TUESDAY, 2 FEBRUARY 2016		
06:30 - 08:00	*Breakfast in Capital Ballroom*	
08:10 - 08:20	**Welcoming Address:** Drs. Chris Williams, *University of Delaware* & Larry Hindman, *Maryland Department of Natural Resources*	
Capital Ballroom **08:20 - 09:40**	**A.1: Plenary**	
8:20	**A.1.1: Plenary Dan Ashe** **The Migratory Bird Treaty at 100: Charting a Course for the Next Century of Bird Conservation** (Dan Ashe*)	
9:00	**A.1.2: Plenary Jerome R. Serie & Robert J. Blohm** **Migratory Bird Treaty: Legacy and Foundation for Waterfowl Management in North America** (Jerome R. Serie*, Robert J. Blohm*, David Sharp)	
09:40 - 10:00	*Coffee break*	
Capital Ballroom **10:00 - 12:00**	**B.1: Waterfowl Legacies: Pioneering Diplomacy, Science, and Management: Celebrating 100 Years of the Migratory Bird Treaty Act** (Organizer: Chris Williams)	
10:00	**B.1.1: Perry**	**Management Research on Waterfowl Life Cycles, Populations and Energetics** (Matthew C. Perry*)
10:25	**B.1.2: Fredrickson**	**A Century of Land Management Evolution: From Guess Work to Complex Decision-making in Highly Modified Landscapes Exhibiting Extreme Variability** (Leigh H. Fredrickson*, Murray K. Laubhan, Kenneth Higgins, Sammy King)
10:50	**B.1.3: Batt**	**Shifting Paradigms for Prairie Habitat Conservation** (Bruce Batt*, James K. Ringelman)
11:15	**B.1.4: Sedinger, J.**	**Eighty-five Years of Monitoring and Modeling Waterfowl Populations** (James S. Sedinger*, Ray T. Alisauskas, James O. Leafloor)
11:40	**B.1.5: Anderson**	**Evolving Perspectives on Waterfowl Research and Conservation: Scale, System Integrity and Human Impacts** (Michael G. Anderson*, David Trauger)
12:00 - 13:20	*Lunch break in Capital Ballroom*	
Capital ABC **13:20 - 15:20**	**C.1: Current Issues in the Conservation and Management of Sea Ducks** (Organizer: Chris Dwyer)	
13:20	**C.1.1: Koneff**	**Prioritizing Research and Monitoring to Improve Sea Duck Harvest Management** (Mark D. Koneff*, Chris P. Dwyer, Guthrie S. Zimmerman, Kathleen K. Fleming, Paul I. Padding, Patrick K. Devers, Fred A. Johnson)

*Speaker; ^Student

13:40	**C.1.2: Dwyer**	**Defining Sea Duck Populations: What We Wish We Could Measure and How To Interpret What We Can Measure** (John M. Pearce*, Paul. L. Flint, Sarah S. Sonsthagen)
14:00	**C.1.3: Rothe**	**Understanding the Diverse Sea Duck Harvest Communities for Responsive Management and Conservation** (Tom Rothe*, Liliana C. Naves)
14:20	**C.1.4: McClellan**	**Identifying Areas of Importance for Sea Ducks Throughout Their Annual Cycle** (Nic McLellan*, Tim Bowman, Sean Boyd, Shannon Badzinski, Christine Lepage, Scott Gilliland)
14:40	**C.1.5: Silverman**	**Sea Duck Habitat Associations along the Atlantic Coast of the United States** (Emily Silverman*, Anthony Roberts, Kyle Detloff)
15:00	**C.1.6: Boyd**	**Pacific Harlequin Ducks are Altering their Molt Behavior** (W. Sean Boyd*)
Capital D **13:20 - 15:20**	**C.2: Foraging, Nutrition, and Energetics of Waterfowl: The Foundations of Habitat Management** (Organizers: Scott McWilliams, Bruce Dugger)	
13:20	**C.2.1: Heitmeyer**	**Energetics and Nutrition of Migrating and Wintering Dabbling Ducks – What Have We Learned in the Past 50 Years and Where Should Management be Headed** (Mickey E. Heitmeyer*)
13:40	**C.2.2: Heitimeyer**	continued
14:00	**C.2.3: Lovvorn**	**Are Detailed Energetics Studies Needed to Assess Habitat Requirements? Allometry, Mechanistic Models, and Other Confounding Factors** (James R. Lovvorn*, Susan E. W. De La Cruz, John Y. Takekawa, Samantha E. Richman)
14:20	**C.2.4: Webb**	**An Empirical Evaluation of Landscape Energetic Models: Mallard and American Black Duck Space Use During the Non-breeding Period** (William S. Beatty, Elisabeth B. Webb*, Dylan C. Kesler, Luke W. Naylor, Andrew H. Raedeke, Dale D. Humburg, John M. Coluccy, Gregory J. Soulliere)
14:40	**C.2.5: Johns^**	**Influences of Individual Quality and Energetic Carry-Over Effects on Reproductive Success: Evidence from Dabbling Ducks** (David W. Johns*, Robert G. Clark)
15:00	**C.2.6: Williams**	**Improving Bioenergetic Carrying Capacity Estimates by Including Morphometrics in Cost of Thermoregulation** (Christopher K. Williams*, Mark C. Livolsi, Scott R. McWilliams)

*Speaker; ^Student

Senate 13:20 - 15:20	**C.3: Breeding Ecology 1** (Chair: Joe Marty)	
13:20	**C.3.1: Hepp**	**Importance of Reproductive Costs and Quality of Female Wood Ducks on Survival and Future Reproductive Success** (Robert A. Kennamer*, Gary R. Hepp*, Bradley W. Alexander)
13:40	**C.3.2: Dyson^**	**Habitat Selection and Survival of Female Wood Ducks and Ducklings at Long Point, Ontario** (Matthew E. Dyson*, Ted Barney, Hugh A.L. Henry, Michael L. Schummer, Scott A. Petrie)
14:00	**C.3.3: Hartke**	**A Breeding Population Survey for Western Gulf Coast Mottled Ducks** (Kevin M. Hartke*, Larry A. Reynolds, Kathy Fleming)
14:20	**C.3.4: Carrlson**	**Duck Brood Abundance in the Prairie Pothole Region of North and South Dakota** (Kaylan M. Carrlson*, C. Tanner Gue, Johann A. Walker, Charles R. Loesch)
14:40	**C.3.5: Eichholz**	**Area Sensitivity of Productivity in Mixed Grass Prairie Upland Nesting Ducks** (Mike Eichholz*, Ryan D. Hafflel)
15:00	**C.3.6: Feldheim**	**Ecology of Breeding Mallards in California: a Synthesis of Existing Information, and the Challenges of Harvest Management at a Local Scale** (Cliff L. Feldheim*, Joshua T. Ackerman, Joseph P. Fleskes, Shaun L. Oldenburger, Gregory S. Yarris)
Caucus 13:20 - 15:20	**C.4: Climate Change** (Chair: Lena Vanden Elsen)	
13:20	**C.4.1: Guillemain**	**Combined Effects of Climate Change and Fluctuating Habitat Quality on the Distribution of Ducks in Southern Europe** (Matthieu Guillemain*, Jocelyn Champagnon, Claire A. Pernollet, Olivier Devineau, Johan Elmberg, François Cavallo, Grégoire Massez)
13:40	**C.4.2: Nilsson**	**Changes in Numbers and Distribution of Wintering Waterbirds in Sweden 1966 – 2015** (Leif Nilsson*)
14:00	**C.4.3: Vanden Elsen^**	**Factors Influencing Autumn-Winter Distributions of Dabbling Ducks in The Atlantic and Mississippi Flyways** (Lena M. Vanden Elsen*, Michael L. Schummer, Scott A. Petrie, Christopher G. Guglielmo)
14:20	**C.4.4: Schummer**	**Weather Severity Indices for Estimating Influences of Climate on Autumn-Winter Distributions of Waterfowl and Hunter Opportunity and Satisfaction** (Michael L. Schummer*, Michael Notaro, Lena M. Vanden Elsen, John Collucy, Michael Mitchell, and Robb Macleod)

*Speaker; ^Student

14:40	**C.4.5: Beaman^**	**Implications of Climate Change for Land Use and Waterfowl Productivity in Prairie Canada** (Benjamin C. Beaman*, Benjamin S. Rashford, David W. Howerter, Christopher T. Bastian, Timothy J. Robinson)
15:00	**C.4.6: Baranyuk**	**Current Status of Lesser Snow Geese on Wrangel Island, Russia** (Vasiliy V. Baranyuk*)
15:20 -15:40	*Coffee break*	
Capital ABC **15:40 - 17:40**	**D.1: Current Issues in the Conservation and Management of Sea Ducks** (Organizer: Chris Dwyer)	
15:40	**D.1.1: Hindman**	**Avian Cholera Epizootics in Sea Ducks and Sea Birds On Chesapeake Bay** (Larry J. Hindman*, Gary Costanzo, William F. Harvey, Mark A. Wilson)
16:00	**D.1.2: Spragens**	**San Francisco Bay Diving Duck Ecology: Distribution, Movements and the Unknown** (Kyle A. Spragens*, Susan E.W. De La Cruz, Lacy M. Smith, Stacy M. Moskal, John Y. Takekawa, Cheryl Strong, Orien Richmond)
16:20	**D.1.3: Wiese**	**Are Common Eider Nest Predators Limiting Species Recovery?** (Wilhelm L. Wiese*, Christopher J. Latty)
16:40	**D.1.4: Bowman**	**What Tools Do We Have for Sea Duck Conservation and What Constituencies Do We Need to Engage?** (Tim Bowman*, Christine Lepage, John Takekawa)
17:00	**D.1.5: Bowman**	continued
17:20	**D.1.6: Dwyer**	**Industrial Interests within Arctic and Marine Environments of Importance to Sea Ducks** (James Woehr*, Mary Boatman, H. Grant Gilchrist) **Are We Addressing the Right Things at the Right Scale?** (Chris Dwyer*)
Capital D **15:40 - 17:40**	**D.2: Foraging, Nutrition, and Energetics of Waterfowl: The Foundations of Habitat Management** (Organizers: Scott McWilliams, Bruce Dugger)	
15:40	**D.2.1: Guillemain**	**Foraging, Nutrition, and Energetics of Waterfowl: A European Perspective** (Matthieu Guillemain*, Claire A. Pernollet, Céline Arzel, Johan Elmberg, John Eadie)
16:00	**D.2.2: Guillemain**	continued
16:20	**D.2.3: Alisauskas**	**Diet and Nutrition of King Eiders and Long-tailed Ducks Arriving to Breed at Karrak Lake, Nunavut** (Ray T. Alisauskas*, Dana K. Kellett)
16:40	**D.2.4: Perry**	**Geographic and Interspecific Variation of Seaduck Food Habits In Northeastern North America** (Matthew C. Perry*, Peter C. Osenton, Alicia M. Wells-Berlin)

*Speaker; ^Student

17:00	**D.2.5: Coluccy**	**True Metabolizable Energy of Waterfowl Foods: Our Current Understanding and Implications for Conservation Planning** (John M. Coluccy*, Matt T. DiBona, Bruce D. Dugger, Mark C. Livolsi, Mark J. Petrie, Kevin M. Ringelman, Chris K. Williams)
17:20	**D.2.6: Krapu**	**Effects of Recent Trends in Agriculture on Waterfowl Nutrition and Energetics** (Gary L. Krapu*)
Senate **15:40 - 17:40**	**D.3: Breeding Ecology 2** (Chair: Clark Nissley)	
15:40	**D.3.1: Pöysä**	**Environmental Conditions in Early Life, Recruitment Age and Performance at First Breeding in Common Goldeneye Females** (Hannu Pöysä*, Robert G. Clark, Antti Paasivaara, Pentti Runko)
16:00	**D.3.2: Craik**	**Potential Role of Brood Parasitism on High Rates of Nest Desertion for Red-breasted Mergansers** (Shawn R. Craik*, Rodger D. Titman, Mohammadi Kaouass, Éric Tremblay)
16:20	**D.3.3: Ward**	**Changes in Pacific Black Brant Breeding Productivity Through Space and Time** (David H. Ward*, Robert A Stehn, Courtney Amundson, Christian P. Dau)
16:40	**D.3.4: Nissley^**	**Assessing Pre-emptive and Apparent Competition Exhibited by Cackling Geese and Lesser Snow Geese on Breeding Atlantic Brant** (Clark Nissley*, Christopher K. Williams, Kenneth F. Abraham)
17:00	**D.3.5: Straub**	**Simulations of Wood Duck Recruitment from Nest Boxes in Mississippi and Alabama** (Jacob N. Straub*, J. Brian Davis, Guiming Wang, Richard M. Kaminski, Bruce D. Leopold)
17:20	**D.3.6: Stair***	**Tracking the Breeding Ecology of Cavity-Nesting Waterfowl with RFID Devices** (Tez Stair*, Ami Olson, Cara Thow, Eli Bridge, Bruce Lyon, John Eadie)
Caucus **15:40 - 17:40**	**D.4: Habitat Use** (Chair: Fritz Reid)	
15:40	**D.4.1: Janke^**	**Novel Contributions of Wetlands in Agricultural Landscapes to Duck Migration in the Southern Prairie Pothole Region** (Adam Janke*, Michael Anteau, Joshua Stafford)
16:00	**D.4.2: Schepker^**	**Evaluating Relationships Amongst Local and Wetland Landscape Structure in Determining Waterfowl Habitat Use** (Travis J. Schepker*, Elisabeth Webb, Ted LaGrange)
16:20	**D.4.3: Palumbo^**	**Habitat Selection and Survival of Female Mallards in the Lake St. Clair Region During Autumn and Winter** (Matthew D. Palumbo*, Michael L. Schummer, Scott A. Petrie)

*Speaker; ^Student

16:40	**D.4.4: Foth^**	**Waterbird Use of Wetlands and Aquaculture Ponds in the Mississippi Alluvial Valley and Gulf Coast Regions** (Justyn R. Foth*, Francisco J. Vilella, Richard M. Kaminski)
17:00	**D.4.5: Pernollet^**	**Winter Flooding and Use of Rice Fields by Waterfowl in Europe: Towards Mutual Benefits for Ducks and Farmers** (Claire A. Pernollet*, François Cavallo, David Simpson, Anne Brogi, Amadou Niang, Michel Gauthier-Clerc, Matthieu Guillemain)
17:20	**D.4.6: Austin**	**Habitat Use of Postbreeding Female Lesser Scaup** (Jane E. Austin*, Shawn O'Neil, Jeffrey M. Warren)
17:40 - 19:00	*Dinner break - on your own*	
Senate **17:30 - 18:30**	**Pintail Action Group Meeting/Scaup Action Team**	
17:30	**Welcome and Logistics**	
17:35	**Updates on Directed Studies of Northern Pintails** **Body Condition on the Texas Coast** (Bart Ballard*) **Pacific Flyway Pintail-related USGS Research Update** (Joe Fleske*) **Conservation Planning Pertinent to Pintails in the Intermountain West** (Josh Vest*) **Breeding Pintails: an Update on Recent Prairie Research** (Jim Devries*) **Fidelity of Pintails to Minto Flats** (Mark Lindberg*) **Duckling Survival Rates in Relation to Habitat in PPR** (David Johns*)	
18:20	**Updates on Directed Studies on Scaup** **Evaluating Scaup Populations in Response to Spring Phenology** (Dave Messmer*) **Body Condition and Diet of Scaup during Spring** (Mark Lindberg*) **Update on the Long-term Demographic Study of Lesser Scaup in SW Montana** (Jeff Warren*)	
18:50 - 19:00	*Break*	
19:00	**Modeling Studies** **Northern Pintails** (Erick Osnas*) **Northern Pintails** (Mitch Weegman*) **Scaup** (Dave Koons*) **Scaup** (Todd Arnold*)	
19:45	**Discussion - Status of PAG and SAT Working Groups**	
Caucus **19:00 - 20:00**	**Mentor/Mentee** (Organizers: Jacob McPherson, Joseph Lancaster, Joseph Marty)	
	Panelist: **Jim Feaga**, Regional Biologist NJ/PA/Long Island, Ducks Unlimited **Kevin Ringelman,** Assistant Professor, Louisiana State University **Anthony Roberts**, Wildlife Biologist, Atlantic Flyway, US Fish & Wildlife Service **Anne Mini**, Science Coordinator, Lower Mississippi Valley Joint Venture	
Parks Place **19:00 - 20:00**	**Hospitality** *by California Waterfowl Association*	

*Speaker; ^Student

A.1: Plenary

A.1.1: Ashe

The Migratory Bird Treaty at 100: Charting a Course for the Next Century of Bird Conservation

Dan Ashe[1]*

[1] Director, U.S. Fish and Wildlife Service, Easton, MD 21601, USA

A.1.2: Serie-Blohm

Migratory Bird Treaty: Legacy and Foundation for Waterfowl Management in North America

Jerome R. Serie[1]*, Robert J. Blohm[2]*, David E. Sharp[3]

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The period from the Civil War until the turn of the century was a time of massive industrial growth, westward expansion, and unprecedented exploitation of native wildlife and their habitats. Naturalists were outspoken in their belief that wildlife, especially game species, needed protection from the onslaught of market hunting and spring shooting. The events that ensued, lead by George Bird Grinnell and Theodore Roosevelt who advocated for greater Federal protection, generated wide-spread public support but were countered by those advocating “States Rights.” Following a 20-year struggle of weakened attempts for Federal protection of migratory birds, including the passage of the Lacey Act in 1900 and the Weeks-McLean Act in 1913, the idea of a Migratory Bird Treaty with Canada began to take hold. Then, in 1916, a treaty was signed by President Wilson between the U. S. and Canada (represented by Great Britain, signed by King George V). Canada quickly passed into law the Migratory Bird Convention Act in 1917. But, a two year struggle followed in the U.S., after which Congress ultimately passed the Migratory Bird Treaty Act in 1918. This law was unsuccessfully challenged in the U.S. Supreme Court, clearing the way for Federal protection for all migratory game birds. It became a template for other international treaties and amendments for migratory birds as well as the foundation for modern day waterfowl management. The drought of the 1930s brought greater attention to waterfowl and wetland resources. “Ding” Darling and Professor Aldo Leopold advised President FDR to appropriate emergency funds to relieve the desperate situation. Many new Federal initiatives followed, most notably the “Duck Stamp Act” of 1934, Fred Lincoln’s introduction of “Flyways” in 1937, and the implementation of the Waterfowl Flyway Management System, beginning in 1947-1948. In cooperation with Canada, systematic waterfowl breeding ground surveys began in 1955 to inventory annual population and wetland changes. Leg banding efforts for ducks and geese were expanded to be regionally representative and methods to track recoveries continued to improve. Harvest surveys developed in the 1960s, with information from hunters yielding insights on species harvests and age and sex composition. These international data-gathering programs, all originating from the Migratory Bird Treaty of 1916 and its

articulation of Federal responsibilities and oversight, were soon bolstered by cooperative partnerships with State/Provincial agencies and NGOs, and continue to be reviewed and updated periodically. Today, they remain the hallmark monitoring programs that guide waterfowl and wetland management in North America.

B.1: Waterfowl Legacies: Pioneering Diplomacy, Science, and Management: Celebrating 100 Years of the Migratory Bird Treaty Act (Organizer: Chris Williams)

B.1.1: Perry

Management Research on Waterfowl Life Cycles, Populations and Energetics

Matthew C. Perry[1]*

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In the 1920-30s, biologists (Uhler, Sperry, Hotchkiss) of the Bureau of Biological Survey scoured the country looking for key waterfowl areas that provided optimum habitat as refuges for declining waterfowl populations. Darling and Gabrielson had the foresight to realize the value of wildlife research dealing with habitat, and in 1936, Patuxent Research Refuge developed out of their dream. Scientists stationed at Patuxent (McGilvrey, Uhler, Webster), initiated innovative studies on techniques, including impoundment management, nest-box construction, green-tree reservoirs, and moist-soil management, to improve waterfowl populations on a continental basis. Concurrently, other scientists (Stewart, Sincock, Stennis) conducted extensive surveys in Chesapeake Bay and Currituck Sound on the distribution of submerged aquatic vegetation (SAV) and the control of exotic SAV, to better understand and manage habitats in a more natural setting. Stewart and Uhler conducted studies of waterfowl foods in the Bay and demonstrated major changes in food habits due to environmental degradation. Stewart's 1962 report does not mention grazing on land by Canada geese, which now is common, and was subsequently adapted as a feeding mechanism for swans, snow geese, and brant. Stewart was one of the key researchers who established the Northern Prairie Wildlife Research Center (NPWRC), which was devoted to waterfowl breeding ground studies. Biologists at NPWRC developed the first telemetry studies with prairie ducks, and their techniques were used extensively nationwide. Following early studies of the canvasback at Delta Waterfowl Station by Hochbaum, new studies with this species were conducted in Manitoba and on the Mississippi River by Trauger, Anderson, and Serie. Realizing not all problems were on the breeding grounds, wintering studies were started with canvasbacks on Chesapeake Bay by Uhler, Perry, and Haramis. Haramis developed techniques with implanted transmitters, which led to their use in seaducks with satellite telemetry throughout North America to better delineate populations. The distribution of seaducks was linked to food habits in these habitats, which led to energetic studies with captive seaducks by Wells-Berlin in 3-meter dive tanks at Patuxent. Current telemetry and energetic studies are being conducted in relation to wind turbine sites on the east coast. Research at Patuxent and other facilities was key to improved management of waterfowl populations.

B.1.2: Fredrickson

A Century of Land Management Evolution: From Guess Work to Complex Decision-making in Highly Modified Landscapes Exhibiting Extreme Variability

Leigh H Fredrickson[1]*, Murray K Laubhan[2], Kenneth Higgins[3], Sammy L King[4]

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Land management constantly evolved over the past century from simply protecting a site and/or species of concern to implementing complex and costly programs to produce foods and habitats to meet waterfowl life cycle events over broad spatial and temporal scales. Federal areas requiring management expanded from one in 1903 to over 500 in the new millennium with similar increases in state ownership. During the drought era, most areas were representative of the ecological systems in which they occurred, but by the 21st Century these same sites became small remnants in a sea of urban or agricultural development.

Although the general characteristics and distributions of nearly all waterfowl species were described before the 20th century, critical information regarding, lifecycle events and their relationship to ecological processes developed more slowly. Consequently, important information to make informed land management decisions was lacking during major periods of expansion. As public lands expanded there was increasing need for qualified professionals to plan, develop, and manage the constantly increasing area of protected sites. The early growth of the refuge system coincided with the creation of the CCC program that provided jobs during the recession. In many cases, the expertise of engineers and laborers in the CCC program was well- suited to build the physical infrastructure to manage public lands in modified systems. Unfortunately, a similar depth of understanding required to develop ecologically based objectives and an infrastructure suitable for growing foods and sustaining habitats for the complex life history needs and habitat dynamics of waterfowl in a wide suite of geomorphic settings was lacking.

Management infrastructure protocol developed during the CCC days was based on early dogma set in place in response to wide-spread drought and the fear of no water, agricultural thinking, and the lack of understanding about wetlands and ecological processes at a landscape level. Unfortunately the knowledge to develop appropriate infrastructures necessary to successfully manage and achieve objectives appropriate for a site were insufficient, considering the abundance of modified habitats that formed the bulk of the public domain in combination with a rudimentary understanding of waterfowl ecology in relation to both upland and wetland habitats, as well as the processes that drive these systems. Early biologists studying waterfowl held positions in the Biological Survey and focused on diseases and food habits. Thus, publications often held habitat information. Techniques and approaches used in early studies, however, were often inadequate or inappropriate to stimulate thinking appropriate for anatids with a wide spatial distribution and constantly changing needs to meet life cycle events. Furthermore, the term “wetland” was not commonly used until the 1970s, and techniques to study wetlands were poorly developed until late in the 20th Century. Thus factors such as soils, ground water, and a host of abiotic conditions were largely ignored. Our collective experience suggests current approaches facilitate broad-scale modeling of waterfowl populations which have affected management decision processes across broader scales. Nevertheless we argue that management at local and regional scales has been eroded due to complex, multi-scale

systemic changes in combination with a lack of process-level ecological understanding. Thus to move forward, researchers must work within integrated multi-disciplinary groups and challenge themselves to learn non- traditional disciplines (e.g. hydrology, soils, geology) to understand the role of changing climates, landscapes, water availability, and other abiotic factors on model assumptions and validity. This presentation is an attempt to capture the successes and failures of land management across a large spatial and temporal scale and to encourage a new generation of talent to attack these critical challenges with renewed vigor.

B.1.3: Batt

Shifting Paradigms for Prairie Habitat Conservation

Bruce D. Batt[1]*, James K. Ringelman[2]

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A “paradigm” provides the basic assumptions, beliefs, and methodologies that are embraced by a scientific and management community. The paradigms that drive duck conservation have shifted and expanded over the last century with advances in scientific knowledge and changes in land- use and societal values. Paradigm shifts have been especially apparent in the conservation of prairie duck breeding habitat. Stimulated by the devastating drought of the 1930’s, early management focused on restoring individual, large wetlands to drought-proof the prairies. Drought and agriculture were the enemies, and there was concern that duck populations would not recover without human intervention. A few government and private conservation organizations, motivated by dedicated duck hunters, led the way. Researchers focused on understanding the natural history of species and managers used their best professional judgment when selecting projects. Little thought was given to “uncertainty” in the science guiding management actions. Over the ensuing decades, as paradigms evolved, wetland managers recognized the threats to small wetlands but had few tools to protect them until public policy in the form of the Clean Water Act provided a mechanism in the U.S. When new findings revealed alarmingly low duck nest survival due to predation, the spotlight shifted to the uplands and prompted the development of intensive management techniques to improve nest success. The NAWMP stimulated private-public Joint Ventures of land owners and conservation organizations. Simulation models were developed to prescribe management actions, and momentum shifted to working with agriculture instead of against it. Research became more focused on hypothesis testing, and uncertainty was quantified by confidence intervals. As we enter the latest era of duck conservation, our paradigms continue to shift. The populations of many duck species have rebounded from historic lows. Most intensive management techniques are considered cost-prohibitive, not scalable in a manner that will have a significant impact on continental duck populations, or ineffective at increasing recruitment. The current paradigm emphasizes the permanent protection of existing upland and wetland habitat on private lands and the promotion of more waterfowl friendly farming practices on whole prairie landscapes.
Private-public partnerships engage industry and other non-traditional partners and new sources are funding conservation through the recognition and commoditizing of the ecological goods and services provided by wetlands and grasslands. Much of this is made possible by sophisticated geospatial models that include entire watersheds. Uncertainty is embraced and is being systematically reduced through the application of adaptive resource management and other approaches. Continued investment in research, adaptation and creative thinking will continue to shape new paradigms for waterfowl conservation.

B.1.4: Sedinger, J.

Eighty-five Years of Monitoring and Modeling Waterfowl Populations

James S. Sedinger[1]*, Ray T. Alisauskas[2], James O. Leafloor[3]

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Management of North American waterfowl has been in the vanguard of the application of quantitative approaches since Frederick Lincoln's leadership in organizing the North American bird banding and his innovative approach in 1930 to estimating abundance of ducks from band recoveries. Aerial reconnaissance surveys to assess distribution and abundance, especially in remote boreal and arctic regions, soon followed and methods were standardized and institutionalized beginning in the 1950s, producing what we now know as the May breeding waterfowl survey. The May breeding waterfowl survey is the longest running and most extensive assessment of wildlife populations in existence and is often pointed to as an example of effective monitoring of wildlife. Statistically based aerial surveys of goose populations began in the 1970s in for some midcontinent Canada Geese and in the mid-1980s for geese nesting in southwestern Alaska. Counts of individuals in surveys have been combined with analysis of data from marked individuals since at least the 1950s to inform management. Joe Hickey was among the first to attempt to estimate survival rates from band recovery data using ad hoc methods that he developed. Harvest surveys were instituted in the U.S. in the early 1960s, followed by Canada in the 1970s. Formal statistical approaches to estimation of survival and harvest rates were developed by Brownie, Robson and David Anderson (then of the U. S. Fish and Wildlife Service) in the late 1970s. Accompanying analytical software (BROWNIE) revolutionized demographic analysis based on band recovery data. Groundbreaking work by Anderson and Burnham provided a sound theoretical basis for assessing the relationship between harvest and survival, with important implications for population management. A general consensus has emerged that harvest is largely additive to other sources of mortality in geese, although recent studies suggest the potential for compensation at low harvest rates even in geese. The situation for ducks remains more clouded.

B.1.5: Anderson

Evolving Perspectives on Waterfowl Research and Conservation: Scale, System Integrity and Human Impacts

Michael G. Anderson[1]*, David L. Trauger[2]

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Since the beginning of systematic waterfowl conservation in North America, research has helped inform management decisions. This research has become more diverse, topically and geographically, and more systematized (e.g., structured decision making) as it evolved from natural history and basic inventories toward management experiments, ecosystem studies and linked social/ecological investigations. Collaborations of habitat managers and scientists in formal or informal adaptive management have been particularly useful. This experience has led many of us to focus on new problems, often at larger scales, as those most vital to long-term conservation successes. A shifting focus from managing nesting habitat patches to conserving grassland-dominated landscapes is one example. Likewise we have gained greater understanding of the importance of regional hydrology and watershed processes for maintaining wetland systems, and such work at the watershed scale is different than more fine-grained small-unit management approaches that have consumed much of our attention. Accompanying this scaling up has been a trend from working within single agencies, to multi-agency partnerships (e.g., NAWMP Joint Ventures) to coalitions of interest groups pursuing conservation of ecosystem processes for multiple objectives. Harvest managers also have begun to re-think micro-managing individual species, recognizing the limitations of system control, and considering the possibilities of less-risk-averse or multi-stock approaches to harvest management. We also have recognized the need to manage waterfowl from an annual-cycle perspective, so our scale of interest has expanded temporally and well as spatially. Biologists now understand a little more about the connections between wintering, staging and breeding areas, and the combined effects of conditions there on population dynamics. But there still is much to learn. These expanded scales of thinking about waterfowl management have offered useful lessons for other migratory taxa, and developments like the “other bird” initiatives under NABCI and the National Fish Habitat Partnership attest to this. However, we are also increasingly aware of the expanding, indeed overwhelming, human impact on our planet – from the demands of land and water to produce food and fiber for billions of people, to the alteration of our climate system and widespread destruction of ecosystem integrity. These global issues have become those that will matter most for sustaining the habitats and social cohesion on which 21st century waterfowl conservation will depend.

C.1: Current Issues in the Conservation and Management of Sea Ducks (Organizer: Chris Dwyer)

C.1.1: Koneff

Prioritizing Research and Monitoring to Improve Sea Duck Harvest Management

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In 2012, the Sea Duck Joint Venture (SDJV) created a Harvest Management Subcommittee (hereafter we) and initiated an effort to determine the priority information needs to support harvest management decisions for 5 focal species: American common eider, surf scoter, white-winged scoter, black scoter and long-tailed duck. To prioritize information needs, we assessed the influence of uncertainty in individual reproductive and survival parameters on the capacity to determine whether contemporary harvest levels exceeded an assumed management objective of maximum sustained yield (MSY).

We compiled estimates from published and unpublished literature and used them to develop probability distributions for each parameter that reflected uncertainty about true mean values for each population. Available field data for these species frequently were collected at small spatial scales (i.e., local sub-population), and may not be representative of mean values for the populations of interest. Therefore, we conducted an expert elicitation to supplement available empirical data. We used Monte Carlo simulation to propagate uncertainty in demographic parameters into probability distributions describing uncertainty in the intrinsic rate of increase (rmax), population size, and harvest (harvest rate for common eider) for each population. We used the Prescribed Take Level framework to contrast contemporary harvest levels with allowable harvest levels (i.e., MSY). We assessed the sensitivity of comparisons of contemporary and allowable harvest levels to uncertainty in each of the demographic parameters, Finally, we summarized priority information needs for the SDJV by identifying parameters which were both highly uncertain and had the most influence on the comparison of contemporary and allowable harvest levels. We present the results of the harvest potential assessment and a summary of priority information needs for each of the five species.

C.1.2: Dwyer

Defining Sea Duck Populations: What We Wish We Could Measure and How to Interpret What We Can Measure

John M. Pearce[1]*, Paul. L. Flint[1], Sarah S. Sonsthagen[1] (Presented by Chris Dwyer)

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A population is composed of individuals that share resources such that they have the same expectation of survival and fecundity. If each group of individuals segregates spatially throughout the annual cycle, then identification and description of populations is a relatively simple task. If spatial segregation is temporally variable then the definition of a population becomes nebulous and management complicated. For migratory wildlife, understanding levels of migratory connectivity between breeding and wintering areas is a first step in describing populations. Determining levels of mixture or gene flow between groups is the next step because a group of birds present at any given location and time, may not represent a single population. Sea ducks have been little studied up until the recent past. Through the efforts of the Sea Duck Joint Venture and partners, a great deal has been learned about the migratory movements of individuals and levels of site fidelity for a variety of sea duck species throughout North America. It is now time to summarize the state of our knowledge regarding population delineating to inform management units, harvest assessments, and determining which surveys are most informative for tracking status and trends of sea duck species. Methods for determining levels of migratory connectivity and population definition include genetic markers, band-recovery or band-resight data sets, and satellite telemetry. However, what is less well-understood is the methods of quantification of these data streams into metrics of population subdivision that can be used for informing management decisions. In this talk, we will summarize recent research on sea duck population delineation and discuss metrics that should and should not be used to define population structure of sea duck species.

C.1.3: Rothe

Understanding Diverse Sea Duck Harvest Communities for Responsive Management and Conservation

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In recent decades, dedicated efforts have broadened knowledge on sea duck ecology and conservation status. However, our understanding of the role of harvest in sea duck population dynamics is limited and little is known about the relation of hunter behavior to regulatory regimes. In the Pacific Flyway, the total sea duck harvest (168,000 birds/year) has four components differing in species composition and harvest amount: Alaska subsistence harvest, Alaska sport harvest, sport harvest in coastal Lower-48 states, and sport harvest in inland Lower-48 states. The Alaska subsistence harvest accounts for 44% of the total sea duck harvest in this Flyway. Since the Alaska spring-summer subsistence harvest of migratory birds was first authorized in regulation in 2003, much progress has been made in communication and collaboration among stakeholders and data on subsistence harvest have become more available. Processes, partnerships, and subsistence harvest regulations are still evolving. In this multi-cultural landscape, efforts to include western science and local and traditional ecological knowledge (TEK) face challenges. While western management is concerned with large scale, quantified biological and ecological data, TEK deals with smaller geographic scales integrating qualitative information and historical, socio-economic, and spiritual dimensions. In harvest management, issues related to knowledge, communication, decision-making power, and resource allocation are intertwined and dynamic. A better understanding of cultures and traditions of subsistence users, sport hunters, and wildlife biologists and managers is key to ensure genuine exchanges of information among individuals and organizations to establish mutual understanding of resource status and shared conservation goals, develop transparent expectations about allocation, and maintain management regimes that build trust and collaboration. Stakeholders must clearly frame perspectives and develop cross-cultural negotiation skills to be able to collectively solve socio-economic and resource sustainability issues. This involves commitment from all stakeholders, processes that are inclusive, and leadership.

C.1.4: McLellan

Identifying Areas of Importance for Sea Ducks Throughout Their Annual Cycle

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Studies supported by the North American Sea Duck Joint Venture (SDJV) partnership have helped improve our understanding of important sea duck habitats across the continent and beyond. This work has involved a variety of techniques including satellite telemetry, and new or improved waterfowl surveys. The SDJV's goal is to make information on habitat use available to decision makers and ultimately improve the conservation and management of these species. Currently, we are developing an atlas that identifies key sites for sea ducks throughout North America and documents their seasonal importance, current protection or designations, and potential threats. Our next step is to make accessible spatially explicit sea duck data into one or more geospatial databases that can be queried by interested folks, along with other environmental parameter data. We envision these products will be used to: 1) provide justification for protecting areas of importance to sea ducks, 2) improve decision making for resource development in key areas, 3) direct research investigating biotic and abiotic features that characterize sea duck habitats, and 4) predict how habitat conditions may change and potentially impact populations. In this presentation we highlight some of the most important habitats/areas for sea ducks in North America.

C.1.5: Silverman

Sea Duck Habitat Associations Along the Atlantic Coast of the United States

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Recent aerial survey efforts along the Atlantic coast of the United States, as well as an effort to integrate all marine bird data for the coast into a single 'seabird compendium,' are allowing researchers to map the distribution of wintering sea ducks and understand their association with features of the marine environment. These analyses should provide planners charged with decisions about permitting energy development critical information relevant to potential impacts on sea duck wintering habitat. Understanding sea duck-habitat associations will also improve our ability to predict distribution shifts that may occur as climate changes. We characterize the winter range and distribution of four species of sea ducks (long-tailed duck, and surf, white-winged, and black scoter) and present results highlighting relationship between the abundance and habitat characteristics including depth, bottom slope, sea surface temperature, and the strength of the North Atlantic Oscillation. We include a detailed exploration of the distribution of black scoters in the southernmost portion of their wintering range (along the coast of South Carolina and Georgia); the importance of this region to black scoters is not well characterized, while changes in winter use could provide early indication of range shifts.

C.1.6: Boyd

Pacific Harlequin Ducks are Altering their Molt Behavior

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A small population of harlequin ducks (*Histrionicus histrionicus*) has been surveyed intensively over the last 30+ years at White Rock in the Salish Sea (B.C.). From the early 1980s to the early 2000s adult males consistently returned from their breeding areas to the coast in June-July to molt their body and flight feathers. Females followed 1-2 months later and long-term pair bonds were re-established once they completed their own molts, usually by mid-late October. However, since the mid-2000s the males have been avoiding White Rock completely, molting at some unknown location(s) and returning to the study area ca. 2+ months later than usual. Coinciding with this change in molt pattern, the number of males declined, resulting in a local population level effect. Recent surveys at two nearby coastal sites indicate similar delayed return patterns by males, suggesting a larger, regional population level effect. In contrast to males, the adult females in the study area have not altered their return times, molt patterns, or abundance level. Research is needed to determine if this altered male molt pattern is happening over an even larger geographic scale such as the Salish Sea and, if so: what are the ultimate and proximate driving factors and what, if anything, can be done management-wise? In spring 2015 we marked adult males with satellite transmitters and discovered that they migrated to largely uninhabited coastal locations 100s of km north of their capture sites to molt. The following factors are suspected to be responsible for this change in behavior during what may be considered a vulnerable (flightless) period: 1) increasing levels of recreational disturbance from humans and/or 2) increasing levels of predation risk from bald eagles (*Haliaeetus leucocephalus*). Results of this study have implications for conservation efforts in regions where both human and eagle populations are increasing.

D.1: Current Issues in the Conservation and Management of Sea Ducks (Organizer: Chris Dwyer)

D.1.1: Hindman

Avian Cholera Epizootics in Sea Ducks and Sea Birds on Chesapeake Bay

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An epizootic of avian cholera (*Pasteurella multocida*), in sea ducks, diving ducks, and sea birds occurred on Chesapeake Bay, during late February - early April 1994. More than 36,700 carcasses of 57 bird species were recovered during shoreline surveys. Of those identified long-tailed duck (*Clangula hymalis*) (86%), scoters (*Melanitta* sp.) (4%), bufflehead (*Bucephala albeola*) (3%), and common goldeneye (*Bucephala clangula*) (2%) suffered the highest mortality. Based upon aerial survey estimates of waterfowl and sea bird populations at risk, published methods to measure the losses of carcasses at sea or on beaches, applied models to account for such losses, and extrapolating from the number of dead birds recovered, we estimated that the total mortality from the1994 epizootic to be >179,000 birds. Stresses caused by low winter temperatures, limited open water due to extensive ice cover, and overcrowding of birds are believed to have contributed to the 1994 epizootic. Common *P. multocida* serotypes 3,4 and 3, affecting waterfowl and sea birds were identical to serotypes found in nearby commercial poultry rearing facilities where rodents serve as the source of infection. We compare the timing of epizootics, *P. multocida* serotypes, bird species affected, and environmental parameters during the 1970, 1979, and 1994 avian cholera epizootics on Chesapeake Bay.

D.1.3: Wiese

Are Common Eider Nest Predators Limiting Species Recovery?

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The Pacific common eider (Somateria mollissima v-nigrum; COEI) population declined by 50–90% since the 1950s, and has since stabilized at these reduced numbers. It is a USFWS Bird of Management Concern, Tier 1 Priority Species, and pilot Flagship Surrogate Species for the barrier islands and associated lagoons. COEI breeding on barrier islands in the Beaufort and Chukchi Seas are uniquely at risk due to small population size and genetic and physical segregation throughout the annual cycle. The intensity and frequency of storm surges along the Beaufort Sea Coast is increasing, which may lead to a rise in flooding events. Nest predator populations are also reportedly increasing on the North Slope of Alaska and some species may be becoming more reliant on eggs for food. To assess the role of depredation as limiting factor for COEI recovery, we placed ~100 time-lapse cameras 2-5 m from COEI nests across 120 miles of barrier islands in the Eastern Beaufort Sea. Our objectives were to identify the causes of nest failure (abandonment, depredation, flooding, etc.) and quantify predators. We also assessed the effectiveness of traditional nest fate assessment methods. Preliminary results suggest abandonment and flooding events were low in 2015 and glaucous gulls and arctic fox were the primary nest predators. Video evidence also suggests that traditional methods of identifying nest fate and causes of nest failure may introduce bias. For example, we found that most abandoned nests were soon depredated, instances of egg membranes being removed by avian predators post-hatch, and occurrences of both avian and mammalian predators depredating the same nest.

D.1.4: Bowman

What Tools Do We Have for Sea Duck Conservation and What Constituencies Do We Need To Engage?

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Sea duck science and conservation, although still in its infancy relative to other waterfowl, has advanced to the point where managers are now able to focus on a few specific management actions or conservation issues. We highlight potential management tools that can be used to advance conservation of sea ducks or their habitats, and identify certain constituencies that could be influential in implementing conservation measures.

D.1.6: Dwyer

Industrial Interests within Arctic and Marine Environments of Importance to Sea Ducks

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Expanding interests in alternative energy and resource extraction within marine and Arctic environments will likely create both issues and opportunities for sea duck conservation in North America. Within the U.S., efforts are underway among State and Federal partners to conduct monitoring and research programs that will help inform decisions about ocean planning, public interests and marine resources, including sea ducks. Across northern Canada and Alaska, a reduction in sea ice is creating an increasing interest in access, resource extraction and shipping in Arctic environments. This may also create issues and opportunities for the conservation of marine birds and sea ducks across the Arctic.

We provide an overview of the growing interests in marine and Arctic habitats for industrial use and development, and the potential threats or stressors they may create for sea ducks.

Are We Addressing the Right Things at the Right Scale?

Chris Dwyer[1*]

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Despite our increasing knowledge base for sea ducks, future efforts to conserve and manage each of the 15 species under the revised objectives of the North American Waterfowl Management Plan will require much different approaches, partners and public engagement than we've previously experienced or implemented.

The objective of maintaining long-term average populations of breeding sea ducks is certainly a primary interest. However, determining what the population estimates are for sea ducks during any portion of the annual cycle have been constrained by factors that are logistically and financially difficult to overcome. Without greater focus on the need to align population data with information necessary for supporting clear and explicit management (or policy) decisions, it will be difficult to accomplish this objective and measure our success over the next 25 years. The spatial and temporal scale at which we address this objective for sea ducks will be important, given our limited resources.

Conserving a habitat system with the capacity to maintain long-term average populations of sea ducks is vital. Efforts that are currently underway to improve our knowledge and understanding of the key geographic areas and habitats of importance to sea ducks in North America will increase our ability to focus on avenues of protection, provide information to support management and policy decisions, and help identify the appropriate constituencies to engage with. More critical for this broader audience is our ability to effectively communicate what the “conservation ask” actually is, and why they should care. Once again, the scale and approach that we use to protect or increase habitat for sea ducks, and the public support needed to accomplish that objective will be important given our limited resources.

This presentation will wrap up the session by highlighting key accomplishments in our knowledge of sea ducks, and propose novel ideas for moving forward in the conservation and management of sea ducks to achieve the objectives of the North American Waterfowl Management Plan.

C.2: Foraging, Nutrition, and Energetics of Waterfowl: The Foundations of Habitat Management (Organizers: Scott McWilliams, Bruce Dugger)

C.2.1: Heitmeyer

Energetics and Nutrition of Migrating and Wintering Dabbling Ducks – What Have We Learned in the Past 50 Years and Where Should Management Be Headed

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The abundance and availability of food are among the most important drivers of waterfowl ecology, including the inherent abundance and distribution of populations. Consequently, is it no wonder that understanding food use and energetic/nutritional needs, and then attempting to produce presumed important foods, has been a major part of the history of waterfowl and wetlands management in migration and wintering areas of North America. Beginning with early studies of what ducks actually ate, biologists have greatly expanded our understanding of more comprehensive energetic and nutritional ecology of species, especially the integration of dynamics related to variable annual cycle events. This information has demonstrated the complex interactions of physiological, nutritional, and behavioral adaptations – and has helped provide a foundation for management of key resources used, and needed, by waterfowl during winter and migration periods. The majority of this information has been developed for dabbling ducks, and has strongly influenced habitat management across North America with several hundred million dollars spent annually trying to produce duck food. Despite advancements, management strategies remain constrained by a focus on energy (Kcals); a pre-disposition toward producing grains for mallards; indiscriminate emphasis on specific habitat types, such as moist-soil impoundments, in relation to season and locations; and flooding regimes that generally coincide with hunting seasons. Waterfowl conservation will be advanced further if future management strategies can more strongly and directly couple comprehensive nutritional needs of species with annual cycle events engaged in across continental landscape scales. Examples of landscape-scale understanding of the historical wetland community type, distribution, and dynamics that drove evolutionary form and function of waterfowl are starting to emerge from hydrogeomorphic (HGM) studies, for example in the Mississippi and Lower Missouri River Valleys, and should be a foundation for directing future habitat restoration and management strategies including revised NAWMP, SHC, LCC, and other continental- to local-scale programs.

C.2.3: Lovvorn

Are Detailed Energetics Studies Needed to Assess Habitat Requirements? Allometry, Mechanistic Models, and Other Confounding Factors

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From a habitat management perspective, one ultimate goal of energetics studies is to estimate the quality and extent of habitat needed to support a given number of animals. Allometry, or the metabolic theory of ecology, presumes that most aspects of energetics that affect food requirements F are subsumed within the single variable of body mass Mb in equations of the form F = a Mbx, derived from regressions including multiple taxa over a range of body masses. Such estimates of food requirements have been compared to all or some fraction of food stocks to evaluate the adequacy of existing or proposed habitat. If such estimates are realistic, they would be very powerful and inexpensive to implement. However, a number of issues such as threshold prey densities needed for profitable foraging, prey patch structure and associated search costs, and varying thermal regimes might cause important deviations from simple allometric relationships. Parameterizing models that account for such mechanisms is expensive and time-consuming, albeit more satisfying to functional ecologists. Seldom, however, have estimates from allometry versus mechanistic models been compared to assess the relative value of in-depth studies of the components of energy balance. This talk will describe the results of detailed mechanistic models of food and habitat needs of three diving duck species of differing body mass – lesser scaup, surf scoter, and greater scaup – when feeding on the same prey (Asian clams) in northern San Francisco Bay. I will compare these results to allometric estimates of metabolic requirements relative to prey standing stocks. I will also explore caveats to both these approaches, given that most mechanistic studies have found that diving ducks and a range of other taxa typically abandon feeding areas well before energetics models indicate that food has been depleted.

C.2.4: Webb

An Empirical Evaluation of Landscape Energetic Models: Mallard and American Black Duck Space Use During the Non-breeding Period

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A subset of Bird conservation Joint Ventures has developed energetic carrying capacity models (ECCs) to translate regional waterfowl population goals into habitat objectives during the non-breeding period. Energetic carrying capacity models consider food biomass, metabolism, and available habitat area to estimate waterfowl carrying capacity within regional landscapes. Thus, ECCs provide a method to generate non-breeding waterfowl habitat restoration targets. To evaluate Joint Venture ECCs in the context of waterfowl space use, we monitored 33 female mallards (*Anas platyrhynchos*) and 55 female American black ducks (*A. rubripes*) using global positioning system satellite telemetry in the central and eastern United States. To quantify space use, we measured first-passage time (FPT: time required for an individual to transit across a circle of a given radius) at biologically relevant spatial scales for mallards (3.46 km) and American black ducks (2.30 km) during the non-breeding period, which included autumn migration, winter, and spring migration. We developed a series of models to predict FPT using Joint Venture ECCs and compared them to a biological null model that quantified habitat composition and a statistical null model, which included an intercept and random terms. Energetic carrying capacity models predicted mallard space use more efficiently during autumn and spring migrations, but the statistical null was the top model for winter. For American black ducks, ECCs did not improve predictions of space use; the biological null was top ranked for winter and the statistical null was top ranked for spring migration. Thus, existing ECCs provided limited insight into predicting waterfowl space use, especially for black ducks, during the non-breeding period. Refined estimates of spatial and temporal variation in food abundance, habitat conditions, and anthropogenic disturbance will likely improve ECCs and benefit conservation planners in linking non-breeding waterfowl habitat objectives with distribution and population parameters.

*Speaker; ^Student

C.2.5: Johns^

Influences of Individual Quality and Energetic Carry-Over Effects on Reproductive Success: Evidence from Dabbling Ducks

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Individual quality is an important component in determining timing of breeding and reproductive success in waterfowl. While measures of quality have typically focused on age or indices of body condition, an individual's intrinsic quality may not be fixed but responsive to varying energetic demands or environmental conditions. As migratory species winter and breed in distant locations, demands in one season may ultimately influence intrinsic quality and performance of individuals in subsequent seasons. (i.e., carry-over effects). In birds, the hormone corticosterone is deposited in feather tissue (CORTf) during feather growth and represents an integrated record of an individual's energetic response over periods of days to weeks which persists until the feather is molted. Collection of feathers grown prior to breeding enables retrospective insight into energetic responses and investigations of potential carry-over effects that may influence future reproductive performance. While negative relationships between CORTf from the wintering period and subsequent survival have been demonstrated in arctic-nesting eiders, investigations in other systems are lacking. Incorporating information gained from captive experimental work on the relationships between energetic response and CORTf, we can further inform and refine investigations of extrinsic (i.e. landscape, habitat) influences on reproductive success. Our objective was to determine how individual quality, in terms of current (measured upon capture; age, body condition, behavior, and timing of breeding) and antecedent (CORTf from previous breeding and wintering periods) periods, affects waterfowl reproductive success. During 2011 and 2012, 104 female pintails were captured, radio-marked and monitored during brood rearing in southern Saskatchewan. We collected wing and body feathers from captured pintails as well as indexed body morphometrics, age and behavior during capture and brood-rearing. Feather samples were analyzed for CORTf and stable isotopes of hydrogen (δ^2 H), sulfur (δ^34 S), nitrogen (δ^15 N) and carbon (δ^13 C). Using a combination of direct band recovery information, Bayesian probabilistic and multi-isotope assignment approaches, we estimated likely origins of pintails during the previous post-breeding period (wing molt) and winter provenance (body molt). Using structural equation modeling we tested whether reproductive success (number of fledged young) was influenced by past (CORTf) and current (scaled body mass) quality, with respect to known (hatch date) and hypothesized (behavior) sources of variation in waterfowl reproductive success. Based on isotopic assignment the majority of pintails molted wing feathers in the prairies, followed by arctic and boreal regions. Body feathers were likely grown in mid-latitude locations during migration between known breeding and putative wintering locations. Pintail body condition was dependent on wing molt location with boreal origin birds having reduced body condition in the following year. CORTf values did not differ between likely wing molt locations but CORTf in body feathers was higher for pintails wintering in non-agricultural settings. We did not find evidence of direct influences of intrinsic quality on pintail fledging success. The use of intrinsic biomarkers such as feathers provides an integrated method for assessing retrospective quality and its future use will provide a novel method to enhance our understanding of reproductive variation in migratory birds.

*Speaker; ^Student

C.2.6: Williams

Improving Bioenergetic Carrying Capacity Estimates by Including Morphometrics in Cost of Thermoregulation

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Bioenergetics modeling is a popular tool used by waterfowl biologists to estimate carrying capacity based on food energy availability and daily energy expenditure (DEE). For wintering waterfowl, estimates of DEE may incorporate a cost of thermoregulation (CT) component, which accounts for metabolic heat production when ambient temperatures fall below a species-specific Lower Critical Temperature (LCT). Typically, DEE estimates have utilized either a fixed CT component or a simple CT model based solely on the magnitude of the difference between ambient temperature and LCT. Using a more complex CT model that accounts for differential heat loss from individual body regions due to temperature, wind speed, and contact with air or water may provide more detailed estimates of CT and in turn, carrying capacity. However, such models required detailed morphometrics as model inputs in addition to environmental data. We present morphometrics for 8 dabbling duck species for use in thermoregulation models, as well as regression equations that may substitute for measurements of unmeasured species. We compared CT values produced via simple and complex CT models for American Black Ducks (*Anas rubripes*) wintering on the Delaware Bayshore, 2011–2013. We found that the complex CT model produced significantly higher CT estimates (5.38 ± SE 0.38 kJ/bird/hr) compared with the simple model (1.26 ± 0.04 kJ/bird/hr). Applying these CT values to bioenergetics models for American Black Ducks wintering in southern New Jersey suggested that this disparity in CT could produce substantial differences in estimated carrying capacity. Thus, we recommend that researchers consider incorporating detailed CT models into their estimates of DEE to reduce bias in carrying capacity estimates.

D.2: Foraging, Nutrition, and Energetics of Waterfowl: The Foundations of Habitat Management (Organizers: Scott McWilliams, Bruce Dugger)

D.2.1: Guillemain

Foraging, Nutrition, and Energetics of Waterfowl: A European Perspective

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Much attention has historically been devoted to feeding ecology of waterfowl, providing an extensive research record for Europe and North America alike. However, research in this field has gradually followed different paths on the two continents. American scientists have adopted a more applied perspective, often aiming at assessing the extent to which food requirements of waterfowl can be fulfilled in different habitats, and how management of these can increase carrying capacity. As opposed to this “energetic” approach, European scientists have rather framed their studies in a “behavioral” perspective, using waterfowl as model species for more theoretical approaches to foraging ecology. Consequently, while North American research has most often been carried out at the scale of waterfowl populations, the individual bird has more frequently been the scale of study in Europe. We present three examples of such European studies: first, a detailed analysis of the trade-offs made by dabbling ducks between foraging and anti-predator vigilance, leading to divergent strategies to face gradual food depletion during the winter. Second, we do a flyway-scale analysis of duck foraging needs and behavior, from Mediterranean wintering grounds to breeding sites in the Boreal, and point out the main hurdles faced by these birds across their annual cycle. Such detailed European studies can provide useful parameter values to fuel modern agent-based models of habitat use and carrying capacity developed in North America, hence cross-fertilizing the approaches on the two continents. This is exactly what our third example is about; namely adapting the SWAMP model developed in California to better understand and predict the use of harvested rice fields by wintering ducks in southern France.

D.2.3: Alisauskas

Diet and Nutrition of King Eiders and Long-tailed Ducks Arriving to Breed at Karrak Lake, Nunavut

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The relative contribution of nutrient reserves vs. exogenous nutrients for egg formation has implications for cross-seasonal effects on reproduction and recruitment to sea duck populations. We studied body composition, and diet of both King Eiders, *Somateria spectabilis*, and Long-tailed Ducks, *Clangula hyemalis*, shot as they arrived to breed at Karrak Lake, about 60 km inland from the south shore of Queen Maud Gulf in Canada's central arctic. From 13 to 21 June in each of 2009 to 2011, we shot 28 (19 female, 9 male) King Eiders and 43 (18 female, 25 male) Long-tailed ducks shortly after their arrival at Karrak Lake, where they nest at relatively high densities. Ten morphometric measurements were recorded. Major organs of all birds were dissected and weighed, and proximate analysis of carcasses was done to determine whole body fat, protein, and mineral. Esophageal contents were removed and sorted to Genus and Species, where possible, but at least to Order (Diptera, Trichoptera, Coleoptera, Plecoptera, Aranea) or Family (most common were Anthomyiidae, Chrinomidae, Tipulidae, Limnephilidae, Nemouridae, Circulionidae, and Syrphidae) in most cases. The number of individuals in each identifiable taxonomic group found in each esophagus was counted and aggregate mass of such groups was recorded, followed by proximate analysis. Finally, we conducted stable Carbon and Nitrogen isotope analysis of liver, breast muscle, abdominal fat (Carbon only), oviduct, developing follicle (lipid and lean dry portion, separately), and any oviducal eggs (albumen, yolk lipid and lean dry yolk, separately); as well, stable isotope analysis was done on identifiable taxonomic groups of esophageal contents separately for lipid and lean dry fractions. Final stable isotope results have not been received from the contracted laboratory, but program SIAR will be used to compare the relative estimated contributions of endogenous nutrients toward various egg components in both King Eiders and Long-tailed Ducks.

D.2.4: Perry

Geographic and Interspecific Variation of Seaduck Food Habits in Northeastern North America

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Food selection was determined among four species of seaducks (n = 716) collected by hunters during 1999-2008 from three areas of the Atlantic Coast (Maritime Provinces, Massachusetts, and Chesapeake Bay). Objectives were to determine geographic and interspecific differences in food and compare to data from historic food habits file (1890-1985). Scoters (black, surf, and white-winged) and common eiders fed mainly mussels and clams, which varied greatly among locations and species. Aerial waterfowl surveys, in general, suggest that the four species of seaducks were more commonly located in the meso- to polyhaline areas of the coast where the food collected from the ducks is typically found. Three species of mussels (*Ischadium recurvum, Mytilus edulis, Modiolus modiolus*) and four species of clams (*Gemma gemma, Mulinia lateralis Ensis directus, Spisula solidissima*) constituted 62% of the food, with a north to south increase in clam and a decrease in mussel composition. No major differences were noticed between the sexes in regard to food selection in any of the wintering areas for any of the seaduck species. Comparisons of recent data to historic food habits data failed to detect major temporal differences in all areas. However, several invertebrate species recorded in historic samples were not found in current samples and two invasive species (*Rangia cuneata* and *Carcinas maenas*) were recorded in modern samples, but not in historic samples. Benthic sampling in areas where seaducks were collected showed a close correlation between consumption and availability. Concurrent energetic studies done with captive scoters in large 2-meter deep dive tanks compared energy value from the dominant mussel and the dominant clam eaten by scoters in Chesapeake Bay. The mussel provided greater energetic value, which could be problematic as mussel beds are declining in the Bay, and possibly other areas of the Atlantic coast.

D.2.5: Coluccy

True Metabolizable Energy of Waterfowl Foods: Our Current Understanding and Implications for Conservation Planning

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Bioenergetic models are the primary tools used to estimate habitat requirements for non-breeding waterfowl. Determining the carrying capacity of any landscape requires knowledge of both the types and amounts of different foods available and their energetic value. Despite the importance of food energy content in estimating carrying capacity, true metabolizable energy (TME) values are currently only available for 5 agricultural seeds, 5 acorns, 15 species of animals, the parts of 6 plants, and the seeds of 16 moist soil plants known to be consumed by waterfowl. These TME values are often based on a single study, represent a small fraction of the foods consumed by waterfowl, are skewed towards a few species of waterfowl, and largely represent foods available in a limited number of geographies. In the face of limited TME data, conservation planners have had to had to improvise: for example, by using a single TME value to represent a broad assortment of similar food types (e.g., seeds, invertebrates, etc.), or by estimating unknown TMEs using values from taxonomically-related foods. Many Joint Ventures have used a mean TME value of 2.5 kcal/g for moist-soil seeds. However, this approach could substantially over- or underestimate carrying capacity depending on the dominant seed species present within the planning area of interest. In addition, inherent uncertainty in TME values is rarely acknowledged or addressed when estimating carrying capacity. Even relatively small variation in TME values can produce highly variable estimates of carrying capacity for a given landscape. Finally, our current energy-based conservation planning approach addresses a single nutritional requirement for waterfowl while ignoring other nutritional needs (e.g., protein, mineral, etc.). The quality of foods can best be judged when information on nutritional composition is considered along with energy. In this paper, we will review the state of knowledge regarding TME values, ramifications for conservation planning, how uncertainty in TME values compares to uncertainty associated with other bioenergetics model inputs and recommendations for future research directions.

*Speaker; ^Student

D.2.6: Krapu

Effects of Recent Trends in Agriculture on Waterfowl Nutrition and Energetics

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Agriculture in North America over the past 15 years has become more intensive with the introduction and widespread planting of GMO crops and increased planting of row crops, the latter influenced by passage of the Renewable Fuel Standard (RFS) by Congress in 2005. Taken together, these actions have changed agricultural landscapes in ways that have reduced availability of key foods sought by many species of migrant and breeding waterfowl. Increased efficiency of corn harvest combined with soybean expansion has reduced capacity of geese to store fat on some major spring staging areas in mid-continent North America potentially affecting reproductive success. The diets of prairie-breeding ducks generally require a high level of protein during egg production and early brood-rearing with most of this nutrient need supplied by macro-invertebrates taken from shallow wetlands. Drawing upon insight gained from recent scientific studies and other sources, I discuss ways intensification of land use in the Prairie Pothole Region affects the distribution and abundance of foods required by breeding waterfowl and follow by considering implications to reproductive success. I conclude by briefly discussing possible measures beyond existing federal programs to enhance wetland habitat for waterfowl and other water birds breeding in prairie pothole landscapes.

C.3: Breeding Ecology 1 (Chair: Joe Marty)

C.3.1: Hepp

Importance of Reproductive Costs and Quality of Female Wood Ducks on Survival and Future Reproductive Success

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Estimates of vital rates and their sources of variation are necessary for understanding the population dynamics of any organism. These data have been used to test predictions of life-history theory as well as to guide decisions of wildlife managers and conservation biologists. Life history theory predicts trade-offs among life history traits such that current reproductive effort will be negatively correlated with survival and/or future reproduction. Many studies support this predicted tradeoff; however, others report positive covariation between fitness traits and attribute positive correlations to differences in individual quality. In this study, we used 11 years of mark-recapture data of breeding female Wood Ducks (*Aix sponsa*) along with their breeding histories to examine sources of variation in annual survival rates and to assess the impact of current reproductive costs on probabilities of future reproductive success and survival. Apparent survival of female Wood Ducks did not vary annually and was only weakly affected by age class and breeding habitat conditions, but there was a strong positive relationship between survival and the number of successful nests. Next, we used a multistate analysis to examine the importance of current reproductive success on probabilities of future reproductive success and survival. Relative female body mass was used to assess nutritional status and quality of females. We found strong positive covariation between nest success in year t and probabilities of surviving and nesting successfully in year t +1. However, relative body mass of females had no effect on these relationships. Our results were consistent with the idea that quality of female Wood Ducks was heterogeneous and that differences in individual quality, independent of body mass, helped to mitigate increased reproductive costs associated with nesting successfully.

C.3.2: Dyson^

Habitat Selection and Survival of Female Wood Ducks and Ducklings at Long Point, Ontario

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Wood duck (*Aix sponsa*) recruitment is influenced by the number of birds hatched and their subsequent survival during brood-rearing. Survival is influenced by habitat availability, which provides cover and food necessary for females and their ducklings. Therefore, knowledge of post-hatch movements, habitat use, and survival during this period is critical to understanding recruitment, and ultimately population dynamics. The goal of our study was to gain a better understanding of brood-rearing ecology for wood ducks produced from nest boxes close to their northern range in Canada. Our objectives were to: 1) determine movement and habitat use of female wood ducks and ducklings, and 2) quantify survival during brood-rearing. We hypothesized that female wood ducks would select for the greatest quality habitats during brood-rearing. We predicted that movement and habitat selection of wood ducks with broods would be different from those without broods (i.e., lost broods), because of specific dietary requirements of ducklings and necessity for increased predator avoidance. We also predicted that habitat selection would be affected by female age/experience, hatch date, and nest site location. Additionally, we hypothesized that wood ducks and ducklings at northern latitudes would have lower survival rates than wood ducks at southern latitudes as a result of increased costs of migration and a contracted breeding/rearing period. We predicted brood and duckling survival would be influenced by female age and mass, hatch date, initial brood size, and an interaction between temperature and precipitation. We used radio-telemetry to monitor females and ducklings to 30 days post-hatch. Females selected swamp, scrub-shrub, and emergent marsh habitats, showed no selection for open water and forest habitats, and avoided urban and agricultural habitats. Habitat selection did not vary by female age, presence/absence of a brood, or hatch dates. However, nest site location did influence brood rearing habitat selection; females nesting away from swamp habitats subsequently showed stronger selection for swamp habitats. Female brood-rearing survival was high (0.90, 95% CI = 0.81 – 1.0), whereas brood (0.47, 95% CI = 0.33 – 0.69) and duckling (0.18, 95% CI = 0.14 – 0.22) survival were low, but similar to estimates from other wood duck research. Brood survival was best explained by a cox proportional hazards model containing hatch date and precipitation covariates, where the risk of brood mortality increased by 8% for every later day of hatch date and decreased by 5% for every mm increase in precipitation over the rearing period. Duckling survival was best explained by a model containing female age, female mass, and initial brood size as covariates. The risk of duckling mortality decreased by 53% for second year females relative to after second year females, decreased by 1% for every gram increase in female mass, and increased by 15% for every additional duckling in a brood. Wood duck management should focus on conservation of swamp, scrub-shrub, and emergent marsh habitats in areas with nest box programs.

*Speaker; ^Student

C.3.3: Hartke

A Breeding Population Survey for Western Gulf Coast Mottled Ducks

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Following a review of the population status, distribution, vital rates, and habitat requirements of mottled ducks (*Anas fulvigula*) at a 2006 workshop, participants acknowledged the limitations of available population data for mottled ducks in the western Gulf of Mexico Coast (WGC) and recommended the development of an improved range-wide survey. A visibility-corrected survey was developed using airplanes and helicopters to count mottled ducks along transects within the coastal portions of Louisiana and Texas. A double-sampling approach was employed where a subsample of the area surveyed by airplane crews was re-flown by helicopters to calculate a visibility-correction factor (VCF), to correct for birds missed by observers in the airplane. The survey has been conducted annually since 2008 with modifications following each of the first three years of the survey (2008-2010) to achieve better precision in the VCF and the resulting population estimates. Sampling effort was allocated proportionally to strata within each state representing course habitat types (coastal marsh and other) and expected spatial distribution of mottled ducks. Thus, population estimates are calculated for each state and each stratum by state. The survey design has been consistent for the past five years (2011-2015), and coefficients of variation on total breeding population estimates have ranged from 14-20%. Annual population estimates for WGC mottled ducks during the same period have ranged from 104,107 ± 14,970 (SE) to 171,684 ± 25,922. Trends in population estimates, spatial distribution of breeding mottled ducks, and potential use of survey results for population management and conservation planning will be discussed.

*Speaker; ^Student

C.3.4: Carrlson

Duck Brood Abundance in the Prairie Pothole Region of North and South Dakota

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Current conservation targeting efforts and metrics for Prairie Pothole Joint Venture performance in the Prairie Pothole Region (PPR) lean heavily on assessments of breeding duck pair density and nest success, but measures of brood abundance could prove to be a valuable addition to these methods of evaluating and characterizing breeding habitat. Taken together with pair density, estimates of brood abundance could be used by conservation managers to assess potential tradeoffs between landscapes that may support larger numbers of broods and fewer nesting pairs versus landscapes that may support more pairs and fewer broods. We expanded upon previous work assessing brood occupancy in the PPR of North and South Dakota to provide estimates of brood abundance. We used repeat-visit brood counts and hierarchical abundance and detection models to assess the relationship of abundance across a gradient of environmental variables. Our sample consisted of 5,956 wetland basins surveyed on 187, four-square mile study plots during 2007 – 2010 and 2012. Preliminary log scale parameter estimates indicated that the abundance of duck broods on a basin varied among years. Our study demonstrated that brood abundance has relationships with environmental covariates that can improve conservation targeting and emphasized the importance of maintaining abundant wetlands on the landscape.

C.3.5: Eichholz

Area Sensitivity of Productivity in Mixed Grass Prairie Upland Nesting Ducks

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Area sensitivity (the negative relationship between habitat patch size and reproductive success) has been invoked as the basis for studies demonstrating detrimental impacts of forest and tall grass prairie fragmentation on bird productivity. An edge effect is typically described as the mechanism for this relationship. For grassland nesting species in short or mixed grass prairies, which may not be as susceptible to edge effects, inverse area sensitivity of prey species density or predator (the enemies hypothesis) density is often invoked as an alternative mechanisms for a patch size, bird productivity relationship. Large patches are thought to benefit the nest success of birds by allowing birds to allocate themselves in a more dispersed distribution or disperse predators, reducing predator density. Empirical evidence supporting the patch size bird productivity relationship in short and mixed grass prairie grassland birds remains week and inconsistent. To test for area sensitivity of ducks in mixed grass prairies, we conducted a nest survival study of dabbling ducks in the mixed grass prairies of North America. If area sensitivity plays an important role in duck nest survival, we predict a negative relationship between duck nesting density and patch size and a positive relationship between nest survival and patch size. We analyzed data from 2,157 nests monitored in 2010 and 2011. We found no evidence for relationship between nesting density and patch size ($F_{1,27} = 1.33$, $p = 0.27$) and evidence for a negative quadratic relationship between patch size and nest survival. These results are consistent with other recent studies but inconsistent with predictions of area sensitive reproductive success. We conclude our results are most likely a result of the relationship between patch size and the diversity of the wildlife community a patch is able to support.

C.3.6: Feldheim

Ecology of Breeding Mallards in California: a Synthesis of Existing Information, and the Challenges of Harvest Management at a Local Scale

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Mallards are the most abundant breeding waterfowl in California and one of the most abundant duck species that winter in the state. California is unique among major North American wintering waterfowl areas in that the state also produces ducks, particularly mallards (*Anas platyrhynchos*), that contribute substantially to hunter harvest. Between 1961 and 2009 it is estimated that as much as 87% of the mallards harvested annually in California were produced in California. Since 2008, the Western Mallard population has been one of three mallard populations managed within an Adaptive Harvest Management (AHM) framework. However, Western Mallards, mallards that breed in California, Oregon, and Alaska, have received relatively little attention compared to mid-continent and eastern populations. Herein, we synthesized existing information on the ecology of breeding mallards in California, and used a lifecycle approach to present key demographic rates (e.g., breeding probability, nest success, duckling survival, and adult survival). In general, demographic estimates differed substantially from other mallard populations in North America, highlighting the importance of separate management of the Western Mallard population. It has long been recognized that California has the unique opportunity to manage for breeding mallards because California's mallards complete most of their lifecycle within the boundaries of the state. However, California's breeding mallards also face some unique challenges that result from spending their life in a state that in 2015 had the seventh largest economy in the world and more than 40 million people. Waterfowl managers in California face an additional challenge from an AHM model that in 2015 produced a season matrix that would recommend a Liberal duck season even with a California mallard breeding index of zero.

D.3: Breeding Ecology 2 (Chair: Clark Nissley)

D.3.1: Pöysä

Environmental Conditions in Early Life, Recruitment Age and Performance at First Breeding in Common Goldeneye Females

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Environmental conditions experienced early in life may have long-term impacts on life history traits. We investigated whether ambient temperature experienced during the first two weeks of life and weather severity during the first two winters affected recruitment age and relative timing of breeding in the year of recruitment in common goldeneye (*Bucephala clangula*) females. Our sample consisted of 135 female recruits hatched in a study population in central Finland between 1985 and 2011. About 56% of the recruited females bred for the first time when 2 years old (range: 2 to 6 years). Individuals facing colder ambient temperatures during the first two weeks post hatch or more severe winter conditions during the first two winters did not recruit at an older age. For those females that recruited at the age 2 years, first breeding date was usually late relative to the population mean that year (median difference 7.5 days, range: -7 to 21 days). However, the magnitude of the delay in the timing of breeding was not related to the climatic conditions faced by these individuals during the first two weeks post hatch or during the two winters before the first breeding attempt. Our results suggest that some sort of developmental buffering enables common goldeneye females to mitigate the impacts of harsh climatic conditions experienced early in life, at least in terms of first breeding. Negative impacts on subsequent breeding performance, lifetime reproductive success and other life history characteristics such as longevity may still exist.

D.3.2: Craik

Potential Role of Brood Parasitism on High Rates of Nest Desertion for Red-breasted Mergansers

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Offspring abandonment is likely beneficial when current reproduction is outweighed by its costs. Conspecific brood parasitism (CBP) may incur costs to host females, such as reduced egg success. Nest desertion, therefore, may be an adaptive host response if parasitism is detected early during laying. Little effort has been made to examine the prevalence of CBP among nests abandoned during egg laying, and whether it differs from clutches reaching incubation. Our study focused on CBP in a colony of Red-breasted Mergansers (*Mergus serrator*) in New Brunswick, Canada, and that is characterized by high rates of nest abandonment during egg laying (~30% of nests/year). Observations and microsatellite markers were used to compare 1) rates and intensity of CBP, 2) initiation dates, and 3) level of concealment between a sample of 23 nests abandoned during egg laying and nests reaching incubation. At least one parasitic egg was identified at each abandoned nest and at the majority (70%) of incubated nests, suggesting that presence of parasitism is not a correlate to nest abandonment. Intensity of parasitism at abandoned nests, however, was greater than that at clutches reaching incubation. On average, 70% of eggs in abandoned nests were parasitic and 6-7 females (range 2-10) contributed eggs to these clutches. Conversely, only 30% of eggs in incubated clutches were laid by parasites, and typically ≤2-3 parasitic eggs were in each of these nests. Abandoned nests were among the earliest nests initiated, indicating that heavy CBP may be the result of limited nest sites early during the season. Level of concealment varied little between abandoned and incubated nests. Our results provide some of the first evidence that heavy CBP during egg laying may have implications for nest success of mergansers, and that the earliest initiated nests are particularly vulnerable to high levels of CBP and host desertion.

D.3.3: Ward

Changes in Pacific Black Brant Breeding Productivity Through Space and Time

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The majority of the Pacific Flyway (PF) population of Black Brant traditionally breed on the Yukon-Kuskokwim Delta (YKD), Alaska, and have experienced dramatic declines in first-year survival (from 0.46 in 1986 to 0.27 in 2007) and a slight? reduction in numbers of nests ($\lambda = 0.995$) since 1985) . However, despite these declines, long-term trends in the overall population of Black Brant have remained relatively stable, suggesting that increases in nesting and productivity are occurring in some other segment of the breeding population. Recent reports of increasing trends in the number of nests ($\lambda = 1.04$, 1995-2014) and breeding pairs ($\lambda = 1.076$, 1986-2012) on Alaska's Arctic Coastal Plain suggest that overall increases in Black Brant nests and productivity may be occurring in northern Alaska and other parts of their Arctic breeding range. We examined >50 years of fall age ratio surveys at Izembek Lagoon, Alaska, where >90% the entire PF population of Black Brant stage each year, to provide insight into long-term trends in the annual productivity of black brant. We also evaluated the contribution of the annual production that originates from the YKD and non-YKD (Arctic) sources via stable isotope analyses of primary feather samples from juvenile Brant collected in fall at Izembek Lagoon to determine whether declines in productivity on the YKD are being offset by increases in productivity from non-YKD sources. Analyses are pending, but preliminary results suggest age ratios have declined through time at Izembek and upwards of 50% of juveniles sampled were produced in areas other than the YKD.

D.3.4: Nissley^

Assessing Pre-emptive and Apparent Competition Exhibited by Cackling Geese and Lesser Snow Geese on Breeding Atlantic Brant

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Atlantic brant populations are known to fluctuate; however, productivity surveys on the wintering grounds indicate the number of young in flocks has declined in recent decades. This may be indicative of a limitation on the breeding grounds. Expanding populations of lesser snow geese (*Chen caerulescens caerulescens*) and cackling geese (*Branta hutchinsii*), utilizing the same breeding grounds, may be contributing to the decline in brant breeding success. Identifying all forms of interspecific competition among brant and these other arctic nesting goose species is key to understanding any possible limitations that may be occurring. Southampton Island has historically supported breeding populations of Atlantic brant, lesser snow geese, and cackling geese; however, the number of breeding brant on the island decreased significantly in the last 35 years. We studied the interactions occurring between brant, snow geese, and cackling geese at East Bay, Southampton Island in the summers of 2014 and 2015. We compared historical brant nesting sites to those found in 2014 and 2015 to assess potential pre-emptive competition occurring between brant and cackling geese. Increased presence of cackling geese nesting in areas previously occupied by brant has limited brant to nesting in small and less than optimal pockets. Exclusion from optimal nesting islands can lead to increased depredation by predators. In addition to this exclusion, increased populations of nesting snow geese and cackling geese at East Bay may be drawing higher densities of predators than a nesting area occupied predominantly by brant. To test these hypotheses we monitored brant nest sites in the summers of 2014 and 2015 to document availability and density of competing geese. We calculated nest fate probabilities in both 2014 and 2015 using the same set of covariates to determine under what circumstances brant nest success increases. In addition, we also trapped and marked foxes in the study area to quantify the number of foxes prior to brant incubation and assess depredation pressure on nesting brant as a potential force driving the decline in brant nest success. As Atlantic brant populations have experienced long-term fluctuations, efforts to understand their limitations have focused on the wintering grounds. However, as lesser snow geese and cackling geese populations continue to grow and exert potentially direct or indirect competitive pressure on the brant breeding grounds, it is critical for future management to quantify the presence and strength of such a possible limitation.

D.3.5: Straub

Simulations of Wood Duck Recruitment from Nest Boxes in Mississippi and Alabama

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Since the early 20th century, wildlife managers have deployed artificial nesting structures for wood ducks (*Aix sponsa*) to increase availability of nest sites and local reproduction of the species. However, knowledge is lacking of the effects of nest structure size (i.e., large vs. small; Stephens et al. 1998) and reproductive data (e.g., clutch size, hatch date, duckling survival) on recruitment of wood ducks. We used stochastic simulation analyses to predict recruitment of wood ducks into late summer by analyzing data from a 6-year study of box-nesting wood ducks, and 4-year (Mississippi) and 2-year (Alabama) studies of radiomarked female wood ducks and their ducklings. Our index of recruitment was the number of radio-marked ducklings per nest box that survived until 1 September. Ducklings hatched after 1 June exhibited a 30-day survival probability of 0.29, which was nearly 3 times greater than those hatched before 1 June. In east-central Mississippi, 68% and 65% of total wood duck recruits from large and small boxes, respectively, were hatched and reared from June to August. In western Mississippi, 91% of recruits from each box size also were hatched and reared from June to August. Mean number of wood duck recruits produced from large boxes was greater than small boxes at each study site; each large box in western Mississippi produced approximately 4 recruits on average, whereas small boxes in east-central Mississippi produced approximately 1 recruit. Wood duck recruits in our study resulted primarily from late spring and summer hatched birds in contrast to most Nearctic ducks with adaptive, early nesting to promote recruitment. In Mississippi and similar southern environments, we recommend use of large boxes and cleaning boxes around 1 May after completion of initial nests, and emphasize the importance of late spring and summer duckling production to wood duck recruitment.

D.3.6: Stair

Tracking the Breeding Ecology of Cavity-Nesting Waterfowl with RFID Devices

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Methods for monitoring wild animals have advanced considerably in the past 20 years, from miniaturization providing cost and weight savings to improvements in GPS and GSM accuracy; there is now an extensive array of methods available to collect data remotely. Unfortunately, most of these technologies are expensive, many require recovering the device, and almost all require a power source that limits the duration of data collection. A relatively low-cost and robust alternative for some types of wildlife monitoring can be found in using radio-frequency identification (RFID) implants, often called passive integrated transponder (PIT) tags. An RFID system is composed of many inexpensive implantable PIT tags and a series of readers which record the presence and identification number for each tag. When a tagged animal approaches the antenna of an RFID reader, the reader queries the PIT tag and records that animal's unique code along with a timestamp. We have been using RFID tags to collect population level data for nesting wood ducks (*Aix sponsa*) in the California Central Valley for the past two years, tagging nearly a thousand ducks each year. By placing RFID readers on several hundred nest boxes across multiple field sites, we can record the number and frequency of nest visitations for each individual female, identify usage trends for each nest box, and follow successive breeding attempts of females throughout their lifetimes. Challenges to using RFID technology include preventing interference from multiple antennas, providing consistent reader power to prevent data loss, and managing reader maintenance; tag loss has not been a significant issue. RFID readers allow us to track thousands of individuals over long periods of time for relatively low cost. Here, we consider potential benefits and pitfalls of adopting RFID technology to follow the breeding ecology of cavity-nesting waterfowl, and explore potential applications to other species.

C.4: Climate Change (Chair: Lena Vanden Elsen)

C.4.1: Guillemain

Combined Effects of Climate Change and Fluctuating Habitat Quality on the Distribution of Ducks in Southern Europe

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Changes in waterfowl ranges over the last decades are increasingly reported, both in North America and in Europe. The relative importance of different winter quarters may fluctuate under the influence of changing local habitat conditions, as well as according to general trends caused by global climate change. Several European duck species have shifted their winter range to the North-East, i.e. the distance between breeding and wintering grounds was reduced, in a pattern consistent with a global temperature increase. In northern countries, this could also indicate an increasing proportion of sedentary birds. We compared the geographic distribution of recoveries of bands fitted to Mallard (*Anas platyrhynchos*) and Common Teal (*A. crecca*) in Camargue, southern France, over the last 60 years. Close to 75,000 ducks were banded since the early 1950s. Band recoveries occurred to a much greater extent in the Camargue area than in other parts of the flyways during the last decade compared to earlier years: as opposed to earlier studies, recoveries of Camargue-ringed ducks are increasingly made to the South-West. For migratory Teal, this indicates an increased faithfulness to the Camargue winter quarter. For Mallard, though, some birds may have become around-the-year residents: while the distance from banding site to recovery location was >400 km between the 1950s and 1970s, it is <75 km nowadays. Several hypotheses are proposed to explain these changes in European duck distributions. Survival analyses are also carried out, which help assessing whether changes in geographic distribution have also translated into altered demographic rates. Besides the overriding effects of climate change in the long-term, the present results suggest that local habitat management practices still have the potential to greatly affect the distribution of waterfowl.

C.4.2: Nilsson

Changes in Numbers and Distribution of Wintering Waterbirds in Sweden 1966 – 2015

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During the last fifty years marked increases have been noted in the national wintering populations of most waterbird species in Sweden according to a national monitoring program started in 1966 (from 1967 as a part of the International Waterfowl Counts, IWC). The counts were undertaken by volunteers on about 600 counting units in the southern part of the country each year (areas further north were ice-covered) with country-wide aerial surveys in some years. Inshore species increased from about 174 000 at the first country-wide survey in 1971 to about 600 000 in January 2015. On the other hand the most common wintering species in Sweden, the Long-tailed Duck, decreased from about 1.4 million to 600 000 in 2009-2011. Comparison with the counts in other European countries show that the increases in Swedish waters were to a large extent due to a northwards shift in the distribution of the different species, a pattern that was also apparent within Sweden. The decrease in the number of Long-tailed Ducks was on the other hand part of an all-Baltic pattern. Shifts in the distribution of different waterbird species was related to changes in the hardness' of the winters with smaller ice-coverage in the Baltic in later years. Similar changes were also found in goose numbers in Sweden, but these counts started later (1977/78). For the geese less snow coverage in later milder winters was probably an important driver. During the survey period a number of species established new wintering traditions in the country: the Wigeon, Greylag Goose and Barnacle Goose.

C.4.3: Vanden Elsen^

Factors Influencing Autumn-Winter Distributions of Dabbling Ducks in the Atlantic and Mississippi Flyways

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As climate changes, wildlife managers would benefit from a better understanding of how weather influences autumn-winter distributions of dabbling ducks throughout the Atlantic and Mississippi Flyways of North America. These two flyways include 70% and 73% of hunters in the United States and Canada respectively and winter 50% of the dabbling ducks in North America. Changing climates may influence the availability of dabbling ducks to hunters and other waterfowl enthusiasts that contribute financially and politically to wetlands conservation. Our aim was to determine which weather factors had greatest influence on autumn-winter distributions of gadwall; *Anas strepera*, American wigeon; *A. americana*, American black duck; *A. rubripes*, mallard; *A. platyrhynchos*, blue-winged teal; *A. discors*, northern shoveler; *A. clypeata*, northern pintail; *A. acuta*, and green-winged teal; *A. crecca carolinensis*. Based on dabbling duck life history strategies, we hypothesized that weather-based models would best predict changes in abundance for all study species except for blue-winged teal and northern pintails, which we predicted would be best explained by day length models. We used standardized waterfowl survey data from 25 waterfowl concentration areas and local weather data to model rate of change in relative abundance with weather and photoperiod for each species. We included latitude in models to determine if effects of weather differed by geographic location. Species-specific Weather Severity Index (WSI) thresholds (i.e., the WSI value where duck abundance is neither increasing nor decreasing) were determined. Variation in rate of change in relative abundance of ducks was best explained by weather models that incorporated temperature and snow for all species except blue-winged teal, which was best explained by photoperiod. Variation in models were in agreement with anecdotal observations by waterfowl enthusiasts. Mallards and American black ducks migrated following freezing conditions (at approximately -5°C) that often included snow accumulation, while other dabbling ducks generally migrated prior to the onset of these freezing conditions. Temperature thresholds predicted to cause migration were least for green-winged teal and American wigeon (weekly mean = 10°C), followed by northern shoveler (9°C), gadwall (7°C), and northern pintail (4°C). All study species were also influenced by latitude, indicating a change in response to weather severity and photoperiod dependent on where dabbling ducks were located. Based on these results, dabbling ducks using weather severity as their primary cue for autumn migration will likely experience a northward shift in distribution with increasing temperatures and decreasing snow depth. We suggest using developed WSI thresholds with historical weather data to estimate how dabbling duck distributions may have changed (e.g., 1980 – present). We also suggest that species-specific WSI thresholds be combined with future climate change scenario models to predict future dabbling duck distributions in the Atlantic and Mississippi Flyways.

C.4.4: Schummer

Weather Severity Indices for Estimating Influences of Climate on Autumn-Winter Distributions of Waterfowl and Hunter Opportunity and Satisfaction

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Each year, millions of waterfowl migrate from their breeding grounds in Arctic, northern and mid-latitudes to more southern locales to exploit abundant food and wetland resources as freezing wetlands and snowfall progress from north to south in North America. These migrating birds consume and distribute an abundance of plants and seeds, are a cultural resource for waterfowl watchers and hunters (hereon waterfowl enthusiasts), and provide substantial economic benefit through the activities of waterfowl enthusiasts. Recognition of the tangible and intangible importance of this diverse group of birds by waterfowl enthusiasts also gave rise to substantial international efforts to conserve wetlands and associated upland habitats throughout North America. Because of the importance of waterfowl, inter-annual variation in their distribution during the non-breeding season can influence ecological, environmental, cultural, and economic relationships. We developed weather severity indices (WSIs) to estimate autumn-winter distributions of gadwall (*Anas strepera*), American wigeon (*A. americana*), American black duck (*A. rubripes*), mallard (*A. platyrhynchos*), blue-winged teal (A. discors), northern shoveler (*A. clypeata*), northern pintail (*A. acuta*), and green-winged teal (*A. crecca carolinensis*) based on contemporary weather conditions (1980–2000), describe historic changes to weather known to influence migration by these ducks (September – March 1979 – 2013), and forecast their future spatial distributions based on dynamically downscaled climate change scenarios (mid-21st [2046–2065], late-21st [2091–2100]). For all species, the WSI models with the greatest explained variance in the timing of migration included combinations of temperature and snow depth thresholds that predicted decreased abundances of these ducks at northern and mid-latitudes with increasing WSI. Our models predict that the arrival of these ducks from Canada into the U.S. and on to more southern latitudes may become delayed by at least a month by the late 21st century; such a shift would have substantial ecological, cultural, and economic consequences, and necessitate changes to North American-wide conservation efforts.

C.4.5: Beaman^

Implications of Climate Change for Land Use and Waterfowl Productivity in Prairie Canada

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North America's Prairie Pothole Region (PPR) is both a highly productive agricultural region and a crucial breeding ground for Nearctic waterfowl. Spanning three Canadian Provinces and six U.S. states, this 176 million acre mosaic of native prairie, wetlands, and cultivated crops produces 50-80% of North America's duck population each year. Conversion of native grassland to intensive agriculture, however, continues to fragment and degrade productive breeding habitat for waterfowl and other wildlife. On the Canadian prairies, nearly 60% of native mixed grass prairie and 70% of wetlands have been lost due to the expansion of agriculture. Given the importance of the PPR to North American duck production, continued habitat fragmentation poses a threat to continental waterfowl populations. Moreover, since 90% of land in the Canadian Prairie Provinces is privately owned, it is important that waterfowl conservation organizations understand how private landowners respond to price and policy changes to effectively target habitat conservation. We use an econometric land-use shares model to predict the proportion of total farm area in eight agricultural land-use categories for each of the 39 Census Agricultural Regions in Alberta, Saskatchewan, and Manitoba. Modeled land uses include spring wheat, winter wheat, oats and barley, canola, flaxseed, fall rye, hay, and pasture. The model predicts shares of land devoted to each land use based on expected revenue, landscape characteristics, and climate variables. We project future (2030, 2060, and 2090) distributions of land cover under three International Panel on Climate Change emission scenarios (Representative Concentration Pathways 4.5, 6.0, and 8.5). We then integrate the econometric land-use shares model with Ducks Unlimited Canada's five-species Waterfowl Productivity Model to yield production estimates for Mallard (*Anas platyrhynchos*), Blue-winged teal (*A. discors*), Northern Shoveler (*A. clypeata*), Gadwall (*A. strepera*), and Northern pintail (*A. acuta*) in the PPR given predicted land-use change. Results suggest that warmer, wetter future climates in Prairie Canada will favor intensive row-crops, leading to increased rates of prairie conversion and higher cropland acreage. Preliminary results from integrating the land-use change model with the waterfowl productivity model suggest that climate-driven land-use change is likely to be an important driver of waterfowl distribution and production. Predicted expansion of intensive row crops will generally reduce the availability of productive breeding habitat and thus reduce the ability of the region to produce waterfowl. The ultimate effect of climate and land-use change on waterfowl productivity, however, depends on the climate scenario examined and species considered.

*Speaker; ^Student

C.4.6: Baranyuk

Current Status of Lesser Snow Geese on Wrangel Island, Russia

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Wrangel Island snow geese (WISG) are an internationally recognized population of the Lesser Snow Goose. They winter primarily in British Columbia, Washington, Oregon, and California. Surveys of snow geese on Wrangel Island were initiated in 1969 by Russian scientists and through cooperative Russia and United States government agency efforts, and were conducted annually for over 45 years. During this period, the WISG population declined significantly in the 1970s but increased to about 155,000 in 2011. The increase in this population is due to natural reduction of predation pressure on the Tundra River colony and general warming patterns of the arctic and subarctic. The ratio of Wrangel Island arctic foxes to snow geese nests decreased tenfold (from 1:500 to less than 1:5,000), and foxes on Wrangel Island are no longer a limiting factor for snow geese. As a result of the change in age structure, the population has become more mobile and expanded its distribution. Until recently, WISG was a closed population, with very limited exchange of males occurring mainly in the California wintering grounds shared by geese from the western Arctic population. In 2015 on the Tundra River snow goose colony, there were 107,800±2,600 nests and the total spring population increased to 240,000 birds, which does not match intra-population dynamics. We believe that there was a significant proportion of migrants on Wrangel Island, as indicated by a sevenfold increase in the number of blue geese compared to 2011(this year, about 200 blue geese were nesting on Wrangel Island). On the northern wintering area (Fraser-Skagit flock) in 2014-2015, there were 65,000 birds and about 10 were blue geese. On Wrangel Island it appears we are witnessing a sharp increase in the influx of geese from California, possibly from the western Arctic population. In this regard, we propose to renew mass marking of WISG using the latest technology. In 2015, we used satellite images to investigate the possibility of monitoring the colony, and according preliminary results, estimates were close to those of our traditional ground transects.

D.4: Habitat Use (Chair: Fritz Reid)

D.4.1: Janke^

Novel Contributions of Wetlands in Agricultural Landscapes to Duck Migration in the Southern Prairie Pothole Region

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The Prairie Pothole Region (PPR) is widely regarded as North America's 'duck factory' because it annually accounts for significant proportions of North American duck production. However, the region also provides important stopover habitat for ducks bound for North America's 'other' duck factories in the boreal forest and arctic, playing an important role in facilitating successful reproduction in those landscapes through mediating timing and condition upon arrival among pre-breeding ducks. Despite the potentially important role of the region during spring migration, ecology of ducks and the wetland resources on which they depend during spring migration has received little study and traditional conservation efforts in the region focus intensively on local breeding habitats. We sought to evaluate the contributions of wetlands in intensively farmed landscapes along the southern edge of the PPR in eastern South Dakota for two wetland-dependent migrating ducks — lesser scaup (*Aythya affinis*) and blue-winged teal (*Anas discors*)— during spring migration of 2013 through 2015. We collected migrating females of each species and sampled aquatic invertebrates in wetlands (n = 306) on thirty 50 km^2 study sites stratified into high, medium, and low agricultural crop production intensity. We predicted that if wetlands in agricultural landscapes were highly degraded we may observe lower protein or lipid reserves in ducks stopping over in those landscapes, and would observe differences in the trajectory of fat and protein reserves indexed through concentrations of key lipid and protein metabolites circulating in plasma. If nutrient reserve trajectories were influenced by agricultural impacts on wetlands, metabolite concentrations of ducks sampled in intensively farmed landscapes would indicate catabolism of reserves, whereas metabolites of those in more natural, grass-dominated landscapes would indicate accumulation of additional reserves. Stratum-level analyses indicated that body condition (fat and protein reserves) of lesser scaup (n = 171) and blue-winged teal (n = 279) were not systematically different across the crop intensity strata. Further, the trajectory of nutrient reserves, as measured with the metabolites in blood, was not systematically different across the three strata for either species. Analyses on densities of invertebrate prey in wetlands and abundance of migrating waterfowl on the study areas is ongoing and will help comprehensively evaluate the contributions of these agricultural landscapes to spring-migrating ducks. Coarse-scale analyses indicated that wetlands in intensively farmed landscapes were at least providing comparable refueling habitats for wetland-dependent ducks as those found in more grass-dominated landscapes that are the typical focus of conservation efforts in the region. If this pattern indeed holds across the southern PPR, waterfowl populations may benefit from targeted conservation efforts on wetlands in intensively farmed landscapes outside of traditional high-density breeding regions that provide novel, but important migration habitat for pre-breeding ducks prior to arrival at more-northern breeding sites.

D.4.2: Schepker^

Evaluating Relationships Amongst Local and Wetland Landscape Structure in Determining Waterfowl Habitat Use

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Wetland biologist and resource managers rely on species distribution models (SDM) to generate an ecological explanation and prediction of how wetland dependent species interact within a system. Typically, SDM are developed by identifying relationships between species distributions (response variable), and varying attributes within the physical environment they inhabit (causation variable). Waterfowl tend to be one of the more frequently studied wetland dependent groups, however even waterfowl SDMs are far from complete. Previous studies have identified food resource availability, vegetative dispersion, depth, and wetland size as factors influencing waterfowl distribution, however these variables are generally only applicable for local scale (within wetland) assessments. Waterfowl are highly mobile and capable of exploiting wetlands in the surrounding landscape to acquire food resources, form pair bonds, and avoid predation. Therefore it is important that SDMs incorporate relevant variables at multiple scales (both the local and landscape-level) to accurately predict how waterfowl distribute themselves across an ecological complex. We conducted weekly avian surveys at 20-27 playas in Nebraska's Rainwater Basin, USA, to determine dabbling duck, diving duck, and goose density, and species richness during springs of 2014 and 2015. At the wetland scale, we assessed spring food resource phenology (seed and invertebrate biomass), changes in vegetative cover, depth, and wetland area. At the landscape scale we used aerial imagery and Recurring LandSat satellite imagery to quantify change in total wetland area within a 4.6km radius of our individual study sites. Local and landscape attributes were designated as independent variables, and waterfowl density and species richness were designated as dependent variables. From our independent variables we developed different combinations of a priori candidate models and used multiple generalized linear mixed models and Akaike information criterion to evaluate and select the models that best explained variation in waterfowl density and species richness. Preliminary analysis from 2014 data indicated invertebrate biomass was the only covariate in the top model predicting waterfowl density, however, wetland area and density within 4.6 km of a study site were covariates in competing models. Finally the interaction between invertebrate biomass and wetland density appeared in 3 of the 5 top models predicting waterfowl density, indicating that wetland landscape structure may compensate for lower food availability at a local scale. Given the current limitations in wetland habitat across North America, it is essential that regional managers develop a reliable method for evaluating and predicting waterfowl distribution and our results suggest incorporating site attributes at both the local and landscape levels will improve SDM for migrating waterfowl.

*Speaker; ^Student

D.4.3: Palumbo^

Habitat Selection and Survival of Female Mallards in the Lake St. Clair Region During Autumn and Winter

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Spatial and temporal use of habitats by animals is influenced by availability and quality of resources, energy expenditure to acquire resources, predation risk, and their interactions. Animals can associate human disturbance equivocally to potential predation risk and may modify habitat use in relation to that risk. Human disturbance associated with hunting can also influence the local abundance and distribution of waterfowl. The diversity of habitat management and conservation strategies, including spatial and temporal refuges at Lake St. Clair, Ontario, provide opportunity to investigate how waterfowl movements and foraging strategies vary in response to human disturbance (i.e., hunting), habitat quality and food availability across the landscape. We hypothesize that adult female mallards exhibit different foraging strategies (e.g., habitat selection) based on the trade-off between food resource acquisition, availability of different habitats, and potential risk of mortality from hunting which will influence survival in the Lake St. Clair region during autumn and winter. Therefore, we predict that habitat use will influence probability of surviving while in the Lake St. Clair region. Our primary objective is to evaluate habitat selection of adult female mallards (Anas platyrhynchos) in relation to perceived risk and to determine if foraging strategies (i.e., habitat use) influences survival during autumn and winter. Harvest information supports that Great Lakes mallards should be managed separate from Mid-continent mallards because they are subject to different environmental conditions, habitats, and population drivers. The Great Lakes mallard population may be more sensitive to non-breeding season survival of adult females than Mid-continent mallards. Evaluating habitat use and how it influences mallard survival could be used to guide management throughout the region. We captured and banded over 800 mallards, August – September 2014. Of these ducks, we selected 20 adult females that met our weight requirement (>900 g) and equipped them with Global Positioning Satellite (GPS) transmitters (30 g) that provide multiple diurnal and nocturnal locations. We tracked GPS equipped mallards until they migrated out of the region or died. We determined fate of each individual from hunter reports or verification of apparent mortality from tracking to the GPS unit via VHF radio telemetry. We plan to deploy approximately 40 additional GPS transmitters on adult female mallards, August - September 2015.We classified regional habitat types based on vegetative composition and ranked each habitat based on potential mortality risk to mallards from hunting (low, moderate, high) based on access to hunting (hunting prohibited, private, public). We will determine the daily survival probability and how the use of different habitat types of varying risk may influence survival. Our research represents a novel approach to assess how adult female mallards navigate a dynamic landscape of variable resource benefits and mortality risks. Our results will provide relevant information regarding resource selection and migratory ecology in addition to providing useful information to conservation planners for future management to ensure that the Great Lakes population of mallards can be sustained.

*Speaker; ^Student

D.4.4: Foth^

Waterbird Use of Wetlands and Aquaculture Ponds in the Mississippi Alluvial Valley and Gulf Coast Regions

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Historically, the Mississippi Alluvial Valley (MAV) landscapes were dominated by extensive forested wetlands. During the last century, most of the MAV was converted to agricultural, aquaculture, and other anthropogenic uses. However, these land use changes created previously unavailable stop-over habitats for migrating shorebirds, waterfowl, and other waterbirds (hereafter, waterbirds). Prior to modification, some species of waterbirds (i.e., shorebirds) likely migrated past or sparingly used the MAV before settling in wetlands along the Gulf Coast (GC). Shorebirds exhibit some of the longest annual migrations of any animal. During migration, they rely heavily on interior and coastal wetlands in the Atlantic and Mississippi Flyways for stopover sites. In 2010, the Deep-water horizon oil spill impacted coastal marshes of the northern Gulf of Mexico. In response, the Natural Resources Conservation Service (NRCS) implemented the Migratory Bird Habitat Initiative (MBHI) to provide migratory waterbirds with interior wetland habitats to mitigate coastal wetland degradation. Our objective was to estimate species composition and relative abundance of migrating waterbirds on MBHI and associated wetlands in the MAV and GC regions during fall migration. We surveyed waterbird use of aquaculture farms, national wildlife refuges, and conservation areas throughout the MAV and GC during August-October 2011-2013. We followed the protocols of the Integrated Waterbird Management and Monitoring Program's Monitoring Manual (2011) for whole area counts, assuming we observed ≥ 70% of the wetland from available vantage points. We conducted surveys on individual ponds or moist-soil units in the MAV. We substituted NWRs in the north and south MAV to aid in establishment of a longitudinal gradient for tracking fall migrating waterbirds. We conducted surveys along tidally influenced mudflats and lagoons using a boat or by walking line transects when coastal sites were accessible by land. We recorded waterbird relative densities (birds/wetland ha surveyed) and species composition at all locations. We ran an analysis of variance on waterbird densities and associated covariates (i.e., year, month, time period, wetland type, study site, and average rainfall 5 days prior). Preliminary results indicate year ($F = 3.51$, $P = 0.0305$), month ($F = 5.17$, $P = 0.0059$), wetland type ($F = 5.42$, $P = 0.0003$), and study site ($F = 3.55$, $P < 0.0001$), were significant factors within our model. We found birds/ha on MBHI wetlands were more than 8 times greater in 2011, more than 4 times greater in 2012, and more than 7 times greater in 2013 than wetlands not enrolled in MBHI during peak migration. Ongoing research on shorebirds in the MAV and GC will incorporate stable isotope analysis to assess migratory connectivity between the two regions. Stable isotope analysis may also allow us to detect presence of oil signatures in shorebird tissue and food sources along the GC. Our research will eventually provide conservation planners with tools to predict shorebird abundance and manage wetlands accordingly.

*Speaker; ^Student

D.4.5: Pernollet^

Winter Flooding and Use of Rice Fields by Waterfowl in Europe: Towards Mutual Benefits for Ducks and Farmers

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In the U.S., winter flooding of post-harvest rice fields has been identified as a waterfowl-friendly management practice that also provides agronomic benefits for farmers. Whether the practice would provide mutually-beneficial outcomes in a European context has received little attention so far, and is the topic of this study. We first assessed if the average waterfowl abundances at the flyway scale in five European rice production regions was positively affected by winter flooding. Total wetland area (i.e., natural wetlands plus flooded rice fields) explained the number of ducks in a given winter quarter, but the proportion of rice fields flooded during winter varied considerably between countries (0.2–62%), owing to differences in agricultural policy. We then conducted an empirical study addressing seed availability and nocturnal duck use of post-harvest rice fields on more than 50 fields with different agricultural practices in Camargue, France. An average of 350 kg/ha (± 58 SE) of rice and 142 kg/ha (± 21 SE) of weed seeds remained after harvest. Flooding was the main determinant of nocturnal duck use of the fields (23.5 ducks/ha ± 2.3 SE vs. 0.3 ± 0.1 SE if unflooded). We experimentally tested the effect of wing-clipped ducks on the weed seed bank and straw stalk reduction, as well as the effect of winter flooding on the viability of weed seeds. The presence of waterfowl enhanced straw decomposition, but did not have any detectable effect on the weed seed bank. Flooded fields did experience enhanced weed seed deterioration, which was species-dependent, red rice (*Oryza sativa* L.) being most affected by the practice. Flooding rice fields after harvest therefore provides nocturnal foraging habitats for ducks as well as agronomic benefits through increased straw decomposition and reduction of the weed seed bank. We then completed a cost-benefit analysis (C/B) evaluating whether winter flooding in France would be an economically realistic undertaking and a benefit to society in general. We determined that the alternative practice of chopping-flooding-ploughing would be twice as profitable for farmers and more than four times as beneficial to society than the burning-ploughing practice that is widely employed today (Ratio C/B for farmers: 1.02 vs. 2.08; for society: 0.78 vs. 4.19). Our study suggests that winter flooding of rice fields in Europe is an economically feasible practice that would benefit farmers, wintering waterfowl, and society, and should therefore be promoted by adequate agro-environmental policy wherever possible.

*Speaker; ^Student

D.4.6: Austin

Habitat Use of Post-breeding Female Lesser Scaup

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Habitat-selection studies of post-breeding waterfowl have largely focused on landscape or intermediate scales. Fewer studies have examined habitat use within a wetland relative to attributes such as water depth, escape cover, and food availability. Flightless waterfowl must balance habitat selection between avoiding predation risks and feeding. Reproductively successful female ducks face the greatest challenges because they begin the definitive prebasic molt at or near the end of brood rearing, when their body condition is at a low point. We assessed the relative importance of habitat attributes and group behavior in habitat use by post-breeding female lesser scaup (*Aythya affinis*) on Lower Red Rock Lake, Montana, during the peak flightless period (August) over 7 years. Hypothesis-based habitat attributes included percent open water, view shed area, open water:emergent edge density, water depth, percent aquatic bare substrate, fetch, group size, and various interactions. Surveys of uniquely marked females were conducted within randomly-ordered survey blocks. We fitted two-part generalized linear mixed-effects models to counts of marked females within survey blocks, which allowed us to relate habitat attributes to 1) relative probability of occurrence and, given the presence of a marked female, 2) abundance of marked individuals. Post-breeding scaup selected areas with water depths >40 cm, large open areas, and intermediate edge densities but they showed no relation to bare substrate, suggesting habitat selection was more influenced by avoiding predation risks and disturbances than in meeting foraging needs. Grouping behavior by post-breeding scaup at Lower Red Rock Lake suggests habitat selection is influenced in part by behavioral components and/or social information, conferring survival and energetic benefits (predation and disturbance risks) but potentially also contributing to competition for food resources. Understanding factors contributing to within- and among-year variability in habitat selection of post-breeding waterfowl is important for informing conservation and management decisions.

Mentor/Mentee Session

Jacob McPherson[1], Joseph Lancaster[2], Joseph Marty[2]

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This session will begin with a panel of four young professionals who are currently employed in a waterfowl or wetland conservation related position. Panelists will offer details about their unique paths to employment before opening the floor for specific questions. Discussion topics will include: effective job search tactics, networking methods, job interview do's and don'ts, resume writing tips, and more. Upon conclusion of the Young Professional Panel, participants who have signed up as mentees will be introduced to their respective mentors and will have time for unstructured discussions related to waterfowl conservation, graduate school, and future employment.

Panelist:

Jim Feaga, Regional Biologist NJ/PA/Long Island, Ducks Unlimited

Kevin Ringelman, Assistant Professor, Louisiana State University

Anthony Roberts, Wildlife Biologist, Atlantic Flyway, US Fish and Wildlife Service

Anne Mini, Science Coordinator, Lower Mississippi Valley Joint Venture