification, optimal allocation of transects, strategic increases in survey effort in areas of high duck densities, and simulations to evaluate proposed variance-reduction methods. Moreover, we advocate an adaptive monitoring framework to improve precision and survey efficiencies of future waterfowl surveys in South Carolina.

P.2-07: Applications of Unmanned Aerial Vehicles to Survey Duck Nest Predators

Presented by: Jacob Bushaw (jbusha1@lsu.edu)

Jacob Bushaw – Delta Waterfowl and Louisiana State University
Dr. Kevin Ringelman – Louisiana State University
Dr. Frank Rohwer – Delta Waterfowl

Nest predation is the primary cause of nest failure in waterfowl, and in many geographies, mesocarnivores are the primary threat to nests and hens. However, terrestrial predators are difficult to survey at a population level because their widely spaced territories and nocturnal behavior depresses detection probability. Existing field survey techniques such as track plates and motion-sensitive camera traps are time-consuming and expensive, and yet still yield data prone to systematic errors. Unmanned Aerial Vehicles (UAVs) have recently emerged as a new tool for conducting population surveys on a wide variety of wildlife, eclipsing the efficiency and even accuracy of traditional methods. Here, we used a UAV equipped with a thermal imaging camera and conducted two rounds of nighttime mesocarnivore surveys in the prairie pothole region of southern Manitoba, Canada. We used a modified point-count survey from 6 waypoints that surveyed a spatial extent of 29.5 ha. We conducted a total of 200 flights over 53 survey nights during which we detected 32 mesocarnivores of 8 different species. Given the large home ranges of nest predators relative to the spatial and temporal scale of our spot sampling approach, results of these types of point-count surveys should be considered estimates of minimum abundance and not a population census. UAV-mounted thermal imaging cameras appear to be an effective tool for conducting nocturnal population surveys on terrestrial nest predators at a moderate spatial scale.

P.2-08: Assessing invertebrate sampling methods for landscape-level brood survey research

Presented by: Blake J Mitchell (bjmitch@iastate.edu)

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Duckling survival has potential to drive population dynamics and has been related to conditions experienced on wetlands including forage availability. Specifically, invertebrate forage is linked to early growth and greater energy reserves for young ducklings, both of which improve overall body condition and thus survival. Although invertebrates comprise a significant portion of duckling diets, not all invertebrate species are consumed equally and selection of sampling gears and timing could have substantial impact on inferences of wetland quality for ducklings. We evaluated two sampling strategies -- surface activity traps and sweep nets -- to evaluate their utility in effectively gauging invertebrate forage availability in landscape-level brood studies. We found that surface activity traps captured invertebrate groups that are mobile and live near the surface, such as cladocerans and copepods, more consistently than sweep net samples. Benthic and vegetation-dwelling invertebrates, including gastropods and some hemipteran and beetle taxa, were more common in sweep net samples. Additionally, surface activity traps provided samples that were relatively free of sediment and vegetation, and therefore reduced processing time by 152 hours over sweep net samples for 29 wetlands. In this presentation, we will present on our results discussing opportunities and tradeoffs for sampling aquatic macroinvertebrates in prairie wetlands on the landscape scale.

P.2-09: Development of a Long-Term Monitoring Program for Waterfowl in the Rainwater Basin Region

Presented by: Dana Varner (Dana_Varner@fws.gov)

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The Rainwater Basin Wetland region (RWB) of Nebraska is the focal point of spring waterfowl migration in the Central Flyway. Currently, over 85% of the historic wetland basins have been drained for agriculture production. Based on population objectives and waterfowl foraging requirements, the Rainwater Basin Joint Venture (RWBJV) estimates 60,000 acres of wetland habitat are needed to support migrating waterfowl, more than double the amount available in a typical year. Currently, the RWBJV partnership does not yet have survey-based, geospatial models that are needed to help prioritize those wetlands and wetland complexes that will best meet the needs of migrating waterfowl. To build these models, a better understanding of the local and landscape level factors that drive habitat selection by the various waterfowl guilds (dabbling ducks, diving ducks, geese) is needed. To help better target conservation efforts, the RWBJV partnership is developing a waterfowl monitoring protocol to be implemented each spring for the next 10 or more years. At sample wetlands, observers measure waterfowl abundance, local wetland conditions, and other variables. Each wetland is surveyed up to three times a week between sunrise and sunset from mid-February to mid-April. From 2017-19, we completed nearly 5,000 surveys on over 500 wetlands in the RWB. Preliminary results indicate that number of ponded hectares had the strongest positive relationship with abundance for dabbling ducks, diving ducks, and geese. Size of the historic footprint and local density of wetlands were also relevant for ducks but not geese. Future modeling efforts will examine effects of vegetation structure, human disturbance, and other variables. The resulting models will be used to develop decision support tools to highlight areas on the landscape the have the greatest probability of use for waterfowl.

P.2-10: Efficacy of Aerial Photography to Estimate Waterfowl Abundance

Presented by: Andrew D. Gilbert (agilb849@illinois.edu)

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Important aspects of contemporary wildlife surveys for use in adaptive management frameworks include logistical practicality, cost efficiency, and minimal or estimable visibility bias. While logistical and financial feasibility can be readily determined before surveys, assessing visibility bias can be costly due to the number of personnel or equipment needed, impractical if timing or observer constraints prevent repeated sampling or introduce additional sources for error, and challenging to continually address if sources and magnitudes of bias change over time. Therefore, we evaluated the efficacy of using low-altitude aerial photography to estimate visibility bias and abundance of waterfowl and other waterbirds during aerial surveys as a potentially low-cost incessantly available method. We calculated error rates for each survey by comparing abundance obtained from aerial photographs to visibility-bias corrected abundances obtained during aerial surveys. Overall, we found error rates for waterbird abundance from aerial photographs to be high (100% 48%) which we attributed to a small portion (2.9%) of the survey area sampled by photographs and non-random waterbird distribution. Large variation in the number of waterfowl and other waterbirds per photograph would necessitate photographing a large portion (81% 1%) of a survey location for precise (CV 15%) abundance estimates. Consequently, low-altitude photographic-style aerial surveys would require greater time and cost than traditional aerial surveys, and were not a cost or logistically-efficient method for large scale monitoring of abundance and visibility bias of waterfowl and other waterbirds.

P.2-11: Origins of harvested American Black Ducks: a stable isotope approach

Presented by: Jackson W. Kusack (jkusack@uwo.ca)

Jackson W. Kusack – Western University, London, Ontario
Douglas C. Tozer – Long Point Waterfowl and Wetlands Research Program, Bird Studies Canada, Port Rowan, Ontario
Keith A. Hobson – Western University, London, Ontario

Conservation and management of waterfowl requires accurate information on migratory connectivity between breeding and harvest areas. The international adaptive harvest management strategy between Canada and the US for the American Black Duck (Anas rubripes) uses information from harvested and banded individuals and assumes that they originate from the same geographic extent, although growing evidence suggests that this may not be the case. The northern part of the black duck breeding range in the boreal is not sampled by banding, making banding data biased to the southern portion of the breeding range. By contrast, individuals harvested in at least some regions are known to originate from throughout the boreal region. There are also differences in the adjusted age ratios that go into the strategy based on banding and harvest data when calculated only for Canada or only for the US, which may further suggest differences in the spatial extent of the origin of banded compared to harvested individuals among the two countries. Our objective was to utilize ratios of naturally-occurring stable isotopes (2H) within wing feathers to determine probabilistic origin of American Black Ducks harvested within black duck conservation regions located throughout Canada and the US. Feathers were collected from wings submitted by hunters to the species composition and parts collection surveys (2016 2019). Probabilistic origin was determined using likelihood-based assignment algorithms based on a predicted feather 2H isoscape. Using this information, we tested how origin of harvested individuals varies with (i) age (adults and hatch-years), (ii) sex, (iii) timing of harvest, and (v) conservation region. To further refine assignment of origin, additional priors (e.g., breeding density) and additional stable isotopes (13C, 15N) will be employed. Results from our integrative approach will be useful for evaluating and potentially improving the adaptive harvest management strategy.

P.2-12: Population size estimation with CountEm

Presented by: Scott Gilliland (sgg64@mac.com)

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Population size estimation is essential in ecology and conservation studies. Aerial photography can provide high resolution images of an entire population in many cases. However, exhaustive manual counting is tedious, slow and difficult to verify, whereas current automatic methods of computer vision are generally biased and known to fail in most cases. The CountEm method was proposed recently. It is an unbiased method based on geometric sampling, that can be directly applied to all sorts of populations that can be projected onto an observation plane. The only requirement is that the discrete objects (e.g. animals, plants) in the target population are unambiguously distinguishable for counting in a still image. It typically requires to count only about 100 200 properly sampled objects to achieve relative standard errors of about 10% irrespective of population size. A new, guided protocol for selecting the CountEm parameters is proposed and analyzed here. The method is applied to fixed-wing aircraft images of Greater Snow Geese and Common Eiders in Eastern Canada. Over half a million manually annotated bird positions in 278 images were used in order to evaluate the relative standard errors of the CountEm method via Monte Carlo replications. Our results confirm that flocks of N > 35, 000 can be estimated in a few minutes, with 100 200 particle counts, yielding relative standard errors of about 10%. Therefore, the CountEm method becomes an attractive option to save money and time in population size estimation.

P.2-13: Rapid assessment tool for estimating seed and tuber densities in northeastern US wetlands

Presented by: Edward B. Farley (efarley@ducks.org)

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Wetland managers need to understand food availability of wetlands to adapt management techniques and provide adequate resources for migrating waterfowl. Soil core sampling is an important tool to determine the density of seeds and tubers available to foraging waterfowl. A major issue with soil core sampling is the intensive time it takes to collect and analyze samples in a sufficient sample size to get an accurate estimate of seed and tuber density in a wetland. We developed a rapid assessment tool for estimating food densities without need of full soil core sample protocol. We collected 10 soil core samples in each of 30 randomly selected wetlands in the Montezuma Wetlands Complex, October 2016 - 2018. At each sampling point, we recorded the predominant vegetation type as annuals, mixed perennial emergent, invasive, mudflat, or open water. Annual points (n = 174, mean = 1061.7100.5 kg/ha) had greater mean seed and tuber density than other categories, and mixed perennial emergent points (n = 224, mean = 799.363.8 kg/ha) had greater densities than invasive (n = 229, mean = 347.5325.3 kg/ha), mud flat (n = 67, mean = 263.339.9 kg/ha), and open water points (n = 143, mean = 400.092.2 kg/ha). Our analysis showed that mean invasive, mud flats, and open water points did not differ, so we grouped them together in a new category, other (n = 439, mean = 351.533.2 kg/ha). All habitat categories showed low variation (annuals: coefficient of variation [CV] = 9.5%, mixed emergent: CV = 8.0%, and other: CV = 9.4%). By recording wetland habitat types among 40 points throughout wetlands and using mean seed and tuber density values from our analysis, wetland managers in the northeastern US can rapidly assess wetland food densities to better understand existing habitat needs in relation to local and regional Duck-Energy-Day goals.

P.2-14: Using GSM/GPS Transmitters to Improve our Understanding of Cinnamon Teal Migration

Presented by: Desmond Mackell (dmackell@usgs.gov)

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Kyle Spragens – Washington Department of Fish and Wildlife
Christopher Nicolai – Univeristy of Nevada, Reno
Blair Stringham – Utah Division of Wildlife Resources
Mike Carpenter – U.S. Fish and Wildlife Service
Michael D'Errico – U.S. Fish and Wildlife Service
Patrick Donnelly – Intermountain West Joint Venture
John Eadie – University of California, Davis

Identifying the migration routes and stopover sites of migrating Cinnamon Teal (Spatula cyanoptera septentrionalium) can provide a spatial guide to conservation efforts of this understudied species. Most information known about the distribution of Cinnamon Teal in North America has been derived from band returns and visual surveys. With recent advancements in GPS tracking technology, we now have the capability to study the movements and habitat use of this species in a new light. The focus of this project is to investigate the movements and habitat use of Cinnamon Teal by marking up to 70 individuals each year with GSM satellite transmitters across the western states (California, Oregon, Washington, Idaho, Utah, Colorado and Nevada). Cinnamon Teal were marked primarily during the spring and summer of 2017-2019, with the goal of capturing the movements of Cinnamon Teal across much of their known distribution in North America. Each bird was marked with either a 15g (Ecotone Telemetry) or a 10g (Ornitela) GPS/GSM transmitter via a backpack harness. We have marked 157 individuals and have recorded over 164,000 individual locations. Preliminary data is already highlighting interesting movement trends. Of the 59 individuals marked in California, only 4 traveled outside of the state, with almost all activity consolidated in the Central Valley and Suisun Marsh. Of the 20 individuals marked in southern Oregon, only 2 individuals traveled to the Central Valley of California, though almost all birds left the state on their southern migration. The data from this study draws attention to the variation in movements between birds marked in different regions and builds upon traditional flyway maps. The study also highlights the international scope of Cinnamon Teal migration, with 11 marked individuals traveling to Mexico. The connectivity exhibited across state and national boundaries can help coordinate collaborative management efforts between agencies.

P.2-15: Using thermal imagery for waterfowl breeding ecology research in floating bog wetlands of northern Wisconsin

Presented by: Drew N. Fowler (drew.fowler@wisconsin.gov)

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The advancement of unmanned aerial vehicle (drone) technology has facilitated a new field of drone ecology and offers expanding applications in waterfowl breeding ecology and research. Estimates of nest success and brood counts are important measures of waterfowl productivity and have historically relied on in-person detection and monitoring. In these cases, nest and brood detection probabilities can be highly influenced by species specific habitat associations that may impair detection by dense vegetative cover or difficult to traverse topography. In the summer of 2019, we evaluated the potential for drone detection and reconnaissance of over water nesting Ring-necked duck (Aythya collaris) nests and their broods using a drone equipped with high resolution visual and thermal sensors in floating bog wetlands in northern Wisconsin. We assessed the ability to detect known nests given presence and absence of hens under variable altitudes and sensor settings of the DJI XT2 Zenmuse FLIR radiometric thermal sensor. Further, we conducted repeated paired brood surveys between visual observers alongside wetland edges and in canoes and drone flights to compare brood counts at locations where traditional roadside brood surveys are largely prohibitive. Drone flights using the radiometric thermal sensor detected known nests (n = 6) and additionally identified previously unknown nests of ring-necked ducks, trumpeter swans (Cygnus buccinator), and Canada geese (Branta canadensis). Preliminary results from drone brood surveys suggest that brood detection is possible but is influenced by environmental conditions such as heat reflectance from floating leaf vegetation. In this pilot study, we demonstrate applications of drone technology to assist in breeding waterfowl ecology research in remote landscapes where visual observation can be constrained. Future work could utilize an occupancy modeling framework using drone flights to relate waterfowl productivity with habitat characteristics and management regimes.

P.2-16: Using trail cameras to investigate human and ecological factors that influence the nesting habits of Canvasbacks (Aythya valisneria) in South-western Manitoba.

Presented by: Hannah Edwards (hannahedwards@trentu.ca)

Hannah Edwards – Trent University, Environmental Science, Peterborough, Ontario

There are a variety of human and ecological factors that can influence the nesting habits of Canvasbacks in South-western Manitoba. This research examines (1) length of incubation breaks (off bouts) and the influence of ground observers on the length of these breaks, (2) the extent of Redhead parasitism at Canvasback nests and (3) the accuracy of ground observers at fating nests. Canvasback nests were located by Delta Waterfowl research teams in South-western Manitoba in 2018. Trail cameras were placed on nests, and time-lapse photos were analysed and compared to visitation data to examine the factors that influence nesting habits of Canvasbacks. Time lapse photography helped determine that ground observers negatively influence the length of off bouts, the extent of parasitism at Canvasbacks is greater than observed during weekly nest visits, and that the fate of a nest assigned by ground observers may be biased due to a lack of evidence during weekly nest checks.

P.2-17: Volume based corrections for soil cores

Presented by: Dan J. Smith (djssmith@ucdavis.edu)

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In 1986 the North American Waterfowl Management Plan called for the protection and enhancement of habitat for wintering waterfowl, specifically citing the need to increase the waterfowl carrying capacity of these habitats. In response, numerous studies across North America have assessed the abundance of food resources, typically seeds and tubers, and the management practices aimed at producing these essential food items. Many of these studies sampled foraging habitats using soil cores which can be effectively employed in a variety of wetlands. Previous studies have addressed potential sources of error associated with this sampling method, but surprisingly, no study has examined the potential variation in sample volume of soil cores, often assuming the volume to be constant. To determine if soil core volume varied and thereby impacted estimates of seed abundance, we collected soil cores from managed (N = 494) and tidal wetlands (N = 96) in the Suisun Marsh California in fall and winter 2017-18. We measured sample volume via displacement; to control for water content in the soil cores, each sample was pressed with a 5.5lb weight in a 250 m sieve until no water passed through the sieve. Although soil cores were taken with a diameter of 6cm and depth of 5cm, we found that soil core volume varied dramatically (55 to 558 ml). We regressed soil core volume against seed abundance and found relationships. We then assessed regression and density-based correction factors to standardize soil core volumes. Applying these correction factors had a large impact on seed estimates (typically lowering the values) and we discuss the merits and pitfalls of such corrections. We urge researchers to consider carefully the potential variation of soil core volumes, and to be explicit in their assumptions when extrapolating from soil cores to estimates of food availability (lbs/acre) at the landscape scale.

P.2-18: Wildfowl scientific journal

Presented by: Bruce D. Dugger (bruce.dugger@oregonstate.edu)

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Wildfowl is an international scientific journal published annually by the Wildfowl & Wetlands Trust (WWT). It disseminates original material on the ecology, biology and conservation of wildfowl (Anseriformes) and ecologically associated birds (such as shorebirds, rails and flamingos), and on their wetland habitats. Research and review articles related to policy development and application are welcome. Material on habitat management is also sought, particularly where this is directed to the conservation of wildfowl and other wetland birds. Instructions for authors, and the full back catalogue of the journal from 1948 onwards, can be found on the journals website at http://wildfowl.wwt.org.uk/. The journal is also included in the Web of Science Core Collection, and has recently been awarded an Impact Factor of 0.762. Authors are encouraged to consider Wildfowl for their future publications.

P.2-19: Interactions of individual mesopredators and waterfowl nests identified using nest temperature loggers and GPS-collared predators

Presented by: Joshua T. Ackerman (jackerman@usgs.gov)

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Mammalian predation on ground-nesting waterfowl often is the primary cause of nest failure. Understanding how individual predators interact with duck nests and move through different habitats may inform management practices and improve nest success. We quantified movement and habitat use of raccoons (Procyon lotor; n=29) and striped skunks (Mephitis mephitis; n=25), using GPS collars in Suisun Marsh, CA. Mesopredators were collared prior to duck nesting (20162019), with locations recorded during the nesting period every 15 min (raccoons) and 7.5 min (skunks). At monitored nests, iButton temperature dataloggers recorded temperature every 8 min. We identified temperature decreases associated with hen departure from a nest, using a camera-validated algorithm. Nocturnal hen departures likely indicate response to a predator, allowing us to use them as further evidence for the timing of depredations. Raccoons and skunks differed in upland habitat use, although all mesopredators were captured within or along the edges of upland fields. Raccoons and male skunks primarily moved along habitat edges, specifically roads, levees, and canals. Raccoons spent most of their time in managed wetlands adjacent to, and occasionally within, upland fields. Female skunks remained almost entirely within upland fields. Furthermore, raccoons demonstrated a high level of territoriality, with limited overlap between individuals of the same sex. Collared raccoons were observed < 25m from 17% of monitored nests and depredations occurred at 32% of those nests. Collared skunks were concentrated within a smaller area of the upland nesting fields, were observed < 25m from only 4% of monitored nests, and depredations occurred at 53% of those nests. We revealed sections of upland nesting habitat more commonly frequented by mesopredators, which can inform habitat management to potentially decrease encounters between mesopredators and duck nests.

P.2-20: Ecological separation of the Mallard and American Black Duck in the Adirondack Mountains of New York

Presented by: Gary Macy (gjmacy@syr.edu)

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The Anas rubripes (hereon black duck) population decreased by 50% since the 1950s and is a focal species of the U.S. Fish and Wildlife Service. Anas platyrhynchos (hereon mallards) have since replaced black ducks across much of their range in eastern North America. Black ducks and mallards are sympatric during breeding season in the Adirondack Park (AP), but also appear to segregate their habitat use between beaver-modified wetlands and human influenced areas, respectively. This segregation may favor mallards because wetland productivity is often greater in human influenced lakes relative to beaver-modified wetlands. Although studies of competitive exclusion between these ducks provide varying results, two species cant occupy the same niche indefinitely. We aim to test for differences in occupancy between black ducks and mallards in beaver-modified wetlands and human influenced lakes. Multi-species occupancy modeling is useful in generating estimates of occupancy for rare species (e.g., black ducks) that co-occur with more common species (e.g., mallards). We adapted a multi-species occupancy model in a Bayesian statistical framework that uses a time to detection function for detection probability. We will apply this analysis method to waterfowl surveys of beaver-modified wetlands and lakes in the AP. We will report preliminary results from surveys through early August 2019.

P.3-02: Identifying spring migration routes and phenology for blue-winged teal using GSM satellite transmitters

Presented by: Brett Leach (brettleach@alumni.uwsp.edu)

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Blue-winged teal (Spatula discors, BWTE) are among the first ducks to migrate south in the fall and last to migrate north in the spring. Primarily wintering in the Neotropics, little is known about their winter habitat use and survival. With recent advancements in technology we are now able to track BWTE via GPS/GSM transmitters and gain crucial information on migration phenology, survival (particularly south of the U.S. border), and identify critical staging, nesting and wintering areas for BWTE. Birds will be captured using baited rocket nets during the spring throughout a four week period in Louisiana to sample early, mid-, and late migrants, as there is a high rate of turnover at banding sites. With the use of baited swim-in traps, BWTE will also be captured and marked in Saskatchewan at multiple sites at the end of August. A minimum of 40 transmitters will be deployed in 2020 and another 40 in 2021, with half being deployed in Louisiana and the remainder in Saskatchewan. Spring of 2019 was the start of the pilot season, in which we marked 10 adult females in Louisiana with OrniTrack-10 GPS-GSM/GPRS/3G transmitters and another 10 hens in Saskatchewan in August 2019 to evaluate transmitter performance. Currently, transmitters record a GPS location once per hour and check in once per day. Among the ten spring-marked birds, six reached the breeding grounds, two stopped transmitting 5-7 days after marking, one did not check in after release, and one unit failed. A majority of the spring marked birds traveled approximately 1,600 km north from the Louisiana banding site over a period of two days, reaching South Dakota, North Dakota, Nebraska, and Minnesota, with one bird traveling 2,980 km over the course of twenty days before going off-line just south of the boreal forest region in Saskatchewan.

P.3-03: Migration Chronology of Dabbling Ducks in Iowa 1970-2009

Presented by: Matthew J. Garrick (matt.garrick@dnr.iowa.gov)

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Migration chronology plays an important role in the timing of waterfowl hunting seasons. The objective of this study is to investigate trends in timing of migration chronology of dabbling duck species common to Iowa. We counted ducks on waterfowl refuges weekly between the second week of September and the third week of December 1970-2009 on 26 state managed properties. Surveys were grouped to six regions of the state. Regression analysis was used to determine trends in timing of peak abundance of each dabbling duck species across survey years. There is no trend in the timing of peak mallard ($P > 0.100$), wood duck ($P = 0.616$), or blue-winged teal ($P = 0.077$) abundance across survey years. There is a trend toward later dates of peak abundance of green-winged teal ($P < 0.001$), northern pintail ($P = 0.002$), American wigeon ($P < 0.001$), and gadwall ($P = 0.001$). These data suggest midseason migrants appear to be migrating through Iowa later, while the timing of peak mallard abundance varies substantially from year to year, likely as a result of severe weather events.

P.3-04: Migration Patterns of Lesser and Greater Snow Geese through New York State

Presented by: Michael L Schummer (mlschumm@esf.edu)

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In the Atlantic Flyway, lesser snow geese (Chen caerulescens caerulescens; LSGO) as depicted as migrating through central and western New York, whereas greater snow geese (Chen caerulescens atlantica; GSGO) are confined to eastern New York. Anecdotal evidence from hunters and birders indicated this pattern may be true during autumn migration, but it was thought that GSGO were increasingly migrating through central and western New York during spring. Our study focused on New York because it represents a substantial percentage of the total Atlantic Flyway snow goose harvest during spring migration and is the eastern boundary of most snow goose migration. LSGO and GSGO also are sympatric here during winter and migration and presumably begin to separate into different migratory pathways towards geographically separated breeding areas. We used head morphology, discriminant function analysis, and genetic testing (i.e., sex determination) of snow geese harvested during spring (n = 1,704) to differentiate between LSGO and GSGO and describe their migratory pathways through New York, 2016 - 2018. We also used autumn and spring band recoveries to test for seasonal differences in migration. We detected LSGO and GSGO in the harvest throughout New York, with proportions of 20% LSGO and 80% GSGO. Mean longitude of GSGO band recovered differed between autumn (73.8W) and spring (76.0W) migration and the harvest distribution shifted west between the 1990s and 2010s. Band recoveries of LSGO in New York are limited (n = 6), but our results suggest a greater abundance migrating through New York which may indicate that these LSGO are derived from colonies that are not currently banded. Results can be used in harvest management strategies to understand the spatial distributions of LSGO and GSGO harvest and proportions of these sub-species in the harvest.

P.3-05: Aggression and Behavioral Dominance in Wintering Mallards and American Black Ducks

Presented by: Michael L Schummer (mlschumm@esf.edu)

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Environmental change can reduce species barriers and increase interactions between closely-related species. In closely-related species with recent evolutionary divergence and little niche differentiation, behavioral dominance may lead to range collapse of the subordinate species. Mallards (Anas platyrhynchos) and American black ducks (A. rubripes; hereon black ducks) are closely-related species with recent evolutionary divergence and secondary contact. We investigated aggression and behavioral dominance between mallards and black ducks on Cayuga Lake, New York, January March 2015 2017. We compared the number of aggressors, aggressive behaviors performed, aggressive behaviors received, and number of victims of aggression by analyzing video footage obtained from Go-Pro cameras mounted in traps baited with corn. Our baited sites likely represented the greatest energy density available to ducks on Cayuga Lake during winter, were areas logistically feasible to monitor aggression and behavioral dominance, and thought aggression and behavioral dominance would be detectable at these sites if it existed among species-sex classes. We also assessed behavioral dominance by determining probability of a species-sex class being deterred from these feeding sites. We detected that male mallards were more common, aggressive, and dominant than black ducks. Further, female black ducks had a greater likelihood of deterrence from a feeding site than other species-sex classes when male mallards were the aggressor. Our results indicate that mallards were dominant of black ducks at our study site and we think there is potentially for similar dominance elsewhere these ducks are sympatric during winter. Mallard dominance would decrease carrying capacity of wintering areas for black ducks through interference during foraging and displacement from feeding locations, as observed in our study. It is plausible that the observed range collapse of black ducks may partially result from dominance by mallards.

P.3-06: Evaluating post-fledging movements of hatch year mallards in the Dakotas

Presented by: Cynthia E. Anchor (cynthia.anchor@sdstate.edu)

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Past research has provided evidence that movement patterns and habitat use by waterfowl shift as cover and foraging needs change across life history periods. During the post-fledging period, the behavior and physiology of young mallards (Anas platyrhynchos) are unique as they learn to fly and navigate, exploit new forage and wetland types, develop settling and social cues, molt, avoid predators, and prepare for migration. Despite the occurrence of these unique life history events, the movements and ecology of hatch year mallards during this time are essentially unstudied. However, the advent of small (< 35 g) transmitters integrated with GPS and cellular technologies has enabled us to investigate movements over larger spatial and temporal extents. We implanted 32g abdominal transmitters into hatch year mallards in North and South Dakota and collected one location every five hours for each individual from August through December 2018. The mean distance between locations across 47 individuals was 1.86 ± 0.05 (SE) km during the pre-migration period and 26.2 ± 2.6 km after migration began. The earliest observed migration by our marked birds was initiated on 3 October and the latest observed migration was initiated on 23 November. The relatively short and infrequent movements made by hatch year mallards during the post-fledging period, and the timing of migration relative to hunting seasons, likely contribute to the vulnerability of young birds to hunting pressure and may directly affect the recruitment of young mallards into next year's breeding population.

P.3-07: Factors Influencing Wetland Use in Mexico by Wintering Midcontinent Greater White-fronted Geese

Presented by: Jay A. VonBank (jay.vonbank@students.tamuk.edu)

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Greater white-fronted geese (Anser albifrons frontalis) use both agricultural and wetland habitats throughout winter with changes in use exhibited temporally and in relation to environmental and landscape factors. Currently, an unknown proportion of white-fronts winter in Mexico, largely in Tamaulipas and Vera Cruz along the Laguna Madre, and in the Central Highland states of Zacatecas and Durango, where little information regarding wintering ecology is largely unknown. Because conservation efforts for waterfowl typically focus on wetland habitats, understanding what factors influence wetland use by species of interest is imperative to develop informed conservation strategies. During the winters of 2016-2018, we captured and placed GPS/GSM tracking devices on 72 adult white-fronts throughout Texas, of which 7 individuals made movements into Mexico. These white-fronts wintered in the Central Highlands, Interior Plains, and Coastal ecoregions of Mexico in the states of Tamaulipas, Nuevo Leon, Durango, Zacatecas, and Jalisco. We used current satellite imagery to determine dominant vegetation type for each wetland, and water extraction modelling using surface water reflectance to determine wetland size. We also measured distances from the center of each wetland to the nearest agricultural field used for foraging and distance to the nearest used wetland. We used linear mixed-effects models and AIC model comparison to explore how wetland and landscape variables influenced use by white-fronted geese. Our top model indicated that larger wetlands and wetlands that were closer to other used wetlands were related to increased use. Additionally, there was an interaction between wetland type and distance to agriculture, indicating that white-fronts exhibited increased use of grass/pasture and woody wetland types that were closer to food sources. Wetlands in Mexico are being degraded at a rapid rate, and information such as this is important for future management and conservation planning efforts throughout Mexico for wetland-dependent species such as the greater white-fronted goose.

P.3-08: Wintering Movements and Energy Expenditure following a Large-Scale Distribution Shift in Greater White-fronted Geese

Presented by: Jay A. VonBank (jay.vonbank@students.tamuk.edu)

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Mitch D. Weegman – School of Natural Resources, University of Missouri
Paul T. Link – Louisiana Department of Wildlife and Fisheries
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Greater white-fronted geese (Anser albifrons frontalis) commonly wintered in the Gulf Coastal marshes of Texas and Louisiana before moving inland following agricultural expansion during the 1940s. During the last decade, white-fronted geese have further shifted their main wintering range northeastward into the Mississippi Alluvial Valley, presumably influenced by large-scale landscape modification and global climate change. Several regions in Texas and coastal Louisiana still support large populations during winter, but movements among these regions and contemporary wintering regions, and the timing of such movements during winter, are largely unknown. Land use varies dramatically among wintering regions, and there are likely differential region-specific energetic costs to wintering areas. Our research aims to determine the probability of movement among regions, and to compare energy expenditure among regions to understand drivers and consequences of the large-scale distribution shift. We used GPS/accelerometer tracking devices deployed on 97 white-fronts captured in Texas and Louisiana during winters 2016-2018. Mean daily movement distance was greatest in early winter and decreased as winter progressed, and was not influenced by daily temperature extremes. Of white-fronts tracked during winter 2016-2017 (n=62), 32.3% moved among wintering regions and 12.9% moved between the Central and Mississippi flyways. However, white-fronts marked earlier in winter, before 1 December (n=29), moved at greater rates among regions (37.9%) and flyways (44.8%). Among white-fronts tracked during winter 2017-2018 (n=55), 50.9% moved among regions and 14.5% moved between flyways, but white-fronts marked before 1 December (n=36) moved among regions (66.7%) and flyways (16.7%) slightly more than birds captured later in winter. Our analyses indicate that most large-scale movements among wintering regions and between flyways occur early in winter. Energy expenditure was greatest in rice producing regions in Texas and Louisiana. Addressing the role of movement and energy expenditure following a large-scale distribution shift will aid in the future management and conservation of white-fronted geese.

P.3-09: Investigating spring migration strategies of northern pintails

Presented by: Georgina R. Eccles (missgreccles@gmail.com)

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The continental population of the northern pintail (Anas acuta) remains depressed after 3 decades of good to excellent habitat conditions on breeding areas. As most other duck populations have realized record population abundance over this period, northern pintails have remained below population objectives. Although factors on breeding areas undoubtedly have impacts on pintail populations, it is likely that factors on nonbreeding areas also have impacted the species given its unique life-history characteristics. Pintails wintering in these different areas use different habitats during winter, are subject to different stressors during winter, appear to survive at different rates across winter, and migrate through markedly different landscapes during spring migration. Thus, our objectives are to (1) compare spring migration strategies of northern pintails within and among wintering areas in North America, (2) investigate linkages between migration strategies and reproductive success, (3) assess the contribution of endogenous nutrients to reproduction for different regions and different migration strategies, and (4) identify critical stopover areas for pintails migrating from different wintering areas. We propose to capture northern pintails at major wintering areas across North America (e.g., Louisiana coast, Texas coast, Texas Panhandle, New Mexico, Arizona, and central California) during December-January each year (2019-20, 2020-21, 2021-22). Adult females (n = 500) will be outfitted with hybrid GPS-ACC tracking devices. Expected outcomes of this research include identification of important stopover sites, linking individual decisions (behavior and habitat use) during migration to reproductive success, and understanding differences in migration strategies within and among wintering regions and the potential for carry-over effects. Our results will provide a strong understanding of migration ecology of northern pintails that will help address questions important to resource managers.

P.3-10: Mallards in New Zealand exhibit adaptive and maladaptive habitat choices of brood-rearing areas

Presented by: Todd W. Arnold (arnol065@umn.edu)

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Todd W. Arnold – Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, St. Paul, Minnesota
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Duckling survival is the most influential factor affecting population growth of mallards (Anas platyrhynchos) in New Zealand. Understanding how habitat choices affect duckling survival can provide valuable insights for managing landscapes to increase productivity. During 20142015, we conducted 2,252 observations of 190 brood-rearing female mallards on two study sites in New Zealand (NZ). We used ArcGIS Pro to identify used and available habitats around brood travel routes and we used these data to predict duckling survival from interval-specific observation matrices of offspring counts and other covariates. We analyzed data using a Bayesian hierarchical generalized linear model that simultaneously estimated daily duckling and brood survival, and individual duckling and brood detection. Habitat selection was strongest when drains, ponds, effluent ponds or sedge habitat constituted greater than 11%, 7%, 5%, or 13% of the brood buffer, respectively. Mallards that selected brood-sites with greater proportions of effluent ponds experienced higher duckling survival, indicating adaptive selection. However, mallards also selected drains and ponds despite lower duckling survival associated with greater amounts of these habitat types, suggesting these habitats may be ecological traps. Although we found no evidence of selection or avoidance of streams and hedgerows, both habitats were associated with higher duckling survival, implying mallards may not always recognize beneficial habitats. Mallards in NZ exhibited both adaptive and maladaptive patterns of habitat selection of brood-rearing areas, which may result from their non-native status, anthropogenic land use, or intense habitat fragmentation.

P.3-11: Nest Attendance in Boreal Ducks

Presented by: Ryan Johnstone (ryanphjohnstone@gmail.com)

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Stuart Slattery – Research Scientist and Boreal Science Lead, Institute for Wetlands and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB, Canada and Adjunct Professor, School of Environment, Resources and Sus

Incubation plays a crucial role in embryonic development and nest and parental survival in birds. Among most waterfowl species, only females incubate eggs and therefore face a tradeoff between self-maintenance and incubation. These patterns of nest attendance can influence the fitness of hens and their offspring. Greater attentiveness results in faster development rates and healthier, more capable offspring. Given the precocial disposition of waterfowl broods, their body condition at hatch is critical for survival. Several studies have investigated incubation patterns in waterfowl, though we are missing baseline information regarding the incubation investment and behaviour of boreal nesting ducks. This is critical, as the boreal forest is an important breeding ground. Additionally, few studies have investigated the potential influence of habitat conditions on nest attendance. We monitored nest attendance in seven ground-nesting species of waterfowl across a gradient of industrial disturbance in the western boreal forest of Alberta, Canada. We hypothesized that highly disturbed nesting habitats would result in longer, more frequent, incubation breaks. Incubation behaviour was measured using small temperature probes (iButton, Maxim Integrated) inserted into the bottom of the nest bowl. We then compared patterns of incubation to surrounding levels of disturbance to quantify the correlation between habitat disturbance and incubation sessions. Our findings will provide further insight into the hypothesis that industrial development effects ducks.

Q.1-1: Mallard Introductions to New Zealand Result in Extensive Hybridization with Endemic Grey Ducks

Presented by: Joshua I. Brown (jibrown@miners.utep.edu)

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A sub-species of the Pacific Black Duck (Anas superciliosa), the New Zealand Grey Duck (A. superciliosa superciliosa) is endemic to New Zealand (NZ). The closely related Mallard (A. platyrhynchos), was introduced to NZ in the mid-1860s, although sustainable breeding populations were not established until the release of 25,000 additional Mallards from 1940-1960. Previous research suggested wide-spread hybridization resulted in only ~5% of pure Grey Ducks remaining throughout NZ and that the population may now be a hybrid swarm. Here, we use a landscape level approach to determine whether hybridization between Mallards and Grey Ducks has indeed resulted in a hybrid swarm (i.e., various generations of hybrids and backcrosses), and to identify any geographic or biological barriers that limit hybridization. During 2014-2018 we collected samples from 673 Mallards, Grey Ducks, and putative hybrids from the North (N = 378) and South (N = 295) Islands of New Zealand. Using ddRAD-seq techniques to sequence ~3,500 nuclear loci, we report that pure Grey Ducks are strongly genetically structured from Mallards (ST = 0.085). However, only 5% and 10% of samples were identified as pure Grey Duck or Mallard, respectively. The remaining 85% of samples comprised a variety of hybrids forms (hybrid swarm) that largely resulted from backcrossing into Mallards, suggesting that assortative mating may limit further dilution of the Grey Duck gene pool. In general, hybrid prevalence was highest on the North Island and east of the Southern Alps mountain range in the South Island, which are areas most affected by urban and agricultural development. In contrast, most pure Grey Ducks were concentrated in more remote montane habitat west of the Southern Alps, indicating that the Alps act as a strong geographic barrier to hybridization. Finally, Mallards were genetically differentiated between Islands, suggesting that gene flow is limited by Cook Strait.

Q.1-2: Pre-historic ranges of endemic, endangered ducks in Hawaii

Presented by: Philip Lavretsky (plavretsky@utep.edu)

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Robert Fleischer – Center Conservation and Evolutionary Genetics, Smithsonian Institution, Washington, D.C.
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One challenge facing reintroductions of long-extirpated species is knowledge of past range extent and ecology. The Laysan duck (Anas laysanensis) is one of the few remaining endemic species of Hawaiian waterfowl, and is critically endangered; currently restricted to the low-lying atolls of the Northwestern Hawaiian Islands, it is further at risk from sea-level rise. On the main Hawaiian Islands, Laysan duck-like fossils and subfossils have been excavated from sites spanning a range of elevations and habitats, as have subfossils thought to belong to a related endemic duck, the endangered koloa maoli (Hawaiian duck, Anas wyvilliana). However, the species identities are ambiguous. Here, we couple 3D geometric morphometric modeling of wing and leg bones, radiocarbon dating, and ancient DNA techniques to identify subfossils to species, with the goal of evaluating the paleontological record for evidence of species past ranges and habitats. We used structured light scanning to create 3D models of 28 fossil, subfossil, and archaeological bones excavated from 8 sites across the Hawaiian Islands, and contemporary references from 33 wild Laysan and koloa. We then used a custom bait capture array synthesized from 3,750 Anas duck double-digest RAD-seq (ddRAD-seq) loci to genotype 12 sub fossils. We found that nearly all of the fossils and subfossils clustered with contemporary Laysan ducks, suggesting widespread Laysan presence from sea-level, coastal habitats to higher elevation, dry- and wet-forested locations. Interestingly, modern Laysan ducks had shorter, more robust leg bones than those of the Pleistocene-era fossils, possibly reflecting eco-morphological adaptation to extreme terrestriality in their current habitat. Only 2 subfossils were morphometrically and genetically aligned with the koloa, and both were from archaeological sites; these could have been brought from elsewhere on the island, but both sites were at sea-level. Notably, we also recovered a Laysan duck in the same archeological site (400-500 ybp), suggesting that the two species co-occurred on the Islands well after Polynesian arrival. A total of 6 samples had both molecular and morphometric data. Of these, 5 indicated discord between molecular and a priori expert species designations, emphasizing the importance of genetically-vetting samples. The applied use of ancient DNA to establish a genetically-vetted paleo-ecological record will help inform the current management of the endangered koloa, the possible reintroduction of the endangered Laysan duck to the main Hawaiian Islands, and add to the scant data on the evolution of these two endemic species.

Q.1-3: The role of the Rice Stewardship Partnership in waterfowl conservation in the Mississippi Alluvial Valley

Presented by: Taylor J. Linder (LinderTJ@uamont.edu)

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Ricelands in the Mississippi Alluvial Valley (MAV) of Arkansas, Louisiana, and Mississippi provide rich foraging habitat for wintering waterfowl, supporting the energetic demands of nearly 40% of wintering waterfowl in the Mississippi Flyway. Though many studies have evaluated the effects of management techniques on waste rice availability on winter ricelands, few have quantified the scope of practices currently implemented on privately managed winter ricelands. Many studies have also assessed the number of duck energy days on the landscape but do not account for the different riceland management practices and their effect on waste rice availability. Moreover, little information is available to waterfowl managers as to the decision-making processes of rice producers engaging in practices that influence waste rice availability and waterfowl conservation. Here, we present the results of a census of the first cohort of Rice Stewardship Partnership (RSP) participants in the MAV (N=51). Using a semi-structured interview protocol, researchers asked participants about their current management practices, their motivations for choosing those specific practices, and the motivations and barriers that exist to flooding rice fields post-harvest to promote waterfowl habitat. Initial results demonstrate the importance of the RSP to help offset the cost of winter flooding. Additionally, many rice producers implement straw management in the fall before flooding to allow for earlier planting dates in the spring. The most popular technique for straw management gleaned from this study was rolling rice stubble, which is known to significantly effect waste rice availability. Lastly, with respect to certain regions, crawfish operations can negatively impact habitat availability for waterfowl as many rice producers implement disturbance practices to limit the presence of waterfowl on crawfish ponds.

Q.1-4: Wetland Conservation through the Louisiana Waterfowl Project

Presented by: Aaron Pierce (apierce@ducks.org)

Aaron Pierce – Ducks Unlimited, Inc., Lafayette, Louisiana

Louisianas coastal wetlands are critical natural resources that provide habitat for millions of wintering waterfowl. However, Louisiana also has the highest coastal wetland loss rate of any state in the U.S., approximately 44 km2 per year. Thus, restoration and enhancement of Louisianas wetlands is imperative to help offset coastal wetland loss and provide quality habitat for waterfowl and other wetland-dependent wildlife. The Louisiana Waterfowl Project (LWP) is a cooperative private lands partnership program which includes: Louisiana Department of Wildlife and Fisheries, U.S. Fish and Wildlife Service, Natural Resources Conservation Service, and Ducks Unlimited, Inc. LWPs mission is to provide critical migratory and wintering habitat for waterfowl and other wetland-dependent wildlife. Priority is also given to enhance nesting and brood-rearing habitat for Mottled Ducks. LWP strives to accomplish its mission by providing cost-sharing on private lands restoration/enhancement projects, engineering and design services, and technical assistance for landowners. Typical LWP projects involve installation of water control structures, pumps, levee work, and land shaping. In addition, landowners agree to maintain and manage the project for waterfowl over a 15-year period following project construction. LWP focuses on projects in coastal Louisiana, with priority given to projects in the Chenier Plain and Mississippi River Deltaic Plain. With the overwhelming need for coastal restoration in south Louisiana and with over 80% of the state being privately owned, it is imperative to work diligently with private landowners to offer restoration/enhancement support that will provide long-term wetland conservation benefits. Since the start of LWP in 1992, the program has restored/enhanced over 100,000 acres of privately-owned wetlands. Habitat types restored/enhanced through LWP include: coastal marshes, moist soil units, palustrine emergent wetlands, and flooded timber. LWP projects provide quality habitat for a wide variety of resident, migratory, and wintering species of waterfowl, shorebirds, wading birds, and other wetland-dependent species.

Q.1-5: Evaluating Hunter Surveys at Oakwood Bottoms Greentree Reservoir in Southern Illinois

Presented by: Ethan M Dittmer (ethan.dittmer@siu.edu)

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Human-dimensions research provides wildlife managers with feedback from the users of sites they manage. These user data can help managers to make informed decisions that aim to reach long-term management goals while addressing users opinions. During our first field season, we tested two different methods online open-web surveys and paper mail-in surveys to garner voluntary feedback and harvest reporting from hunters at Oakwood Bottoms Greentree Reservoir (hereafter Oakwood) in southwestern Illinois. Online surveys were available to hunters every day of the duck season (November 10th 2018 January 8th 2019) and mail-in surveys were placed on hunters vehicles every other day of the season. The principle objectives of the project are to: (1) collect feedback from users that will be provided to site managers, (2) evaluate which survey type (online or mail-in) is best suited for Oakwood, and (3) evaluate trends in harvest, satisfaction, and opinion at Oakwood. We found apparent individual response rates of 20.9% and 2% for paper and online surveys, respectively, demonstrating that online surveys alone will be inefficient for garnering voluntary feedback from hunters at Oakwood. Regardless of satisfaction level reported by respondent, most (78%) stated that they plan to return to Oakwood, possibly indicating that desire to return is driven by factors other than success and satisfaction. We will be conducting a second field season this fall to compare response rates of paper surveys placed on vehicles to those picked up by hunters at several survey stations around the site. We will compare data from both seasons to further evaluate trends in motivation and satisfaction while determining which survey type is best suited for long-term use at Oakwood and similar sites.

Q.1-6: Predicting waterfowl hunter attitudes towards greentree reservoir management practices

Presented by: Jakeb G. Spears (SpearsJG@uamont.edu)

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The attitude concept is a ubiquitous evaluative measure used by agencies to understand stakeholders views on wildlife management policy. In Arkansas, the Arkansas Game and Fish Commission (AGFC) manages greentree reservoirs (GTRs) and assesses stakeholder views of their management. A GTR is impounded bottomland hardwood forest that is flooded each fall/winter to provide habitat for wintering waterfowl and duck hunting opportunities. However, scientific evidence indicating traditional GTR management practices negatively affects forest health prompted AGFC to implement new GTR management policy in 2016. This study sought to measure and predict Arkansas waterfowl hunters attitude of towards the new policy. As part of a preregistered study (https://osf.io/vzf7a), we hypothesized that value similarity (between AGFC and hunters) would be positively associated with the perceived trustworthiness of AGFC, procedural trust, and dispositional trust; and that these four factors would predict hunters attitude towards AGFCs GTR policy. Using Qualtrics, a questionnaire was sent to a random sample of 10,000 Arkansas residents who purchased duck stamps in 2017-18. Results from a 3-item semantic differential attitude scale found hunters have a slightly positive attitude towards the new GTR flood management (= .97, M = 4.25, SD = 1.62) (N = 3,343). A structural equation analysis supported our hypothesis. We observed a significant, positive relationship between value similarity (= .96, M = 4.28, SD = 1.74) and sophistication (= .86, M = 4.47, SD = 1.55) and trust (= .97, M = 4.25, SD = 1.73), and each were positively associated with attitude (2 = 233.58, RMSEA = .06, NNFI = .94, CFI = .95). Findings highlight the important roles that value similarity and trust have on a hunters attitude. Agencies can use these findings to anticipate stakeholder views on management decisions and design appropriate communications or interventions.

Q.1-7: Rice Agriculture and Wildlife Conservation in California: A grower's perspective

Presented by: Luke Matthews (lmatthews@calrice.org)

Luke Matthews – California Rice Commission, Sacramento, California
Dr. Mark Lubell – Environmental Science and Policy, UC Davis, Davis, California
Dr. John Eadie – Wildlife, Fish, and Conservation Biology, UC Davis, Davis, California

In the face of large-scale changes to agricultural practices, we developed a survey to better understand how environmental and economic factors shape the decisions made by rice growers related to post-harvest practices on their farms. We sent a comprehensive survey to 1,650 rice growers to solicit information on post-harvest management of fields, costs of common post-harvest treatments, water-related costs of rice agriculture, and views of growers towards wildlife and hunting. We achieved a 20.2% response rate (based on American Association for Public Opinion Research 4.0 calculations). Key observations from our survey include the following: 1) 89% of rice farmers and landowner allow hunting on their property; 27% of those collect fees from leases, which enables them to recoup 63% of their water costs. 2) Over 80% of respondents view rice as either 'very important' or 'somewhat important' as both food and habitat for wildlife, despite the observation that 70% and 60% of grower's experience wildlife related losses in the spring and fall respectively. 3) 50% of respondents indicated that water costs would be the primary factors causing them to stop post-harvest flooding. The average water cost that growers were willing to pay, before shifting away from flooding, was approximately $24/acre. 4) Finally, when asked which post-harvest treatment growers would use if they did not have winter water, 89% of the respondents would select to incorporate waste straw (using a variety of methods).

Q.2-01: Changing Post-Harvest Practices in Rice and Corn fields in California

Presented by: Luke Matthews (lmatthews@calrice.org)

Luke Matthews – California Rice Commission, Sacramento, California
Dr. John Eadie – Wildlife, Fish, and Conservation Biology, UC Davis, Davis, California

Agricultural practices are constantly evolving as the climate changes, crops are modified, and advanced technology becomes more readily available. Waste grains from agricultural crops, specifically rice and corn, supply 70% for the food needs for waterfowl in the Central Valley. Considering these factors, understanding how post-harvest treatments have changed in the Central Valley of California is an area of critical information need for the Central Valley Joint Venture. To address this, we conducted road surveys in December and January of 2016-17 and 2017-18. The timing of these surveys was designed to target the post-harvest period of rice and corn agriculture. The most common post-harvest treatments detected in rice fields were flooding, incorporation, chopping, and baling. Over the two survey years we found that rice straw Incorporation was used on 25.8% of the total rice acreage while Flooding only occurred on 47% of rice acreage. Over the two survey years we observed very little change in the use of each post-harvest treatment across the landscape. Corn fields are largely not treated in a way that benefit waterfowl. Corn as a rotational crop was the most common post-harvest treatment at 55% of the total acreage, ground work involved in crop rotation is assumed to eliminate essentially all of the waste grain from the fields. Incorporation was the second most common post-harvest treatment detected in corn fields, at 23% of the total acreage. Ultimately, only 34.7% of the corn acreage was treated in a way that is considered to provide any food value for waterfowl.

Q.2-02: Impacts of neonicotinoid treated corn to aquatic invertebrates in floodplain wetlands

Presented by: Kyle Kuechle (kkuechle@ducks.org)

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Neonicotinoid insecticides (NI) are commonly used as seed-treatments on major agricultural row crops (e.g., corn). Indeed, neonicotinoid treated agricultural crops are often planted directly in floodplain wetlands managed for wildlife, specifically waterfowl. Numerous studies have documented impacts of neonicotinoids to aquatic invertebrates in laboratory and mesocosm settings; however, there is limited information on how direct application of neonicotinoids to wetlands impacts aquatic invertebrate in field settings. We investigated invertebrate community response to planting of neonicotinoid-treated seed in managed wetland ecosystems in Missouri. In 2016, we sampled water, sediment, and aquatic invertebrates from 22 paired wetlands during spring (pre-wetland drawdown) and fall (post-wetland flood-up) followed by a third sampling period (spring 2017). During summer, portions of study wetlands were planted with either neonicotinoid-treated corn or untreated corn (control). Water and sediment concentrations of the three most common neonicotinoids were used to calculate overall NI toxicity equivalents (NI-EQs). Mean total NI-EQs peaked in autumn and were an order of magnitude greater for sediment (0.60 g/kg) than water (0.02 g/L). Water quality parameters and pesticide concentrations were used to evaluate effects of neonicotinoid concentrations on aquatic macroinvertebrates using a series of generalized linear mixed effects models. Results indicate an overall decrease in aquatic insect abundance and richness with increasing NI-EQs in both wetland water and sediments. Post-treatment treated wetlands had lower insect richness and abundance compared to untreated wetlands, but invertebrate communities recovered in the following spring 2017. Our results have implications for aquatic invertebrates and wetland-dependant species (e.g., migrating waterfowl) as neonicotinoids, although below lethal concentrations for many common wetland insects, are impacting wetland ecosystems. Research results will be useful to wetland managers in making decisions regarding use of neonicotinoid seed-treatments, and potentially, provide broader considerations of the role agriculture may play in future wetland management and conservation plans.

Q.2-03: Seasonal habitat partitioning by sympatric sea ducks in eastern North America

Presented by: Juliet Lamb (jslamb@uri.edu)

Juliet Lamb – University of Rhode Island and Rhode Island Department of Environmental Management, Kingston, RI, USA
Peter Paton – University of Rhode Island, Kingston, RI, USA
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Habitat partitioning, wherein species that occupy the same geographic areas select different locations or resources within their habitats, is considered key to the coexistence of closely related sympatric species. However, partitioning can be difficult to observe in natural settings due to the complexity of measuring niche breadth across relevant environmental features. Sea ducks, which form large mixed-species flocks in winter and spatially and temporally overlap extensively throughout the annual cycle, provide an opportunity to determine how habitat partitioning of closely-related species allows coexistence while utilizing shared resources. We used satellite telemetry data and a multivariate habitat selection analysis to investigate habitat partitioning across the annual cycle in five species of sea ducks (Black Scoter, Surf Scoter, White-winged Scoter, Long-tailed Duck, and Common Eider) from throughout eastern North America and the Great Lakes, U.S.A. Our results suggest that niche separation and habitat selectivity are strongest at breeding sites and during the post-breeding molt and migration period, when highly productive habitats are spatially limited and individual mobility is restricted. During winter, when productivity is low throughout the shared range, and during spring, when productivity is uniformly high, species overlap extensively across environmental covariates. We discuss the effects of seasonal variation in environmental conditions on competitive interactions and habitat partitioning, identify key multi-species habitat features throughout the annual cycle, and the associated management implications.

Q.2-04: Waterfowl use of mine tailing ponds in comparison with beaver ponds in the eastern Boreal

Presented by: Emilie Desjardins (Emilie.Desjardins@uqat.ca)

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The mining industry is believed to have negative impacts on ecosystems, including waterfowl. In Abitibi-Témiscamingue, a region in eastern Boreal Canada, wetlands and deep waters cover 43% of the 65, 000 km² and it is renowned for waterfowl diversity. Mining potential is also high, and the industry is very active, with 32% of the region claimed for mineral rights and numerous operating mines. Even if numerous avian species are frequently observed on certain mining sites, the diversity of species found on these sites is still poorly documented. Our project aims to determine to what extent mining sites can be considered breeding habitat for waterfowl as compared to natural sites. We compared 14 mining sites and 39 beaver ponds of similar sizes. We visited each site twice in summer 2018 and three times in summer 2019, in order to estimate occupancy and detection probabilities of different waterfowl species for two different life stages (broods and breeding adults). We also considered other habitat factors such as water pH, shoreline development index, pond area and water depth as predictors of the occupancy of these species. Preliminary analyses indicate that at least 12 species use mining sites during their breeding period. In 2018, the three most common species (Mallard, Ring-necked Duck and American Wigeon) showed no preference between beaver ponds and mining sites. In contrast, a fourth species, Common Goldeneye, was more likely to occur at mining sites. The occupancy patterns did not vary with any additional habitat variable we considered. In 2019, we will add new variables such as fish presence and vegetation cover to determine if they can explain site utilization by waterfowl. To date, this study suggests that some tailing ponds could be considered as high quality habitat for some waterfowl species.

Q.2-05: Estimating the energy landscape of the Suisun Marsh

Presented by: Dan Smith (djssmith@ucdavis.edu)

Dan J. Smith – University of California, Davis
Josh T. Ackerman – USGS
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Cliff Feldheim – California Department of Water Resources
John M. Eadie – University of California, Davis

The Suisun Marsh is one the largest brackish marshes in the western United States, containing both extensively managed wetlands and tidal wetlands. The managed wetlands are especially important to migratory waterfowl early in the wintering period, as they provide wetland habitat before many of the wetlands in the Central Valley receive water. Historically, the marsh supported over 300,000 wintering waterfowl as recently as the 1960s, but in the last decade that number has fallen to 60,000. To determine the carrying capacity of Suisun Marsh we collected 10 soil core samples from 45 managed wetlands (26 private, 19 Public) and 15 tidal wetlands throughout Suisun Marsh in early November and in early February for two years. To evaluate seed depletion we will use a trio of sample plots 5m in diameter, two open plots and one exclosure. Using historic telemetry data and expert opinion we will place the exclosure and one open plot in a position within five wetlands that receive high amounts of waterfowl use, while the other open plot will be placed in the same wetland in an area that receives traditionally low use. We will collect three soil cores from the plots every two weeks over winter to assess seed depletion. We will also measure the decomposition rates of the five most commonly consumed seeds by placing freshly collected mature seeds into fiberglass bags. Four replicate bags per species will be placed within the exclosures, every month a bag for each species will be removed, and seeds will be dried and weighed before their caloric content is quantified via bomb calorimetry. With estimates of seed availability, seed depletion rates, and seed decomposition, we will provide one of the first comprehensive estimates of the contemporary carrying capacity for waterfowl in Suisun Marsh under a number of different management scenarios.

Q.2-06: Estimating the impact of delayed drawdown on seed production

Presented by: Dan J. Smith (djssmith@ucdavis.edu)

Dan J. Smith – University of California, Davis
Brian W. Olson – California Department of Fish and Wildlife
John M. Eadie – University of California, Davis

In an attempt to mitigate the dramatic loss of wetland habitat in Californias Central Valley, wetland managers extensively manipulate remaining wetlands to provide foraging habitat for wintering waterfowl. Providing information to wetland managers so they can improve wetland productivity and thus waterfowl carrying capacity is essential for the future viability of wintering waterfowl in California. Drawdown date is an influential factor in determining germination success of wetland plants that provide food resources to wintering waterfowl. By delaying drawdown into spring, wetland habitat that is typically only available in winter becomes available for breeding waterfowl and numerous other wetland depend species. This study seeks to determine the impact of delayed drawdown on vegetation composition and height, biomass production, and seed production of waterfowl food plants. Three drawdown dates, the 15th of March, April and May, were tested. To examine the interaction between drawdown timing and irrigations, half of the replicates in each treatment group received a ten day summer irrigation six weeks after drawdown. These treatments were implemented in 18 research wetlands, each 1.58 acres in size. Vegetation composition was measured using percent cover, vegetation height was measured, and seed abundance was quantified using soil cores and vegetation clippings. We found that the Early drawdown treatment resulted in the tallest vegetation. Biomass production was not influenced by drawdown treatment, yet biomass produced in the first year was significantly greater than the second. While we found no effect of drawdown on total seed abundance, we did find species-specific responses. Both seed abundance and percent cover for Echinochloa crus-galli was greatest in the late irrigated treatment, while Crypsis schenoides plant and seed abundance was greatest in early irrigated treatment. These results indicate that wetlands can be managed to produce food for wintering waterfowl while also providing spring habitat for a multitude of species

Q.2-07: Assessing the Consequence of Invasive Phragmites australis on Dabbling Duck Carrying Capacity

Presented by: Chris Williams (ckwillia@udel.edu)

Kristen Van Neste – University of Delaware
Chris Williams – University of Delaware
Paul Catselli – Edwin B. Forsythe National Wildlife Refuge

Phragmites australis, a non-native perennial grass, is considered a nuisance species and a form of biological pollution. Phragmites thrives in areas with reduced soil salinities and increased nitrogen availability, which is caused when woody vegetation bordering salt marshes is removed often connected with anthropogenic shoreline development. The expansion of non-native Phragmites australis into tidal wetlands of North America detrimentally affects native wildlife by altering resource utilization, modifying trophic structures, and changing disturbance regimes. Thus, it also has the potential to drastically impact dabbling duck energetic carrying capacity in salt marsh ecosystems. This research determined the impact of invasive Phragmites on dabbling duck (mallard, American black duck, green-winged teal, northern shoveler, northern pintail) preferred food (invertebrate and seed) availability by comparing energy values in non-Phragmites invaded saltmarshes (mudflat, low marsh, high marsh, and impoundments) to energy values in Phragmites dominated areas, from two locations within Forsythe National Wildlife Refuge, New Jersey, 201516. To estimate habitat specific energy supply, we collected sediment core samples, fixed with formalin, washed, dried, sorted and weighed for seeds/invertebrates. We multiplied biomass (g) by True Metabolizable Energy (TME) values to estimate species-specific dabbling duck preferred food energy availability. We further estimated habitat specific energetic carrying capacity by predicted duck-use days based on known species-specific energetic demand. For all dabbling duck species, Phragmites invaded salt marsh contain an increased amount of consumable seed energy yet reduced amount of consumable invertebrate food energy to non-Phragmites invaded habitat types. Thus, combining food types, Phragmites had equal or greater energy food than non-Phragmites habitat types and greatly increased the duck use days. However, we caution that while sufficient food energy may exist in a Phragmites invaded area, it is likely that Phragmites grass is too dense for dabbling ducks to efficiently forage and extract the energy source thus potentially lowering landscape level availability. However increased seed availability in soil strata may aid in restoration efforts.

Q.2-08: Assessment of macro-invertebrates in restored wetlands managed for waterfowl in east-central, WI

Presented by: Marissa Kaminski (marissakami77@gmail.com)

Marissa Kaminski – UW-Stevens Point
Jake Straub – UW-Stevens Point
Rachel Schultz – The College at Brockport, State University of New York

In the summer of 2017, we evaluated factors affecting macro-invertebrate communities and biomass estimates for waterfowl broods across 80 restored wetlands in southeastern Wisconsin. Studied wetlands were within the Glacial Habitat Restoration Area (GHRA), which covers 558,879 acres in east-central Wisconsin, and consists of mostly agriculture with a mix of farms, crops, small woodlots, wetlands, shallow lakes, and residential development. Wetlands in our study were categorized into three groups based on hydrologic modification (e.g., least to most intensively engineered) and included Waterfowl Production Areas as a reference group. A non-metric multidimensional scaling analysis (NMDS) indicated macro-invertebrate community assemblages were similar between all wetland categories. Additionally, among the multiple environmental variables studied, the NMDS indicated dissolved oxygen, seasonal water fluctuation, and the amount of leafy pondweed (Potomageten foliosus) as the only variables that explain differences in community composition of macro-invertebrate taxa. Next, we used a macro-invertebrate biotic index (MBI) developed for shallow depressional wetlands and determined a good ranking for all wetlands with no statistical difference in MBI scores among the restored wetland types. We also failed to find any statistical differences among any of our wetland categories for macro-invertebrate diversity, richness, abundance, or total biomass. Finally, among macro-invertebrates, we found Gastropods and Odonates, which are preferred by duck broods, to be abundant in all wetland types. Given that there was no significant statistical differences across examined variables, as well as ample biomass to support waterfowl broods, we conclude that macro-invertebrate communities found across studied wetlands are robust to differences in restoration treatments. Together, we report that the integrity and abundance of macro-invertebrates are sufficient to support breeding waterfowl, at least in the Glacial Habitat Restoration Area of Wisconsin.

Q.2-09: Building Resiliency in Coastal Waterfowl Habitats on the Texas Coast

Presented by: Kevin Hartke (khartke@ducks.org)

Kevin Hartke – Ducks Unlimited, Inc., Richmond, Texas
Todd Merendino – Ducks Unlimited, Inc., Richmond, Texas
Greg Green – Ducks Unlimited, Inc., Vancouver, Washington

Coastal wetlands on the Texas Gulf Coast provide critical habitat for a diversity of waterfowl species, serving as essential foraging habitats during migration and winter and nesting and brood rearing habitats during breeding seasons. These critical estuarine wetlands are subjected to long-term negative impacts from the interaction of anthropogenic and environmental factors. For example, the negative effects of relative sea-level rise on coastal marshes have been exacerbated by dredged commercial navigation channels and petroleum extraction along the Texas Coast. Impacts from shoreline erosion, saltwater intrusion and marsh subsidence result in habitat degradation and loss, chiefly in the form of conversion from vegetated marsh to contiguous open water and higher salinity. Ducks Unlimited, in collaboration with their conservation partners in Texas, are actively restoring impacted coastal marsh habitats using shoreline protection measures to reduce shoreline erosion and rebuilding marsh habitats through the beneficial use of dredged materials. Examples of these projects and techniques will be presented. Considering the magnitude of scope and expense of these projects and the scale of impacts along the Texas Coast, Ducks Unlimited has developed decision support tools and planning guides to identify and prioritize projects. These products will be advantageous to Ducks Unlimited and their partners in Texas when seeking financial support for priority coastal marsh projects from the various potential funding sources associated with the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (aka RESTORE Act), Gulf of Mexico Energy Security Act (aka GOMESA), and others.

Q.2-10: Dabbling duck use of agriculturally manipulated and unmanipulated wetlands in the Drift Prairie of North Dakota and South Dakota

Presented by: Dustin Toy (dustin.toy@ndsu.edu)

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Michael Anteau – US Geological Survey, NPWRC, Jamestown, ND
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Edward – North Dakota State University, Fargo, ND

Agricultural expansion has led to conversion of much of the Drift Prairie, a subregion of the Prairie Pothole Region, into cropland. In turn, >80% of the remaining temporary and seasonal wetlands are in crop or alfalfa fields. During dry periods, these wetlands may be manipulated by landowners to prepare for planting crops within the wetland, whereas, during wetter periods, wetlands may be left idle. However, these wetlands continue to provide waterfowl foraging habitat. Our study examined spatiotemporally and hydrologically similar manipulated (burned, disked, mowed, harvested) and unmanipulated (idled) wetlands located in agriculture fields to determine the influence of agricultural manipulation techniques on the presence of five common dabbling duck species (blue-winged teal, gadwall, mallard, northern pintail, northern shoveler). Preliminary results indicated that burning a wetland had a slightly negative influence on probability of presence for most species. Disking and mowing manipulations, surface water area, and water depth positively influenced probability of presence for most species. These results may help guide better wetland manipulation techniques in agricultural fields. Future data analysis will explore vegetation measurements and more complex manipulation models.

Q.2-11: Mallard (Anas platyrhynchos) brood use of man-made wetlands in Southland, New Zealand

Presented by: Erin Garrick (erin.garrick@southlandfishgame.co.nz)

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The Southland region of New Zealand has numerous small (~1 hectare) man-made wetlands purposed for duck hunting, however, it is unclear how suitable these man-made wetlands are for mallard brood rearing. Our objective was to assess differences in mallard brood use of man-made wetlands based on wetland habitat characteristics. We selected 22 wetlands and stratified sites by the degree of overhead cover. Data was collected on variables including wetland area, perimeter, area-shoreline ratio, shallow feeding area, location of overhead cover (N,E,S,W), direction of weather exposure, percent of emergent vegetation, surrounding land use, invertebrate food abundance, whether the wetland periphery was grazed and whether the wetland was fenced. We monitored each wetland using game cameras and the time-lapse function, which took photos every five minutes during daylight hours from September to December 2015. We collected a total of 258,035 photos, and identified the most used wetland, which had ducklings present 11.7% of the time, and the least used wetland, which had no ducklings present throughout the term of the study. Linear regressions were used to identify variables that resulted in increased brood use of wetlands. Wetland usage by broods tended to increase with an increase in the ponds shallow feeding zone, cover reducing exposure on the west and south side of the wetland, overhead cover on the western edge of the wetland, and stock exclusion from the wetland. We recommend minimal earthworks, strategic planting, and fencing with stock exclusion to encourage mallard brood use of wetlands in Southland. Further analysis on the relationship between wetland habitat and duckling survival should be investigated.

Q.2-12: Restoring a Large Freshwater Coastal Wetland on the Prairies; Waterfowl Response to Common Carp Exclusion at Delta Marsh, Manitoba

Presented by: Dale Wrubleski (d_wrubleski@ducks.ca)

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Delta Marsh is an important mid-continent waterfowl staging area in Manitoba. However, the marsh has been degraded by an artificially regulated water regime, eutrophication and invasive species, all of which have contributed to declining waterfowl numbers. A multi-agency partnership has embarked on a restoration project to address factors contributing to the deterioration of the marsh. The first phase of the restoration project consists of partial exclusion of an invasive fish species, common carp (Cyprinus carpio), which overwinter in Lake Manitoba but use the marsh as spawning and feeding habitat. Experimental field studies demonstrated that common carp contributed to habitat changes observed in the marsh, including increased turbidity, phytoplankton blooms and loss of submersed vegetation. During the winter of 2012-2013, exclusion structures were constructed on channels connecting the marsh to the lake. These structures restrict large common carp (> 70 mm maximum body width) access to the marsh. A ten-year research program (pre- and post-carp exclusion; 2009 to 2018) assessed the impacts of common carp exclusion on the marsh. In survey transects in the east unit of the marsh, the area of submersed aquatic vegetation increased sevenfold (37 ha to 267 ha) between 2009 and 2018. Northern watermilfoil (Myriophyllum sibiricum) initially dominated the submersed plant community response but sago pondweed (Stuckenia pectinata) has also increased. The waterfowl response has been positive fall staging canvasback and scaup densities have increased 20 and four times, respectively, from the decade prior to common carp exclusion, and are the highest numbers recorded since the 1960-1980s.

Q.2-13: The Efficacy of Marsh Terraces for Enhancing and Restoring Gulf Coastal Wetlands

Presented by: Madelyn McFarland (mbm391@msstate.edu)

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Marsh terracing is a restoration technique that uses in situ sediment to construct segmented ridges in open water areas of coastal wetlands. Marsh terraces are constructed primarily to: 1) reduce wave fetch and associated wave energy; 2) mitigate for marsh erosion; 3) promote growth of submerged aquatic vegetation; 4) create emergent marsh, and; 5) improve marsh conditions and habitat for various wildlife species. Over 81 projects that have constructed >980 km linear feet of terrace in coastal Texas and Louisiana have occurred since 1990. Despite terraces being a potentially viable coastal restoration technique, long-term efficacy of terraces has not been studied. Our project is comprised of a multi-disciplinary team that is using modeling, and field and remote sensing techniques to study winds, waves, sediment transport, shoreline change, submerged aquatic vegetation, and avian species habitat use across multiple marsh terrace sites in coastal Louisiana. Wintering waterfowl and secretive marsh bird surveys were conducted to compare avian habitat use in terraced fields, control sites (unterraced fields), and reference marshes (intact marsh). Although preliminary, results for some of these surveys include: 1) Terraced fields were used predominantly by non-focal species such as red-winged blackbirds; 2) there was generally low use of terraced fields by focal species such as rails; 3) there was generally low use of both terraced and control sites by wintering waterfowl, although species abundances varied spatially and temporally; 4) and vegetation surveys suggest a correlation between vegetation type and structure and avian species use of terraced fields. Ongoing monitoring efforts of submerged aquatic vegetation, emergent marsh loss and gain, and wind and wave modeling will provide further insight into these preliminary results.

Q.2-14: Use of moist-soil management for wintering waterfowl in fallow rice fields on the upper Texas coast

Presented by: Michael D. Whitson (michael.d.whitson@ttu.edu)

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Wetlands on the Texas coast provide important winter habitat for millions of waterfowl, crucial stopover sites for migrating shorebirds, year-round habitats for mottled ducks (Anas fulvigula), and summer breeding habitats for a variety of other avifauna, including fulvous whistling ducks (Dendrocygna bicolor) and black-bellied whistling ducks (D. autumnalis). Moist-soil management (MSM) is effectively used in other regions to improve the quality of wetland habitats by promoting seed and invertebrate production for waterfowl forage through manipulation of wetland hydrology to direct plant community composition towards favored hydrophytic species. The extended growing season on the upper Texas coast, and existing hydrologic infrastructure, provides an opportunity to implement a variety of MSM strategies for waterfowl. We conducted a two-year research project in 21 fallow rice fields (~260 ha) on Anahuac National Wildlife Refuge in Jefferson County, Texas. Fields were subjected to variations in inundation seasonal timing, duration, depth, and drawdown length. We quantified plant community composition, seed production, and winter invertebrate biomass to measure responses to these MSM strategies, estimate waterfowl food production, and duck-energy-days (DEDs). Highly desirable plant species (65%) dominated early-season inundated fields and accounted for 50% of the cover in fields subjected to fast drawdown treatments and 61% cover in fields subjected to slow drawdown treatments. Measured MSM plants produced enough seeds and available metabolizable energy for nearly 20,000 DEDs and biomass from estimated winter macroinvertebrate assemblages could provide metabolizable energy for an additional 45,000 DEDs on our 21 MSM fields. Collectively, these results provides strong support for MSM implementation on fallow rice fields on the upper Texas coast that will provide substantial waterfowl benefits and support regional waterfowl goals.

Q.2-15: Assessment of rapid seed yield monitoring protocols to assess foraging habitat quality in moist-soil wetlands on National Wildlife Refuges in the Southeast

Presented by: B. Cody Martin (bcm22830@uamont.edu)

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Moist-soil wetlands in the Mississippi Alluvial Valley and Southern Coastal Plain provide essential foraging habitat for migrating and wintering waterfowl. National Wildlife Refuges focus resources on managing and monitoring moist-soil wetlands to maximize seed yield which increases the number of migratory and wintering waterfowl each wetland can support. Currently available seed production assessment methods range from rapid ocular estimates with moderate or unknown precision to labor-intensive morphometric measurements with relatively high precision but limited spatial validation. Our objective was to test several published rapid seed production assessment methods against the Integrated Waterbird Monitoring and Management Program method using standard soil core sampling procedure as a control. This study was conducted on 16 moist-soil wetlands across 6 National Wildlife Refuges in Arkansas, Missouri, Mississippi, and North Carolina. Average seed yield estimates derived using the Naylor et al. 2005 and the IWMM method appear to be more conservative compared to estimates using the Laubhan 1992 method. This research is expected to assist in the validation and refinement of rapid seed yield assessment protocols for the Integrated Waterbird Monitoring and Management Program.

Q.2-16: Geographic Differences in the Wintering Sites of the Atlantic Population of Black Scoters

Presented by: Hannah M Plumpton (hplumpt@clemson.edu)

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Scott G. Gilliliand – Canadian Wildlife Service, Environment Canada, Sackville, New Brunswick, Canada
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Habitats used across a species range can vary spatially on a longitudinal and latitudinal gradient. For migratory species, such as black scoters (Melanitta americana), whose range encompasses a variety of habitats, it is especially important to obtain habitat use information across the species range. The objective of our study was to investigate the wintering sites and habitat use of black scoters in the Atlantic Ocean by quantifying area of a wintering site, distance between wintering sites, differences in habitat features for wintering sites by latitude. To quantify wintering sites of black scoters, we used satellite telemetry data from 2009 to 2012. We used generalize linear models to examine the relationship of black scoter wintering sites and habitat use by latitude. Our results indicated that the average wintering site area and distance between wintering sites varied with latitude. Wintering sites located at southern latitudes were larger and further apart than wintering sites located at more northern latitudes. Our results suggest that black scoter wintering sites in terms of area and distance vary by latitude. Additionally, wintering sites varied in bathymetry, distance to shore, and the slope of the ocean floor at different latitudes; northern wintering sites were in deeper waters, closer to shore and on steeper slopes than southern wintering sites. Our results suggest that habitat use may differ by latitude, indicating that habitats used in northern locations are not representative of habitats used in more southern wintering areas. Understanding the geographic variation in wintering sites and use, will enable managers to focus sampling effort for black scoter abundance and distribution along the Atlantic coast, and provide insight that allows for more effective conservation and management of black scoters.

Q.2-17: Habitat Assessment for Wintering American Black Ducks in the Chesapeake Bay Refuge System.

Presented by: Alicia M. Berlin (aberlin@usgs.gov)

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American black duck (Anas rubripes) utilize marshes throughout the Chesapeake Bay and are considered an indicator species of the ecosystems health. Thus, conserving and increasing black duck habitats will subsequently benefit the general health of the Bay. We used a bioenergetics model to determine the viable habitat types for wintering black ducks (where benefits outweigh costs during foraging) and modeled the influences of two stressors (sea-level rise and land use change) on these viable habitats. Captive black ducks exhibited a Type II functional response curves (intake rate exponentially increases with increases in prey density up to an asymptote) for R. maritima, Z. palustris, G. holbrooki, and M. bidentatus and a Type I functional response curve (linear relationship between intake rate and prey density) for S. validus. The critical foraging densities concluded in this study were 749 g/m2 for R. maritima, 435 g/m2 for Z. palustris, 26 g/m2 or 91fish/m2 for G. holbrooki, and 1.4 g/m2 or 24 snails/m2 for M. bidentatus. S. validus did not have a critical density as a result of having a linear relationship between intake rate and prey density. Quality habitat types for wintering black ducks when they arrive in the Fall were: 1. submerged aquatic vegetation (SAV), 2. high marsh; 3. low marsh, 4. mudflat, and 5. freshwater. Eastern shore refuges (Marshlands Refuge Complex) are at risk more from sea-level rise than development pressure, whereas, Western shore refuges (Virginia Rivers Refuge Complex) are at risk from both sea-level rise and development pressures. Ultimately the management and recovery of SAV in the Bay is potentially beneficial for wintering black ducks as long it does not become unavailable due to disturbance caused by close proximity to developed lands. Therefore, strategically placed SAV and living shoreline restoration efforts could provide more viable habitat for wintering black ducks.

Q.2-18: Yield, Waterfowl Use, and Grain Depletion on Chopped Corn Fields Long Island, New York During Winter

Presented by: Aidan J. Flores (aflore06@syr.edu)

Aidan J. Flores – SUNY College of Environmental Science and Forestry
Michael L. Schummer – SUNY College of Environmental Science and Forestry

Agricultural grains are an energy-dense food eaten by granivorous waterfowl throughout North America. Waterfowl make extensive use of waste corn following harvest and standing corn that is intentionally flooded. Chopping standing corn after the close of waterfowl season as a supplement to traditional foods could provide additional energy needed by waterfowl to survive winter and initiate spring migration. We determined initial yield, depletion rates and waterfowl use of chopped standing corn on eastern Long Island, February April, 2018 and 2019. Our aim was to determine how American black ducks (Anas rubripes) used these resources compared to mallards (Anas platyrhynchos; a habitat competitor) and Canada geese (Branta canadensis; a perceived nuisance species), estimate energy days produced, and determine the most efficient chopping schedule. Black ducks historically inhabited the northeastern portion of the United States and were the most abundant duck species until they experienced a steady population decline between 1950-1980s. Decreased winter carrying capacity for black ducks on the Atlantic Coast from urbanization, loss of coastal marsh and other stressors may necessitate novel management options. As coastal marsh habitat declines in quantity and quality and while black ducks selectively forage in these areas there may be a benefit, particularly in prolonged freeze events, to feed on a more reliable food source such as chopped standing corn fields We will present results of initial yield, waterfowl use, and grain depletion on chopped corn fields on Long Island, New York during winter 2018 and 2019.

Q.2-19: Occurrence and drivers of neonicotinoid concentrations in Missouri floodplain wetlands

Presented by: Elisabeth B. Webb (webbli@missouri.edu)

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Widespread use of neonicotinoid insecticides in North America has led to frequent detection of neonicotinoids in surface waters. Despite frequent surface water detections, little is known about neonicotinoid concentrations in floodplain wetlands. Thus, we sampled water and sediments for neonicotinoids during a one year period at 40 intensively managed floodplain wetlands throughout Missouri. Water and sediment samples analyzed for six common neonicotinoids consistently (63% of samples) contained neonicotinoids (e.g. imidacloprid, clothianidin) in all sampling periods and mean sediment and aqueous neonicotinoid concentrations were 1.19 g kg-1 (range: 0 to 17.99 g kg-1) and 0.03 g L-1 (0 to 0.97 g L-1), respectively. We used Boosted Regression Tree analysis to explain sediment neonicotinoid concentrations and ultimately identified six variables that accounted for 31.6% of concentration variability with water temperature (31.8%), % wetland planted to agriculture (23.5%), and water depth (18.3%) having the greatest variable importance scores. Therefore, efforts to mitigate sediment neonicotinoid contamination could include reducing agriculture within a wetland (<25% planted) to limit contamination. Also, prolonging periods of overlying water >25cm deep when water temperatures reach/exceed 18C could promote conditions favorable for neonicotinoid degradation. Results of this study can be useful in determining potential routes and levels of neonicotinoid exposure experienced by non-target benthic aquatic invertebrates which represent an important food resource for migrating waterfowl. Additionally, BRT results identify key mitigating factors to limit neonicotinoid contamination of wetland sediments through the reduction of seed treated agriculture within and surrounding the wetland. Further water management practices can facilitate the degradation of neonicotinoids once in sediments, as we detected concentrations in wetlands with no record of seed treatment use.

Q.2-20: A rake sampling method to estimate biomass of submersed aquatic vegetation for waterfowl in managed South Carolina coastal wetlands

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Managers of impounded brackish wetlands in coastal South Carolina manipulate water depth, hydroperiod, and salinity to promote growth of widgeongrass (Ruppia maritima) and other submersed aquatic vegetation (SAV) as forage for waterfowl. Researchers need accurate and precise methods to estimate SAV biomass and foraging carrying capacity of these wetlands for wintering waterfowl. These data are critical for habitat conservation planning and management in South Carolina. Therefore, we evaluated two rake sampling methods for predicting total and species-specific SAV biomass within managed tidal impoundments (MTIs) at Bear Island Wildlife Management Area in the Ashepoo-Combahee-Edisto Rivers Basin, South Carolina. We collected SAV from MTIs using a modified rake within 0.086 m2 cylindrical sampler (CS), a non-modified rake within 0.2-m2 quadrat (QS), and by hand within each enclosure after raking to calculate total SAV biomass (i.e., rake + hand grab = total). We used linear mixed models to evaluate rake sampling methods in predicting total (QS and CS) and species-specific SAV biomass (QS). Both rake sampling methods explained 95% of the variation in total and species-specific biomasses. Therefore, we recommend use of our rake-enclosure SAV sampling methods and regression equations to estimate SAV biomass in South Carolina MTIs and elsewhere applicable.

Q.3-01: Fecal biomarkers of stress in mallard ducks

Presented by: Breanne Murray (bam170@mail.usask.ca)

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Waterfowl populations are expected to decline because of anthropogenic and environmental changes (stressors such as altered habitat and food supply, climate change, etc.). These stressors can trigger the hypothalamic pituitary adrenal (HPA) axis to release corticosterone (CORT) which triggers a myriad of physiological processes that provide energy to deal with the stressor, restore homeostasis and increase survival. Corticosterone has been used to monitor the impacts of stressors in many species. However, as CORT can be highly variable (fluctuates amongst normal life history stages) and is impacted by acute stressors, such as handling during blood sampling, it may not be a reliable biomarker. Metabolomics is a novel tool that involves a systems approach to studying small, endogenous metabolites which participate in metabolic reactions including response to stressors. The objective of this study was to validate the use of fecal metabolomics as a biomonitoring tool in waterfowl. We hypothesized that metabolomics can be used to differentiate ducks that were subjected to a stressor (restricted feed) from unstressed control ducks. Captive mallard ducks (Anas platyrhynchos) were subjected to either a stressor of a six-day restrictive food trial (75% of basal metabolic rate, treatment, n=9) or ad lib food (control, n=9). Fecal samples were collected from ducks prior to and during feed restriction. H1 Nuclear Magnetic Resonance (NMR) spectroscopy was performed to analyze metabolites. We found that fecal metabolite profiles could be used to distinguish ducks subjected to restricted feed from control individuals. Fecal metabolomics shows promise as a non-invasive novel tool in identifying and characterizing physiological responses associated with large-scale environmental changes in wild birds.

Topics: Stress, Physiology, Mallard duck, Anas platyrhynchos, Biomonitoring, Fecal metabolites

Q.3-02: Does Diet Composition Influence Plasma-Lipid Metabolites Concentrations in Lesser Scaup?

Presented by: Cheyenne R. Beach (cr-beach@wiu.edu)

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Lipid reserves are important energy stores for endurance flights and egg production in wild birds. Plasma-lipid metabolites have been useful in assessing habitat quality for avian species during migration, particularly for wetland-obligate species. Physiological measures can provide information on whether individuals are catabolizing or accumulating lipids. Comparing known daily mass changes (DMC) with plasma-lipid metabolite concentrations provides a quantitative method to index spatial and temporal changes in lipid reserves, and thus provides a reliable technique for assessing foraging habitat quality during migration. However, there is little information regarding the effects of diet composition on metabolite concentrations. Our objective was to quantify the relationship of plasma-lipid metabolite concentrations (free triglycerides and -hydroxybutyrate; hereafter TRIG and BOHB) and diet composition. During spring migration 2017, we captured and held wild lesser scaup (Aythya affinis) in short-term captivity to control for feeding rates, amount and type of ingesta. Scaup were assigned to one of three experimental diet types (i.e., amphipods, n = 20; chironomids, n = 20; and corn, n = 19), and manually fed for the duration of captivity (~ 24 hrs). Further, we included scaup that had been fasted over duration in captivity to represent individuals that were catabolizing lipids. We obtained plasma samples upon completion of trials, froze at -20 C, and analyzed by endpoint and kinetic assays using established protocols. We used multiple linear regression to evaluate if variation in DMC was explained by TRIG and BOHB between diet types; corn diet ($R^2 = 0.48$, $P < 0.001$), chironomid diet ($R^2 = 0.13$, $P = 0.03$), and amphipod diet ($R^2 = 0.07$, $P = 0.18$). Though we are awaiting results from proximate analysis on diet nutritional values, our preliminary results suggest that diet may influence plasma-lipid metabolite concentrations and therefore, the ability to predict short-term mass changes in lesser scaup.

Q.3-03: Evaluating the Physiological Response of Sub-lethal Infections of Sphaeridiotrema spp. and Cyathocotyle bushiensis Trematodes in Captive Lesser Scaup

Presented by: Cheyenne R. Beach (cr-beach@wiu.edu)

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During fall and spring migrations throughout the upper Midwest, U.S., thousands of lesser scaup (Aythya affinis) die from Cyathocotyle bushiensis (Cb) and Sphaeridiotrema spp. (Ss) intestinal infections after consuming exotic faucet snails (Bithynia tentaculata). Lesser scaup serve as the final host for Cb and Ss while the faucet snail serves as the first and second intermediate host. As recommended by previous literature, this experimental study will evaluate the effects of sub-lethal trematode infections on the cellular immunological response, body condition, and survival of lesser scaup in the Upper Mississippi River System. Female lesser scaup (n = 48) will be hatched from wild eggs and raised in captivity at Forbes Biological Station, Havana, IL. Faucet snails will be collected by hand from Pool 7 of the Mississippi River and dissected to recover mature Cb and Ss metacercariae for infection of birds. The captive lesser scaup will undergo repeated or single dose trematode infections and will be euthanized 10 days post-infection. Information collected during this experiment will provide data to evaluate temporal changes in health along a continuum from initial infection to shedding eggs to point of euthanasia. Addressing basic questions related to physiological responses of lesser scaup to infection with trematodes will aid in potential management strategies to minimize co-occurrence of lesser scaup and infected faucet snails.

Q.3-05: Body Condition of Spring-migrating Green-winged Teal

Presented by: Samuel T. Klimas (sklimas@illinois.edu)

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Resource availability during spring migration may limit body condition of dabbling ducks at mid-latitude wetlands used as stopover sites. Body condition can impact stopover length and ability to reach breeding grounds which may affect reproductive effort. We performed proximate analysis on the carcass of 161 green-winged teal (Anas crecca, hereafter teal) collected at active foraging locations in the Illinois River Valley (IRV) during FebruaryApril 20162018. We evaluated the effects of extrinsic (e.g., wetland location and connectivity, timing, weather, river level, food availability) and intrinsic (diet composition, sex, age) factors on carcass lipid and protein levels using linear mixed models. Additionally, we used morphometric measures of collected teal to evaluate the accuracy of three commonly used non-destructive condition indices; the scaled mass index, scaled wing index, and body-size index. Carcass lipids were 18.3% (95% CI = 1.038.5) and 21.6% (4.841.0) greater at collection sites with moderate (250600 kg/ha) and high (>600 kg/ha) moist-soil seed densities, respectively, than low densities (<250 kg/ha) sites. Lipids also increased 2.4% (0.25.1) with every 10% increase in the proportion of plant seeds in diets. Carcass fat decreased 0.9% (0.41.4) and 3.8% (2.15.4) with every 1-day delay in collection date and 1-degree C rise in temperature, respectively. Non-destructive condition indices were poor (r 0.45) estimators of carcass lipid content, and we suggest researchers develop and further evaluate indices before broad application across species. While stopover duration and arrival time in the IRV likely affected body condition, the availability of quality seasonal-emergent wetlands with ample food resources may be most critical to teal body condition during spring migration.

Q.3-06: Evaluating Diet and Body Condition of Dabbling Ducks in the Rapidly Changing Landscape of the Suisun Marsh, California

Presented by: Jacqueline Satter (jmsatter@ucdavis.edu)

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The Suisun Marsh is an estuarine system adjacent to the San Francisco Bay at the confluence of rivers that drain Californias Central Valley. Historically, it supported large numbers of wintering waterfowl with current peak counts approaching 60,000. Despite high historic use of Suisun, current use by dabbling ducks has been in decline the past several decades. To better understand these declines, we conducted a comprehensive study focusing on diet preferences and corresponding body condition of seven common species of dabbling ducks in the Suisun Marsh during two winters: 2017-2018 and 2018-2019. We investigated how body condition and diet differ between species, between sexes, and across the wintering season from October to March. Diet samples were obtained by removing and analyzing contents of esophagi from hunter-donated samples (n=500, 2017-2018) and collection by pass shooting (n=700, 2017-2018 and 2018-2019). The collected specimens were extensively measured, necropsied, and homogenized. Aliquots of homogenate were sent to the UC Davis analytics lab for proximate analysis, focusing on lipid content as an index for body condition. Our study will provide insight into current food selection, food preference, and nutritional shifts of dabbling ducks in the Suisun Marsh, and will indicate how diet and nutrition relate to overall body condition across winter. We are also comparing contemporary diets of three species to corresponding historical diet data collected in the Suisun Marsh 20 years ago to examine shifts in diets over the past two decades. Current dietary preferences will inform habitat management of specific food plant species needed to support the current and targeted populations of waterfowl in this important wetland region of California.

Q.3-07: Hematological Values Across Ten Species of Diving Ducks

Presented by: Elizabeth Schell (elizabeth.r.schell@miami.edu)

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Results for several hematological characteristics are presented for ten species of diving ducks (n=81) and three species of dabbling ducks (n=16). Samples were collected in March 2019 from Kodiak, Alaska, and in May 2019 from around Fairbanks, Alaska. Birds were lethally collected and blood was collected via heart puncture. Hemoglobin concentration ([Hb]) and packed cell volume (PCV) were analyzed immediately. Mean corpuscular hemoglobin concentration (MCHC) was calculated using the collected values. Hematology values did not vary significantly between the sexes. [Hb] was significantly higher in divers versus non-divers (Students t-test, $p<0.01$). There was also a significant difference overall between species (ANOVA, $p<0.01$), and Tukeys HSD showed significant differences between two species pairs: both Long-tailed Ducks and Common Goldeneye had significantly higher [Hb] than American Wigeon ($p=0.0093$, $p=0.0207$). There were no significant differences between divers and non-divers or between species in PCV or MCHC. These results indicate that overall, diving ducks have a higher carrying capacity for oxygen in the blood through an increase in hemoglobin concentration. This could represent an adaptation in these species to facilitate transport of oxygen to the muscles under the hypoxic conditions they are subjected to while diving.

Q.3-08: Seasonal and annual variation in body condition among four diving duck species wintering in the San Francisco Bay

Presented by: Mason A. Hill (mahill@ucdavis.edu)

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As the largest estuary on the Pacific Coast of North America, San Francisco Bay (SFB) is a critically important waterfowl stop-over and wintering area. Diving ducks account for up to 75% of the waterfowl observed during the midwinter survey in SFB and adjacent managed ponds. This region is characterized by cyclical drought, increasing urbanization, non-native species invasions, and intensive water management. Consequently, diving ducks using this system are subjected to frequent changes in the quantity and quality of available habitat and associated prey. Waterfowl body condition can be a useful metric for measuring the quality of wintering ground habitat that can be linked to reproductive success and survival. Thus, our objective was to assess seasonal and annual variations in body condition of the four most abundant diving duck species (Canvasback, Greater and Lesser Scaup, and Ruddy Duck) in SFB. During November through April of 2017 - 2018 and 2018 - 2019 we collected 307 diving ducks to assess body condition using proximate analysis of moisture, lipid, protein, and mineral content. Initial generalized linear mixed models suggest that moisture and lipid content of all four species fluctuates seasonally, with some of the lowest values occurring in March when individuals should be maximizing endogenous reserves for migration and breeding. As body condition can be among the most important determinants of breeding propensity in diving ducks, understanding the underlying factors driving these trends is critical for optimizing restoration and management that can benefit diving duck winter habitat in SFB.

Q.3-09: Species-specific true metabolizable energy of California waterfowl foods

Presented by: Rob Blenk (RHBLENK@UCDAVIS.EDU)

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Energetic carrying capacity is an integral element of winter waterfowl management at a population level. Understanding the total amount of energy available to waterfowl is dependent not only on knowing the distribution of food on the landscape, but also on the true metabolizable energy content of each food item. Historically, measurements of true metabolizable energy for waterfowl have been obtained using either wild Mallards or domestic ducks as model species. However, documented differences in the internal digestive morphology of waterfowl species suggest that different functional guilds may vary in their digestive efficiency with respect to various food types. Only a single study has assessed true metabolizable energy for a waterfowl species other than Mallards, but this study did not include Mallards as a basis for comparison. I assessed true metabolizable energy of several seed species that differ in their physical characteristics. The true metabolizable energy of each of these seed species are being evaluated for four species representing a diversity of functional guilds within the dabbling duck clade: Northern Pintail (Anas acuta), Mallard (Anas platyrhynchos), Northern Shoveler (Spatula clypeata), and Gadwall (Mareca strepera). Determining whether these species differ in the amount of caloric energy they obtain from common seed foods via captive feeding experiments will provide insight into the appropriateness of generalizing estimates derived from Mallards to other waterfowl species.

Q.3-10: Variation in body condition of wintering ducks in California

Presented by: Joshua T. Ackerman (jackerman@usgs.gov)

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Michael Casazza – US Geological Survey; Western Ecological Research Center

During the fall and winter, waterfowl body condition fluctuates considerably because of habitat conditions on the wintering ground and species-specific life history strategies. Using hunter-shot birds in 3 regions of northern and central California (Sacramento Valley, San Joaquin Valley, and Suisun Marsh), we evaluated the variation in body condition, observed across 7 species of dabbling ducks (Anas spp.) and 2 species of diving ducks (Aythya spp.). We observed significant regional variation in body condition among dabbling duck species, where nearly all species were heavier in the agricultural rich Sacramento Valley. In contrast, regional variation in diving ducks was significantly less pronounced. In addition, we observed lighter dabbling ducks during a severe California drought (2014-2016) than was observed during a much wetter winter period (2007-2008). We did not observe significant regional differences in how the drought affected dabbling ducks that might indicate a specific region would be more resilient to drought than another. Finally, we observed temporal variation among species through the winter season. Dabbling ducks typically increased in mass during the early winter season (November / early December), followed by a significant decrease in mass that continued until the end of January. In contrast, diving ducks continued to increase in mass much later into the season (late December / early January). For some species these dynamics may represent decreasing habitat quality throughout the season, but these trends are also a documented life history strategy for many waterfowl species. Our results indicate that dabbling ducks are currently in better condition than historically, but the declining condition throughout winter should be investigated further to determine if this is due to limited food availability as seed reserves are depleted.

Q.3-11: Gastrointestinal parasites of Lesser Scaup wintering on Lake Pontchartrain, Louisiana

Presented by: Kevin M. Ringelman (kringelman@agcenter.lsu.edu)

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High intensities of helminth infection have been documented to cause direct mortality or induce morbidity during the non-breeding period in waterbird species of conservation concern. One such species, the Lesser Scaup (Aythya affinis), suffers from sub-lethal effects of parasite infection, including declines in body condition which can carry-over to affect breeding success and overall population health. While scaup parasites have received substantial attention on spring migratory staging grounds in the Midwest, only one has examined intestinal helminth infections on the wintering grounds where scaup begin building lipid reserves for migration. We enumerated helminths in the lower gastrointestinal systems of 33 scaup collected from a major scaup wintering habitat, Lake Pontchartrain, Louisiana during winter 2016. 75% of scaup were infected with a total of 465 helminths (mean abundance 14.09 4.07 SE). Helminth abundance did not vary by sex, but there was a weak trend for juveniles to have higher parasite abundance (= 23.2 8.9 SE) than adults (= 8.2 3.0 SE). We found no significant relationship between helminth abundance and body condition, likely because so few parasites infected the scaup in our sample. Our helminth counts from scaup wintering on Lake Pontchartrain were substantially lower than those observed in scaup elsewhere in the Mississippi Flyway. We identified three trematode species (Psilochasmus oxyurus, Zygocotyle lunata, and Echinoparyphium recurvatum) infecting the scaup. None of the known first intermediate hosts for these parasites have been found in Lake Pontchartrain, suggesting that this lake may provide a refuge from parasites for wintering scaup.

Q.3-12: Blood-lead concentrations in mottled ducks (Anas fulvigula) in the Louisiana Chenier Plain

Presented by: Joseph R. Marty (jmarty@wlf.la.gov)

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The Western Gulf Coast is home to approximately 90% of the worldwide population of

mottled ducks (Anas fulvigula), a nonmigratory species that must satisfy its annual cycle needs within a small geographic range. Population survey data suggest the Western Gulf Coast mottled duck population is experiencing declines in Texas and Louisiana. In Louisiana, coastal marsh and agricultural habitats are utilized by mottled ducks year round, yet these habitats are characterized by long traditions of waterfowl and other game-bird hunting, which potentially exposes mottled ducks to historical sources of lead persisting in the environment. Evidence suggests that mottled ducks and other waterfowl continue to ingest lead pellets despite strict shotshell regulations. In 2017, we collected blood samples (n = 124) from molting mottled ducks captured during banding efforts in Louisiana and from hunter-harvested mottled ducks during winter to determine blood lead and antimony concentrations. We found that 14% of mottled ducks contained elevated levels of lead (>200ppb), 1.5% contained toxic but sub-lethal levels of lead (500-1,000ppb), and no mottled ducks contained lethal levels of lead (>1,000ppb). We found no difference in lead concentration between age and sex of mottled ducks, and found a slightly negative, yet weak correlation between lead concentration (ppb) and body weight (g; R2 = 0.018). Lead and antimony isotope ratios showed correlation with lead shot exposure and all samples considered elevated had isotope ratios matching lead shot. Blood lead concentrations remain elevated in mottled ducks in Louisiana and Texas despite lead shot bans nearly 30 years ago. If lead levels in mottled ducks becomes an elevated concern, identifying habitats and areas where lead shot density and exposure is greatest would be an appropriate step towards reducing future threats. Additionally, identifying potential available sources of environmental lead will be important to minimizing this persistent threat to mottled ducks.

Q.4-01: Bluebills and bayou bivalves: hurricane-driven trophic cascades affect wintering abundance of Lesser Scaup in Louisiana

Presented by: Kevin M. Ringelman (kringelman@agcenter.lsu.edu)

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The estuaries of Louisiana overwinter a continentally-significant proportion of Lesser Scaup (Aythya affinis; colloquially, bluebills), a species of conservation concern since population declines began in the 1980s. Thirty-eight years of aerial waterfowl surveys of Lake Pontchartrainan oligohaline estuarine lagoon in southeast Louisianashow that scaup abundance fluctuates between 0 and 1,194,907 birds, though the mechanisms driving this variation are unknown. Previous studies have shown that scaup feed primarily on mollusks, so changes in the benthic prey community have the potential to strongly influence scaup dynamics on the Lake. Benthic communities are in turn shaped by both natural and anthropogenic disturbances (e.g., hurricanes and spillway openings), potentially creating a lagged bottom-up trophic cascade that ultimately affects scaup abundance. Here, we evaluated diet of scaup collected from Lake Pontchartrain and found that scaup consumed almost entirely mollusks, especially selecting medium-sized (616 mm) common rangia clams (Rangia cuneata). Scaup also selected dark false mussels (Mytilopsis leucophaeata) and dwarf surf clams (Mulinia lateralis) relative to their availability. Having established important diet items for scaup, we then used 22 years of paired benthic invertebrate and aerial waterfowl survey data to diagnose their covariation in relation to environmental disturbance. We found scaup abundance increased with the abundance of medium-sized rangia and dwarf surf clams. Those prey species declined in years when the Lake was hit by a hurricane, but medium-sized Rangia rebounded strongly the year after, likely because storm surge salinity induces spawning. Using long-term aerial survey data for scaup, we indeed found strong scaup declines on the Lake in years when a hurricane made landfall, but scaup abundance increased the following year, presumably responding to large numbers of medium-sized rangia. Our multi-part analysis makes a strong case for a hurricane-driven bottom-up trophic cascade that affects scaup abundance on Lake Pontchartrain.

Q.4-02: Changes in Waterfowl Abundance and Species Composition in Coastal Louisiana

Presented by: Joseph R. Marty (jmarty@wlf.la.gov)

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Coastal Louisiana supports more than one quarter of the continental dabbling duck population during winter. Thus, considerable effort is allocated to monitoring waterfowl abundance in coastal Louisiana with implications for future waterfowl research and habitat management in the region. We conducted monthly surveys on nine state-owned coastal wildlife management areas and refuges, NovemberJanuary 20042016. Across all sites and survey years, the most commonly observed species were gadwall (Mareca strepera), green-winged teal (Anas crecca), and mallard (Anas platyrhynchos). Despite increases in continental breeding population indices to near record highs, their populations were stable region-wide in coastal Louisiana, with minor declines on some heavily-hunted and unmanaged areas. In contrast, northern pintail (Anas acuta) experienced a precipitous decline region-wide and on four of the nine major wintering areas surveyed. We hypothesize that this decline is related to changes in coastal and agricultural habitats. Diving duck populations tended to be increasing or stable: lesser scaup (Aythya affinis) increased on two areas, and ring-necked ducks (Aythya collaris) increased substantially on one area, perhaps because of increases in water depth from increased rainfall and changes in water management capacity on these areas. Our results demonstrate the utility of aerial surveys for monitoring waterfowl populations and documenting important trend data for commonly observed species.

Q.4-03: Use of banding age ratios to characterize drivers of temporal variation in fecundity

Presented by: Todd Arnold (arnol065@umn.edu)

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Fecundity estimates for demographic modeling are difficult to acquire at the regional spatial scales that correspond to climate shifts, land use impacts or habitat management programs, yet are important for evaluating such effects. Widely available age ratios from late-summer banding data present an underutilized opportunity to examine a regional fecundity index with broad temporal replication. We used age ratios from banding data and hierarchical mixed-effect models to examine how fecundity of five North American dabbling duck species was affected by temporal variation in hydrological cycles, intra- and inter-specific density dependence and alternate prey availability, and whether those relationships were consistent across a broad geographic area. Ecological covariates explained between 16 and 53% of the temporal variation in fecundity. Increasing wetland inundation and an indicator of vole population irruptions were consistent predictors of increasing fecundity across all species. Species exhibited mixed positive and negative responses to interspecific and intraspecific breeding pair densities hypothesized to affect nest and brood survival respectively. Declines in fecundity over time and across space may reflect stronger policies for grassland and wetland protection in the U.S. versus Canadian portions of the prairies. Maintaining the capacity of less permanent basins to rehydrate in wetter periods benefits fecundity. Age ratios at capture could be useful as a fecundity metric in integrated population models and for evaluating population dynamics of extensively banded species, especially if adjusted for capture vulnerability using within-season recapture data.

Q.4-04: Combining professional and citizen data sets to quantify spatiotemporal dynamics of the Sandhill Crane

Presented by: Marcel Darveau (m_darveau@ducks.ca)

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The eastern population of Sandhill Crane (Antigone canadensis) is showing an increasing trend since the 1980s, and its geographic range is expanding. More opportunistic than most waterfowl species, this wetland-nester feeds also in agricultural land. In Qubec, crop damage seems particularly important in the Boreal Transition Zone, where agricultural lands are close to extensive areas of wetlands. The aim of this project is to better understand the habitat use by the Sandhill Crane during breeding season in the context of global change to inform population management and agricultural practices. Our objectives are to (i) identify the factors explaining crane distribution in Qubecs landscapes, (ii) construct a spatiotemporal model using existing historical data, and (iii) project this model in the future according to different climate change scenarios. We combined three data sets in occupancy models to estimate changes in the crane distribution after accounting for detection probability. These data sets consisted of (i) the Breeding Waterfowl Plot Survey of Eastern Canada, a helicopter survey conducted annually by the Canadian Wildlife Service since 1990; (ii) the Second Breeding Bird Atlas of Southern Qubec, a 5-year citizen science project; and (iii) the online citizen-science database eBird. The 10 x 10 km atlas grid was used to divide the 540,000 km study area into spatial units. Preliminary analyses indicate that annual (April to June) detection probability was 0.80 for CWS surveys, 0.12 for the Atlas, and 0.25 for eBird. Our occupancy models allow the production of maps that provide a more complete coverage of the study area and time periods, leading to a better understanding of current and future colonization and extinction patterns of this rapidly increasing species (12% annual increase from 2000-2016).

Q.4-05: Estimating Contributions to Continental Fecundity in Northern Pintails

Presented by: Dennis Dongmin Kim (kimx3725@umn.edu)

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Vulnerability-adjusted age ratios at harvest are widely used to estimate fecundity in hunted populations of birds. However, one drawback to using this method for migratory waterfowl is that fecundity represents a mixture of all contributing source populations, so it can be difficult to pinpoint particular breeding regions that contribute to above- or below-average recruitment, especially for birds harvested in the southern United States. Using northern pintails as a case study, we explore how annual variation in age ratios at harvest for the Pacific Flyway and Midcontinent Regions are differentially affected by recruitment in Alaska versus the Prairie Pothole Region by modeling harvest age ratios in each wintering population as latent mixtures of birds from each of the two breeding source populations. This work represents a critical step in parameterizing the northern pintail meta-population model developed by Mattsson and colleagues.

Q.4-06: Changes in winter goose abundance and distribution in the Central and Mississippi flyways 19552018

Presented by: James M. Whitaker (jwhitaker@wlf.la.gov)

James M. Whitaker – Louisiana Department of Wildlife and Fisheries
Kevin M. Ringelman – Louisiana State University AgCenter

Lesser snow geese (Anser caerulescens), Rosss geese (A. rossii) (collectively, light geese), and greater white-fronted geese (A. albifrons) historically wintered in the Central Valley of California and coastal Louisiana and Texas. However, recent mid-winter waterfowl surveys in Louisiana and Texas suggest that the abundance and distribution of mid-continent geese is changing, with more geese overwintering farther north. We analyzed 63 years (1955-2018) of aerial mid-winter survey data from Central and Mississippi flyway states to investigate long-term distribution and abundance trends in light and white-fronted geese. Light goose abundance has declined in Texas and Louisiana over the last 20 years, and their distribution has shifted towards Arkansas, Missouri, and Kansas. On the other hand, greater white-fronted goose populations have continued to increase throughout the region, but their distribution has changed dramatically. Texas and Louisiana historically overwintered nearly 100% of white-fronted geese in their respective flyways, but in the last 10-20 years have supported less than half of the flyway populations, with major redistributions to Kansas and Arkansas. Coastal marshland loss, increased salinities, shoreline erosion, and warmer winters, coupled with anthropogenic changes (e.g., increased rice production) are likely contributing to the decline in goose abundance in Texas and Louisiana. We suggest that light and dark geese may be utilizing habitats further north in the Mississippi Alluvial Valley because of the high-energy food resources that rice and moist-soil seeds provide for migrating and wintering waterfowl.

Q.4-07: Evaluating dynamics of habitat resource availability for Lesser Scaup at Pools 13 and 19 of the Mississippi River

Presented by: Lauren D. Larson (l-larson@wiu.edu)

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The Lesser scaup (Aythya affinis; hereafter, scaup) is an omnivorous diving duck listed as a focal species of concern in the Midwest. Since the 1970s, the continental scaup population has declined notably, with numbers well below the 6.3 million goal set forth by the North American Waterfowl Management Plan. Several factors have been implicated in the scaup decline, including decreased available food sources during migration, specifically those at key staging areas of the Upper Mississippi River System (UMRS). Navigational Pool 19 of the UMRS is a crucial stopover site for migratory waterfowl, as there are few mid-latitude habitats with similar resources. Pool 19 itself has experienced changes in hydrology, traffic, and sedimentation since the installation of the Keokuk lock and dam system in 1913. Unlike other navigational pools of the UMRS, few aquatic invertebrate and vegetation evaluations have been conducted on Pool 19 in relation to environmental factors. Our research will seek to create a spatial and temporal habitat assessment of Navigational Pools 13 and 19 using historical and current data. We will use aquatic surveys to characterize distribution and density of vegetation and macroinvertebrates. We will use aerial survey data to evaluate Lesser Scaup abundance in relation to habitat factors. Lastly, we will conduct true metabolizable energy (TME) trials using wild-caught scaup to establish energy values for common diet items. Though results will be preliminary, we plan to present detailed objectives, study design, and management outcomes. This information will be used to determine energetic carrying capacity of those areas in response to current and future environmental change. Findings may also contribute to the geographical prioritization of conservation efforts and the development of habitat enhancement strategies.

Q.4-08: Impact of preharvest mortality on waterfowl population estimation using Lincolns method

Presented by: Ray T. Alisauskas (ray.alisauskas@canada.ca)

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Banding waterfowl, in combination with the citizen science provided by hunters that report marks from harvested birds, is a long-standing, institutionalized practice for estimating probabilities of survival and exploitation, i.e., harvest from such populations. However, estimation of range-wide population abundance is also possible from these data when combined with total population harvest. Waterfowl marking with uniquely identifiable bands done during late summer in North America is often referred to as preseason banding. Mass capture of arctic geese for preseason banding is normally done in July (nonbreeders) or August (failed breeders and breeders with young) during flightless molt of respective groups. An important assumption for proper inference about harvest rate provided from such samples of birds is that there is no mortality, natural or otherwise, during the interval between when birds are marked and the time that hunting seasons begin. Using simulation pertinent to midcontinent snow goose biology, we evaluated the effect of variable mortality that could occur between marking in the arctic and subsequent hunting seasons in Prairie Canada on estimates of survival and recovery probability of both juvenile and adult geese. There was no effect on survival probability during the interval between annual banding in subsequent years, but recovery probability and thus harvest probability was directly and inversely related to pre-harvest mortality of juvenile geese. We discuss the implications for inference about population abundance of midcontinent snow geese and other waterfowl drawn from Lincolns estimator.

Q.4-09: Reproductive consequences of climate variability in migratory birds: evidence for species-specific responses to spring phenology and cross-seasonal effects

Presented by: Amelia J. Raquel (araquel@ducks.org)

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Climate change is altering global temperature and precipitation regimes, and the ability of species to respond to these changes could have serious implications for population dynamics. Flexible species may adjust breeding dates in response to advances in spring phenology. Furthermore, in migratory bird species, conditions experienced during the non-breeding season may have cross-seasonal effects during the subsequent breeding season. We evaluated species-specific responses to antecedent non-breeding (winter) and current breeding (spring) conditions. We used a dataset composed of 21,230 duck nests from 164 sites in the Canadian Prairie Pothole Region, 1993–2011, to determine how environmental conditions influenced timing of nesting and subsequent nest survival in eight duck species representing varying life-histories. We tested how species responded in timing of nesting and nest survival, respectively, to El Nio Southern Oscillation (ENSO) conditions experienced during the preceding non-breeding season (winter; Dec-Feb), and spring (Mar-Jun) temperature and moisture conditions on the breeding grounds. Ducks tended to nest earlier in warmer springs; however, in El Nio winters, with warmer spring temperatures, nesting tended to be later. We did not find evidence for direct effects of environmental variables on nest survival; however, evidence of indirect effects of winter conditions on nest survival for some species via strong direct effects on timing of nesting provides new insights into mechanisms for cross-seasonal effects on reproductive success.

Q.4-10: Scaup Banding on Great South Bay, Long Island, New York

Presented by: Jake Chronister (Chronisterjake@gmail.com)

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Michael L. Schummer – Roosevelt Waterfowl Ecologist, State University of New York College of Environmental Sciences and Forestry, Syracuse, NY

Historically, tens of thousands of greater scaup (Aythya marila) wintered at Great South Bay, Long Island, New York but this population declined to near zero by the early 1990s. Since super-storm Sandy in 2012, numbers of wintering scaup increased substantially and were at historic levels in 2018 and 2019. It is hypothesized that super-storm Sandy flushed Great South Bay of legacy organic matter and pollutants, revitalizing sand substrates and traditional foods of molluscivorous ducks (e.g., duck clams [Gemma gemma]). Because of the return of scaup to Great South Bay, we established a scaup banding station there, February – April 2019, to determine the feasibility of trapping and banding 1,000s of scaup per winter. Our aim was to help meet continental banding goals for scaup and facilitate winter population estimates using mark-recapture methodology. We captured 1,141 scaup (925 lesser [Aythya affinis] and 216 greater scaup) over four weeks at two traps sites; and 161 and 17 were recaptures of lesser and greater scaup, respectively. We will present results of mark-recapture analyses to estimate populations of lesser and greater scaup and determine factors affecting capture probabilities at Great South Bay.

Q.4-11: Survival and recovery rates of Canada geese in urban areas of Iowa

Presented by: Ben Luukkonen (bzluukko@iastate.edu)

Ben Luukkonen – Iowa State University
Robert Klaver – USGS, Iowa Cooperative Fish and Wildlife Research Unit
Orrin Jones – Iowa Department of Natural Resources

Temperate-breeding Canada goose (Branta Canadensis maxima) populations have increased to historic levels, providing social, ecological, and economic value. However, human-goose conflict including reduced water quality, damaged landscape aesthetics, crop depredation, and safety concerns related to aircraft strikes are costs associated with Canada geese. The adaptability of geese to urban areas creates novel problems that traditional wildlife management actions may not fully address. Our goal was to compare survival and band recovery rate estimates for Canada geese in urban and rural areas of Iowa to assess potential differences in population trends and efficacy of hunting to manage goose populations in urban areas. We hypothesized survival would be greater and recovery rates lower for geese banded in urban areas compared to rural areas. We analyzed capture histories of 69,316 geese banded in Iowa between 1999 and 2017 using Burnhams joint live-dead recovery model in Program MARK with package RMark. This allowed us to use data from live recaptures (n=7,471) of Canada geese in addition to banding and dead recovery (n=25,207) data. We examined age (juvenile, sub-adult, or adult), year, time, banding site (urban or rural), harvest regulation index, and winter severity index. The top-ranked model held 78% of the model weight and indicated age and winter severity were influential on survival and recovery rates, while the second-ranked model held 21% of the model weight and indicated survival and recovery rates were a function of age, winter severity index, and banding site. Survival estimates indicated urban-banded juveniles may have lower survival and urban-banded sub-adults may have higher survival compared to juveniles and sub-adults banded in rural areas. Urban goose populations likely have different vital rates than rural populations, potentially warranting different management strategies to achieve population goals.