FRIDAY, 5 FEBRUARY 2016		
06:30 - 08:00	*Breakfast in the Capital Ballroom*	
08:10 - 08:20	**Opening Remarks & Announcements -** Chris Williams	
Capital Ballroom **08:20 - 09:40**	**M.1: Plenary**	
8:20	**M.1.1: Plenary Michael Anderson** **From Coherence to Integration: Challenges of Multiple Scales, Decision Authorities, and Processes** (Michael G. Anderson*)	
9:00	**M.1.2: Plenary David Fulton** **Values Translated into Objectives: Engaging Waterfowl Stakeholders** (David C. Fulton*, Andrew Raedeke, Jason Spaeth, Michael Kilgore, Howie Harshaw, Gray Anderson, and Dale D. Humburg)	
09:40 - 10:00	*Coffee break*	
Capital Ballroom **10:00 - 12:00**	**N.1: Featured Session: Implementing the 2012 NAWMP Revision: Management Decisions to Integrate Multiple Objectives at Varying Scales** (Organizer: Dale D. Humburg)	
10:00 - 10:05	**N.1.1: Humburg**	**Introduction to the Session** (Dale Humburg*)
10:05 - 10:20	**N.1.2: Runge**	**Modeling and Managing Linkages across Objectives: Beyond the JTG** (Michael C. Runge)
10:20 - 10:35	**N.1.3: Vrtiska**	**Adaptive Harvest Management: Re-examining Harvest Objectives and Approaches** (Mark P. Vrtiska*, Min Huang, W. Adam Phelps, Paul I. Padding, James R. Kelley, Jr., and James A. Dubovsky)
10:35 - 10:50	**N.1.4: Carter**	**Integrating Human Dimension Considerations into Joint Venture Habitat Delivery** (Michael F. Carter*, Andy Bishop, and Beth Huning)
10:50 - 11:05	**N.1.5: Brasher**	**Focusing Resources on Important Landscapes: A Spatial Framework for Integrating NAWMP Objectives** (Michael G. Brasher*, Mark J. Petrie, David W. Howerter, and Dale D. Humburg)
11:05 - 11:20	**N.1.6: Eadie**	**Integrated Annual Cycle Models of North American Ducks: Progress, Pitfalls and Prospects** (John M. Eadie*, Robert G. Clark, Jane Austin, G. Scott Boomer, Pat Devers, Jim H. Devries, Brady J. Mattsson, Eric E. Osnas, and Michael C. Runge)
11:20 - 11:50	**N.1.7: Johnson**	**Plenary Fred A. Johnson** **Multi-Level Learning in Waterfowl Conservation** (Fred A. Johnson*, Dale D. Humburg, David J. Case)
11:50 - 12:00	**N.1.8: Humburg**	**Closing Comments: A Challenge to the Technical Community**

12:00 - 13:20	*Lunch break in Capital Ballroom*	
Capital ABC **13:20 - 15:20**	**O.1: Waterfowl and Water 1: The Crisis is Now** (Organizer: Mark Petrie)	
13:20	**O.1.1: Petrie**	**Introduction to the Session** (Mark Petrie*)
13:40	**O.1.2: Zarzycki^**	**Evidence for Cross Seasonal Effects: Insights from Long-Term Data on Northern Pintail** (Megan C. Zarzycki*, Bruce D. Dugger)
14:00	**O.1.3: Yarris**	**The California Drought: The Effects of the Current Drought on Waterfowl Habitat in the Central Valley** (Gregory S. Yarris*, Joseph P. Fleskes, Mark J. Petrie, Mike A. Wolder, Craig R. Isola, Daniel A. Skalos)
14:20	**O.1.4: Brasher**	**Implications of Limited Water Supplies for Waterfowl Habitats on the Texas Coast** (Michael G. Brasher*, Kirby Brown)
14:40	**O.1.5: Vest**	**Water Issues for the Great Salt Lake: Implications to Wetlands and Waterfowl** (Josh L. Vest*, Mark J. Petrie, Bruce D. Dugger, Jeffrey. M. Warran, W. Dave Smith)
15:00	**O.1.6: James**	**Future Implications of Groundwater Depletion on Waterfowl Foraging Capacity in the Mississippi Alluvial Valley** (J. Dale James*, Anne E. Mini, Mark J. Petrie)
Capital D **13:20 - 15:20**	**O.2: The Pride of the Salt Marsh: Status and Future Conservation of the American Black Duck** (Organizer: Pat Devers)	
13:20	**O.2.1: Serie**	**Early History of Concern for the American Black Duck and Formation of the Black Duck Joint Venture** (Jerome R. Serie*, Brigitte Collins, Robert J. Blohm, Ken Ross)
13:40	**O.2.2: Sauer**	**Development and Implementation of the Eastern Breeding Waterfowl and Habitat Survey** (John Sauer,*, Daniel Bordage, Mark Koneff, Guthrie Zimmerman)
14:00	**O.2.3: Conroy**	**Development and Implementation of an International Black Duck Harvest Strategy** (Michael J. Conroy*, Eric T. Reed, Paul I. Padding, Mark D. Koneff, Patrick K. Devers)
14:20	**O.2.4: Robinson**	**Integrating Habitat and Population Dynamics: Achieving NAWMP Goals Through the Use of an Annual Life Cycle Model** (Orin Robinson*, Conor McGowan, Patrick K. Devers)
14:40	**O.2.5: Devers**	**Testing the Winter Limitation Hypothesis Using a Two-Season Banding Program** (Patrick K. Devers,*, Guthrie S. Zimmerman, and G. Scott Boomer)
15:00	**O.2.6: Darveau**	**American Black Duck Breeding Habitat: Knowledge and Conservation in a Changing World** (Marcel Darveau*, Daniel Bordage3, Rod Brook, Patricia Edwards, David J. Lieske, Daniel G. McAuley, Nic McLellan, Shawn Meyer, J. Bruce Pollard)

Senate		
13:20 - 15:20	**O.3: Winter Ecology** (Chair: Rick Kaminski)	
13:20	**O.3.1: Collins**	**Impacts of Wind Energy on Wintering Redheads** (Daniel P. Collins*, Cory J. Lange, Bart M. Ballard)
13:40	**O.3.2: Lancaster1^**	**Linking Habitat Use and Survival to Identify Suitable Winter Habitats for Female Mallards in Mississippi** (Joseph D. Lancaster*, J. Brian Davis, Richard M. Kaminski, Edward J. Penny, Alan D. Afton)
14:00	**O.3.3: Williams**	**Bioenergetics, Behavior, and Sea Level Rise: Current Status and Future Implications for Wintering Dabbling Ducks in Delaware** (Mark C. Lovolsi, Christopher K. Williams*, John M. Coluccy, Matthew T. DiBona)
14:20	**O.3.4: Askren^**	**Habitat Selection of Midcontinent Greater White-fronted Geese During the Wintering Period** (Ryan J. Askren*, Douglas C. Osborne)
14:40	**O.3.5: Kennedy^**	**Wintering Redhead Duck Effects on Northern Gulf of Mexico Seagrasses** (Maddie Kennedy*, Kenneth L. Heck Jr., John Valentine, Thomas Michot)
15:00	**O.3.6: Raquel^**	**Species-specific Timing of Breeding in Response to Winter Climate and Spring Pond Conditions** (Amelia J. Raquel*, Robert G. Clark, James H. Devries, David W. Howerter)
Caucus		
13:20 - 15:20	**O.4: Foraging Ecology** (Chair: Heath Hagy)	
13:20	**O.4.1: Vanderhorst^**	**True Metabolizable Energy of Submersed Aquatic Vegetation for Dabbling Ducks** (Sarah E. Vanderhorst*, Heath M. Hagy, John W. Simpson, Chris N. Jacques)
13:40	**O.4.2: Behney**	**Worth the Reward? An Experimental Assessment of Risk-taking Behavior in Foraging Ducks** (Adam C. Behney*, Ryan O'Shaughnessy, Michael W. Eichholz, and Joshua D. Stafford)
14:00	**O.4.3: DuBour^**	**Dietary Patterns of Lesser Scaup Ducklings in a Heterogeneous Landscape** (Adam J. DuBour*, Kirsty E. Gurney, Mark S. Lindberg)
14:20	**O.4.4: Marty^**	**Waste-Rice and Natural Seed Abundance in Rice Fields in the Gulf Coast Prairies of Louisiana and Texas** (Joseph R. Marty*, J. Brian Davis, Richard M. Kaminski, Michael G. Brasher, Guiming Wang)
14:40	**O.4.5: Drahota**	**Anas spp. Body Condition and Ingested Foods During Spring Stopover** (Jeff L. Drahota, Dustin Casady, Mery Casady, Ryan Walters)

15:00	**O.4.5: VonBank^**	**Food Habits and Availability for Lesser Scaup (*Aythya affinis*) during spring** (Jay A. Vonbank*, Heath M. Hagy, Joshua M. Osborn, Jamison C. England, Aaron P. Yetter, Michelle M. Horath, Chris S. Hine,Douglas R. McClain)
15:20 - 15:40	*Coffee break*	
Capital ABC **15:40 - 17:40**	**P.1: Waterfowl and Water 2: The Crisis is Now** (Organizer: Mark Petrie)	
15:40	**P.1.1: Dugger**	**Current and Future Water Shortages in Southern Oregon/Northeastern California (SONEC)** (Bruce D. Dugger*, Josh L. Vest, Patrick Donnely, John Vradenburg , Joseph P. Fleskes, Mark J. Petrie)
16:00	**P.1.2: Fleming, S.**	**Overview of Water Quality Issues in the Upper Mississippi River, Great Lakes, and Chesapeake Bay and Long Term Implications for Diving Duck Distribution** (K. Sarah Fleming*, John Coluccy, Jason Hill, Heath M. Hagy, Michael L. Schummer)
16:20	**P.1.3: Eadie**	**Using an Agent-based Model (SWAMP) to Predict the Response of Waterfowl to Drought, Urban Expansion and Reduced Water for Agriculture and Managed Wetlands in California** (John M. Eadie*, Matt L. Miller, Kevin M. Ringelman, Joseph P. Fleskes, Elliott Matchett, Robert H. Blenk, Jeffrey C. Schank)
16:40	**P.1.4: Smith**	**Water Will Go Where it is Legally Required to Go: Being Realistic about Future Wetland Water Supplies and Exploring a New Path of Collaborative Working Lands Conservation** (W. David Smith*, Mark J. Petrie)
17:00	**P.1.5: Overton^**	**Is California's Wintering Waterfowl Habitat Drought Proof?** (Cory Overton*, Joseph P. Fleskes, Joshua T. Ackerman, Jeffrey D. Kohl, Mark P. Herzog, Elliott Matchett, Caroline M. Brady, Cliff Feldheim, Greg Yarris, Michael L. Casazza)
17:20	**P.1.6: Symmank**	**From the Duck Marsh to the Water Faucet: Constructed Wetlands are Becoming a Critical Component of the Texas Municipal Water Supply** (Matthew E. Symmank*)
Capital D **15:40 - 17:40**	**P.2: The Pride of the Salt Marsh: Status and Future Conservation of the American Black Duck** (Organizer: Pat Devers)	
15:40	**P.2.1: Coluccy**	**American Black Duck Bioenergetics Model: A Synthesis of Research and Results** (John M. Coluccy*, Paul M. Castelli, Patrick K. Devers, Heath M. Hagy, Gregory J. Soulliere, Christopher K. Williams)
16:00	**P.2.2: Peck**	**Overwinter Survival and Wintering Ground Fidelity of American Black Ducks in Atlantic Canada** (Liam E. Peck*, Randy Milton, J. Bruce Pollard, Garry Gregory, Gregory J. Robertson, Mark L. Mallory)

16:20	**P.2.3: English^**	**Winter Diet and Body Condition of American Black Ducks in Atlantic Canada** (Matthew D. English*, Gregory J. Robertson, Mark L. Mallory)
16:40	**P.2.4: Ringelman**	**A Meta-analysis of American Black Duck Winter Habitat Use along the Atlantic Coast** (Kevin M. Ringelman*, Christopher K. Williams, Patrick Devers, John M. Coluccy, Paul Castelli, Kurt A. Anderson, Jacob L. Bowman, Gary R. Constanzo, Dane M. Cramer, Matt DiBona, Michael Eichholz, Min Huang, Benjamin Lewis, Dawn Plattner, Tina Yerkes)
17:00	**P.2.5: Jones**	**Non-breeding Habitat Planning and Delivery for American Black Ducks** (Malcom Jones*, John Coluccy, Kirsten Luke, Patrick K. Devers)
17:20	**P.2.6: Devers**	**Discussion** (Patrick Devers)
Senate		
15:40 - 17:40	**P.3: Miscellany** (Chair: Beth Ross)	
15:40	**P.3.1: Ross, B.**	**Drivers of Mottled Duck Pairs on the Upper Texas Gulf Coast** (Beth E. Ross*, David Haukos, Patrick Walther)
16:00	**P.3.2: Moon**	**A Stochastic Model to Simulate Mottled Duck Population Dynamics** (Jena A. Moon*, Stephen J. DeMaso, Michael G. Brasher, Warren C. Conway, David A. Haukos)
16:20	**P.3.3: Lancaster2^**	**Diurnal Use of Private, Public, and Incentivized Conservation Wetlands by Female Mallards in Mississippi** (Joseph D. Lancaster*, J. Brian Davis, Richard M. Kaminski, Kevin D. Nelms)
16:40	**P.3.4: Minor^**	**Avian Productivity and Community Ecology of Restored PPR Grasslands** (Ashlee K. Minor*, Michael Eichholz)
17:00	**P.3.5: Pokley^**	**Testing Competing Hypotheses for the Seasonal Variation in Nesting Success** (Kalen J. Pokley*)
17:20	**P.3.6: Martorelli^**	**Evaluation of Waterfowl Use and Thermal Characteristics of Alfalfa and Perennial Grasses in Eastern South Dakota** (Neal Martorelli*, Joshua Stafford)
Caucus		
15:40 - 17:40	**P.4: Energetics** (Chair: Brandt Meixell)	
15:40	**P.4.1: Mini^**	**From Equations to Reality: Building a Bioenergetic Model to Improve Waterfowl Conservation** (Anne E. Mini*, Blaine Elliott, Dale James, Keith McKnight, Luke Naylor, John Tirpak)
16:00	**P.4.2: Garrick, M.^**	**Dynamics of Nutrient Reserves and Digestive Tract of Female Northern Pintails Wintering Along The Texas Coast** (Matthew J. Garrick*, Nathaniel R. Huck, Bart M. Ballard, Kevin J. Kraai)

16:20	**P.4.3: McClain**	**Using Plasma-lipid Metabolites to Predict Lipid Reserve Dynamics in Free-living Lesser Scaup** (Douglas R. McClain*, Heath M. Hagy, Joshua M. Osborn, Aaron P. Yetter, Chris Hine, Michelle Horath, Jamison C. England, Jeffrey Levengood)
16:40	**P.4.4: Boyd**	**Pacific Harlequin Ducks are Altering their Molt Behavior** (W. Sean Boyd*)
17:00	**P.4.5: Fino^**	**The Energetic Value of Mid-Atlantic Forested Wetlands to Wintering American Black Ducks** (Samantha Fino*, Christopher K. Williams, Mark Lovolsi, Kevin M. Ringelman, John M. Coluccy, Patrick K. Devers, Paul M. Castelli)
17:20	**P.4.6: Henson**	**Does Hunting Alter Waterfowl Body Condition and Stress Physiology?** (Jerad R. Henson*, Christopher Sims, Stephan Schoech)
17:40 - 19:00	*Break before Banquet*	
19:00 - 22:00	**Banquet & Awards Dinner -** *Capital Ballroom*	

M.1: Plenary

M.1.1: Plenary Michael Anderson

From Coherence to Integration: Challenges of Multiple Scales, Decision Authorities, and Processes

Michael G. Anderson[1]*

[1] Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, Manitoba, R0C 2Z0, Canada, m_anderson@ducks.ca

Waterfowl conservation has not yet explicitly integrated population, habitat, and user/supporter objectives in management actions. A more coherent system would feature the elements of an informed decision process; namely explicit objectives, system models, monitoring programs, and institutional processes to adapt to new information. Because waterfowl management decisions are made at multiple spatial scales, by multiple decision authorities within and among countries, at various time steps, and with varying degrees of system control, no grand optimization scheme is plausible, and no single entity possesses clear responsibility for such interrelated decisions. We might focus instead on identifying and aligning a few multi-objective management decisions at spatial and temporal scales where integration is most “natural” and co-dependencies most strong. Every decision need not include all three objective classes. A key challenge will be developing the monitoring programs necessary to help inform choices in the pursuit of multiple objectives, but the first step should be to identify the decision problems and associated model predictions and uncertainties of greatest importance. Increasing the adaptive capacity of waterfowl management should address each level in the learning process (so-called “triple-loop” learning). The innermost level focuses on predicting outcomes of routine management actions and monitoring to determine if those actions produce the predicted results. The second level focuses on whether we are doing the right things, including periodic revision of Plan objectives or posing alternative models of system dynamics. The outer most loop is about reviewing organizational structures and processes to enable efficient achievement of management objectives. While it may be useful to think about an overarching conceptual model of how a comprehensive integrated system might work, tangible progress seems more likely with more narrowly defined problems at smaller scales – and Plan partners have begun to explore the pursuit of multiple objectives at regional scales. I hope that we will continue to make progress in developing a coherent system of waterfowl management that is tractable and widely embraced, adaptive, and inclusive of the multiple goals of the 2012 NAWMP. A proximate technical challenge may be to specify the minimum necessary conditions for a coherent management system, given well described multiple objectives, and then engage agency leaders in aligning processes and institutions that will enable the adaptive pursuit of those objectives.

M.1.2: Plenary David Fulton

Values Translated into Objectives: Engaging Waterfowl Stakeholders

David C. Fulton[1]*, Andrew Raedeke[2], Jason Spaeth[3], Michael Kilgore[3], Howie Harshaw[4], Gray Anderson[5], Dale Humburg[6]

[1] U.S. Geological Survey, Minnesota Cooperative Fish & Wildlife Research Unit, University of Minnesota, Saint Paul, MN, 55108, USA, dcfulton@umn.edu
[2] Missouri Department of Conservation, Columbia, MO, 65201, USA
[3] University of Minnesota, Saint Paul, MN, 55108, USA
[4] University of Alberta, Edmonton Alberta, T6G2J9, Canada
[5] Tennessee Wildlife Resources Agency, Nashville, TN 37220, USA
[6] Ducks Unlimited, Inc., One Waterfowl Way, Memphis, TN 38120, USA

A critical aspect of the North American Waterfowl Management Plan (NAWMP) is the identification of goals and fundamental objectives for managing waterfowl and related resources. Such fundamental goals and objectives represent a statement of human values for desired future conditions of the resource and the social welfare or benefits provided by those conditions. In the Adaptive Management framework such fundamental objectives are defined by stakeholders through participatory and collaborative processes, but the specific processes and techniques that can be used for defining such fundamental objectives are not necessarily clear. We describe a process through the application of discrete choice methods that can provide a key source of data that can be used to inform and define fundamental objectives within an adaptive management framework. This approach is founded on Random Utility Theory originally developed by Thurstone in his method of paired comparisons and famously extended to multiple comparison choices by McFadden in his Nobel-winning work on discrete choice theory and methods. We are using this approach to quantify stakeholders' (waterfowl hunters and viewers) preferences (values) related to waterfowl-based recreational experiences to facilitate revisions of NAWMP objectives. The approach identifies the relative importance of different attributes of a waterfowl-related recreation experience, the utility curves of different levels within an attribute and the interactions and trade-offs among different attributes when making a choice about preferred experiences. Expected outcomes of the study include: 1) quantified measures of stakeholder preferences; 2) NAWMP objectives and management actions that are informed by the values and preferences of waterfowl and wetland stakeholders; 3) a focus on harvest management actions that will provide the greatest benefits in terms of stakeholder preferences within the context of what is biologically feasible. This science-based rigorous approach to developing fundamental objectives can make substantive contributions to the NAWMP adaptive management process.

N.1: Featured Session: Implementing the 2012 NAWMP Revision: Management Decisions to Integrate Multiple Objectives at Varying Scales (Organizer: Dale D. Humburg)

N.1.1: Humburg

Introduction to the Session

N.1.2: Runge

Modeling and Managing Linkages across Objectives: Beyond the JTG

Michael C. Runge[1]*

[1] U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD 20708 USA, mrunge@usgs.gov

In 2007, the Joint Task Group (JTG) described a framework for linking waterfowl harvest and habitat management by recognizing the shared dynamics that underlie both decision contexts. Although this was not meant to be an all-encompassing integrated framework for waterfowl management, the tantalizing concept of integration opened up discussions of the broad linkages among waterfowl harvest, habitat, and human management. When broadening this focus, it is useful to recognize that the pursuit of multiple objectives is often complicated by tradeoffs among them, and multi-criteria decision analysis provides a set of useful tools for understanding and navigating these tradeoffs. There is a four-fold challenge in making decisions that affect the wide array of waterfowl objectives. First, all of the separate fundamental objectives need to be clearly articulated. This has proven to be difficult, but the methods described in Dr. Fulton's plenary provide some new promise. Second, the linkages among the objectives, as driven by various decision contexts, need to be understood. It might be useful to think about sets of objectives that need to be actively integrated, because there are decisions that directly affect them all, and sets of objectives that only need to be passively integrated, in the sense that achievement of one might be conditional on achievement of another, but they do not directly compete. Third, models need to be developed that predict the performance of the management alternatives against the multiple objectives, recognizing the linkages among the decision contexts and objectives. Fourth, for those objectives for which there are tradeoffs, a process of weighing the objectives is needed. A daunting set of challenges, but one made easier, perhaps, by recognizing two things: (1) not all of the decisions and objectives are linked, so several smaller models, rather than a comprehensive, fully integrated model, may suffice; and (2) the central role of predictive modeling provides a way to think about these linkages by thinking about how we could predict the effects of decisions on waterfowl, their habitats, and the humans who enjoy them.

N.1.3: Vrtiska

Adaptive Harvest Management: Re-examining Harvest Objectives and Approaches

Mark P. Vrtiska[1]*, Min Huang[2], W. Adam Phelps[3], Paul I. Padding[4], James R. Kelley, Jr.[5], James A. Dubovsky[6]

[1] Nebraska Game and Parks Commission, Lincoln, Nebraska, USA, mark.vrtiska@nebraska.gov
[2] Connecticut Department of Energy and Environmental Protection, North Franklin, Connecticut, USA
[3] Indiana Department of Natural Resources, Bloomington, Indiana, USA
[4] U.S. Fish and Wildlife Service, Laurel, Maryland, USA
[5] U.S. Fish and Wildlife Service, Bloomington, Minnesota, USA
[6] U.S. Fish and Wildlife Service, Lakewood, Colorado, USA

Adaptive harvest management (AHM) was implemented in 1995 as a process to set annual duck harvest regulations in the U.S., based on the population dynamics and status of Mid-continent mallards (*Anas platyrhynchos*). Given an agreed-upon management objective(s), this process provides a framework for making optimal decisions in the face of uncertainty about waterfowl demographics, responses to changes in the environment and harvest regulations. Since then, the AHM protocol has evolved to consider three separate stocks (Eastern, Mid-continent, and Western) of mallards. Periodically, stakeholders need to revisit the objectives of management to assess whether they have changed, determine whether changes to the model set are appropriate, and whether the regulatory alternatives should be revised. Both the Atlantic (Eastern ducks) and Mississippi/Central (Mid-continent ducks) Flyways are re-examining harvest management objectives, underlying population models, and potential approaches to duck harvest management. The harvest management objective initially developed in 1995 of maximizing cumulative harvest over the long term may not accurately reflect contemporary harvest management goals. Stakeholders are recognizing the need for an explicit consideration of hunter participation in the process, as recommended in the revised North American Waterfowl Management Plan (NAWMP). In the Atlantic Flyway, the formulation of a multi-stock decision framework explicitly acknowledges hunter demographics as a fundamental objective. The multi-stock framework also accounts for habitat goals in conjunction with harvest management objectives to provide the necessary shared context for both sets of objectives. For the Mid-continent, all facets of AHM are being considered, including hunter participation. For example, stakeholders are reconsidering whether the NAWMP population goal should be retained in the objective function, and whether a multi-stock approach to duck harvest management is preferable and feasible. Because the key to implementation of a successful management program is identification of clear and unambiguous objectives, resolution of these issues is a necessary first step in the process.

N.1.4: Carter

Integrating Human Dimension Considerations into Joint Venture Habitat Delivery

Michael F. Carter[1]*, Andy Bishop[2], Beth Huning[3]

[1] Playa Lakes Joint Venture, 2575 Park Lane, Lafayette, CO 80027 USA, mike.carter@pljv.org
[2] Rainwater Basin Joint Venture, 2550 N. Diers Ave., Ste Grand Island, NE 68803 USA
[3] San Francisco Bay Joint Venture, 735 B Center Blvd. Fairfax, CA 94930 USA

The 2012 NAWMP Plan revision recommends integration among traditional waterfowl management institutions but also suggests integration among disciplines. One such discipline is human dimensions (HD). We are finding, especially among habitat managers, that occasionally using a technique (e.g. do a survey) to understand an aspect of HD relative to a decision by clients is not a challenging practice or particularly new. However, institutionalizing human dimensions work to the point of routinely and correctly using it and incorporating results into adaptive management loops is completely new. With this Plan revision, the joint venture community began regional experiments designed to better understand and demonstrate how HD work could be integrated into habitat management decisions. We present three case studies demonstrating this integration by three joint ventures using habitat delivery to serve viewers, hunters and the general public. The first case study will focus on the ecological goods and services (EG&S) work done by Playa Lakes Joint Venture to tie playa conservation efforts to Aquifer recharge which will benefit the general public. Landowner surveys and focus groups have informed playa conservation messages and strategies, resulting in the development of a replicable, prioritized, targeted playa restoration process in the Texas Panhandle, working within small focal areas. The second case study, from Rainwater Basin Joint Venture, demonstrates how hunter satisfaction surveys guided habitat restoration decisions. And the third will show how the SFBJV used human dimensions methods to understand how to improve habitat delivery to benefit viewers in an urban setting. Each of these local experiments uses data driven processes to inform adaptive management decisions. We end with a general survey of all joint ventures and their progress in implementing the 2012 revision through use of human dimensions work.

N.1.5: Brasher

Focusing Resources on Important Landscapes: A Spatial Framework for Integrating NAWMP Objectives

Michael G. Brasher[1]*, Mark J. Petrie[2], David W. Howerter[3], Dale D. Humburg[4]

[1] Ducks Unlimited, Inc., Gulf Coast Joint Venture, Lafayette, LA 70506, USA, mbrasher@ducks.org
[2] Ducks Unlimited, Inc., Pacific Northwest Office, Vancouver, WA 98683, USA
[3] Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, MB R0C 2Z0, Canada
[4] Ducks Unlimited, Inc., One Waterfowl Way, Memphis, TN 38120, USA

The 1986 NAWMP and subsequent updates emphasized the need to focus conservation resources in areas most important to waterfowl demography. Indeed, advancements in geospatial technology and databases have enabled more thoughtful identification of priority areas for habitat conservation to achieve NAWMP population objectives. Examples include continental scale efforts like the NAWMP map of areas considered most important to waterfowl populations and various regional scale, conservation targeting tools. Thus far, such efforts have not considered the social elements which are critical components of the integrated goals of the 2012 NAWMP, particularly the goal of growing populations of resource users and conservation supporters. Spatial targeting of waterfowl habitat conservation has clear linkages to providing or enhancing ecological goods and services as a means of growing conservation support, but it is increasingly postulated that strategically targeted habitat delivery may also contribute to growing numbers of hunters and other resource users by providing effectively located access opportunities. As such, spatially-explicit decision support systems are envisioned as useful frameworks for integrating and optimizing habitat conservation delivery to benefit NAWMP waterfowl population and social goals. Waterfowl demographics and social dynamics associated with habitat conservation are inherently complex and vary at ecological and political scales. Consequently, such tools will likely have greater impact at regional scales where knowledge of system dynamics is most detailed and decision bodies for allocating resources are well established. We will discuss ongoing efforts to develop prototype tools for targeting habitat conservation to achieve multiple NAWMP goals, at both regional and continental scales. This will include presentation of hypothesized relationships among spatial variables and waterfowl population and user-supporter objectives, as well as consideration of tradeoffs and valuations (i.e., weightings) among objectives. Limitations of existing knowledge and spatial datasets, as well as adaptive implementation and refinement of resulting tools will also be discussed.

N.1.6: Eadie

Integrated Annual Cycle Models of North American Ducks: Progress, Pitfalls and Prospects

John M. Eadie[1]*, Robert G. Clark[2], Jane Austin[3], G. Scott Boomer[4], Pat Devers[4], Jim H. Devries[5], Brady J. Mattsson[6], Eric E. Osnas[7], Michael C. Runge[7]

[1] Department of Wildlife, Fish & Conservation Biology, University of California, Davis, One Shields Avenue 95616, USA, jmeadie@ucdavis.edu
[2] Environment Canada and Department of Biology, University of Saskatchewan, 115 Perimeter Road, Saskatoon, Saskatchewan S7N0X4, Canada
[3] US Geological Survey, Northern Prairie Wildlife Research Center, 8711 37th Street SE, Jamestown, ND 58401, USA
[4] U.S. Fish & Wildlife Service, 115 Merriam Lab, 11510 American Holly Drive Laurel, MD 20708-4016, USA
[5] Ducks Unlimited Canada, P.O. Box 1160, Stonewall, MB R0C2Z0, Canada
[6] Department of Integrative Biology and Biodiversity Research, University of Natural Resources and Life Sciences, Vienna, Austria
[7] U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD 20708 USA

The North American waterfowl management community is working to better integrate harvest management, habitat conservation and the interests of people (human dimensions). A significant challenge has been to articulate the linkages among these components and to develop decision support frameworks to guide management actions in light of alternative and often conflicting management objectives. Annual cycle models have been developed for several duck species of conservation concern and all share a common purpose in defining the linkages between habitat management actions at regional levels (e.g., Joint Ventures), and population and harvest dynamics at a continental scale. Here, we explore recent progress, identify challenges that have emerged, and suggest directions for future progress. These efforts have demonstrated, first, that it is fully possible to link habitat and harvest management across scales and second, that an integrated approach can inform conservation allocation decisions. Furthermore, a broad stakeholder community has been engaged to develop model components and motivate a deeper understanding of the complex processes that link dynamics across scales. Effectively capturing spatial and temporal dynamics and modeling integration across scales remains a challenge for all annual cycle models. Developing parameterized functional relationships will also be an ongoing task in the face of limited data, uncertainties about key vital rates, and the form and strength of density-dependence. Finally, our understanding of the dynamics of human dimensions is in its infancy. Efforts are underway to better define the functional relationships between waterfowl populations, harvest regulations, and the desires and contributions of end-users. Existing models should be developed to completion, as these will inform all future efforts at integrated management. Similar approaches should be considered for other species and perhaps guilds of ducks that share similar life-histories. Perhaps the greatest utility of such efforts will be the engagement of managers and stakeholders in the process of identifying objectives, specifying underlying assumptions, and posing hypotheses about the linkages that connect regional processes to continental dynamics. Finally, these models will be useful for evaluating alternative management scenarios and providing insights about trade-offs and consequences inherent in multi-objective decision-making.

N.1.7: **Plenary:** Johnson

Plenary Fred A. Johnson
Multi-Level Learning in Waterfowl Conservation

Fred A. Johnson[1]*, Dale D. Humburg[2], David J. Case[3]

[1] Wetland and Aquatic Research Center, U.S. Geological Survey, 7920 NW 71 Street, Gainesville, FL 32038 USA, fjohnson@usgs.gov
[2] Ducks Unlimited, Inc., One Waterfowl Way, Memphis, TN 38120 USA
[3] D.J. Case & Associates, 317 E. Jefferson Blvd., Mishawaka, IN 46545, USA

The 2012 revision of the North American Waterfowl Management Plan is part of a growing trend in conservation in which social and ecological systems are seen to be linked, with each affecting the behaviors of the other. The approach has less to do with regulating a steady stream of ecological goods and services and more to do with expanding the capacity of socio-ecological systems to cope with uncertainty and adapt to change. This "resilience" perspective emphasizes the need for continual learning at multiple scales, with careful attention to cross-scale effects and feedbacks. Adaptive management can play a critical role in building a culture of learning, in which the focus is on planned, iterative learning for problems that are well bounded and conservation objectives and actions are tightly linked. But adaptive management can also foster social learning about the objectives and actions used to frame and determine (adaptive) management policies, and the forms of resource governance that are conducive to healthy, resilient socio-ecological systems. Social learning will necessarily be less structured than adaptive management and will be more discontinuous in time and space. We discuss these ideas about learning in the context of waterfowl harvest and habitat management, and the desire to make waterfowl conservation relevant to broader societal interests. Going forward, we suggest that the waterfowl management community must embrace an effort to better understand the relationship between waterfowl and people, and how that relationship can change over time. Critical to this effort will be mechanisms for monitoring and analyzing the values of diverse stakeholders within the context of a changing socio-ecological system, and for understanding the extent to which those values are shaped by what managers do.

N.1.8: Humburg

Closing Comments: A Challenge to the Technical Community

O.1: Waterfowl and Water 1: The Crisis is Now (Organizer: Mark Petrie)

O.1.1: Petrie

Introduction to the Session

Mark Petrie[1]*

[1] Ducks Unlimited Inc., Rancho Cordova, CA 95670, USA, mpetrie@ducks.org

Recent droughts in Texas, the Central Valley of California, and Oregon's Klamath Basin are at the forefront of water shortages that will challenge waterfowl managers in the 21st century. Conservation efforts for migrating and wintering waterfowl often focus on providing adequate foraging habitat. At the Joint Venture scale, this involves "stepping down" waterfowl population objectives from the NAWMP and describing the landscape characteristics needed to support these populations. The habitat objectives that emerge from this process have helped guide traditional activities like wetland restoration and agricultural enhancement. As a result, the waterfowl management community has rightly focused on creating additional opportunities for wetland restoration and forming strong relationships with agricultural groups. Although the need for adequate water supplies to properly manage these natural and agricultural habitats has long been recognized, the recent droughts in Texas, California, and Oregon have exposed the vulnerability of major migration and wintering areas to long-term water shortages. It is no longer enough to add habitat in the absence of reliable sources of water. Yet, the regulatory nature of water allocation poses a serious challenge for the waterfowl management community. Most conservation gains for non-breeding have relied on incentive based programs, not regulation. Special interests representing long-standing water rights, the needs of endangered fish species, and the growing demands of expanding urban centers are frequently immune to even the best waterfowl and hydrologic science. It is not yet clear how waterfowl advocates will succeed in future environments characterized by less water and more demand. The intent of this session is to highlight water shortages that are now afflicting continentally important migration and wintering areas, and describe water issues that are emerging outside of these areas. Finally, we discuss possible solutions to meeting the needs of non-breeding waterfowl in landscapes where recurring water shortages are likely to be the norm.

O.1.2: Zarzycki^

Evidence for Cross Seasonal Effects: Insights from Long-Term Data on Northern Pintail

Megan C. Zarzycki[1]*^, Bruce D. Dugger[1]

[1] Department of Fisheries & Wildlife, Oregon State University, Corvallis, Oregon, 97333, USA, megan.zarzycki@oregonstate.edu

Migratory waterfowl use a wide variety of habitats throughout their annual cycle, often distributed across broad spatial scales. The influence conditions in previous seasons have on a populations demographic rates or abundance in another are termed cross-seasonal effects and have been demonstrated in a wide variety of taxa. Waterfowl present an ideal model system for exploring the role of cross-seasonal effects on population dynamics. Work by Raveling and Heitmeyer found that the size of the breeding population of Northern pintail and the apparent reproductive success was influenced by habitat conditions in the California Central Valley the previous winter. Since that publication, researchers have developed a better understanding of the migratory connectivity of pintail across the landscape, and have highlighted the importance of the Southern Oregon North Eastern California (SONEC) region during spring migration. In this presentation we will expand on the work of Raveling and Heitmeyer to evaluate the importance of a major spring migration staging area (the SONEC region) to pintail productivity. The main objectives of this research are to 1) evaluate the importance of non-breeding season habitat conditions in SONEC on Northern pintail productivity and 2) compare the relative importance of winter habitat vs spring staging habitat to productivity.

A variety of publicly available information were obtained to explore the effects of non-breeding season habitat in years 1961-2012. Published fall age-ratios were used as an index of productivity in pintail. To examine the seasonal importance of available habitat, May pond counts for strata 26-40 were used as an index of the breeding ground conditions and average monthly precipitation as an index of habitat conditions on the wintering and spring staging grounds for the previous year. Habitat in the SONEC region is influenced by snowmelt and artificial flooding, which will be included in the index of SONEC habitat availability to reflect actual conditions pintail experience during migration.

Preliminary findings suggest winter precipitation in the California Central Valley may influence the productivity of pintail. Inclusion of spring precipitation in SONEC improved the fit of the model. With the addition and improvement of habitat indices for both wintering and staging grounds for the pintail population we hope to expand our understanding of cross-seasonal effects in waterfowl populations and speak to the role and importance of the non-breeding season in the productivity of this species.

O.1.3: Yarris

The California Drought: The Effects of the Current Drought on Waterfowl Habitat in the Central Valley

Gregory S. Yarris[1]*, Joseph P. Fleskes[2], Mark J. Petrie[3], Mike A. Wolder[4], Craig R. Isola[4], Daniel A. Skalos[5]

[1] Central Valley Joint Venture, U.S. Fish and Wildlife Service, Sacramento CA 95825, USA, greg_yarris@fws.gov
[2] U.S. Geological Survey, Western Ecological Research Center, Dixon, CA 95620, USA
[3] Ducks Unlimited, Inc., Rancho Cordova, CA 95670, USA
[4] Sacramento National Wildlife Refuge Complex, U. S. Fish and Wildlife Service, Willows, CA 95988, USA
[5] California Department of Fish and Wildlife, Sacramento, CA 95811

The Central Valley of California (CVC) has lost approximately 95% of its original wetlands due to flood control, urbanization and conversion to agriculture. Despite these loses, remaining wetlands are intensively managed for food production and, together with post-harvest flooded grain fields (especially rice), continue to support 5-6 million wintering waterfowl annually. However, increasing demands for water, exacerbated by drought, has made procuring water for wetlands and beneficial agricultural habitats more difficult in recent years. California is experiencing its most severe drought in history. Since 2011, precipitation has been well below average throughout the state, and the winter of 2014-2015 was the driest on record for the CVC. Managed wetlands rely heavily on state and federal water projects for surface water to provide habitat for breeding and wintering waterfowl. Because reservoir levels were less than 50% of their capacity during the drought, water use was restricted to some degree for all users and allocated based on California's complicated system of water rights and environmental regulations. In general, wetland surface water supplies have been reduced by 25-50%. The California drought has reduced waterfowl habitat values and carrying capacity of the CVC in several ways. Wetland habitats were impacted by: 1) reduced summer irrigation to promote moist-soil plants, 2) delayed or eliminated fall/winter flooding, and 3) decreased flows to maintain water quality (and minimize conditions for disease outbreaks). Agricultural habitats were impacted by: 1) widespread fallowing of crops important to waterfowl, 2) reduced post-harvest flooding, and 3) detrimental and potentially long-term changes to agricultural practices beneficial to waterfowl. The impacts of these changes relative to habitat availability and waterfowl populations will be a major consideration in conservation planning for anticipated future drought and climate change scenarios.

O.1.4: Brasher

Implications of Limited Water Supplies for Waterfowl Habitats on the Texas Coast

Michael G. Brasher[1]*, Kirby Brown[2]

[1] Ducks Unlimited, Inc., Gulf Coast Joint Venture, Lafayette, LA 70506, USA, mbrasher@ducks.org
[2] Ducks Unlimited, Inc., Austin, TX 78748, USA

Waterfowl habitats along the Texas coast are expected to support greater than 5.3 million ducks and geese during the non-breeding period. Marshes and ricelands are the dominant habitat types in this region and are counted on to provide >88% of total food resources for migrating and wintering waterfowl. Like essentially all waterfowl habitats, annual variation in their quality and quantity is heavily influenced by the abundance and timing of water. While the abundance of water to influence marsh conditions is affected primarily by climatic events that are beyond management and policy control, riceland-based habitats have a more direct tie to the regulation of limited water supplies. The decline of rice along the Texas coast (i.e., >500,000 acres of planted rice during 1970s and <200,000 acres during the 2000s) has been well-documented, yet interestingly, little of this historical decline can be exclusively attributed to water supplies. However, looking into the future, competition for limited water supplies is likely to be the single most important determinant of the sustainability of rice production and rice-based habitats on the Texas coast. In fact, the effects are already being felt. As a result of the record-setting drought from autumn 2010 – spring 2015, regional water authorities reduced the amount of irrigation water available to rice farmers for an unprecedented four consecutive growing seasons (2012-2015), leading to an immediate 52,000 acre reduction in planted rice acreage. Although water levels in storage lakes recently recovered sufficient to permit normal irrigation releases during 2016, the extent to which lost rice acreage will return is uncertain. Moreover, the prospects for more frequent droughts and continued human population growth in this region foreshadow intensified competition for limited water supplies. Diverse solutions are needed to ensure reliable water supplies for a sustainable Texas rice industry; without it, the remaining habitat will be unable to support wintering waterfowl at desired levels.

O.1.5: Vest

Water Issues for the Great Salt Lake: Implications to Wetlands and Waterfowl

Josh L. Vest[1]*, Mark J. Petrie[2], Bruce D. Dugger[3], Jeffrey. M. Warren[4], W. Dave Smith[1]

[1] Intermountain West Joint Venture, Missoula, MT 59801, USA, josh_vest@fws.gov
[2] Ducks Unlimited, Inc., Rancho Cordova, CA 95670, USA
[3] Department Fisheries & Wildlife, Oregon State University, Corvallis, OR 97331, USA
[4] U.S. Fish and Wildlife Service, Red Rock Lakes National Wildlife Refuge, Lima, Montana, USA

The Great Salt Lake landscape (GSL) is among the largest and most diverse wetland complexes in the western US and recognized internationally for its importance to wetland dependent migratory birds. Several million waterfowl use the GSL as a primary migration hub in the Pacific Flyway as they move between key breeding (e.g., prairie Canada) and wintering (e.g., Central Valley of California) areas on the continent. The GSL is a terminal lake basin in a xeric environment yet is surrounded by ≥ 470,000 acres of wetlands maintained by three primary river systems which are dependent on annual snowpack accumulations. More than 160,000 acres of these wetlands are actively managed for waterfowl and other wetland birds. However, development of water resources for agriculture, energy, industrial, and municipal use has reduced the amount and quality of fresh water reaching the lake and its marshes. Over the past decade, hydrologic inputs to GSL were 44% lower than the long-term (1955–2010) average due to both climatic inputs and water resource developments. Rapid human population growth in the region will place increasing demands on scarce water resources and result in more water use conflicts. This pattern is likely to be exacerbated if current climatic trends persist. We will discuss potential impacts to GSL waterfowl populations from a suite of hydrologic scenarios and energetic carrying capacity evaluations. Preliminary estimates suggest available waterfowl habitat could be reduced by 40–60% within the next several decades as a result of climatic and water-use trends. Potential implications to waterfowl populations in the Pacific Flyway from reductions in GSL habitats will also be discussed.

O.1.6: James

Future Implications of Groundwater Depletion on Waterfowl Foraging Capacity in the Mississippi Alluvial Valley

J. Dale James[1]*, Anne E. Mini[2], Mark J. Petrie[3]

[1] Ducks Unlimited Inc., Ridgeland, MS 39157, USA, djames@ducks.org
[2] Lower Mississippi Valley Joint Venture, Ridgeland, MS 39157, USA
[3] Ducks Unlimited, Inc., Rancho Cordova, CA 95670, USA

It is estimated that approximately 40% of the waterfowl food energy within the Mississippi Alluvial Valley (MAV) landscape is provided through harvested crop fields (e.g., rice, soybeans, corn) subject to natural flooding or managed through impoundments on private land. With nearly 80% of the total land use in agriculture, it is currently the largest user of water resources. Approximately 8 billion gallons/day of groundwater are pumped each year to meet the irrigation requirements of Arkansas, Mississippi and Louisiana. As irrigation of cropland has become more extensive in some areas of the MAV, there are indications that the current level of water withdrawal from irrigation is unsustainable. In the region's two primary aquifers, Alluvial and Sparta, water use exceeds aquifer recharge, and in certain areas has caused water-level declines of at least 40 feet in the last 40 years. This reduced availability of water could potentially lead to a landscape of less water-intensive agriculture, thereby reducing the availability of surface water and providing less energy rich crops of little to no benefit to migrating and wintering waterfowl. Reduction of water resources and consequences to waterfowl populations have been ongoing throughout the United States for years including areas such as California's Central Valley, the Colorado River Basin, the Ogallala Aquifer in the High Plains, and the coastal prairies of Texas. As water demand continues to increase, understanding and modeling future impacts from reduced water availability coupled with agricultural changes that may occur will help determine how carrying capacity for waterfowl in the MAV will change through time. We will discuss the current and projected water resource conditions in the MAV, potential land use changes as a result of declining water availability and consider future solutions to this on-going issue.

P.1: Waterfowl and Water 2: The Crisis is Now (Organizer: Mark Petrie)

P.1.1: Dugger

Current and Future Water Shortages in Southern Oregon/Northeastern California (SONEC)

Bruce D. Dugger[1]*, Josh L. Vest[2], Patrick Donnely[2], John Vradenburg[3] , Joseph P. Fleskes4, Mark J. Petrie[5]

[1] Department of Fisheries & Wildlife, Oregon State University, Corvallis, OR 97331, USA, bruce.dugger@oregonstate.edu
[2] Intermountain West Joint Venture, Missoula, MT 59801, USA
[3] U.S. Fish & Wildlife Service, Klamath Basin Refuge Complex, Tule Lake, CA 96134, USA
[4] U.S. Geological Survey, Western Ecological Research Center, Dixon, CA 95670, USA
[5] Ducks Unlimited Inc., Rancho Cordova, CA 95670, USA

The southern Oregon-northeastern California region (SONEC) provides critical habitat for migrating waterfowl in the Pacific Flyway. An estimated 80% of all waterfowl that winter in the Central Valley migrate through SONEC in spring or nearly five million ducks when waterfowl populations are at NAWMP goals. Most ducks migrating through SONEC have primarily relied on publicly managed habitats such as Lower Klamath NWR during fall migration and complexes of public wetlands and privately managed agricultural habitats during spring migration. Within SONEC, the Tule Lake and Lower Klamath NWR complex support large numbers of migrating waterfowl and serves as a pivotal hub for waterfowl moving to and from the Central Valley in both fall and spring. Additionally, private lands used for hay production and grazing that are flood-irrigated provide critical habitat for spring migrants. Flood irrigation is a common practice throughout SONEC and occurs mostly on altered seasonal wetlands that were historically dependent on natural flooding from snowmelt. However, these flood irrigated habitats are unavailable during fall migration.

Curtailed water deliveries to Lower Klamath NWR, due to persistent drought and water allocations for native fish, have drastically reduced the amount of habitat provided by the refuge in spring, as well as fall. This has presumably increased the importance of and reliance on flood-irrigated habitats, and other public wetlands by spring migrating ducks throughout SONEC due to the magnitude of historic use at Lower Klamath (>1,000,000 birds). The amount and distribution of flood-irrigated habitat available to spring waterfowl appears strongly related to snowpack amount and timing of snow melt. However, snowpack is expected to decline in the region under forecasted climate scenarios though changes in other precipitation patterns are less certain (e.g., winter rain). This presentation examines possible changes in carrying capacity for spring migrating waterfowl in SONEC that may result from reduced deliveries of water to Lower Klamath NWR and declining regional snowpack.

P.1.2: Fleming, S.

Overview of Water Quality Issues in the Upper Mississippi River, Great Lakes, and Chesapeake Bay and Long Term Implications for Diving Duck Distribution

K. Sarah Fleming[1]*, John Coluccy[1], Jason Hill[1], Heath M. Hagy[2], Michael L. Schummer[3]

[1] Ducks Unlimited Inc., Ann Arbor, MI 48108, USA, sfleming@ducks.org
[2] Illinois Natural History Survey, Champaign, IL 61820, USA
[3] Department of Biological Sciences, SUNY Oswego, Oswego, NY 13080, USA

Diving ducks primarily consume submerged aquatic vegetation (SAV), plant tubers, and invertebrates to fuel migration and survive winter. Due to increased turbidity from pollution and sedimentation, there were substantial reductions in SAV biomass from the 1950s through 1980s in Chesapeake Bay and portions of the Great Lakes and upper Mississippi River. Since the introduction of filter feeding zebra and quagga mussels in the mid-1980s, water clarity has increased and some SAV recovery occurred throughout the Great Lakes. Watershed-level restoration efforts in Chesapeake Bay and the upper Mississippi River have provided moderate improvements in water quality and recovery of SAV. Concurrent with changes in water quality, there also has been an increased frequency of below average lake and river ice coverage on the upper Mississippi River and Great Lakes Basin. In response to increased food abundance and possibly reduced ice coverage, diving duck use of the upper Mississippi River and Great Lakes increased substantial during the 1990s and 2000s. Diving duck use of Chesapeake Bay has decreased by approximately 50% since the 1950s and there has been little recovery in abundance of these birds following improvements to water quality and return of SAV to portions of the bay. We will discuss historical and future regional water quality issues and information needs about how invasive species, landscape practices, and ice coverage influence forage, distributions, and survival of diving ducks that stage and winter in the upper Mississippi River, Great Lakes, and Chesapeake Bay. Water quality is an important factor that can influence carrying capacity for staging and wintering diving ducks; therefore, understanding and modeling future impacts of water quality will help guide long-term conservation efforts.

P.1.3: Eadie

Using an Agent-based Model (SWAMP) to Predict the Response of Waterfowl to Drought, Urban Expansion and Reduced Water for Agriculture and Managed Wetlands in California

John M. Eadie[1]*, Matt L. Miller[2], Kevin M. Ringelman[3], Joseph P. Fleskes[4], Elliott Matchett[4], Robert H. Blenk[1], Jeffrey C. Schank[2]

[1] Department of Wildlife, Fish & Conservation Biology, University of California, Davis, CA 95616 USA, jmeadie@ucdavis.edu
[2] Department of Psychology, University of California, Davis, CA 95616 USA
[3] School of Renewable Natural Resources, Louisiana State University AgCenter, Baton Rouge, LA 70803 USA
[4] Western Ecological Research Center, U.S. Geological Survey, Dixon, California, 95620 USA

We developed a spatially-explicit waterfowl agent-based modeling program (SWAMP) to evaluate alternative landscape scenarios in the Sacramento Valley, CA arising due to urban expansion, drought, and concordant shifts in water allocation priorities. Scenario 1 represents the current management regime, while all other scenarios consider increased urbanization and/or moderate to severe drought. Scenario 2 examines the effects of drought, but with wetland restoration goals being met and current rice acreage; Scenario 3 examines the impact of wetland restoration not being met; and Scenario 4 examines the effect of extensive idling of rice acreage. Scenario 5 represents a worst-case situation with expansive urbanization, wetland restoration goals not met, and extensive rice acreage idled. We used SWAMP to simulate the foraging activities, time activity budgets, lipid reserves, and mortality of 1.2 million ducks under each scenario. In SWAMP, birds select and consume food in patches at a rate that is dependent on the density of food on that patch, modeled as a type II functional response. Birds leave patches based on current energy stores and patch depletion, modeled as an approximation of the marginal value theorem. We parameterized the model using published values for true metabolizable energy (TME) of foods, metabolic rates and expenditures under different activities, lipid metabolism and conversion, and food storage capacity. Models were run for 180 simulated days – the duration of time over which most waterfowl overwinter in the Central Valley. Our results indicate that rice idling due to restricted water supplies would have the greatest impact on body condition and survival of waterfowl. Under Scenarios 4 and 5, birds entered into energy deficit by late December and mortality rates escalated exponentially (assuming birds did not leave Butte Basin). Failure to meet wetlands restoration goals was not as severe if those acreages remained in rice, but energy deficits and mortality increased substantially if rice acreage was instead idled. Our study helps inform managers of the potential implications of restricted water conditions in CA using a novel spatially-explicit agent based modeling approach.

P.1.4: Smith

Water Will Go Where it is Legally Required to Go: Being Realistic about Future Wetland Water Supplies and Exploring a New Path of Collaborative Working Lands Conservation

W. David Smith[1]*, Mark J. Petrie[2]

[1] Intermountain West Joint Venture, Missoula, MT 59801, USA, dave_w_smith@fws.gov
[2] Ducks Unlimited, Inc., Rancho Cordova, CA 95670, USA

Provision of habitat needed to meet the annual cycle needs of migrating, wintering, and breeding waterfowl at North American Waterfowl Management Goal (NAWMP) levels in portions of the West currently hinges on delivery of adequate water supplies to managed wetlands. Yet, many of the iconic public wetlands of the region were historically the sumps that served to take excess floodwaters and agricultural irrigation return flows, thus possess limited or junior water rights. In recent years, escalating demand for this declining resource among municipal, agricultural, and environmental water users has resulted in significant water supply reductions for lands with junior water rights. Climate change, human population growth, and an array of environmental and sociopolitical factors are expected to exacerbate the situation in the future. This tests the fundamental assumption in Joint Venture planning that refuges, wildlife areas, and other protected wetlands will receive the water needed to meet the habitat demands of waterfowl at levels demonstrated in the past. Lessons of the past decade at certain wetland complexes indicate that this assumption may be overly optimistic. Joint Ventures have long recognized the importance of wetland water supplies and some have established water supply objectives or engaged in water policy work. However, even in the instance of landmark legislation allocating federal project water to managed wetlands, massive challenges remain in securing a reliable base of wetland habitat given the highly volatile water policy environment. In short, water will flow where it is legally mandated to flow. The situation calls for a re-thinking of the NAWMP community's approach to conservation planning and delivery in the West. Herein, we offer a new way of looking at this problem: Focus investments in waterfowl habitat conservation on those lands providing waterfowl habitat that exhibit the strongest legal rights to water, rather than simply the lands providing the highest current waterfowl values. This approach inherently emphasizes working collaboratively with private landowners on working lands with senior water rights, thereby marrying agricultural and wildlife objectives in ways that foster increased support for waterfowl conservation from the agricultural community, a goal of NAWMP public engagement.

P.1.5: Overton^

Is California's Wintering Waterfowl Habitat Drought Proof?

Cory Overton[1]*^, Joseph P. Fleskes[1], Joshua T. Ackerman[1], Jeffrey D. Kohl[1], Mark P. Herzog[1], Elliott Matchett[1], Caroline M. Brady[2], Cliff Feldheim[3], Greg Yarris[4], Michael L. Casazza[1]

[1] U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Dixon, CA 95620 USA, coverton@usgs.gov
[2] California Waterfowl Association, 1346 Blue Oaks Blvd., Roseville, CA 95678 USA
[3] California Department of Water Resources, Suisun Marsh Program, 3500 Industrial Blvd., West Sacramento, CA 95691 USA
[4] U.S. Fish and Wildlife Service, Central Valley Joint Venture, 2800 Cottage Way, Sacramento, CA 95825 USA

California is in the midst of an historic drought while also being relied upon by millions of waterfowl for winter habitat. We examined whether these extreme drought conditions have impacted the body condition of wintering waterfowl. During the 2014-15 hunting season we collected data at hunter check stations and private duck clubs on 23,869 individual birds consisting of 23 different waterfowl species. We identified species, sex, and age, measured (flattened wing chord, culmen, short tarsus [± 0.01 mm]), and weighed (±1 g) hunter-shot waterfowl. Waterfowl were weighed and measured in four California regions: Sacramento Valley, San Joaquin Valley, Suisun Marsh, and Northeastern California. We used body mass as a condition index as it is highly correlated with body lipids, and compared body mass for 5 species of dabbling ducks including northern pintails (*Anas acuta*), mallards (*Anas platyrhynchos*) American wigeon (*Anas americana*), green-winged teal (*Anas crecca*), and northern shovelers (*Anas clypeata*) with similar data collected during 2006–2008 in the Sacramento Valley, San Joaquin Valley, and Suisun Marsh. Results indicate that habitat conditions during 2014-15 were adequate to maintain body mass similar to 2006-2008 (prior to extended drought). Significant rainfall in early December of 2014 may have alleviated some of the drought impacts by flooding habitats in the northern and central valley regions. This combined with water deliveries in October and November for rice decomposition and wildlife habitat was apparently adequate to maintain waterfowl body mass similar to that in 2006-2008. If the California drought continues beyond 2015, additional impacts such as changing agricultural practices may play a larger role in answering how drought proof California is for wintering waterfowl.

P.1.6: Symmank

From the Duck Marsh to the Water Faucet: Constructed Wetlands are Becoming a Critical Component of the Texas Municipal Water Supply

Matthew E. Symmank[1]*

[1] Texas Parks and Wildlife Department, Richland Creek Wildlife Management Area, Streetman, TX 75859, USA, matt.symmank@tpwd.texas.gov

Reservoirs supply most municipal water in Texas. With the state's recent drought and growing population, regional water planners are proposing new reservoirs to ensure a reliable supply and meet the increasing water demand. One of the most destructive impacts of reservoir development is the loss of bottomland hardwood habitats with an estimated 80% already lost statewide. As a solution to the water supply problem, Texas Parks & Wildlife Department (TPWD) partnered with Tarrant Regional Water District (TRWD) on a project designed to provide a reliable water supply to Fort Worth and surrounding cities without the construction of a new reservoir. The G. W. Shannon Wetland Water Recycling Facility on Richland Creek Wildlife Management Area (RCWMA) was completed in September of 2013 at a cost of $75+ million and is a model for the future water supply needs because it provides additional water while lessening or eliminating reservoir impacts to bottomland habitat. This project is a unique approach of harnessing the ecological function of filtration, provided by wetlands, to meet our needs for clean water. Nutrient-rich water from the Trinity River is pumped through shallow, constructed wetland cells growing emergent vegetation at a rate of up to 100MGD where it is cleaned by the natural processes of soil nutrient absorption. During the drought year of 2014, this project successfully provided 20% of TRWD's water supply to 1.8 million customers. Twenty wetland cells totaling 1,730 acres are highly productive wetlands ideal for waterfowl, wading birds and shorebirds. The entire area is open to bird watching and waterfowl hunting, providing a low cost, quality hunting experience to a growing constituency of Texas waterfowl hunters. During the 2014-2015 hunting season, RCWMA was one of the most utilized public hunting areas in Texas with approximately 2,600 man-days of duck hunting and 8,000 ducks harvested.

O.2: The Pride of the Salt Marsh: Status and Future Conservation of the American Black Duck
(Organizer: Pat Devers)

O.2.1: Serie

Early History of Concern for the American Black Duck and Formation of the Black Duck Joint Venture

Jerome R. Serie[1]*, Brigitte Collins[2], Robert J. Blohm[3], Ken Ross[4]

[1] Division of Migratory Bird Management, U.S. Fish and Wildlife Service, retired, Easton, MD, 21601, USA, jrserie@goeaston.net
[2] Population Management Unit, Canadian Wildlife Service, Environment Canada, 335 River Road, Ottawa, ON K1A 0H3, Canada
[3] Divison of Migratory Bird Management, U.S. Fish and Wildlife Service, retired, Easton, MD, 21601 USA
[4] Canadian Wildlife Service, Environment Canada (retired), 1732 Dorset Drive, Ottawa, ON KIH 5T8, Canada

Population declines in American black ducks (*Anas rubripes*) were evident in the Mid-winter Surveys from the 1950s. These declines continued throughout the 1960s and prompted the first Black Duck Symposium in 1968. This meeting recommended reducing harvests and coordinating management actions with Canada. A series of harvest restrictions were enacted beginning in the 1970s and culminated with restrictions in 1983 and 1984 (in the U.S. and Canada respectively) designed to reduce country specific harvest by 25%. Although several hypotheses were suggested to explain the decline, a lack of information on population trends, productivity, and survival prevented critical assessments of causes and effects. This lack of information was recognized in the 1986 North American Waterfowl Management Plan which identified the black duck as a species of international concern and called for the establishment of the Black Duck Joint Venture (BDJV). The BDJV strategy was (1) to implement a breeding population monitoring program, (2) improve banding to assess harvests and distribution changes, and (3) support research to identify important factors influencing population status, determine habitat requisites, and recommend appropriate management practices. With the help of the newly appointed Management Board in 1989 and the acquisition of new funding in Canada and the U.S., the BDJV was officially established in 1990. A Technical Committee comprised of wildlife biologists and biometricians from both countries, not only helped guide ongoing research and management activities, but oversaw the design and implementation of foundational survey and banding programs. In the 26 years since its inception, the BDJV has succeeded in providing an improved information base to better support management and conservation decisions, yet important questions remain. Since the decline of black duck was not likely caused by a single limiting factor, informed decision-making will require a more comprehensive consideration of multiple variables on a changing landscape.

O.2.2: Sauer

Development and Implementation of the Eastern Breeding Waterfowl and Habitat Survey

John Sauer[1]*, Daniel Bordage[2], Mark Koneff[3], Guthrie Zimmerman[4]

[1] U.S. Geological Survey, Patuxent Wildlife Research Center, 12100 Beech Forest Road, Laurel, MD 20708, USA, jrsauer@usgs.gov
[2] Environment Canada Canadian Wildlife Service, Population Assessment, 801-1550 avenue d´Estimauville, Quebec, QC G1J 0C3, Canada
[3] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 17 Godfrey Drive, Suite 2, Orono, ME 04473, USA
[4] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 3020 State University Drive, East, Modoc Hall Suite 2007, Sacramento, CA 95819, USA

Surveying waterfowl in eastern Canada has never been easy. Aircraft provide a means of covering the extensive areas to be surveyed, but variable terrain and remote regions prevented implementation of the fixed-wing transect surveys with associated ground counts that were implemented in the prairie regions of North America. The need for status information to better manage stocks of American black ducks in the 1980s spurred Canadian biologists to implement pilot studies for regional, plot based surveys that employed helicopters. In 1990, a plot-based survey employing a consistent design and protocols was implemented across much of the black duck range. To extend the coverage to the entire black duck range, additional fixed-wing transect-based surveys were implemented in the northern United States and in remote parts of northern Ontario, Northern Quebec, Labrador, and Newfoundland. Fixed-wing surveys were also implemented in a portion of the plot-survey area to provide additional data, permit calibration of survey results, and allow for evaluation of the relative merits of fixed-wing and helicopters as survey platforms for black ducks. Analysis of data produced by these surveys has proven challenging, as established double-sampling procedures employed in other waterfowl surveys could not be implemented without the intensive subsamples obtained from ground-based counts. Instead, estimated population sizes from fixed-wing accounts are scaled to helicopter counts, allowing for estimation of a composite regional population estimate using log-linear hierarchical models. It has proven difficult to reach consensus on a single platform for black duck surveys. However, optimization approaches have been used to modify survey effort to increase efficiency in overlap area, and the dual platforms provide useful redundancy when equipment failures or budget shortfalls caused incomplete results from either the plot or the transect surveys.

O.2.3: Conroy

Development and Implementation of an International Black Duck Harvest Strategy

Michael J. Conroy[1]*, Eric T. Reed[2], Paul I. Padding[3], Mark D. Koneff[4], Patrick K. Devers[2]

[1] Warnell School of Forestry & Natural Resources, University of Georgia, Athens 30602, USA
mjconroy52@gmail.com
[2] Canadian Wildlife Service, Environment Canada, 351 St. Joseph Blvd, Gatineau, Quebec K1A OH3, Canada
[3] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 11510 American Holly Drive, Laurel, MD 20708, USA
[4] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 17 Godfrey Drive, Suite 2, Orono, ME 04473, USA

American black ducks (Anas rubripes) are highly sought after by hunters in Canada and the United States. Unlike other species of North American dabblers in which >90% of the harvest occurs in the U.S., the proportion of the annual black duck harvest occurring in Canada has ranged between 40% and 60%. In response to the long-term decline of the black duck population between the 1950s and 1990s, the US Fish and Wildlife Service (USFWS) and Canadian Wildlife Service (CWS) implemented harvest restrictions in 1983 and 1984, respectively, resulting in a 25% decline in the country specific harvest. As the population stabilized in the 1990s, the question of liberalization and allocation between the two countries came under more scrutiny. The Black Duck Adaptive Harvest Management Working Group (BDAHMWG) was established in 1997 to develop an international harvest strategy to establish sustainable levels of continental harvest and acceptable allocation between countries. The BDAHMWG developed an adaptive harvest management framework based on the Eastern Waterfowl Breeding Population and Habitat Survey and four competing hypotheses regarding additive mortality and mallard competition. As technical work on the predictive model developed, harvest managers and policy makers in the USFWS, CWS, and the Atlantic and Mississippi Flyway Councils lacked consensus on the harvest objective and process for allocating harvest between countries. The BDAHMWG used a structured decision making process to resolve these policy issues resulting in an agreement to use an objective of achieving 98% of maximum sustainable yield and a two-part parity constraint that ensures each country receives between 40% and 60% of the allowable continental harvest. The BDAHM framework was implemented in 2012 and is the only international adaptive harvest strategy used in North American waterfowl management. We describe technical elements of the strategy, the process used to resolve debate over policy elements, and future development topics.

O.2.4: Robinson

Integrating Habitat and Population Dynamics: Achieving NAWMP Goals Through the Use of an Annual Life Cycle Model

Orin Robinson[1]*, Conor McGowan[2], Patrick K. Devers[3]

[1] School of Forestry and Wildlife Science, Auburn University, Auburn, AL 36849, USA, Orinjrobinsonjr1@gmail.com
[2] U.S. Geological Survey Cooperative Fish and Wildlife Research Unit, School of Forestry and Wildlife Science, Auburn University, Auburn, AL 36849, USA
[3] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD 20708, USA

Following the confluence of multiple events including the completion of the first continental assessment of the North American Waterfowl Management Plan, the publication of the Joint Task Group Report, the implementation of the Eastern Waterfowl Breeding Population and Habitat Survey and Black Duck Adaptive Harvest Management strategy, the Black Duck Joint Venture established a new vision for the black duck conservation – the development of a decision framework that integrates habitat delivery and population dynamics to achieve population and harvest objectives. This vision served as the foundation of the BDJV 2015-2019 strategic plan. The goal of this framework is to identify the seasonal vital rate (i.e., survival or productivity) and the region(s) that most influence population growth and determine regional habitat delivery needs to increase continental carrying capacity. We developed a conceptual model consisting of 3 competing hypotheses of density dependent growth that link changes in regional carrying capacity to changes in post-season survival or productivity. Using banding data from 1951-2011 and breeding population survey data from 1990-2014, we developed competing full annual cycle population models for the American black duck that account for density-dependent and density-independent processes. Using a Bayesian model weighting routine, we selected the model(s) that best fit the long-term data. This model uses the seven regions as set by the BDJV, allows movement into and out of each region during each season, and estimates survival and fecundity for each region separately. With this model, we can evaluate the effects of habitat loss or gains on the continental black duck population and develop region specific habitat delivery recommendations for implementation by associated Habitat Joint Ventures. In addition, this framework can be used by the BDJV to allocate limited research money to address assumptions and parameters that most influence our understanding of black duck limiting factors and habitat delivery needs.

O.2.5: Devers

Testing the Winter Limitation Hypothesis Using a Two-Season Banding Program

Patrick K. Devers[1],*, Guthrie S. Zimmerman[2], G. Scott Boomer[1]

[1] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 11510 American Holly Drive, Laurel, MD 20708, USA. Patrick_devers@fws.gov
[2] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 3020 State University Drive, East, Modoc Hall Suite 2007, Sacramento, CA 95819, USA

To meet population and habitat objectives, managers and researchers require reliable information describing the abundance and distribution of populations and their vital rates (i.e., survival, recruitment, and harvest rates). Based on the winter limitation hypothesis (WLH), habitat planners within the Atlantic Coast Joint Venture, State and Provincial Agencies, and the National Wildlife Refuge System assume black ducks are limited by energetic demands during the non-breeding season. One prediction from the WLH suggests that black duck post-hunting season survival is negatively affected by winter severity and non-breeding season habitat quality. We designed and implemented a pilot two-season banding program in collaboration with the Atlantic and Mississippi Flyway Councils, Canadian Wildlife Service, and National Wildlife Refuge System to test the black duck WLH and investigate how seasonal survival rates vary in relation to winter habitat and weather conditions. Our objectives were to 1) use historical black duck band recovery information to develop a statistically valid sampling design, 2) estimate annual and seasonal survival and recovery rates, and 3) evaluate the precision and usefulness of seasonal survival rates to improve black duck non-breeding habitat management. Using historical band recovery data we estimated a post-season banding quota of 3,000 black ducks and allocated the quota across regions using transition probabilities. Between 2010 and 2015, partners banded 21,718 black ducks during post-season operations, with an annual average of 3,619. Estimates of annual survival rates based on two-season (e.g., 0.47-0.71 for adult males) and pre-season (0.51-0.77) recovery data were similar, but estimates based on two-season data were more precise. Seasonal survival was higher during summer-fall compared to winter-spring. Recovery rates were lower for post-season banded birds compared to pre-season banded birds. Annual and seasonal survival rates were similar between black ducks and mallards and there is some evidence that post-season survival is influenced by extreme weather conditions.

O.2.6: Darveau

American Black Duck Breeding Habitat: Knowledge and Conservation in a Changing World

Marcel Darveau[1,2]*, Daniel Bordage[3], Rod Brook[4], Patricia Edwards[5], David J. Lieske[6], Daniel G. McAuley[7], Nic McLellan[8], Shawn Meyer[9], J. Bruce Pollard[5]

[1] Ducks Unlimited Canada, Quebec, QC, G1V 0A6, Canada, m_darveau@ducks.ca
[2] Universite Laval, Quebec, QC, G1V 0A6, Canada
[3] Canadian Wildlife Service, Quebec Region, QC, G1J 0C3, Canada
[4] Ontario Ministry of Natural Resources and Forestry, Peterborough, ON, K9J 7B8, Canada
[5] Canadian Wildlife Service, Atlantic Region, Sackville, NB E4L 1G6, Canada
[6] Mount Allison University, Sackville, NB, E4L 1E4, Canada
[7] USGS Patuxent Research Center, Orono, ME, 04473, U.S.A.; 8 Ducks Unlimited Canada, Amherst, NS, B4H 3Z5, Canada; 9 Canadian Wildlife Service, Ontario Region, Ottawa, ON, K1A 0H3, Canada

One goal of the Black Duck Joint Venture (BDJV) is to support research aimed at identifying and understanding the factors affecting the breeding population of the American black duck (Anas rubripes, hereafter black duck) in North America. BDJV has funded research on breeding habitat studies from remote northern Canadian boreal areas, the Atlantic Canada and Maine, to southern Chesapeake Bay. Data from breeding pair and brood surveys has shown that black ducks tend to use smaller wetlands and streams during nesting and move to larger waterbodies during summer. Little is known however about reproductive success in most of its breeding range. Anthropogenic effects such as the long-range transport of acid precipitation have been shown to potentially influence duckling survival through changes in aquatic food webs though at the landscape scale, black ducks appear to be resilient to industrial forestry as currently practiced in the Canadian boreal forest. The species also utilize more southern landscapes partly converted to agriculture. Considering the immense size and remoteness of the boreal forest used by breeding black ducks and that the population seems to be doing well in its core breeding range, it is not surprising that conservation efforts to date have been limited. Currently, <10% of the black duck breeding range is protected (IUCN categories I-VI), conferring proportional protection to black ducks that nest at low and uniform densities (<1 pair/km²) across much of the boreal landscape. Presently, protection focuses on governmental guidelines for sustainable land use, allied with voluntary best management practices and certification programs. These appear very promising in maintaining quality breeding habitat for black ducks, as they target, at a fine scale, key habitats such as riparian zones and wetlands. However, with rapid human development and encroachment into the boreal forest, further efforts will be needed to ensure conservation of black duck populations in North America.

P.2: The Pride of the Salt Marsh: Status and Future Conservation of the American Black Duck
(Organizer: Pat Devers)

P.2.1: Coluccy

American Black Duck Bioenergetics Model: A Synthesis of Research and Results

John M. Coluccy[1]*, Paul M. Castelli[2], Patrick K. Devers[3], Heath M. Hagy[4], Gregory J. Soulliere[5], Christopher K. Williams[6]

[1] Ducks Unlimited Inc., 1220 Eisenhower Place,, Ann Arbor, MI 48108, USA, jcoluccy@ducks.org
[2] U.S. Fish & Wildlife Service, Edwin B. Forsythe National Wildlife Refuge, 800 Great Creek Road, Oceanville, NJ 08231, USA
[3] U.S. Fish and Wildlife Service, 11510 American Holly Drive, Laurel, MD 20708, USA
[4] Illinois Natural History Survey, Forbes Biological Station – Bellrose Waterfowl Research Center, University of Illinois at Urbana-Champaign, Havana, IL 62644, USA
[5] U.S. Fish & Wildlife Service, Upper Mississippi River and Great Lakes Region Joint Venture Science Office, 2651 Coolidge Road, Suite 101, East Lansing, MI 48823, USA
[6] Department of Entomology and Wildlife Ecology, University of Delaware, Newark, DE 19716, USA

Bioenergetic models are increasingly used by bird conservation Joint Ventures to estimate habitat requirements for non-breeding waterfowl. Models translating population objectives to habitat objectives require four basic data inputs: 1) daily bird energy requirements (DER) and 2) time-specific population objectives (e.g., duck use days) are needed to calculate energy demand, while 3) amounts of various habitats available and the 4) energetic value of forage accessible within those habitats are used to calculate energy supply. The difference between energy supply and energy demand can then be used to direct conservation planning and implementation, answering key questions of "what, where, and how much" habitat is needed to achieve a target carrying capacity. Information for conducting bioenergetics modeling for American black ducks was largely lacking. In response, the Black Duck and Atlantic Coast Joint Ventures in partnership with Ducks Unlimited, academic institutions, state and federal agencies, and others initiated a suite of studies to fill information gaps and facilitate more effective conservation planning for American black ducks across their winter range. Beginning in 2004, several replicated field studies commenced on primary black duck wintering areas in multiple states and one province (NY, NJ, CT, VA, TN and NS) to evaluate food resource availability, habitat use and behavior, and food habits. A follow up captive-bird study was undertaken in 2009 to evaluate the true metabolizable energy and nutritional value of black duck foods. During this time frame, research was also initiated to estimate DER based on black duck behavior across the 24-hour time period. This effort lead to the most recently initiated study to evaluate activity multipliers (e.g., relative time spent swimming, preening, etc.) to resting metabolic rate to refine estimates of DER. The culmination of these works will be a decision support tool to help guide habitat conservation for black ducks across their non-breeding range. We summarize methods and results from these studies and discuss implications for ongoing black duck conservation planning.

P.2.2: Peck

Overwinter Survival and Wintering Ground Fidelity of American Black Ducks in Atlantic Canada

Liam E. Peck[1]*, Randy Milton[2], J. Bruce Pollard[3], Garry Gregory[4], Gregory J. Robertson[5], Mark L. Mallory[1]

[1] Department of Biology, Acadia University, Wolfville, NS, B4P 2R6, Canada, liampeck@acadiau.ca
[2] Wildlife Conservation Division, Nova Scotia Department of Lands and Forests, Kentville, NS, B4N 3X3, Canada
[3] Canadian Wildlife Service, Environmental Stewardship Branch, Environment Canada, Sackville, NB, E4L 4A7, Canada
[4] Forests, Fish, and Wildlife Division, Prince Edward Island Department of Agriculture and Forestry, Charlottetown, PE, C1A 7N8, Canada
[5] Wildlife Research Division, Environment Canada, Mount Pearl, NL A1N 4T3, Canada

The American Black Duck (*Anas rubripes*) is a migrant species of waterfowl native to the northeastern United States and Atlantic Canadian provinces. More than 100 years of studying the species has presented a concerning trend: black duck populations have been declining, and remain below desired levels. In recent years, however, winter population survey data and anecdotal observations suggest that the number of black ducks wintering in Atlantic Canada have increased, making Nova Scotia in particular one of the few regions to see an increase of black ducks. How these Eastern Canadian ducks fit in to current models of black duck population structure and the hunting pressures they face is still uncertain. We conducted and expanded banding operations to capture/recapture black ducks in Nova Scotia, and acquired additional overwinter banding data from a number of other sites in eastern Canada in Prince Edward Island, New Brunswick, and Newfoundland (the latter an urban control site approximately 1000 kilometers northeast of Nova Scotia, where birds are known to rely on anthropogenic food sources for survival). Mark-recapture analyses using banding data were used to model survival estimates in MARK while also being used to observe movement among sites in the Maritimes, allowing us to observe fidelity, survival, and the effects of harvest on the American black duck. The American black duck is an important game bird in the Atlantic Flyway where the species makes up a large proportion of ducks harvested; however, excessive harvest is arguably the most significant annual mortality factor for black ducks. With an increased knowledge on the overwintering of black ducks in Nova Scotia and surrounding provinces, it will be possible to implement better harvest strategies to ensure black ducks can achieve population goals, while also shedding light onto why their populations are increasing in Nova Scotia and surrounding areas.

P.2.3: English^

Winter Diet and Body Condition of American Black Ducks in Atlantic Canada

Matthew D. English[1]*, Gregory J. Robertson[2], Mark L. Mallory[1]

[1]Biology Department, Acadia University, Wolfville NS, Canada. B4P 2R6
matthew.english@acadiau.ca
[2] Wildlife Research Division, Environment Canada, Mount Pearl NL, Canada. A1N 4T3

American black ducks (*Anas rubripes*) remain a species of international concern in North America as the population size has decreased by ~50% since the 1950s. Atlantic Canada is the northern limit of black duck wintering range, and in contrast to overall population trends in eastern North America, recent surveys suggest that numbers of black ducks overwintering in Atlantic Canada are increasing. We examined winter diet using gut content analyses from black ducks collected from rural and urban locations in the winter of 2014, and using blood isotopic data from ducks sampled in the winters of 2014 and 2015. Body condition was measured using a scaled mass index, and the carcass composition of ducks in Atlantic Canada was compared to that of black ducks wintering farther south in the United States of America. Black duck movements through the winter and subsequent linkages to previously unknown breeding areas were monitored by deploying 11 satellite transmitters attached to black ducks in 2014. Black ducks wintering in rural areas fed on molluscs and seeds through the winter, while ducks wintering in an urban area relied almost entirely on human food. Despite these differences in diet, black duck body condition in rural and urban areas did not differ through the winter. From looking at previously published data, black ducks wintering in Atlantic Canada are significantly structurally smaller and lighter than those wintering in Maine and Virginia, but still maintain similar fat reserves. This suggests that black ducks wintering in Atlantic Canada must maintain proportionally higher fat reserves to survive the longer and harsher winters than black ducks wintering farther south.

P.2.4: Ringelman

A Meta-analysis of American Black Duck Winter Habitat Use along the Atlantic Coast

Kevin M. Ringelman[1]*, Christopher K. Williams[2], Patrick Devers[3], John M. Coluccy[4], Paul Castelli[5], Kurt A. Anderson[2], Jacob L. Bowman[2], Gary R. Constanzo[6], Dane M. Cramer[2], Matt DiBona[7], Michael Eichholz[8], Min Huang[9], Benjamin Lewis[2], Dawn Plattner[8], Tina Yerkes[4]

[1] School of Renewable Natural Resources, Louisiana State University Ag Center, Baton Rouge, LA, 70805, USA, kringelman@agcenter.lsu.edu
[2] Department of Entomology and Wildlife Ecology, University of Delaware, Newark, DE, 19716, USA
[3] U.S. Fish and Wildlife Service, Laurel, MD, 20708, USA
[4] Ducks Unlimited Inc., Ann Arbor, MI, 48108, USA
[5] U.S. Fish and Wildlife Service, Oceanville, NJ, 08231, USA
[6] Virginia Deparment of Game and Inland Fisheries, Charles City, VA, 23230, USA
[7] Delaware Department of Natural Resources and Environmental Control, Smyrna, DE 19977, USA
[8] Department of Zoology, Southern Illinois University, Carbondale, IL, 62901, USA
[9] Connecticut Department of Energy and Environmental Protection, North Franklin, CT, 06254, USA

American black ducks (*Anas rubripes*) have generally been well studied throughout the annual cycle, but surprisingly, we lack a synthetic, quantitative understanding of their space-use during the winter. This in turn limits our ability to prioritize habitat acquisition and restoration efforts. Here, we used >17,000 telemetry locations from 235 black ducks ranging from Connecticut to Virginia to study home range composition and space-use in relation to habitat quality, severe weather, and urbanization. Despite substantial environmental variation, home range sizes were similar among regions and years. Smaller home and core ranges contained a greater proportion of salt marsh habitat, and ducks experiencing more 4-day freeze events had larger home and core ranges. Ducks exposed to prolonged periods of cold weather had smaller core ranges when those areas were comprised of more energy-rich freshwater habitats. When we examined individual telemetry locations, we found that ducks used irregularly inundated “high marsh” more at night, presumably for foraging, and urban habitats more during the day and evening crepuscular periods. We found that black ducks used regularly inundated “low” marsh less on days where the temperature never rose above freezing, and instead used subtidal areas and forested wetlands more. Finally, we found ducks were marginally more likely to use freshwater habitats during high tides. Our study confirms that black ducks depend on salt marsh for wintering habitat, and points to an unexpectedly important role for forested wetlands during periods of cold weather. We found no evidence that black ducks avoided urban areas or roads, which supports the inclusion of all available habitats in carrying capacity modeling. We emphasize that new hypothesis-driven, local telemetry studies are needed to further elucidate the relationships between black duck movements and environmental variation, especially cold weather.

P.2.5: Jones

Non-breeding Habitat Planning and Delivery for American Black Ducks

Malcom Jones[1]*, John Coluccy[2], Kirsten Luke[3], Patrick K. Devers[1]

[1] U.S. Fish and Wildlife Service, Division of Migratory Bird Management, 11510 American Holly Drive, Laurel, MD 20708, USA, tim_jones@fws.gov
[2] Ducks Unlimited, Great Lakes and Atlantic Region, 331 Metty Drive, Suite 4, Ann Arbor, MI 48103, USA
[3] American Bird Conservancy, 1601 Balboa Avenue, Panama City, FL 32405, USA

The 2015-2019 Black Duck Joint Venture Strategic Plan established a vision of achieving the North American Waterfowl Management Plan (NAWMP) population goal by increasing carrying capacity in region(s) determined to be most influential to continental population growth. During the non-breeding season, habitat researchers and managers assume the primary limiting factor is energy in the form of food resources. Representatives from the Black Duck, Atlantic Coast, and the Upper Mississippi River and Great Lakes Joint Venture(s) are developing a decision framework to guide habitat acquisition, enhancement and restoration throughout black duck non-breeding range based on bio-energetics theory. The current version of the decision framework was developed at the county-level scale and can be scaled up to identify areas that have excess, adequate, or deficient energetic supply to support stepped-down population goals for black ducks. Estimates of energetic supply were derived using results from replicated field studies and laboratory studies that provide empirical estimates of kcal/ha/wetland type and National Wetland Inventory data. Estimates of energetic demand were derived by stepping down the NAWMP population goal and applying estimates of daily energetic requirements and migration chronology to calculate population level energetic demand for the non-breeding period. Estimates of energetic supply and demand were incorporated into a geographic information system (GIS) and used to identify areas with excessive, adequate, or deficient energy. Initial results indicate the northeast United States (i.e., Long Island Sound) may be deficient in terms of energy supply, whereas New Jersey and Delaware have adequate energetic capacity, and the Chesapeake Bay region has excess energetic capacity. On-going work seeks to improve the usefulness of this decision framework by incorporating estimates of competition from other waterfowl species, and risks to existing habitat from urban growth and sea level rise. When completed this decision framework will aid in identifying priority areas for habitat acquisition, enhancement or restoration and the selection of proposed projects that maximize the overall quality of black duck habitat on the landscape.

P.2.6: Discussion

Discussion

Patrick Devers

O.3: Winter Ecology (Chair: Rick Kaminski)

O.3.1: Collins

Impacts of Wind Energy on Wintering Redheads

Daniel P. Collins[1]*, Cory J. Lange[2], Bart M. Ballard[2]

[1] U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, NM 87102, USA, dan_collins@fws.gov
[2] Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, TX 78363, USA

Up to 80% of North America's redhead (*Aythya americana*) population winters along the lower Texas Coast. Throughout winter, these birds make daily movements between foraging areas in the Laguna Madre and inland freshwater ponds used for drinking. Recently, a large wind farm was constructed within a section of the Laguna Madre heavily used by redheads. We ranked each coastal pond based on their water permanence, isolation, and proximity to foraging area in order to investigated impacts from the wind farm on the distribution of redheads and availability of ponds. We conducted weekly aerial surveys during 3 winters prior to construction of the wind farm and during 2 winters following its completion. We documented each pond used and the number of redheads on each pond during each survey. We also extracted surface water from LandSat imagery for the entire lower Texas Coast for the 3 driest, 3 most medial, and 3 wettest winters (based on Palmer Drought Severity Index) over the last 30 years. Our prioritization scheme showed that North Padre Island and the mainland in and around the wind farm were the highest ranked areas prior to wind farm construction. Redhead abundance within the wind farm declined by 78% following construction, but increased by 226% throughout the lower Texas Coast following construction. Our surface water modeling found that coastal pond availability declined within the wind farm, particularly during dry years when < 2% of ponds were available post-construction that were available pre-construction under similar conditions of wetness. Thus, it appears that the wind farm has altered local hydrology and reduced coastal pond availability within the wind farm. Our results identify areas along the lower Texas Coast where development, such as wind farms, should be avoided due to their importance to a large proportion of North America's redheads during winter.

O.3.2: Lancaster1^

Linking Habitat Use and Survival to Identify Suitable Winter Habitats for Female Mallards in Mississippi

Joseph D. Lancaster[1]*^, J. Brian Davis[1], Richard M. Kaminski[2], Edward J. Penny[3], Alan D. Afton[4]

[1] Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University, Mississippi State, MS, 39762, USA, jdl303@msstate.edu
[2] James C. Kennedy Waterfowl & Wetlands Conservation Center, Belle W. Baruch Institute of Coastal Ecology and Forest Science, Clemson University, Georgetown, SC 29440, USA
[3] Mississippi Department of Wildlife, Fisheries, and Parks, Jackson, MS 39211, USA
[4] U.S. Geological Survey, Louisiana Cooperative Fish and Wildlife Research Unit, Louisiana State University, Baton Rouge, LA 70803, USA

The Mississippi Alluvial Valley (MAV) is continentally important for migrating and wintering waterfowl in North America, especially mallards (*Anas platyrhynchos*). Amid extensive hardwood bottomland loss, flooded croplands, moist-soil, and forested wetlands are critical contemporary habitats in the MAV. Research has revealed that greatest abundances of wintering mallards in the MAV occur on landscapes comprised of 50% flooded croplands, 20% moist-soil, 20% forested, and 10% permanent wetlands. However, information is lacking to link daily habitat use and survival to characterize habitat complexes that promote winter survival (i.e., "suitable habitats"). We quantified use of flooded croplands (AG), moist-soil (MS), forested (FO), and permanent wetlands (PW) by female mallards radio-marked in the Yazoo Basin of Mississippi, December-March 2010-2012 and 2013-2015. Using compositional analysis, we divided proportional use of MS, FO, and PW by proportional use of AG and used natural log ratios of these as response variables in a split-plot multivariate analysis of variance (MANOVA). We tested ($\alpha = 0.05$) influences of individual female, north or south Basin, hunting or post-hunting periods, and a period by region interaction. We are also using a multistate mark-recapture with dead recovery model in program MARK to estimate daily survival relative to diurnal habitat use, north or south Basin, hunting or post periods, and a body-condition index. We will rank models using an information theoretic approach and use daily survival rates from the most parsimonious model to assess habitat-complex composition among three levels of winter survival rates (upper 25%, middle 50%, and lower 25%). We will incorporate proportional use of habitats by radio-marked females as the dependent variables in a MANOVA, then use individuals' level of winter survival as the independent variable to test the null hypothesis that habitat-complex composition does not differ among females with high, middle, or low winter survival. We located 241 radio-marked females on 7,441 occasions, including 2,048, 3,477, 349, and 1,567 locations in MS, FO, PW, and AG, respectively. Habitat use varied among females, north or south Basin, hunted and post-hunted periods, and the period by region interaction ($Ps \leq 0.002$). Permanent wetlands were used 70-80% less ($Ps < 0.001$) than AG among all period by region combinations. Moist-soil wetlands were used 108% and 29% more ($Ps \leq 0.024$) than AG during hunting season in north and south Basins, respectively. Post-hunting season, MS wetlands were used 38% less ($P < 0.001$) but 51% more ($P = 0.014$) than AG in north and south Basins, respectively. Forested wetlands were used 88-154% more ($P < 0.001$) than AG among all period by region combinations, except post-hunting season in the north Basin, where use of these habitats did not differ ($P = 0.42$). Comparable to findings from Louisiana and Arkansas, forested wetlands were significant to female mallards wintering in the Yazoo Basin. However, moist-soil wetlands were also important to female mallards in the Yazoo Basin, despite being seldom used in Louisiana and Arkansas. Our continued analyses will enhance understanding of mallard ecology and identify habitat complexes that promote their survival in the MAV.

O.3.3: Williams

Bioenergetics, Behavior, and Sea Level Rise: Current Status and Future Implications for Wintering Dabbling Ducks in Delaware

Mark C. Livolsi[1], Christopher K. Williams[1], John M. Coluccy[2], Matthew T. DiBona[3]

[1] Department of Entomology and Wildlife Ecology, University of Delaware, Newark, DE, 19711, USA, mlivolsi@udel.edu
[2] Ducks Unlimited, Inc., Ann Arbor, MI, 48108, USA
[3] Delaware Department of Natural Resources and Environmental Control, Smyrna, DE, 19901, USA

Coastal wetlands in Delaware provide dabbling ducks with critical habitat and food resources over the wintering period. Bioenergetics modeling suggests that the landscape's ability to support dabbler populations is contingent upon energy supply meeting demand. However, little is known of the relative value of unmanaged saltmarshes compared with managed impoundments. Thus, our objective was to compare energetic carrying capacity (duck use-days; DUD), population abundance, and behavior of 7 dabbler species (*Anas rubripes, A. platyrhynchos, A. acuta, A. clypeata, A. crecca, A. americana, A. strepera)* between these habitats. We estimated energy supply along the Delaware Bayshore within a 10-mi buffer of the coast via soil core (n = 1,346), nekton (n = 426), and saltmarsh snail (n = 87) samples in impoundments and 5 saltmarsh habitats, October–March, 2011–2013. We multiplied food biomass by true metabolizable energy (TME) values to determine energy available to dabblers. We found that for most dabblers, freshwater impoundments (range: 183,344–562,089 kcal/ha) contained greater energy densities than saltmarsh habitats (range: 39,477–361,429 kcal/ha). To estimate energy demand, we constructed time-energy budgets based on 10-min instantaneous scan samples between November–March, 2011–2013 over the 24-hr period. We estimated daily energy expenditure (DEE) between 111.84–349.79 kcal/bird/day. Thus, we estimated between 8.73 x 106 – 7.06 x 107 available DUD, depending on species, suggesting that dabblers are not currently at carrying capacity in Delaware. Additionally, we quantified the proportion of time spent in various behaviors between habitats. Dabblers tended to feed more and fly less on impoundments than saltmarshes. Our results suggest that impoundments are valuable habitat for wintering dabblers, providing more food energy and serving as refugia for feeding and sleeping compared with neighboring salt marshes. With the threat of sea level rise looming, we recommend that managers consider maintaining impoundments for future dabbler populations.

O.3.4: Askren^

Habitat Selection of Midcontinent Greater White-fronted Geese During the Wintering Period

Ryan J. Askren[1]*^, Douglas C. Osborne[1]

[1] Arkansas Agricultural Experiment Station, Division of Agriculture, University of Arkansas, Monticello, AR 71656, USA, askren@uamont.edu

The midcontinent population of greater white-fronted geese (*Anser albifrons frontalis*) has gained considerable attention in recent years from an evident increase in population abundance and perceived shift in winter distribution from the Central to the Mississippi Flyway. This shift is likely due to changing land use practices and availability of water on the non-breeding range. To better understand potential implications of shifting distributions of wintering white-fronts, we must first understand factors influencing habitat selection on the wintering range. To date, little has been quantified on habitat selection of white-fronts wintering in the Mississippi Alluvial Valley, thus warranting further investigation. The objective of this research was to determine local and landscape factors influencing selection of foraging habitat by white-fronts during winter. During July 2014, 10 white-fronts were marked with solar-powered PTT transmitters in the Queen Maud Gulf, Nunavut, Canada and 4 were marked with GSM transmitter on the North Slope in Alaska. Of the 9 surviving PTT-marked white-fronts, 7 wintered in the Mississippi Alluvial Valley of Arkansas and Louisiana and 2 in Texas. Selection ratios (Wi) for habitat availability were calculated for Texas and the Mississippi Alluvial Valley separately using 95% Kernel Density Estimate of all transmitter locations. Composition of both habitat use and availability were calculated for each crop type from National Agricultural Statistics Service GIS data. Notable differences in habitat selection were detected among white-fronts wintering in Texas and those in the Mississippi Alluvial Valley. White-fronts wintering in Texas selected for herbaceous wetlands (26% of foraging locations; Wi = 10.5), pasture (21% of foraging locations; Wi = 2.4), and winter wheat (7% of foraging locations; Wi = 7.2). Whereas white-fronts wintering in the Mississippi Alluvial Valley selected for rice (54% foraging locations; Wi = 5.0) and soybeans (25% foraging locations; Wi =1.5). Regional differences in selection reflect varying strategies for energetic acquisition within the species that have consequences for managers concerned with local and landscape energetics. We suggest that shifting distributions of midcontinent white-fronts into the MAV are increasingly selecting for flooded agriculture, particularly rice, which will impact local resource availability through increased competition for energetics among waterfowl species.

O.3.5: Kennedy^

Wintering Redhead Duck Effects on Northern Gulf of Mexico Seagrasses

Maddie Kennedy[1,2]*^, Kenneth L. Heck Jr.[2,1], John Valentine[1,2], Thomas Michot[3]

[1] Dauphin Island Sea Lab, Dauphin Island, AL, 36528, USA, mkennedy@disl.org
[2] Department of Marine Science, University of South Alabama, Mobile, AL, 36528, USA
[3] Institute for Coastal Ecology and Engineering, University of Louisiana at Lafayette, Lafayette, LA, 70507, USA

While it has been well established that waterfowl grazing can control the distribution and abundance of seagrasses in other regions, less is known about their effects in the northern Gulf of Mexico. This is likely because herbivorous waterfowl are only present during winter when less fieldwork has typically been done. We are evaluating the effects of winter waterfowl (specifically redhead duck (*Athya americana*) feeding on mixed shoalgrass (*Halodule wrightii*) and widgeon grass (*Ruppia maritima*) beds. Considered the dominant winter seagrass grazers in temperate zones, previous studies have found redheads to selectively consume the belowground roots and rhizomes of shoalgrass. Given that the major carbohydrate reserves are stored in its rhizomes, heavy redhead grazing might result in significant impacts on the regrowth and/or of shoalgrass and widgeongrass in the following growing season.

To determine the impacts of redhead grazing on shoalgrass, we are carrying out exclusion caging experiments at three locations along the Alabama coastline. At each location, cages were deployed to exclude waterfowl from grazing, and samples of seagrass biomass were taken from both grazing exclusion and uncaged control locations five times throughout the year: at time zero (before waterfowl presence), one month post bird arrival, following northward bird migration in the spring, during peak summer reproduction, and, finally, in early fall at peak seagrass biomass. Once in the lab, seagrass samples are separated by species and above and below-ground tissues. Time-lapse photography was used to provide estimates of the abundance and feeding activities of the birds and upper digestive system contents are being examined to determine the type and amount of seagrass consumed. Results to date show that redheads actively and regularly feed in all experimental areas for extended periods of time, with as many as 100% of the individuals feeding at any given time. Consequently, a large majority of collected redheads contained seagrass in their digestive tracts. Additionally, there was significantly more shoalgrass root and rhizome biomass in ungrazed areas after redhead departure, indicating that grazing produced a negative impact on rhizomal reserves. In ungrazed areas widgeon grass began flowering earlier, consistent with the loss of rhizomal reserves available to support flowering. Additionally, in grazed areas widgeon grass became more abundant than in caged areas. Thus, it appears that redhead herbivory has affected the relative abundances of both species of seagrass as well as the flowering of widgeon grass. We hypothesize that in the second year of study we will likely see additional evidence of a species shift and/or reduction in shoot density and biomass in grazed locations.

O.3.6: Raquel^

Species-specific Timing of Breeding in Response to Winter Climate and Spring Pond Conditions

Amelia J. Raquel[1]*^, Robert G. Clark[1,2], James H. Devries[3], David W. Howerter[3]

[1] Department of Biology, University of Saskatchewan, Saskatoon, Saskatchewan, S7N 5E2, Canada, amelia.raquel@usask.ca
[2] Environment Canada, Saskatoon, Saskatchewan, S7N 0X4, Canada
[3] Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Stonewall, Manitoba, R0C 2Z0, Canada

Climate change is expected to alter temperature and precipitation regimes across North America, and the ability of duck species to respond to these changes could have serious implications for population dynamics. Presumably, flexible species that can adjust timing of spring migration or lay date are better able to respond to advances in spring phenology. However, flexibility in such seasonal adjustments may be related to species-specific life history traits. Changes in climate are also anticipated to affect conditions on overwintering areas which may have carry-over effects during the subsequent breeding season. Favorable wintering conditions may advance migration and nesting dates, and therefore affect recruitment. We tested for species-specific responses to both winter and spring pond conditions to determine how these conditions influenced timing of breeding in eight duck species representing distinct life-histories. We used records (n = 22,238) for ducks nesting on 164 sites, 1993-2011. Using linear mixed effects models, controlling random effects of site-year, we first tested for species-specific differences in clutch initiation date, and characterized the relative timing of nesting for green-winged teal (*Anas carolinensis*), blue-winged teal (*A. discors*), northern shoveler (*A. clypeata*), American wigeon (*A. americana*), gadwall (*A. strepera*), northern pintail (*A. acuta*), mallard (*A. platyrhynchos*), and lesser scaup (*Aythya affinis*). Then, we related timing of breeding to climate indices such as the El Nino Southern Oscillation (ENSO) and the North Atlantic Oscillation (NAO) for the preceding wintering period (Dec-Feb) and to standardized annual May pond counts. General linear mixed effects models incorporating combinations of the above indices and a random site-year term were used to explore species-specific responses to variation in clutch initiation dates. The best-supported model included a species effect, as expected, along with a negative effect of previous winter ENSO, indicating that in general ducks nested earlier following warmer and wetter winters in the southern U.S. and Mexico. No main effect of current spring pond conditions was detected. There was evidence of an interaction between winter ENSO and nesting dates of American wigeon, blue- and green-winged teals, and shoveler. We explored the interaction between winter ENSO and spring ponds; in general, in years with low pond numbers, clutch initiation dates advanced more rapidly following wetter winter conditions. This suggests that there are species-specific responses in timing of nesting in relation to both antecedent winter and current climate indices which may arise from species-specific life history traits. This also suggests that carry-over effects from the wintering grounds may allow some species to respond more flexibly to anticipated changes in climate. To determine species-specific responses to climate change, we will also consider both winter carry-over effects and local spring climate conditions simultaneously to provide deeper insights into spatio-temporal variation in prairie duck community composition.

O.4: Foraging Ecology (Chair: Heath Hagy)

O.4.1: Vanderhorst^

True Metabolizable Energy of Submersed Aquatic Vegetation for Dabbling Ducks

Sarah E. Vanderhorst[1]*^, Heath M. Hagy[1], John W. Simpson[2], Chris N. Jacques[3]

[1] Illinois Natural History Survey, Forbes Biological Station-Bellrose Waterfowl Research Center, Prairie Research Institute, University of Illinois at Urbana-Champaign, P.O. Box 590, Havana, IL, 62644 USA, sevander@illinois.edu
[2] Winous Point Marsh Conservancy, 3500 S Lattimore Road, Port Clinton, OH 43452 USA
[3] Western Illinois University, 1 University Circle, Macomb, IL, 61455 USA

Aquatic systems in the Midwest have been highly modified since the beginning of the 20th century, including channelization, damming, and dredging of most large rivers (e.g., Illinois, Mississippi, Ohio, Missouri) and disconnection from their natural floodplains with networks of levees. While the loss of submersed aquatic vegetation from hydrologically-connected wetlands and backwater lakes along the Illinois and Mississippi rivers is well-documented, information is unavailable to determine the implications of these losses on energetic carrying capacity for waterfowl, especially dabbling ducks. The objective of this study is to estimate true metabolizable energy of species of submersed aquatic vegetation common to the Upper Midwest for dabbling ducks. We will conduct feeding trials using wild-strain mallards (*Anas platyrhynchos*) during autumn 2015. Feeding trials consist of a 48-hour fasting period followed by precision feeding of seven species of submersed aquatic vegetation (e.g., *Stuckenia pectinata, Ceratophyllum demersum*) and a 48-hour period in a metabolic chamber where excreta is collected. We will estimate gross energy of test foods and excreta using a Parr adiabatic oxygen bomb calorimeter and adjust estimates for digestion efficiency to ascertain true metabolizable energy. We expect the true metabolizable energy of submersed aquatic vegetation to be less than that of seeds, tubers, and other hard mast. Our data may be useful to conservation planners for estimating energetic carrying capacity of semi-permanently-flooded marsh habitats, projecting impacts of wetland management alternatives such as semi-permanently-flooded marsh verses moist-soil management, assessing the tradeoffs in habitat quality for dabbling ducks of hydrologic connectivity with rivers and lakes, and as input parameters in models predicting habitat change over time or in response to stressors (e.g., climate change).

O.4.2: Behney

Worth the Reward? An Experimental Assessment of Risk-taking Behavior in Foraging Ducks

Adam C. Behney[1,3]*, Ryan O'Shaughnessy[1,4], Michael W. Eichholz[1], Joshua D. Stafford[2,5]

[1] Cooperative Wildlife Research Laboratory, Center for Ecology, Department of Zoology, Southern Illinois University, Carbondale, IL, 62901, USA, adam.behney@state.co.us
[2] Frank C. Bellrose Waterfowl Research Center, Illinois Natural History Survey, Institute of Natural Resource Sustainability, University of Illinois, Havana, IL, 62644, USA
[3] Present affiliation: Colorado Parks and Wildlife, Fort Collins, CO, 80526, USA
[4] Present affiliation: Borderlands Research Institute, Sul Ross State University, Alpine, TX, 79832, USA
[5] Present affiliation: U.S. Geological Survey, South Dakota Cooperative Fish & Wildlife Research Unit, Department of Natural Resource Management, South Dakota State University, Brookings, SD, 57005, USA

The way predators influence prey behavior is central to many components of basic and applied ecology. Foraging ducks face a fundamental tradeoff between food consumption and predation risk. Factors that influence ducks' perceived predation risk or valuation of energy may affect how they approach this tradeoff. We manipulated food abundance in wetlands differing in vegetation structure to assess the merits of life history theory, perceived predation risk, and energetic demand in explaining how much risk five duck species during spring migration were willing to engage in while foraging. We found some evidence consistent with our life history prediction; species with a faster life history strategy were willing to engage in riskier behavior, by feeding more intensively, for a greater food reward. Mallards (*Anas platyrhynchos*) and wood ducks (*Aix sponsa*) exhibited risk-taking behavior consistent with perceived predation risk. Mallards devoted more time to feeding when in areas with less cover indicating that they perceive open habitats as safer. Wood ducks devoted more time to feeding in treatment plots, when in shallow areas, and larger flocks. Wood ducks exhibited behavior that was also consistent with an increase in energetic demand as observed by an increase in the proportion of time devoted to feeding later in the spring as they approached nesting. Habitat management for nonbreeding ducks typically focuses on providing large quantities of high quality food. We demonstrate that habitat structure can limit the efficiency with which ducks exploit this food resource due to perceived predation risk. Furthermore, we found that the way ducks balance the risk-reward tradeoff while foraging is dependent on a variety of factors and different for different species.

O.4.3: DuBour^

Dietary Patterns of Lesser Scaup Ducklings in a Heterogeneous Landscape

Adam J. DuBour[1]*^, Kirsty E. Gurney[2], Mark S. Lindberg[1]

[1] Department of Biology and Wildlife, University of Alaska Fairbanks, Fairbanks, AK 99775, USA, ajdubour@alaska.edu
[2] Environment Canada, Science and Technology Branch, Saskatoon, SK, S7N 3R2, Canada

Lesser scaup (*Aythya affinis*) (hereafter scaup) have experienced prolonged population declines since the 1980's. Declines in scaup populations have been blamed on changes in boreal wetland breeding habitats and food resources related to climate warming. Scaup ducklings require abundant aquatic invertebrate prey for growth and survival and spatiotemporal changes in availability of important prey may result in a mismatch with duckling demand. On the Yukon Flats National Wildlife Refuge in interior Alaska scaup broods are associated with lakes with high Amphipod densities. However, scaup duckling diet is known to be diverse and densities of potential prey items on brood-occupied lakes are highly variable. Understanding how ducklings respond to natural variations in food abundance may aid in predictions as to how ecosystem change will affect scaup populations. The objectives of this study are to examine the degree of specialization and variation in diet of scaup ducklings across lakes with varying prey community composition and densities. We used MixSIAR, a Bayesian-based stable isotope mixing model, to estimate the proportional contribution of three broad invertebrate groups [Predatory(Odonata larvae), Pelagic(Gastropods, Corixids and Conchostraca) and Benthic(Amphipods and Chironomid larvae)] to scaup duckling diet. Additionally, the hierarchical nature of MixSIAR allowed us to estimate the variation within and among lakes by modeling "Lake" and "Individual" as random effects. At the population level, scaup ducklings consumed significant proportions of all three prey groups with the highest proportion coming from the Pelagic group, followed by the Benthic group and then the Predatory group. "Lake" accounted for the majority of the variation in the population diet indicating that individuals within lakes had relatively similar diets compared to individuals from other lakes. Together, these findings suggest that scaup ducklings are generalist consumers and that prey availability drives selection.

O.4.4: Marty^

Waste-Rice and Natural Seed Abundance in Rice Fields in the Gulf Coast Prairies of Louisiana and Texas

Joseph R. Marty[1]*^, J. Brian Davis[2], Richard M. Kaminski[3], Michael G. Brasher[4], Guiming Wang[5]

[1] Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University, Mississippi State, MS, 39762, USA, jrm803@msstate.edu
[2] Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University, Mississippi State, MS, 39762, USA
[3] James C. Kennedy Waterfowl & Wetlands Conservation Center, Belle W. Baruch Institute of Coastal Ecology and Forest Science, Clemson University, Georgetown, SC, 29585, USA
[4] Gulf Coast Joint Venture, Ducks Unlimited, Inc., Lafayette, LA 70506, USA
[5] Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University, Mississippi State, MS, 39762, USA

Commercial rice production and idled ricelands provide important habitats for waterfowl and waterbirds in the Chenier Plain (CP) of Louisiana and Texas and the Texas Mid Coast (TMC). Spatio-temporal dynamics of waste rice and natural seeds have not been previously estimated in CP and TMC regions as in other rice growing regions of North America. Nonetheless, contemporary evidence posits that abundance of waste rice is variable and influenced by region, month, and post-harvest treatments. Ricelands in the CP and TMC are assumed to provide approximately 42% of the estimated carrying capacity for wintering waterfowl in this region; thus, precise estimates of waste rice and natural seed densities are necessary for habitat conservation planning by the Gulf Coast Joint Venture. We conducted a spatially stratified multi-stage sampling survey to estimate waste rice and natural seed densities in production and idled rice fields in the CP and TMC. We collected 8,750 soil cores from production and idled rice fields during August, October, and November 2010-2013. We washed cores through a series of graduated sieves to recover rice and natural seeds. We manually removed rice and natural seeds from samples and dried seeds to constant mass (± 0.5 mg) at 87º C before weighing to the nearest 0.0001 g. We used PROC SURVEYMEANS to estimate mean waste rice and natural seed abundance among geographic regions, time-periods, and post-harvest treatments. Analyses of soil cores through 2012 indicated that abundance of waste rice in the CP declined 59% from 525 kg(dry)/ha (CV = 32.1%) in August following the first harvest to 215 kg/ha (CV = 25.6%) after a second crop was harvested in November. In fields without a second rice crop, abundance declined 87% to 66 kg/ha by November (CV = 69.7%), similar to waste rice abundance in the Mississippi Alluvial Valley (78.4 kg/ha, CV = 15%). In the TMC, waste rice abundance increased 120% from 221 kg/ha (CV = 20.3%) following the first harvest to 488 kg/ha (CV = 40.8%) after a second crop was harvested. Rice abundance was greatest in fields with a standing unharvested second crop in both the CP (366 kg/ha; CV = 28%) and the TMC (1,137 kg/ha; CV = 81%) regions. Natural seed abundance ranged from 142 kg/ha (CV = 32.5%) in disked idle fields in the CP to 355 kg/ha (CV = 23.6%) in standing idle fields in TMC. Overall, seasonal trends of waste rice in fields with a harvested second crop decreased in the CP and increased in the TMC, and natural seed abundance was greatest in idled fields with standing vegetation as anticipated. Growing and harvesting a second crop of rice in November likely mitigates rice loss due to decomposition, germination, or granivory that may occur between the first and second harvests. Our results will be critical metrics for daily ration models used to estimate foraging carrying capacity of ricelands in these regions.

O.4.5: Drahota

Anas spp. Body Condition and Ingested Foods During Spring Stopover

Jeff L. Drahota[1]*, Dustin Casady[2], Mery Casady[3], Ryan Walters[4]

1 U.S. Fish and Wildlife Service, Rainwater Basin Wetland Management District, Funk, Nebraska, 68940, USA, jeff_drahota@fws.gov
2 U.S. Fish and Wildlife Service, Buckley Air Force Base, Colorado, 80011, USA
3 U.S. Fish and Wildlife Service, Rocky Mountain Arsenal National Wildlife Refuge, Commerce City, Colorado, 80022, USA
4 Creighton University, Department of Medicine, Omaha, Nebraska,68178, USA

Supporting spring migration by providing adequate wetland-derived food resources is assumed to be an important strategy to support North American Waterfowl populations. Yet little is known about food selection for many puddle ducks while staging on spring mid-latitude habitats. Furthermore, little is known about spring puddle-duck body condition at mid-latitudes. We examined ingesta from 6 species of puddle ducks that fed in wetlands to determine if forage selected is different between early and late arriving ducks. Peak migrations were determined by tri-weekly waterfowl surveys in 2012 (n = 31 wetlands) and 2013 (n = 32 wetlands) during spring migration. The most frequently consumed items were wetland-derived seeds (73.7 ± 1.8% aggregate mass) for all 6 species collected, second was corn at 21.7% ± 1.8% aggregate mass during these two dry springs. Invertebrates comprised 1.4% aggregate mass consumed by all ducks, even norther shoveler who are typically considered invertebrate specialists only consumed 12.4% by mass. Seed mass for all wetlands sampled was 635.6 ± 58.8 kg/ha. The amount of seed mass removed was correlated to the amount of mass available (r^2 = 0.605, P = 0.0001). Mean seed abundance across wetlands sampled was 3.14 ± 0.39 seeds/cm^2. The most abundant seeds found were annual smartweeds (23.8%) and sedges (21.1%). The numbers of seeds removed was also correlated to the number of seeds available (r^2 = 0.320, P = 0.0007) and the mean number of seeds removed from all wetlands available (ponding depth >0.5 - <30.0 cm) was 2.1 ± 0.39 seeds/cm2. Significantly more seeds were removed (Z = -4.33, P = 0.0001) from annual stands ($\bar{X}$ = 3.83 ± 0.54 seeds/cm2) than from perennial stands ($\bar{X}$ = 0.69 ± 0.48 seeds/cm2). Body condition (mass, fat, and protein) did not influence dietary preference for any species (n = 471 ducks) or either sex (n = 220 hens and 251 males) within species. Ducks appear to be focusing on the most efficient foraging habitats during spring stopover. Wetland management is used as a method to increasing wetland-derived energy for waterfowl; however, we recommend future conservation delivery programs focus on wetland restoration practices that increase ponding frequency during spring migration to support population goals identified in the North American Waterfowl Management Plan.

O.4.6: VonBank^

Food Habits and Availability for Lesser Scaup (*Aythya affinis*) During Spring

Jay A. Vonbank[1]*, Heath M. Hagy[1], Joshua M. Osborn[1], Jamison C. England[1], Aaron P. Yetter[1], Michelle M. Horath[1], Chris S. Hine[1], Douglas R. McClain[1]

[1] Illinois Natural history Survey, Bellrose Waterfowl Research Center-Forbes Biological Station, Prairie Research Institute, University of Illinois Urbana-Champaign, Havana, IL 62644, USA, jayvonbank@gmail.com

The Illinois and Mississippi River corridors provide critical stopover habitat for migrating waterfowl. However, recent evidence suggests that wetlands associated with these river systems provide limited seed and invertebrate biomass for waterfowl in spring. The “Spring Condition Hypothesis” states that these declines in midcontinent foraging habitat quality may explain extended declines in species like lesser scaup (*Aythya affinis*). We experimentally collected lesser scaup (n = 232) from foraging flocks throughout the Illinois and Upper Mississippi River valleys during February–April 2014–2015. We extracted upper digestive tracts and collected benthic food samples at collection sites to evaluate food use and selection. Further, we compared food items at collection sites to foods from randomly-collected samples throughout wetlands. Lesser scaup collected in 2014 contained plant material more frequently (92%) and at a greater percent aggregate mass than invertebrates (63%). Digestive tracts also frequently contained invertebrates (87%), but overall aggregate percent biomass (33%) was less than plant material. Overall food density was greater in the Upper Mississippi River Valley (321.6 kg/ha) than the Illinois River Valley (205.1 kg/ha). Food density at collection sites was greater than those from randomly-collected samples in 52.7% of wetlands. However, this frequency was much lower in the Upper Mississippi River (33.3%) than the Illinois River Valley (57.9%). The Upper Mississippi River appeared to be of greater foraging quality during spring than the Illinois River, perhaps contributing to lesser scaup’s lower frequency of selecting sites with greater foods than randomly available in this region. Moist-soil seeds and other plant material were important food items for lesser scaup, but overall food availability was low and likely a limiting factor of diving duck abundance.

P.3: Miscellany (Chair: Beth Ross)

P.3.1: Ross

Drivers of Mottled Duck Pairs on the Upper Texas Gulf Coast

Beth E. Ross[1]*, David Haukos[2], Patrick Walther[3]

[1] Kansas State University, Manhattan, Kansas, 66506, USA, beross@ksu.edu
[2] Kansas Cooperative Fish and Wildlife Research Unit, Manhattan, KS 66506, USA
[3] U.S. Fish and Wildlife Service, Texas Chenier Plain National Wildlife Refuge Complex, Anahuac, Texas 77514, USA

With increased variability in climate and decreased quality of coastal marsh habitat along the western coast of the Gulf of Mexico, the Mottled Duck (Anas fulvigula) on the Texas Gulf Coast has declined by an estimated 94% since 1986, with annual population growth rates as low as 0.54. While both decreases in adult survival and nest success likely account for declines in the population, it remains unknown how changes in climate directly impact population dynamics of the species. We used a Bayesian hierarchical model to simultaneously quantify the influence of changes in drought and density dependence on population density estimates of Mottled Ducks. We obtained data from aerial surveys conducted from 1985-2015 of Mottled Duck populations along the Texas Gulf Coast. Significant decreases in the abundance of Mottled Duck breeding pairs occurred in Texas from 1995 to 2000, and the population has remained at a relatively low but stable level since 2001. The strongest decreases in breeding pairs were seen in Brazoria and Big Boggy National Wildlife Refuges. Our results did not show evidence of strong density dependence, but did indicate that the average Palmer Drought Severity Index during late nesting season (May, June, and July) best predicted changes in population density in the subsequent year. Our results highlight the importance of seasonal effects on Mottled Duck population changes, and support previous research indicating large declines in population abundance along the Texas Gulf Coast.

P.3.2: Moon

A Stochastic Model to Simulate Mottled Duck Population Dynamics

Jena A. Moon[1]*, Stephen J. DeMaso[2], Michael G. Brasher[3], Warren C. Conway[4], David A. Haukos[5]

[1] U.S. Fish and Wildlife Service, Inventory and Monitoring, Winnie, Texas, 77665, USA, jena_moon@fws.gov
[2] U.S. Fish and Wildlife Service, Gulf Coast Joint Venture, Lafayette, Louisiana 70506, USA
[3] Ducks Unlimited, Inc., Gulf Coast Joint Venture, Lafayette, Louisiana 70506, USA
[4] Texas Tech University, Department of Natural Resources Management, Lubbock, Texas 79410, USA
[5] U.S. Geological Survey, Kansas State University, Manhattan, Kansas 66506, USA

A systems-based modeling approach for regional mottled duck populations can be used to elucidate the importance of individual vital rates and develop predictions regarding mottled duck persistence, while simultaneously identifying key uncertainties and priority research needs. We used STELLA 10.0.3, to construct, parameterize, and evaluate a stochastic, seasonally-explicit, annual cycle demographic model based on data currently available from the Western Gulf Coast (WGC) population of mottled ducks. Our model is based on difference equations, with stochastic variables drawn from normal distributions. We simulated mottled duck populations for 100 years and evaluated our model by comparing results with independent estimates of population parameters reported in the literature. The model simulated the flow of individual mottled ducks through the annual cycle within the WGC region (i.e., the system). The flow of individuals was driven by production and began with nest survival in season 1. The model was partitioned into 3 different seasons based on mottled duck life history: breeding/brooding (season 1: February 1 - July 15), post-breeding (season 2: July 16-October 31), and winter (season 3: November 1 - January 31). Ducklings were separated into male and female classes in season 1 at a 50:50 ratio. Mortalities were removed seasonally from each population segment (i.e., ducklings, juveniles, and adults). Because mottled ducks are non-migratory and our model was based on the entire population of WGC mottled ducks, we assumed no immigration and emigration. Following model evaluation a sensitivity analysis was conducted. The model was sensitive to variation in all breeding parameters. As presented, the model assumes constant habitat conditions across time and does not incorporate future degradation of habitats. This quantitative model can be used to clarify functional relationships among demographic rates and population growth to provide input for conservation actions and long-term management of the WGC mottled duck population.

P.3.3: Lancaster2^

Diurnal Use of Private, Public, and Incentivized Conservation Wetlands by Female Mallards in Mississippi

Joseph D. Lancaster[1]*^, J. Brian Davis[1], Richard M. Kaminski[2], Kevin D. Nelms[3]

[1] Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University, Mississippi State, MS, 39762, USA, jdl303@msstate.edu
[2] James C. Kennedy Waterfowl & Wetlands Conservation Center, Belle W. Baruch Institute of Coastal Ecology and Forest Science, Clemson University, Georgetown, SC, 29440, USA
[3] Natural Resources Conservation Service, Greenwood, MS, 38930, USA

The Mississippi Alluvial Valley (MAV) is a continentally important region for migrating and wintering waterfowl, especially mallards (*Anas platyrhynchos*). Historically, mallards exploited bottomland hardwood forests and associated emergent and riverine wetlands in the MAV. Flood abatement facilitated drainage and clearing of 7.5 M ha of hardwood bottomlands primarily for agriculture by early 20th century. Today, habitat and resources available to wintering mallards in the Yazoo Basin of the MAV generally fall within three categories 1) PROG - USDA Natural Resources Conservation Service (NRCS) programs that incentivize landowners' retirement of marginal farmland, wetland restoration, and inundation of restored wetlands and harvested croplands, 2) PRIV – private croplands and seasonal wetlands that are deliberately flooded or receive temporary or backwater flooding after rainfall, and 3) PUB – state or federal lands with wetland complexes. We have no contemporary information on how individual mallards use these classifications of habitats in the Yazoo Basin. We used very high frequency telemetry techniques to monitor use of the aforementioned categories by radio-marked female mallards in the north and south Yazoo Basin from December-March 2010-2012 and 2013-2015. Using compositional analysis, we divided proportional use of PROG and PUB by proportional use of PRIV and used natural log ratios of these as response variables in a split-plot multivariate analysis of variance to evaluate diurnal use of these lands by mallards. Specifically, we tested ($\alpha = 0.05$) influences of individual females, north or south regions, hunting or post periods, and a period by region interaction. We located 268 individual radio-marked females on 7,441 occasions, including 3,080, 1,255, and 3,106 locations on PRIV, PROG, and PUB lands, respectively. Categorical use varied among females, regions, periods, and the period by region interaction ($Ps < 0.001$). Female mallard use of PROG was 0.31-0.79 times less ($Ps \leq 0.03$) than PRIV among period by region combinations. Females used PUB 0.95 and 1.49 times more ($Ps \leq 0.002$) than PRIV during hunted periods in the north and south regions, respectively. After hunting season, mallards used PUB 0.73 times less ($P < 0.001$) than PRIV in the north region but used PUB and PRIV similarly ($P = 0.55$) in the south region. Mallards used federal lands closed to waterfowl hunting extensively during waterfowl hunting season, likely to reduce daytime hunting disturbance and mortality. Use of PRIV and PROG lands increased after waterfowl hunting season in absence of disturbance. Our results suggest that public and private lands are extensively used and provide resources that may promote survival during and after hunting seasons. Moreover, conservation programs increase resource availability by hydrological and other management otherwise unavailable without financial incentives for landowners. Future research may explore how use of public lands and conservation program easements on private lands contribute to wintering mallard survival.

P.3.4: Minor^

Avian Productivity and Community Ecology of Restored PPR Grasslands

Ashlee K. Minor[1]*^, Michael Eichholz[1]

[1] Department of Zoology, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, Illinois, 62901, USA, Ashlee.Minor@siu.edu

Grassland ecosystems of the Prairie Pothole Region (PPR) provide critical nesting habitat for many species of waterfowl and grassland birds. Historically, the PPR consisted of extensive grasslands and wetlands desirable to many avian species. However, altered disturbance regimes, habitat fragmentation, conversion to crop or grazing land, and wetland drainage, have led to the loss of vast expanses of native prairie and declines in numerous avian populations. Considerable conservation efforts have been focused on restoring vital nesting grounds of the PPR, with special attention for waterfowl species. A common restoration practice has been the establishment of low-diversity (3 – 5 species) Dense Nesting Cover (DNC) areas seeded with a mixture of introduced grasses and forbs including intermediate wheatgrass (*Thinopyrum intermedium*), tall wheatgrass (*Thinopyrum ponticum*), alfalfa (*Medicago sativa*), and sweet clovers (*Melilotus* spp.). While DNC provides secure duck nesting habitat, low-diversity seeding mixes have demonstrated vulnerability to invasion by less desirable vegetation species and often fail to meet habitat requirements of grassland nesting passerines. In attempts to develop more ecologically-sound and heterogeneous habitat, recent seeding practices have shifted towards higher-diversity plantings of 16-32 native forbs and grass species. Research indicates ducks select restored species-rich native vegetation at a level similar to DNC, but lower nesting success has been reported in some years, possibly suggesting an ecological trap via increased abundance of co-existing prey and predators. Understanding the impact of vegetation cover on grassland community dynamics and avian productivity is necessary before high-diversity seeding practices are implemented at the landscape level. The goal of this study is to understand the impacts of vegetation cover type on grassland duck and passerine productivity. Nesting density and success of ducks and passerines was monitored on 26, 20-ha experimental plots across south-eastern North Dakota and north-eastern South Dakota. Plots represented a species diversity gradient ranging from low-diversity stands of DNC to progressively more species-diverse plots (8-41 species). From May to July of 2014 and 2015, ATV chain drags and passerine rope drags were conducted at 7-day intervals to monitor density and nesting success of breeding ducks and passerines. Nests were followed until final fate (i.e. predated, abandoned, or hatched) was determined for duck species and until fledging for passerine species. 814 duck nests of 7 species and 215 passerine nests were located during 2014 to 2015. Small mammal abundance was estimated using Sherman live traps for 3 consecutive nights twice per year, during early and late nesting season. Mesopredator abundance was also monitored on 10 study plots, paired geographically, to represent extremes of the vegetation species diversity gradient using trail-camera scent stations for six weeks during June to July 2015. I present preliminary results obtained from this study. Results will provide predictions of how co-existing prey, predators, and grassland bird productivity should respond across a vegetation species diversity gradient. This information will help direct management efforts in developing restoration strategies that best facilitate avian productivity and suitable habitat heterogeneity for the interacting wildlife communities of grassland ecosystems.

P.3.5: Pokley^

Testing Competing Hypotheses for the Seasonal Variation in Nesting Success

Kalen J. Pokley[1]*^

[1] Department of Science Education, Montana State University, Bozeman, Montana, 49715, USA, kpokley@gmail.com

Populations of lesser scaup and greater scaup have been below the North American Waterfowl Management Plan goal of 6.3 million since 1984. As of 2013, scaup populations are down 12% from their long term average (1955-2013) of 4.7 million birds (Walker 2005). Nesting success has shown to be an important factor in determining population growth. If the mechanisms of nesting success can be identified wildlife managers can make the necessary changes to increase scaup nesting success and thus increase the population. Nests were located during nest searches conducted from May through July and monitored until fate was determined. Nest age, nest location, vegetation height, distance to water and depth of water were recorded at each nest. Program MARK was used to determine known fate models. The model that incorporated both nest age and the effect of nest date showed the greatest support. I found a greater influence of date on nesting daily survival rate than age during this study, although both positively influenced scaup nest daily survival rate. The positive relationship between scaup nest daily survival rate and date, provided support for the nest concealment hypothesis. This posits that increasing vegetation height and density throughout the nesting season decreases predation. Sugden and Beyersbergen (1987) found similar results that artificial nests in tall, dense nesting cover escaped predation from crows for longer than those in sparse cover. The positive effect of nest age on nest survival supports the nest heterogeneity hypothesis, i.e., that low quality nests are depredated at a higher rate than nests of higher quality. Although these results have been supported by others (Klett and Johnson 1982) it has not received unanimous support. It is possible that these results might be influenced by the lack of heterogeneity in vegetation and differences in predator community at Red Rock Lakes National Wildlife Refuge compared to other sites.

P.3.6: Martorelli^

Evaluation of Waterfowl Use and Thermal Characteristics of Alfalfa and Perennial Grasses in Eastern South Dakota

Neal Martorelli[1]*^, Joshua Stafford[2]

[1] Department of Natural Resource Management, South Dakota State University, Brookings, SD 57007, USA, neal.martorelli@sdstate.edu
[2] South Dakota Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, Department of Natural Resource Management, South Dakota State University, Brookings, SD 57007, USA

The Prairie Pothole Region provides migratory and breeding habitats for 50-80% of waterfowl in the United States. Increased agricultural production and declining Conservation Reserve Program reenrollment in the Midwest has resulted in declines in grassland habitats on private land, which supports the need for investigating and identifying effective management strategies to maximize available grassland nesting habitat on public lands. South Dakota Game Fish and Parks manages over 119,000 hectares of Game Production Areas (GPA) of primarily grassland habitat. To improve the quality and availability of grassland nesting habitat, marginal grassland and cropland cover are cleared and reseeded to perennial grass and forb mixes. Current management techniques for perennial grassland conversion use genetically modified planted row crops and herbicide treatment to remove noxious weeds and enrich the seedbed prior to reseeding. Although this technique is effective, planted row crops provide poor nesting cover. To evaluate other management techniques, we examined the use of Roundup Ready© alfalfa (*Medicao sative*) for preparing seedbeds for perennial grassland conversion. Previous research with alfalfa has indicated haying, which typically occurs during the peak nesting period, hinders nest productivity. Therefore, we investigated the influence of delaying the first cutting date (July 10) on waterfowl production by systematically nest dragging alfalfa and other typical grassland plantings. Additionally, the dynamic between vegetation structure and thermal qualities of grassland nesting habitat, which can influence nest-site selection and success are poorly understood. Thus, we assessed the vegetation structure and thermal properties of various grassland nesting cover types. We examined operative temperature at both the stand and nest level using thermal probes to identify possible patterns of nest site selection. In the first year of the study during 2015, nest densities appeared lower in Roundup Ready© alfalfa (0.24 nests/ha) than observed in other grassland types (cool-season mix = 0.38 nests/ha, warm-season mix = 0.39 nests/ha, and smooth brome (*Bromus inermis*) dominated stands = 0.30 nests/ha). Apparent nest success followed the same general trend with Roundup Ready© alfalfa appearing to lower nest success (14%) than observed in other grassland types (cool-season mix = 23%, warm-season mix = 23%, and smooth brome dominated stands = 31%). Preliminary results of temperature data revealed considerable inter-field heterogeneity. Further analyses will examine the relative influence of inter-field vegetation and temperature profiles on nest success and nest site-selection. The results of our study will provide land managers with information to maximize the quality and availability of waterfowl nesting habitat on GPAs.

P.4: Energetics (Chair: Brandt Meixell)

P.4.1: Mini^

From Equations to Reality: Building a Bioenergetic Model to Improve Waterfowl Conservation

Anne E. Mini[1]*^, Blaine Elliott[1], Dale James[2], Keith McKnight[3], Luke Naylor[4], John Tirpak[5]

[1] Lower Mississippi Valley Joint Venture, 193 Business Park Drive Suite E, Ridgeland, MS, 39157, USA, amini@abcbirds.org
[2] Ducks Unlimited, 193 Business Park Drive Suite E, Ridgeland, MS, 39157, USA
[3] Lower Mississippi Valley Joint Venture, 11942 FM 848, Tyler, TX, 75707, USA
[4] Arkansas Game and Fish Commission, 2 Natural Resources Drive, Little Rock, AR, 72205, USA
[5] U.S. Fish and Wildlife Service, Gulf Restoration Program, 700 Cajundome Boulevard, Lafayette, LA, 70506, USA

The Mississippi Alluvial Valley (MAV) is an ecologically rich wetland ecosystem, encompassing 25 million acres and wintering up to 40% of the waterfowl in the Mississippi Flyway. To support the mission of the North American Waterfowl Management Plan (NAWMP), the Lower Mississippi Valley Joint Venture uses a bioenergetic model to derive goals for waterfowl conservation. The difference between energy demand and energy supply represents state-level Duck Energy Day (DED) goals to achieve NAWMP objectives. Energy demand of the wintering waterfowl population is calculated for 110 days. Energy supply is estimated for foraging habitat on naturally flooded land and managed impoundments on private and public lands. The bioenergetic model includes acreage of each habitat and its energetic carrying capacity, while incorporating decomposition rates, disturbance, and the probability of flooding based on Monte Carlo simulation. Satellite imagery (1999-2005) and geospatial data (2010-2014) indicate that naturally flooded habitats provide 30% of energy on the landscape, managed private lands 17% and public managed lands 53%. Forested wetlands comprise a significant portion (55%) of all naturally flooded habitats. The Wetland Reserve Program (29%) and riceland agriculture (28%) provide most DEDs on private land, whereas cropland (60%) and moist-soil wetlands (36%) supply DEDs on public managed land. Current modeling estimates that 327,309,371 DEDs are available within the MAV, meaning that partners have achieved 70% of the NAWMP objective of 469,336,891 DEDs. Partners currently manage ~174,000 acres on public lands alone to provide impounded waterfowl habitat, so securing capacities to maintain these areas, as well as numerous private lands sites, is a high priority. However, all strategies to improve delivery of waterfowl conservation represent tradeoffs in acres and DEDs. With this process, the Joint Venture continues to refine its application of science to inform planning, and work through partnership to leverage planning into meaningful conservation for waterfowl.

P.4.2: Garrick, M.^

Dynamics of Nutrient Reserves and Digestive Tract of Female Northern Pintails Wintering Along the Texas Coast

Matthew J. Garrick[1]*^, Nathaniel R. Huck[1], Bart M. Ballard[1], Kevin J. Kraai[2]

[1] Caesar Kleberg Wildlife Research Institute, Texas A&M University–Kingsville, Kingsville, TX, 78363, USA, mjgarrick@gmail.com
[2] Texas Parks and Wildlife Department, Canyon, TX, 79015, USA

Unlike other dabbling ducks in North America, abundance of the northern pintail (Anas acuta) has remained below long-term average population levels and well below population objectives established by the North American Waterfowl Management Plan. A large proportion of pintails in the Central flyway winter along the Texas Coast where changes in land use over the last few decades have greatly changed the capacity of the region to support wintering pintail populations. Our objectives are to investigate several aspects of nutrition and energetics of pintails during winter. We collected pintails along the Texas coast from mid-October to mid-March during 2012-15. We estimated molt intensity using a grab sampling technique from 9 major plumage regions composed of 29 feather tracts. Specimens were plucked and necropsied to determine digestive-organ and muscle mass dynamics. Following necropsies, we dried carcasses and ground them into a fine powder to estimate fat content with ether extraction, and estimate protein content by ashing in a muffle furnace. Preliminary analysis on about 40% of our sample suggests that female pintails maintain protein reserves and catabolize 25% ($P < 0.001$) of their somatic fat reserves across winter. Digestive track mass declined by 18% ($P < 0.001$), primarily as a result of atrophy of the gizzard. Further analyses on molt intensity, blood metabolites, and the remainder of our sample will help reveal patterns in nutrient reserves of female pintails across winter.

P.4.3: McClain

Using Plasma-lipid Metabolites to Predict Lipid Reserve Dynamics in Free-living Lesser Scaup

Douglas R. McClain[1]*, Heath M. Hagy[1], Joshua M. Osborn[1], Aaron P. Yetter[1], Chris Hine[1], Michelle Horath[1], Jamison C. England[2], Jeffrey Levengood[2]

[1] F.C. Bellrose Waterfowl Research Center, Prairie Research Institute, University of Illinois at Urbana-Champaign, Havana, IL, 62644, USA, drmcclai@illinois.edu
[2] Illinois Natural History Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, Champaign, IL, 61820, USA

The “Spring Condition Hypothesis” suggests that midcontinent foraging habitat has declined in quality, negatively impacting survival, reproductive success, and ultimately population size of migratory birds. Extended declines in species like lesser scaup (*Aythya affinis*) have been attributed to low lipid reserves during spring migration due, in part, to poor habitat quality. Current methods relating habitat quality to bird physiology may be influenced by habitat used in previous regions and highly variable among individuals. Recently, researchers noted a relationship between plasma-lipid metabolite changes, notably triglycerides (TRIG) and β-hydroxybutyrate (BoHB), and body mass of small-bodied wild birds. Using similar methods, metabolites explained daily mass changes in free-living lesser scaup at Pool 19 of the Mississippi River. To validate spatial and temporal robustness of this model, we constructed a similar index to detect whether lesser scaup accumulate or catabolize lipid reserves in the Illinois River Valley. During February–April 2015, we captured and banded lesser scaup (n = 130) at the Emiquon Preserve and Chautauqua National Wildlife Refuge near Havana, Illinois. We extracted approximately 1 mL of blood from brachial veins and measured mass of captured and recaptured birds. We regressed plasma-lipid metabolites, TRIG and BoHB, on daily changes in body mass. We excluded birds caught repeatedly (n = ≥4) as well as birds with palpable corn in their crop. Triglyceride and β-hydroxybutyrate explained variation in daily mass change (R2 = 0.23, F = 3.13, P < .005). Change in body mass ranged from -72 to +149 g, and 30% of 130 recaptured lesser scaup experienced body mass gains. Triglycerides were positively correlated (P = 0.009) and β-hydroxybutyrate negatively correlated (P = 0.028) with daily mass changes. Our results provide support for triglycerides and β-hydroxybutyrate as predictors for daily changes in lipid reserves and may aid in assessing the quality of migration habitat for waterfowl.

P.4.4: Open

P.4.5: Fino^

The Energetic Value of Mid-Atlantic Forested Wetlands to Wintering American Black Ducks

Samantha Fino[1]*^, Christopher K. Williams[1], Mark Livolsi[1], Kevin M. Ringelman[1], John M. Coluccy[2], Patrick K. Devers[3], Paul M. Castelli[4]

[1] Department of Entomology and Wildlife Ecology, University of Delaware, Newark, DE, 19716, USA, srfino@mix.wvu.edu
[2] Ducks Unlimited, Great Lakes/Atlantic Regional Office, 1220 Eisenhower Place, Ann Arbor, MI 48108, USA
[3] Black Duck Joint Venture, Laurel, MD, 20708, USA
[4] Edwin B. Forsythe National Wildlife Refuge, Galloway, NJ, 08205, USA

Wintering populations of American black ducks (*Anas rubripes*) have declined throughout their range since the 1950s. Currently, habitat conservation for wintering black ducks is based largely on bioenergetics models of carrying capacity, and managers seek to provide sufficient energy in the form of preferred food items. The importance of saltmarsh habitats to wintering black ducks along the Atlantic Coast is well documented, but, recent evidence also suggests that forested wetlands are important wintering habitats for black ducks, yet their foraging value and energetic potential is unknown. Quantifying the energetic value of forested wetlands is important for estimating black duck carrying capacity. We collected 46 soil core samples taken from forested wetlands on Prime Hook National Wildlife Refuge in Milton, DE in 2014 to estimate food biomass and quantify the energetic capacity of forested wetlands in the Mid-Atlantic region. The energetic value per hectare is 16.064 ± 4.93 kg. In considering forested wetland habitats that are potentially available to coastal black ducks, we estimated that forested wetlands within a 24.1 km distance from the coast provide between 31,181,117 – 54,098,939 duck use days. Forested wetlands may be an important foraging resource for wintering black ducks, and the estimates provided here will help to refine bioenergetic models for black ducks in the Atlantic Flyway.

P.4.6: Henson

Does Hunting Alter Waterfowl Body Condition and Stress Physiology?

Jerad R. Henson[1]*, Christopher Sims[2], Stephan Schoech[1]

[1] Department of Biological Sciences, University of Memphis, Memphis, TN 38152, USA, Jrhenson@memphis.edu
[2] Department of Mathematical and Natural Science, The University of Arkansas Monticello, Monticello, AR 71656, USA

Waterfowl face a multitude of stressors while in the Mississippi Alluvial Valley (MAV). These stressors include energetic demands associated with life history stage, weather, habitat availability, and waterfowl hunting seasons. Many studies have examined the effects of hunting on waterfowl, but very few have focused on how hunting affects the stress physiology of waterfowl. Any stressful stimulus will elicit a physiologic stress response and activate the sympatho-adrenal system. This culminates with the release of epinephrine and corticosterone (CORT). These hormones aid in survival and recovery over the short-term but if CORT is elevated over a long period it can lead to decrements in health. Importantly, maintenance of body condition through winter and spring is well-known to affect reproduction. The aim of this ongoing study is to determine how hunting pressure and duration of hunting pressure alter body condition and stress physiology of mallards (*Anas platyrhynchos*) while in the MAV. Mallards were collected before, during, and after the waterfowl hunting season in eastern Arkansas via hunting methods. Only clean, one-shot killed birds were sampled. A blood sample was taken immediately, and then morphometrics and a breast fat score were recorded for each bird. Blood samples were then analyzed for plasma triglycerides and baseline CORT. Morphometrics were used to create a body condition index. We hypothesized that baseline CORT and body condition would change as the season progressed. Thus far, our data does not support our hypothesis and indicates that hunting and hunting duration do not alter baseline CORT or body condition.