# Poster Session I

## WEDNESDAY, 3 FEBRUARY 2016

**19:00 - 22:00** *Annapolis Ballroom*

### Q.1 Breeding Ecology

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| **Q.1.1: Bidwell** | **Species Diversity of Boreal Waterbirds is Related to Wetland Area, not Habitat Heterogeneity** (Mark T. Bidwell*, Glenn G. Mack, Robert G. Clark) |
| **Q.1.2: Cosgrove** | **Effects of Landscape-Scale Habitat Features on Mallard Nest Survival in New Zealand** (Jillian M. Cosgrove*, Courtney L. Amundson, Jennifer L. Sheppard, David Klee) |
| **Q.1.3: Davis** | **Evidence for Optimal Brood Size in Box-nesting Wood Ducks** (J. Brian Davis*, Todd W. Arnold, Richard M. Kaminski, Robert R. Cox, Jr., Joseph D. Lancaster, Bruce D. Leopold) |
| **Q.1.4: Docken** | **Artificial Nest Island Program for Dusky Canada Geese on the Copper River Delta, Alaska** (Nicholas R. Docken*, Melissa L Gabrielson) |
| **Q.1.5: Dyson^** | **Changes in Predator Communities and Waterfowl Nest Predation Rates in Response to Landscape Development in the Western Boreal Forest** (Matthew E. Dyson, Stuart M. Slattery, James H. Devries, Bradley C. Fedy) |
| **Q.1.6: Fuller** | **Status of Breeding Black Ducks in North Carolina** (Joseph C. Fuller, Douglas L. Howell) |
| **Q.1.7: Johns** | **Linking Reproductive Trade-offs to Habitat Management Actions: Winter Wheat and Survival of Northern Pintail Ducklings**(David W. Johns*, Robert G. Clark, James H. Devries) |
| **Q.1.8: Johnson^** | **Preliminary Assessment of Predator Reduction on Nesting Success in Over-water Nesting Ducks** (Michael K. Johnson*, Todd W. Arnold, Frank Rohwer) |
| **Q.1.9: Kneece^** | **Nesting Ecology of Mottled Ducks in Coastal South Carolina** (Molly R. Kneece*, J. Clay Shipes, J. Brian Davis, Ernie P. Wiggers, Richard M. Kaminski, Michael E. Colvin) |
| **Q.1.10: Kohl** | **To Catch A Predator**(Jeffrey D. Kohl*, Desmond Mackel, Cory T. Overton, Joseph P. Fleskes, Joshua T. Ackerman, Mark P. Herzog, Alex C. Hartman, Elliott Matchett, Caroline M. Brady, Cliff Feldheim, and Michael L. Casazza) |
| **Q.1.12: Moore** | **Assessing Breeding-Site Fidelity of Spectacled Eiders on Kigigak Island, YDNWR, Alaska** (Callie B. Moore, Kyle Spragens, Brian McCaffrey) |
| **Q.1.13: Nicolai, G.^** | **Wood Duck Offspring are Not the Same Size as their Mothers but Those Offspring Which Breed are Large** (Grace V. Nicolai*,Chris A. Nicolai) |

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| **Q.1.14:** | **Skaggs^** | **Effects of Energy Development on Waterfowl Nesting Ecology in the Bakken Formation of North Dakota** (Cassandra G. Skags*, Tait Ronningen, Kevin M. Ringelman, Kaylan Carrlson, Tanner Gue, Chuck Loesch, Frank Rohwer, Michael L. Szymanski) |
| **Q.1.15:** | **Skalos** | **Diurnal Habitat Use and Molt Location of Hen Mallards in Sacramento Valley, California** (Daniel A. Skalos*, Melanie Weaver, John M. Eadie, Robert Blenk, Brian R. Olson) |
| **Q.1.16:** | **Stetter** | **Duckling Survival at the Edge of Scaup Range in Montana** (Andrew P. Stetter*, Jeffrey M. Warren, David A. Hauko) |
| **Q.1.17:** | **Terry^** | **Variation in Egg Coloration in Wood Ducks** (Catrina Terry, John M. Eadie) |
| **Q.1.18:** | **Towery^** | **A Methodology to Predict Canada Goose Breeding Pair Densities** (Brenna N. Towery*, Robert W. Klaver, Guy G. Zenner) |
| **Q.1.19:** | **Warren** | **Previous Success and Current Body Condition Determine Breeding Propensity in Lesser Scaup: Evidence for the Individual Heterogeneity Hypothesis** (Jeffrey M. Warren*, Kyle A. Cutting, John Y. Takekawa, Susan E. De La Cruz, Tony D. Williams, David N. Koons) |
| **Q.2** | **Climate Change** | |
| **Q.2.1:** | **Ballard, B.** | **Predicting Sea-level Rise and its Effects on Wintering Redheads** (Corey J. Lange, Bart M. Ballard*, Kris L. Metzger, Daniel P. Collins) |
| **Q.2.2:** | **Schummer** | **Use of Remote Cameras to Index Atlantic Population Canada Goose Migration** (Jeffrey Benjamin, Michael L. Schummer*, Tyler Pelle James Eckler) |
| **Q.2.3:** | **Matchett** | **Scenario Impacts Modeling Of Waterfowl Habitat In California's Central Valley** (Elliott L. Matchett*, Joseph P. Fleskes, David R. Purkey, Charles A. Young) |
| **Q.2.4:** | **Moon** | **Integrating Sea-Level Rise and Anthropogenic Change into Mottled Duck Conservation** (Jena A. Moon*, Sarah Lehnen, Kris Metzger, Stephen Sesnie, David A. Haukos, Warren C. Conway) |
| **Q.2.5:** | **Osborne** | **Co-occurrence of Shifting Winter Distributions of Midcontinent White-Fronted Geese and Rice Acreage** (Douglas C. Osborne*, Ryan J. Askren, Chris Watt) |
| **Q.3** | **Habitat** | |
| **Q.3.1:** | **Blake-Bradshaw** | **Wetland Quantity and Quality for Waterbirds in Illinois** (Abigail G. Blake-Bradshaw*, Heath M. Hagy, Jeffrey Matthews) |
| **Q.3.2:** | **Bloom** | **Monitoring a Bird Response To Restoration Efforts at Delta Marsh** (Pauline M. Bloom*) |
| **Q.3.3:** | **Clark^** | **Waterfowl and Stock Pond Forage Resource Relationships in West Texas** (Lisa A. Clark*, Samantha S. Kahl, Blake A. Grisham, Dan Collins) |

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| **Q.3.4:** | **Gabor** | **Environmental Impacts of Wetland Loss in a Prairie Watershed: Implications for Waterfow**l (Pascal H. Badiou*, Bryan Page, Lyle Boychuk, Shane Gabor, Wanhong Yang) |
| **Q.3.5:** | **Hidden^** | **Modeling Inundation of Missouri's National Wetland Inventory Wetlands in Autumn** (Brian S. Hidden*, Elisabeth B. Webb, Andy H. Raedeke) |
| **Q.3.6:** | **VonBank^** | **Energetic Carrying Capacity in the Upper Illinois River for Waterfowl** (Jay A. VonBank*, Heath M. Hagy, Andrew F. Casper, Aaron P. Yetter) |
| **Q.3.7:** | **Vrtiska1** | **Balancing Social and Ecological Objectives in the Platte River Watershed** (Jonas Davis, Kaylan Carrlson, Brice Krohn, Matt Reddy, Kirk Schroeder, Greg Stoebner, Bill Taddicken, Mark P. Vrtiska*, Patrick K. Devers) |
| **Q.3.8:** | **Schepker** | **Spring Food Resource Availability In Public, Cropped, and Wetlands Reserve Program Playas** (Travis J. Schepker*, Elisabeth Webb, Ted LaGrange) |
| **Q.3.9:** | **Cofield^ & Clements^** | **Aquatic Invertebrate Biomass and Composition in Managed South Carolina Coastal Wetlands** (Nicholas Masto, Carley Cofield*^, Stephen Clements*^, Chase Cross, Jacob Lazarus, Matthew Marbert, Aurthur Amick, Adam Brown, Ford Courtney, Charles Gallman, Sylvan Jennings, Madeline Thatcher, Joel Turner, Mary Wilkinson, Taylor Byars, Christopher Dukes, Aaron Dunn, Jacob Smith, Jeremy Pike, Greg Yarro, Rick Kaminski) |
| **Q.3.11:** | **Hobson^ & Drummond^** | **Monitoring the Effects of Hurricane Sandy Salt Marsh Restoration on Prime Hook National Wildlife Refuge for American Black Duck Carrying Capacity** (Sara Hobson^*, Elisabeth Drummond^*, Christopher Williams) |
| **Q.4** | **Management** | |
| **Q.4.1:** | **de Sobrino** | **Distribution and Derivation of California Dabbling Duck Harvests** (Cristina de Sobrino*, Todd W. Arnold, Cliff Feldheim) |
| **Q.4.2:** | **Feaga** | **Waterbird Use of Catfish Ponds and Migratory Bird Habitat Initiative Wetlands in Mississippi** (James S. Feagai*, Francisco J. Vilella, Richard M. Kaminski, J. Brian Davis) |
| **Q.4.3:** | **Gue** | **Effects of Oil and Gas Development on Duck Production in the Prairie Pothole Region of North Dakota and Montana** (C. Tanner Gue*, Kaylan M. Carrlson, Johann Walker, Charles R. Loesch, Michael L. Szymanski) |
| **Q.4.4:** | **Krainyk^** | **Validation and Refinement of a Decision Support Tool for Mottled Duck Habitat Conservation in the Western Gulf Coast** (Anastasia Krainyk*, Bart M. Ballard, Michael G. Brasher, Barry C. Wilson, Jena A. Moon) |
| **Q.4.5:** | **Malanchuk^** | **Characteristics of Box and Natural Cavities for Nesting Waterfowl in Northern Vermont** (Boomer L. Malanchuk, Jacob N. Straub) |

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| **Q.4.6** | **McCarty** | **Turning Disaster into Relief for the Greatest Habitat Crisis on the Continent** (Alonda L. McCarty*, Michael R. Carloss) |
| **Q.4.7:** | **Morissette1** | **Are Boreal Waterfowl Resilient to Disturbance by Forestry and Agriculture?** (Julienne L. Morissette*, Glenn G. Mack, Stuart M. Slattery) |
| **Q.4.8:** | **Morissette2** | **Reducing Risk of Incidental Take in Canada's Boreal Forest** (Kylie McLeod, Julienne Morissette*, Bev Gingras, Chris Smith) |
| **Q.4.9:** | **Smith** | **The Effect of Delayed Drawdown on Moist-Soil Seed Production** (Daniel J. Smith, Brian W. Olson, John M. Eadie) |
| **Q.4.10:** | **Whitson1^** | **Waterfowl Identification Skills By Duck Hunters On The Upper Texas Coast** (Michael D. Whitson*, Thomas V. Riecke, Warren C. Conway, David A. Haukos, Jena A. Moon, Patrick Walther) |
| **Q.4.11:** | **Whitson2^** | **Seed Bank Potential of Moist-soil Managed Fallow Rice Fields on the Upper Texas Coast** (Michael D. Whitson*, Warren C. Conway, David A. Haukos, Daniel P. Collins) |
| **Q.5** | **Techniques** | |
| **Q.5.1:** | **Fowler^** | **Using Isotopic Signatures of Arctic and Sub-arctic Nesting Colonies to Determine Breeding Origin of Harvested Lesser Snow Geese** (Drew N. Fowler*, Elisabeth B. Webb, Keith A. Hobson, Mark P. Vrtiska) |
| **Q.5.2:** | **Gilbert^** | **Detection Probability and Disturbance of Waterfowl During Aerial Surveys** (Andrew D. Gilbert*, Heath M. Hagy, Christopher N. Jacques, Aaron P. Yetter) |
| **Q.5.3:** | **Hill** | **Enhancing Prey Availability Damaged by Oil Spill for Migratory Waterfowl in San Francisco Bay** (Mason Hill, Kyle A Spragens, John Y. Takekawa, Susan E.W. De La Cruz) |
| **Q.5.4:** | **Kilchenstein** | **An Improved Technique for Attaching Backpack Transmitters on Diving Duck** (Charlotte B. L. Kilchenstein*, Kevin M. McBride, Alicia M. Wells-Berlin, Jonathan L. Fiely) |
| **Q.5.5:** | **Lutmerding** | **Bird Banding Laboratory Information and Bandit Data Entry Assistance** (Jo Anna Lutmerding*) |
| **Q.5.6:** | **Malachowski^** | **Extrusion of Coelomically Implanted Radio Transmitters from Hawaiian Ducks** (Christopher P. Malachowski*, Bruce D. Dugger, Darryl J. Heard) |
| **Q.5.7:** | **Richmond** | **Refining a Monitoring Design for the San Francisco Estuary Midwinter Waterfowl Survey: Challenges and Opportunities** (Orien M. W. Richmond*, Guthrie S. Zimmerman, Cheryl M. Strong) |
| **Q.5.8:** | **Savoy** | **Successful Breeding and Egg Formation of Satellite Marked Common Eiders** (Lucas Savoy*, Chris Dwyer, Glenn H. Olsen, Samantha E.J. Gibbs, Randall M. Mickley) |

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| **Q.5.9: Schummer** | **Using Go-Pro Video Cameras to Estimate Differential Susceptibility Among Species-Sex Cohorts of Ducks to Capture in Montezuma Confusion Traps** (Michael L. Schummer*, Alison Bickert, Brianna Robinson, Zoe Schapira, Michael Valentino, Jonathan Cohen, Frank Morlock, James Eckler) |
| **Q.5.10: Sedinger, B.^** | **Scaling Nevada's Historical BPOP Data to Adjust for Changes in Survey Design** (Benjamin S. Sedinger*, Christopher A. Nicolai, Russell Woolstenhulme) |
| **Q.5.11: Sheppard^** | **Effects of Handling, Holding, and Surgical Times on Survival and Reproductive Performance of Female Mallards** (Jennifer L. Sheppard*, Todd Arnold, Courtney L. Amundson, Todd Dennis, David Klee) |
| **Q.5.12: Thimot^** | **Potential Effects of Subcutaneous Transmitters on a Pursuit-diving Duck** (Natalie J.Thimot*, Shawn R. Craik, Rodger D. Titman) |

## Q.1: Breeding Ecology

Q.1.1: Bidwell

### Species Diversity of Boreal Waterbirds is Related to Wetland Area, not Habitat Heterogeneity

Mark T. Bidwell[1]*, Glenn G. Mack[2,3], Robert G. Clark[1,4]

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[4] Science and Technology Branch, Environment Canada, Saskatoon, SK, S7N 0X4, Canada

Variation in local diversity of waterbirds, including ducks and geese, that breed in North America's boreal forest could be related to wetland size, wetland heterogeneity, or both. We tested the area per se and habitat heterogeneity hypotheses for waterbird diversity using datasets from three widely separated regions encompassing ~15 million hectares in the boreal and taiga plains ecozones of Canada's western boreal forest. Our sampling regime encompassed 1,517 wetlands and resulted in 29,652 detections of waterbirds (>80% anatids) in 29 species. Waterbird species richness (i.e., number of species) and wetland habitat richness (i.e., number of habitat types) were strongly positively correlated with wetland area, while species and habitat evenness (i.e., the equitability of the proportional abundances of species or habitats) were negatively correlated with area. Species richness and evenness were positively correlated with wetland richness and evenness, respectively, but these relationships were weak or not supported after accounting for correlations between wetland area and wetland diversity. Moreover, there was little support for the area-heterogeneity tradeoff hypothesis, which predicts a unimodel relationship between wetland heterogeneity and species richness (i.e., with diversity declining at high levels of heterogeneity, due to a reduction in effective area) suggesting that wetland size plays a much greater role than heterogeneity in regulating waterbird diversity in boreal wetland ecosystems. We conclude that patterns of waterbird diversity may be better predicted by wetland productivity, as reflected by the occurrence or amount of a relatively small number of food-rich habitat types, rather than by heterogeneity per se. Thus, to promote conservation of the natural range of variation in waterbird species richness and evenness, ecosystem managers should conserve wetlands from across the full range of variation in wetland size, and especially those containing the most important habitats, such aquatic bed, emergent and meadow marsh.

Q.1.2: Cosgrove

## Effects of Landscape-Scale Habitat Features on Mallard Nest Survival in New Zealand

Jillian M. Cosgrove[1]*, Courtney L. Amundson[2], Jennifer L. Sheppard[3], David Klee[1]

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Mallard population management in New Zealand suffers from incomplete understanding of how habitat composition across the landscape influences the life history events that drive population dynamics. North American studies have found that habitat composition around nests significantly impacts nest survival, though the degree of impact varies based on species, the local predator community, and the spatial scale at which habitat composition is measured. Thus, the habitat features important to New Zealand mallards in a highly fragmented dairy-farming landscape are likely to be unique with local management importance. In this study, we digitized 13 habitat variables around 70 mallard nests in the Auckland/Waikato Fish and Game Region and extracted habitat data within 4 nested buffers at 200, 400, 800, and 1600 m radii from the nest. We estimated daily survival rates of nests using the nest survival module in Program MARK and ranked models using Akaike's Information Criterion adjusted for small sample size. Model-averaged daily nest survival was 0.9841 (unconditional SE = 0.0069; 85% CI: 0.9732 - 0.9928) resulting in mean cumulative nest survival of 0.5611 (85% CI: 0.3757 - 0.7712). The most supported model showed that the proportion of effluent ponds and the total length of main roads within the 400 m buffer were positively correlated with daily nest survival ($\beta = 0.62$, SE= 0.41; $\beta = 0.43$, SE= 0.22, respectively), while nest age was negatively correlated ($\beta = -0.04$, SE= 0.02). Though preliminary nest survival estimates are much higher for New Zealand mallards than North American mallards, future research should examine spatio-temporal variation in nest success across New Zealand and how habitats associated with high nest survival are spatially connected to those associated with high brood survival to better understand how habitat composition influences mallard population recruitment in the New Zealand dairy farming landscape.

Q.1.3: Davis

## Evidence for Optimal Brood Size in Box-nesting Wood Ducks

J. Brian Davis[1]*, Todd W. Arnold[2], Richard M. Kaminski[3], Robert R. Cox, Jr.[4], Joseph D. Lancaster[1], Bruce D. Leopold[1]

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[3] James C. Kennedy Waterfowl & Wetlands Conservation Center, Belle W. Baruch Institute of Coastal Ecology and Forest Science, Clemson University, Georgetown, SC 29440, USA
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Nutrient investment in egg formation is widely believed to limit reproductive rates in waterfowl, but other factors could also be important. North American wood ducks (*Aix sponsa*) and other cavity nesting ducks engage in parasitic egg-laying, which can result in supernormal clutches and broods. We monitored 429 radio-marked ducklings from 129 broods in Mississippi (1996-1999) and Alabama (1998-1999) to measure duckling survival to 30 days of age in relation to brood size at nest exodus (range: 3-21 ducklings per brood) to explore reproductive rates in wood ducks relative to initial variation in brood size. On both study areas, per capita duckling survival declined with increasing brood size, but rate of decline was insufficient to overcome a benefit of enlarged broods, such that largest broods fledged most ducklings. However, after we accounted for several additional costs of larger clutches, including longer egg laying and incubation periods and reduced hatching of eggs, we found the optimal brood size for wood ducks on our study areas was a nest with 12 exiting ducklings, with little variation in reproductive value for broods of 10-13. We conclude that clutch size in wood ducks may be limited by incubation and brood-rearing costs, but nest and brood parasitism may have subtle costs to host females, given lower duckling survival among large broods (n >13 ducklings).

Q.1.4: Docken

## Artificial Nest Island Program for Dusky Canada Geese on the Copper River Delta, Alaska

Nicholas R. Docken[1]*, Melissa L Gabrielson[1]

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The dusky Canada goose population breeds primarily on the Copper River Delta in south central Alaska. Habitat changes created by uplift from the 1964 earthquake have caused drastic population declines. Since 1984, artificial nest islands have been installed on the Copper River Delta (hereafter CRD), Alaska to enhance nest success of dusky Canada geese (*Branta canadensis occidentalis*). The average nest success of artificial islands installed on the CRD is approximately 65% (1984-2011), which is nearly double that found on natural sites. A total of 386 artificial nest islands are currently listed in the artificial nest island program. All of which were monitored in 2015. Of the 386 nest islands monitored, 372 were found to be available (96%) for use by dusky Canada geese. In 2015, a total of 123 dusky Canada goose nests were found. Of the 123 nests found, 102 (Apparent nest success = 83%) were successful. Average clutch size was 3.3 (min =1, max =6) and yielded approximately 338 goslings. Nest islands were used for both nesting (33%) and roosting (49%), by dusky Canada geese. A total of 187 (50%) nest islands required maintenance (i.e. landscaping, anchoring, or both) in 2015.

Q.1.5: Dyson^

**Changes in Predator Communities and Waterfowl Nest Predation Rates in Response to Landscape Development in the Western Boreal Forest**

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Canada's Western Boreal Forest (WBF) supports 12-15 million breeding waterfowl annually and is considered the second most important breeding area in North America. Changes in habitat in the WBF caused by timber harvesting, oil and gas exploration and extraction, mining, hydroelectric development, and recreation threaten waterfowl carrying capacity. Consequently, quantifying the effect of landscape change on waterfowl population vital rates is essential to advance conservation planning. Vital rates of waterfowl populations are strongly influenced by predation. The goal of our research is to test a top-down hypothesis that landscape change in the WBF increases predation rates, because of range expansion of new predator species, increased success rates of native predators, or predator population increases in response to increased alternative prey. Demographic implications of increased predation rates are reduced hen, nest, and duckling survival. We intend to quantify predator communities and estimate nest predation rates in relation to different levels of development in the WBF. Based on our results, we can then model predation rates at a landscape scale to help identify potential ecological sinks and better inform future conservation efforts in the WBF.

Q.1.6: Fuller

**Status of Breeding Black Ducks in North Carolina**

Joseph C. Fuller[1]*, Douglas L. Howell[1]

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North Carolina represents the southern extent of the breeding range of the black duck (*Anas rubripes*). Although breeding black ducks in North Carolina are well documented, their long-term population trend is unknown. We suspect that breeding populations have declined over time, similar to breeding populations further north in Virginia and Maryland, but there is no empirical data to support this. While there have been several past attempts to monitor the status of breeding black ducks in North Carolina; prior this endeavor, these efforts were either spatially limited and/or lacked a statistical sampling design. Our objective was to develop a survey that would serve as an index to the breeding population size of black ducks in coastal North Carolina. Our survey was modeled after the Atlantic Flyway's Breeding Waterfowl Plot Survey where we determined indicated pairs (IP's) and total indicated birds (TIB's) in 1-km2 plots. We surveyed, by helicopter, plots containing some amount of marsh within the core area of previously described coastal black duck breeding range in North Carolina. From 2013-2015, we surveyed between 90 and 130 plots and with a goal of improving precision estimates, we have employed several versions of a stratified sampling design. In 2013, we estimated 453 IP's and 906 TIB's. In 2014 and 2015, after we expanded our sampling frame, extrapolated estimates ranged from 806 to 1,446 IP's and 2,001 to 3,159 TIB's. Although there have been no previous empirical estimates of the size of the breeding black duck population in North Carolina, the results of 3 years of pilot surveys have indicated a much larger population than we anticipated. Although not directly comparable to plot survey results in other Atlantic Flyway states, IP's of black ducks in North Carolina may be similar or greater than those estimated further north in Virginia and Maryland.

Q.1.7: Johns

## Linking Reproductive Trade-offs to Habitat Management Actions: Winter Wheat and Survival of Northern Pintail Ducklings

David W. Johns[1]*, Robert G. Clark[1,2], and James H. Devries[3]

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Fall-seeded crops like winter wheat have been promoted to enhance northern pintail (*Anas acuta*) productivity through increases in early nest survival compared to spring-seeded crops. However, if brood survival rates are reduced in cropland landscapes then potential benefits of higher nest survival in fall-seeded crops may not be fully realized. Winter wheat may also enhance duckling survival during initial brood movements when ducklings are particularly prone to mortality, by providing concealing vegetation. Thus, we compared pintail brood survival rates in grassland landscapes to those in cropland landscapes containing winter wheat. During 2011 and 2012, 92 radio-marked female pintails were monitored during brood rearing in southern Saskatchewan. We compared a priori models incorporating known effects of brood age, site, year, hatch date and weather on duckling survival rates (hatch: ≤ 3 days, fledge: ≤ 30 days) post-hatch. We then incorporated effects of landscape type, habitat composition and a habitat by hatch date interaction into models to determine if additional variation was explained. Overall duckling survival increased with duckling age and favorable weather during the early post-hatch period but only declined with hatch date in 2012. Pintail survival to fledging was landscape-dependent, with duckling raised in cropland-dominated environments having lower survival rates compared to ducklings in grassland-dominated environments. Survival immediately following hatch was habitat dependent, ducklings traveling through winter wheat had higher initial survival rates compared to other cropland types. Overall we found evidence that duckling survival is reduced in cropland-dominated landscapes and fall-seeded crops like winter wheat may assist in the survival of pintail broods during critical early-life periods.

Q.1.8: Johnson^

## Preliminary Assessment of Predator Reduction on Nesting Success in Over-water Nesting Ducks

Michael K. Johnson[1]*^, Todd W. Arnold[1], Frank Rohwer[2]

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Although numerous studies have demonstrated that lethal predator management improves nesting success of upland nesting waterfowl, less is known about its potential effect on over-water nesting species. During 2015, we assessed nesting success of over-water nesting waterfowl in the prairie parkland region of southwestern Manitoba. Professional trappers removed 107 raccoon (*Procyon lotor*), 290 striped skunk (Mephitis mephitis), 109 corvids (*Corvus corax, Corvus brachyrhynchos, Pica hudsonia*), and 41 other mammalian predators (*Neovison vison, Vulpes fulva, Spermophilus franklinii, Taxidea taxus*) from three 65-km2 study sites, while three similar-sized but untrapped sites served as controls. We located and monitored 132 Canvasback (*Aythya valiseneria*) and 150 Redhead (*Aythya americana*) nests, plus 239 additional overwater nests from a variety of other species including Lesser Scaup (*Aythya affinnis*), Ring-necked Duck (*Aythya collaris*), Ruddy Duck (*Oxyura jamaicensis*), and Mallard (*Anas platyrhynchos*). We used Shaffer's logistic exposure method, as implemented in SAS GENMOD, to estimate Mayfield nest success. Average nest success across all three trapped blocks was 36.4%, versus 38.9% success on the three control blocks. Pair counts and brood surveys were conducted on one randomly selected quarter-section within each square mile of the study block (i.e., 25 ¼-sections per block). One round of pair counts was conducted during 8-15 May and two rounds of brood surveys were conducted between 6-10 July and 30 July- 4 August to investigate sightability-adjusted brood-pair ratios, and results from these analyses will also be presented. Failure to document a treatment effect on nest survival was unexpected, but may indicate that raccoons were not the dominant predator of overwater nesting ducks in Manitoba. Plans for a second field season include improved documentation of predator identities using trail cameras, which may lead to more focused trapping of mink and corvids.

Q.1.9: Kneece^

## Nesting Ecology of Mottled Ducks in Coastal South Carolina

Molly R. Kneece[1]*^, J. Clay Shipes[2], J. Brian Davis[1], Ernie P. Wiggers[3], Richard M. Kaminski[4], Michael E. Colvin[1]

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Mottled ducks (*Anas fulvigula*) are endemic to Gulf Coastal United States and Mexico, with a separate, genetically distinct subspecies (*A. fulvigula fulvigula*) occurring in peninsular Florida. Birds from Texas, Louisiana, and Florida were released in coastal South Carolina from 1975-1983, and banding data suggest an expanding population in that state. Because autecology of mottled ducks is little known in South Carolina, we initiated studies of mottled ducks by capturing and radio-marking 189 females during remige molt in the Ashepoo, Combahee, and Edisto (ACE) Rivers Basin in August 2010-2012. Our objective was to study nesting ecology using radio-marked females, but transmitter failures in 2010 and low nesting propensity by radio-marked females caused us to locate nests of unmarked females. We searched for nests on foot or via airboat in wetlands and uplands in spring 2011-2014. We monitored nests weekly until ≥1 egg hatched or the clutch was depredated or abandoned. We found 72 active nests, all in managed tidal impoundments. We used a logistic exposure model to determine daily nest survival and evaluate influences of vegetation height, nest site (islets or levees), percent cover, wetland salinity, and year on survival. The most informative model indicated daily nest survival varied by year (range: 0.8768 ± 0.03 [SE] - 0.9596 ± 0.01) and was inversely related to vegetation height at nests. Interval nest success among years was 0.119 (DSR = 0.9409 ± 0.01) and representative of nest success estimates for the species elsewhere in its range. Most nest failures were typified by intact nests void of eggs or shell fragments, suggesting avian or snake depredation. Our mottled duck nest success estimate was <15%, which was reported necessary to maintain midcontinent mallard populations. Until breeding season survival of females and duckling and brood survival are estimated, population status of mottled ducks in South Carolina remains unclear. Because our results indicate that managed tidal impoundments were greatly used by nesting mottled ducks and throughout their annual cycle, we advocate continued management and conservation of these habitats for mottled ducks and other waterbirds in coastal South Carolina.

Q.1.10: Kohl

## To Catch a Predator

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Nest success is important to local waterfowl production and can be greatly impacted by predation. Suisun Marsh in the San Francisco Bay Delta is the single largest estuarine marsh on the west coast and is a well-known waterfowl nesting area. We used videography to identify predators and determine the fate of mallards (*Anas platyrhynchos*) and gadwall (*Anas strepera*) nests throughout the nesting season in upland fields at Grizzly Island State Wildlife Area. We used cameras installed at various stages of incubation, to monitor 63 nests that either were predated and/or hatched. Of these, 30 nests hatched, 3 nests hatched after partial depredation, and 30 nests were completely depredated. We documented the time of the nest depredation, number of visits by the predator to the nest bowl and egg and nest conditions after the depredation occurred. Nest predators were identified at 25 of the 33 depredated nests and striped skunks (*Mephitis mephitis*, n=12) and raccoons (*Procyon lotor*, n=11) accounted for the majority of depredations. The only other predator identified on video was the common raven (*Corvus corax*, n=2) however, one nest was partially destroyed by a resident tule elk (*Cervus canadensis*). Future management actions should consider these results when trying to improve waterfowl production in this region.

Q.1.12: Moore

## Assessing Breeding-Site Fidelity of Spectacled Eiders on Kigigak Island, YDNWR, Alaska

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Spectacled eiders (*Somateria fischeri*) were listed as a threatened species in 1993, prompting several U.S. Fish & Wildlife Service projects aimed at actively monitoring the population throughout its range in Alaska. In response to the decline, the Yukon Delta NWR established a remote field camp in 1991 on Kigigak Island, Alaska due to the island's perceived breeding significance to Alaska-segments of both spectacled and common eider populations. Since project initiation, close to 2000 spectacled eiders have been banded and a number of those females have been resighted and have contributed to multiple nesting attempts. With such a large portion of the female population being marked (approximately 80.7% of observed nesting hens in 2011), it is apparent that the breeding-site fidelity of this population is quite strong, but has not been properly assessed. Encounters of marked individuals at unique and identifiable locations over the years have raised questions as to whether fidelity analyses can be narrowed down to a much smaller scale on Kigigak Island. Using nesting data collected from marked individuals that have been resighted on the nest >2 occasions, we will analyze and interpret the dispersal distance of all nest encounters for each bird, compare them based on the initial nest site when that individual was first recorded and how this comparison has changed since an initial assessment during the first decade of monitoring. Additionally, we will assess the spatio-temporal repeatability that has been recorded in the encounter histories for these females over this long-term nest monitoring project. We place our findings in context of the slow annual growth in nest densities that have been recorded on the Yukon-Kuskokwim Delta with considerations of other processes that may be influencing perceived abundance and distribution of this unique species of concern.

Q.1.13: Nicolai, G.^

## Wood Duck Offspring are Not the Same Size as their Mothers but Those Offspring Which Breed are Larger

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Body size can be related to genetic and/or environmental sources. Between 2005 and 2015, we found 876 wood duck nests in artificial nesting boxes and webtagged 2911 of the 3776 hatched ducklings on their day of hatch. All of these ducklings had records in which their mothers were captured, banded, and had their culmen and tarsus measured. We encountered 212 of these webtagged female ducklings from 91 different hens following the period of asymptotic growth by using floating traps, rocket nets, and encounters in nesting boxes at which time their culmen and tarsus were measured. We created note cards for both ducklings and nest box adult females which met these criteria and matched cards to link measurements of grown ducklings with their mothers. We entered this data into excel and created scatterplots and used the add trendline feature to examine how similar female duckling culmen or tarsus length was to their mothers measures. We found that the correlation (slope) between offspring and mothers were 0.22 and 0.20 for culmen and tarsus, respectively. In addition, we split data from both culmen and tarsus to separate these ducklings which eventually were confirmed to be breeders apart from the rest of the ducklings. We found that for ducklings which were confirmed to be breeders, these ducklings had the same slope as unconfirmed breeders, but these ducklings were 5% larger. These results show a weak relationship between heritability in body size, but that larger offspring were more likely to be confirmed breeders later in life.

Q.1.14: Skaggs^

## Effects of Energy Development on Waterfowl Nesting Ecology in the Bakken Formation of North Dakota

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The Prairie Pothole Region (PPR) is responsible for producing more than half of the dabbling ducks in North America. The PPR in northwestern North Dakota coincides with the Bakken shale formation, where rapidly accelerating oil and gas development has the potential to impact more than 1 million duck pairs. This is more than 25% of the waterfowl that breed in the PPR of the Dakotas and eastern Montana. Nest density and success are important measures of waterfowl production, and understanding changes in these metrics is important for managing waterfowl populations. Our goal is to assess the effect of energy development in the Bakken on waterfowl nest density and success, in conjunction with ongoing studies of breeding pair and brood abundance. We selected sites adjacent to pair and brood survey plots that were stratified by the intensity of energy development as measured by the number of well pads present (Control: 0, Low: 1, Medium: 2-3, High: >3). We searched for waterfowl nests on three 32-ha grassland replicates on each of 28 plots (7 in each category) between 29 April and 30 June 2015. We searched for nests every three weeks using a chain drag and revisited every 4-6 days to determine nest fate. In 2015 we searched 2,637 hectares and found a total of 1,798 nests. Blue-winged Teal (*Anas discors*), Mallard (*Anas platyrhynchos*), and Gadwall (*Anas strepera*) comprised 75% of nests that were located. Data is currently being entered, but we will present an analysis of nest density and fate in relation to oil development categories, the number of active and inactive wells, and the distance to roads. Our overarching goal is to present preliminary results from the first year of our three-year study to spur interest and discussion among the waterfowl management community.

Q.1.15: Skalos

**Diurnal Habitat Use and Molt Location of Hen Mallards in Sacramento Valley, California**

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We conducted a pilot study to investigate habitat use of nesting hen mallards using GSM/GPS transmitters in the Sacramento Valley of California. Our main study area was located on a 1200 hectare conservation easement and surrounding area located near Zamora, California. The easement was comprised of 810 ha of wetland, 300 ha of various upland habitats and 65 ha of rice. Habitat types surrounding the easement were comprised of tree crops, field crops and row crops to the south and rice to the north. In spring 2015 we marked 12 hens captured while nesting in upland habitat. Transmitters were set to log during the daylight hours to minimize battery use. We used 5 categories to reflect life history stages throughout the summer which included: nesting, nest break, brood rearing, not nesting (i.e. pre1 July), and post-breeding (i.e. after 1 July). We excluded points collected after release and prior to return to the nest as they were assumed to be bias. We recorded 8021 GPS points between 1 May and 31 July. The majority of habitat use by hens off nests during the breeding season was rice (67%), followed by seasonal wetlands (13%), semi-permanent wetlands (5%) and water delivery structures and other various agricultural types (15%). Habitat use during the post-breeding season was mostly rice (70%), followed by seasonal wetland (21%) and semi-permanent wetlands (7%). Of the 5 hens that hatched nests, 3 were successful in moving their broods longer than 24 hours. These hens moved from the easement to the area of rice agriculture to the north. Habitat use by brood rearing hens was mostly rice (91%), followed by seasonal marsh (7%). Our findings indicate that rice near large conservation easements serves as an important habitat type to hen mallards during the breeding season, post-breeding season and for brood rearing.

Q.1.16: Stetter

**Duckling Survival at the Edge of Scaup Range in Montana**

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Lesser scaup (*Athya affinis*) experienced a prolonged population decline since the 1980s, resulting in the species being identified as a high priority for conservation by the North American Waterfowl Management Plan. Factors influencing scaup duckling survival are poorly understood, and a better understanding of these factors would help managers make decisions for the future management and conservation of scaup populations. Our objective of the current study was to determine relative factors influencing scaup duckling survival, which will provide information to help guide management decisions aimed at increasing scaup recruitment.

Nests were located from 2010 to 2015 through active searching and monitored until fate was determined, with initiation date determined through egg candling. Individual ducklings were web-tagged at the nest and basic morphometrics recorded. A subsample of ducklings were double marked with Passive Integrated Transponder (PIT) tags to aid estimation of marker loss. Ducklings were recaptured during two, five-day drive-trapping sessions, spaced two weeks apart (mid-August and early September).

We estimated apparent daily duckling survival with capture-mark-recapture models in program MARK using encounter histories from >4,000 individually marked birds. We examined the effects of hatch date, weight, temperature, precipitation, water level, and year. We used an annual growth curve fitted to morphological measurements to estimate hatch date for ducklings that were encountered for the first time during drive-trapping.

Julian hatch date squared was the most significant predictor of survival through all five years. Mass at hatch also was significant as a quadratic effect. Duckling survival to 30 days ranged from 29.0 to 80.0 percent. During this study, stabilizing selection played a significant role in duckling survival, which indicates that there was trade-offs for selection of an optimal timing of hatch on survival and a cost associated with hatching too early or too late and being too heavy or to light.

Q.1.17: Terry^

**Variation in Egg Coloration in Wood Ducks**

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Certain Wood Duck populations have been greatly studied due to the input of nest boxes. But, these nest boxes have created high density situations causing an increase in brood parasitism and a decrease in hatch success, this can lead to a decline in overall population size. Many host species decipher between their own eggs and a parasite's by "ejecting an egg unlike your own". Research is lacking to indicate Wood Ducks are able to prevent parasitism but the majority of unhatched eggs in a clutch tend to belong to the parasitic female. Suggesting that Wood Ducks could be using a cue to differentiate their own eggs from a parasite's. Many birds are able to distinguish their eggs from a parasite by perceiving differences in color and UV reflectance. If Wood Duck hens are combating parasitism in variation of egg color then overall brightness or UV reflectance could be their cue to determine their eggs from another hens. Since Wood Duck eggs look very similar to the human eye this study was conducted to see if overall their eggs had variation in color and if they are reflecting in the UV range. I sampled 119 eggs using a UV-vis spectrometer over the 2014 nesting season. My results conclude that Wood Duck eggs reflect in the UV range and there is significant variation in color between eggs from different sites and between nest within sites. The site with the highest density of boxes had eggs with the highest UV reflectance and the highest total reflectance of any other site. Variation in egg color could be an important management tool to assess the functionality and placement of Wood Duck boxes to prevent increases in parasitism and possible declines in population.

Q.1.18: Towery^

**A Methodology to Predict Canada Goose Breeding Pair Densities**

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Effective management of Canada geese requires precise estimates of the breeding populations. Mississippi Flyway Council states and provinces have been developing and refining methods to estimate Canada goose (*Branta canadensis*) populations in the Flyway since 1993. The key to precisely estimating the Canada goose breeding population in a region is the accuracy of the stratification of the universe of survey plots for the breeding ground survey. Iowa's Canada goose breeding ground survey currently utilizes two strata (Prairie Pothole Region (PPR) and Rest of the State (ROS)) and four sub-strata (intervals of predicted breeding pairs per section). Geese are counted on 163 randomly selected 2-mi2 plots by helicopter each year. Approximately 40% of the plots come from the PPR and 60% come from the ROS. Using 5 years of breeding ground survey data and data from the most recent (2002) National Wetlands Inventory (NWI), we are developing a statistical model to re-predict breeding pair densities for each section in the state. We first reclassified NWI wetlands to a simplified system based on wetland vegetation and water permanence. Then we developed a generalized linear model to predict the breeding pair densities per section. We hypothesized that the number of breeding pairs in a section would be a function of the number, size, and types of wetlands in the section. Based on the breeding pair densities predicted by the model, each section was re-assigned to sub-stratum. The re-stratified sections will provide an updated stratification of survey plots for Iowa's Canada goose breeding ground surveys, which will improve the precision of breeding population estimates.

Q.1.19: Warren

## Previous Success and Current Body Condition Determine Breeding Propensity in Lesser Scaup: Evidence for the Individual Heterogeneity Hypothesis

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The decision to breed influences an individual's current and future reproduction, and the proportion of individuals that breed is an important determinant of population dynamics. Age, experience, individual quality, and environmental conditions have all been demonstrated to influence breeding propensity. To elucidate which of these factors exerts the greatest influence on breeding propensity in a temperate waterfowl, we studied female lesser scaup (*Aythya affinis*) breeding in southwestern Montana. Females were captured during the breeding seasons of 2007–2009, and breeding status was determined on the basis of (1) presence of an egg in the oviduct or (2) blood plasma vitellogenin (VTG) levels. Presence on the study site in the previous year, a proxy for adult female success, was determined with stable isotope signatures of a primary feather collected at capture. Overall, 57% of females had evidence of breeding at the time of capture; this increased to 86% for females captured on or after peak nest initiation. Capture date and size-adjusted body condition positively influenced breeding propensity, with a declining body-condition threshold through the breeding season. We did not detect an influence of age on breeding propensity. Drought conditions negatively affected breeding propensity, reducing the proportion of breeding females to 0.85 (SE = 0.05) from 0.94 (SE = 0.03) during normal-water years. A female that was present in the previous breeding season was 5% more likely to breed than a female that was not present then. The positive correlation between age and experience makes it difficult to differentiate the roles of age, experience, and individual quality in reproductive success in vertebrates. Our results indicate that individual quality, as expressed by previous success and current body condition, may be among the most important determinants of breeding propensity in female lesser scaup, providing further support for the individual heterogeneity hypothesis.

## Q.2: Climate Change

Q.2.1: Ballard, B.

### Predicting Sea-level Rise and its Effects on Wintering Redheads

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We used the habitat model SLAMM 6.2 Beta to predict wetland conversion and shoreline modification due to sea-level rise along the lower Texas coast. We modeled 7 time periods for effects of sea-level rise including 2012, 2020, 2040, 2060, 2080, and 2100. We chose to use a predicted sea level rise of 1 m along the lower Texas coast by 2100, because this value appears to be the most accepted and in the middle of the range of possible outcomes of sea-level rise predictions. We predicted that 59.6% of the currently available coastal ponds will become inundated with salt water from rising sea levels by 2100. Thus, a 1-m rise in sea level will result in only 40.4% of current ponds functioning as freshwater sources for wintering redheads by 2100. Additionally, with this loss in coastal pond availability, the remaining coastal ponds will service 71% of the current foraging area of redheads during a wet year. However, during a year of median wetness, 34.6% of the currently available ponds would be available, servicing 69.6% of the total foraging area. During a dry year, only 11.5% of the currently available ponds would hold fresh water for redheads, servicing only 49.6% of current foraging area. Coastal freshwater ponds along the lower Texas coast are predicted to be greatly affected by sea-level rise by 2100, particularly along North Padre Island/Padre Island National Seashore, the Kenedy Ranch, and South Padre Island, which all lost >50% of the ponds used by redheads. Creating new ponds or pumping fresh water into existing basins that are currently not used by redheads and that will not be impacted by sea-level rise may need to occur to support current abundance of wintering redheads in the future.

Q.2.2: Schummer

## Use of Remote Cameras to Index Atlantic Population Canada Goose Migration

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Local and long-distance movements by migratory birds are greatly influenced by seasonality in weather and may change with a warming climate. Timing of migration and length of stay, in combination with the abundance of waterfowl, can influence foraging pressure by waterfowl (i.e., waterfowl use days) and temporal availability of these birds to waterfowl watchers and hunters (hereon waterfowl enthusiasts). We investigated timing of migration by Atlantic Population (AP) Canada geese and modeled how daily movements were influence by temperature and precipitation at Junius Ponds Unique Area in central New York, September – January 2013-2015. Using counts from images taken hourly by remote cameras and by obtaining data on timing of direct recoveries of AP geese harvested by hunters in nearby areas from 1976-2012, we were able to validate that most geese using our study area likely originated from above 50◦ North in Quebec, Canada. We detected two peaks in migration during late-October and late-December in both years of our study with geese remaining a month longer in 2014-2015 when ice free conditions prevailed. During warmer temperatures geese generally flew out to feed in the morning and evening, but as autumn progressed towards winter and temperatures decreased, geese increasingly restricted flights to mid-day periods when they remained longer away from Junius Ponds. Precipitation (rain or snow) also increased time spent away from roost by > 43 min/day. Our results predict delayed migration by Canada geese and changes in daily flight patterns with a warming climate. We suggest continued monitoring of our study site by remote camera to document long-term variation in migration chronology of AP geese through central New York and estimate the temporal and spatial availability of these birds to waterfowl enthusiasts under various climate change scenarios.

Q.2.3: Matchett

## Scenario Impacts Modeling Of Waterfowl Habitat In California's Central Valley

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The Central Valley of California contains some of the most important habitats for waterfowl in North America. Waterfowl habitats in the Central Valley are dependent on precipitation and snow pack for water supplies. Global climate models indicate substantial changes in temperature and timing and amounts of precipitation in watersheds of the Central Valley, translating into temporal and spatial variations in many of the driving forces that define the availability and productivity of waterfowl habitats. Food availability is a key factor limiting waterfowl during migration and winter, and impacts body condition and other aspects of waterfowl ecology. We developed Central Valley landscape change scenarios based upon precipitation, temperature patterns, and resulting water supplies projected from downscaled climate models, urbanization, and water management scenarios and investigated impacts on habitats of waterfowl. For each scenario, we modeled water supplies and demands in the Central Valley using the Water Evaluation and Planning system (WEAP) to quantify future potential water deficit impacting waterfowl habitats during migration and winter. WEAP results were translated to available habitat. Modeling results focusing on the Central Valley indicate that under some scenarios, water supplies will not be adequate to maintain habitat at the levels necessary to support Central Valley Joint Venture goal populations of waterfowl. Of scenarios we investigated, waterfowl habitats would be impacted the most by a combination of warm, dry future climate, urban encroachment, and certain water supply management policies.

Q.2.4: Moon

## Integrating Sea-Level Rise and Anthropogenic Change into Mottled Duck Conservation

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Shoreline and inland habitats of the Texas Chenier Plain Region (TCPR) support a diverse spectrum of species, whose populations are threatened by anthropogenic stressors such as climate change, sea-level rise, and urbanization. Mottled ducks are a species of conservation concern for the U.S. Fish and Wildlife Service (USFWS) and conservation of their habitats will benefit a suite of species that rely on similar habitats. The conservation response to preserve these species and mitigate threats lies in identifying and prioritizing prospective areas to conserve, restore, and subsequently protect. Challenges to develop conservation strategies in the right places include understanding species needs and diagnosing threats to a species. We first predicted shifts in habitat composition caused by sea-level rise using the Sea Level Affecting Marshes Model (SLAMM). Second, we made predictions describing land conversion and anthropogenic stressors leading to potential habitat loss. Lastly, we focused on building species-habitat association models for mottled ducks inhabiting coastal marsh habitats within the TCPR. Within the landscape we identified habitats most likely to persist, convert to quality habitats, or be maintained as quality mottled duck habitat through the year 2100. Our work identified the present status of habitats along the TCPR and predicted potential future condition to inform strategic land protection by the USFWS and partners mandated to protect priority species and the habitats on which they depend in the TCPR. The final product is a flexible decision support tool to identify, compare, and prioritize current habitat and predicted future habitat under projected urban development and sea-level rise through the year 2100.

Q.2.5: Osborne

## Co-occurrence of Shifting Winter Distributions of Midcontinent White-Fronted Geese and Rice Acreage

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Understanding patterns and processes of environmental change influencing species distribution is required for effective management decisions. Combined with increasing population abundance, evidence suggests winter distribution of midcontinent greater white-fronted geese (*Anser albifrons*) is shifting in a northeasterly direction from its historical range. We developed an interactive map to demonstrate the co-occurrence of a shifting distribution of wintering white-fronts and a change in rice acres planted in the midcontinent. We used a workflow in ArcGIS and Geospatial Modelling Environment to create kernel density estimates (KDEs) of band encounter data from direct encounters of harvested white-fronts for 2 geographically distinct banding regions in the Arctic. We created 50% KDEs from encounter locations of white-fronts banded on the North Slope of Alaska and in Central Nunavut, Canada from 1980–2014. KDEs were developed for each location and year separately. We superimposed KDEs on density "heat" maps of rice acres planted by county within the Mississippi and Central Flyways. Total rice acres planted in Texas and Louisiana during 2014 declined 75% and 25%, respectively from that reported in 1980,whereas Arkansas observed a 13% increase. Our interactive map demonstrates a distinct shift in distribution of white-front band encounter locations from a small core area in southeast Texas during 1980 to a much larger region encompassing the MAV and extending from western Louisiana through northeast Arkansas during 2014. Although the shift in distribution parallels the change in rice acres planted, these data we do not infer a cause and effect relationship but instead only demonstrate a co-occurrence in the shift in distribution and rice acres planted that should warrant concern regarding potential implications. Shifting distributions of wintering white-fronts has ecological implications; particularly as increasing population abundance may lead to higher densities of wintering waterfowl and increased competition for energetic resources within the MAV.

## Q.3: Habitat Use

Q.3.1: Blake-Bradshaw

### Wetland Quantity and Quality for Waterbirds in Illinois

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Waterbirds use a variety of wetland types during critical periods, such as spring migration. However, the amount wetland area in the Midwest has decreased, and remnant wetlands are often degraded and may not meet habitat needs for waterbirds. The National Wetland Inventory (NWI) is currently the most comprehensive measure of wetland quantity in this region, but unfortunately, NWI lacks data regarding the timing, depth, and persistence of surface water inundation. Therefore, current information regarding wetland quantity may overestimate wetland availability for waterbirds because many wetlands are not inundated and accessible to waterbirds during the appropriate periods.

We estimated wetland quantity for waterbirds during critical periods in Illinois and modeled factors that affect wetland quality. We surveyed wetland vegetation characteristics, potential hydrologic stressors, waterbird occupancy, and management intensity on approximately 100 wetland plots (0.25 $km^2$) during three sample periods critical to focal waterbirds (i.e., spring [migrating dabbling ducks], early summer [nesting marsh birds], late summer [migrating shorebirds]) across the state of Illinois. Within each plot, we mapped inundated area of NWI polygons (Forested, Emergent, Pond, Lake, River). Water depth and vegetation cover were assessed for each polygon type. Additionally, high-resolution aerial photographs of all plots and the surrounding area during each sample period were obtained.

During spring, less than 30% of any wetland type was flooded shallowly and accessible for foraging dabbling ducks. Likewise, emergent vegetation (<10%) and overall vegetation (<25%) were rarely inundated. Summer inundation rates were greater than spring, especially in forested (34%) and emergent (61%) polygons. During fall, flooded area was similar to spring, but shallow inundation was slightly greater. However, mudflats, critical for shorebirds, comprised less than 20% of any wetland type. Based on preliminary results, most wetland area assessed by the NWI in Illinois is not flooded at suitable depths for waterbirds during critical periods.

Q.3.2: Bloom

## Monitoring a Bird Response To Restoration Efforts at Delta Marsh

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Delta Marsh – Restoring the Tradition is a multi-partner initiative struck to reverse the deterioration that has been occurring at Delta Marsh, Manitoba over the past 50 years. Fall-staging waterfowl use of Delta Marsh has diminished over time presumably due to reduced food availability. The primary goal of this project is to improve conditions for fall-staging diving ducks. The first phase of this initiative is the exclusion of Common Carp (*Cyprinus carpio*) from Delta Marsh, with the hypothesis that reducing the impacts of Common Carp will increase water clarity and result in the return of a healthy submersed aquatic vegetation community. An increase in staging diving duck numbers is predicted as they respond to increased food availability. Recent advances in waterfowl research make it possible to monitor how waterfowl respond to their immediate environment. Levels of circulating metabolites (triglycerides and β-hydroxybutyrate) can be used to determine if birds are depositing or burning (catabolizing) fat. Diving ducks using the marsh as a stopover site should show a greater tendency to deposit fat while foraging and resting in the marsh as conditions and food availability improve through time. Initial results indicated that fall-staging canvasbacks (*Aythya valisineria*) at Delta Marsh currently have higher levels of the plasma-lipid metabolite β-hydroxybutyrate than those at the reference site, Lake Francis (difference of LS-means: -0.3239, 95% CL: -0.565 to -0.083), indicating greater lipid catabolism at Delta Marsh. Additionally, aerial waterfowl surveys are being conducted annually and modelling efforts using water quality and fish monitoring data indicate that waterfowl abundance increases as water clarity improves, further linking restoration efforts to changes in fall-staging waterfowl numbers.

Q.3.3: Clark^

## Waterfowl and Stock Pond Forage Resource Relationships in West Texas

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Habitat selection during the migratory and overwintering periods are of important consideration to waterfowl populations and management. During the nonbreeding season, the availability, quality, and quantity of habitat, influence the ability and rate at which waterfowl complete annual life cycle events, which can affect waterfowl survival and reproduction. Recent trends in Texas Parks and Wildlife's mid-winter survey data indicate that annual abundance estimates of waterfowl in the Rolling Plains ecoregion have increased since 1997. In the semiarid rangelands of West Texas the construction of numerous man-made livestock stock ponds may be one of the factors influencing the recent trends in the Rolling Plains. During the fall and winter of 2014 – 2015, seeds and aquatic invertebrates were analyzed to estimate energetic carrying capacity across 32 stock ponds. During August 2014, mature inflorescences were collected along a 50 m transect using 0.5 $m^2$ quadrat to estimate seed production. Water-column and benthic samples were collected to sample for nektonic and benthic invertebrates at approximately 2 week intervals from September 2014 – March 2015. Biomass estimates from seeds and aquatic invertebrates were used for estimating Duck Energy Days (DED) across the study stock ponds. Exploring forage resources potentially available to nonbreeding waterfowl will give insight to the functional roles of stock pond habitats and provide information to managers for incorporation in waterfowl management strategies.

Q.3.4: Gabor

**Environmental Impacts of Wetland Loss in a Prairie Watershed: Implications for Waterfowl**

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Eutrophication as a result of phosphorus pollution is a widespread problem throughout North America, and has lead to the degradation of numerous lakes, rivers, wetlands, and estuaries across the continent. In the U.S. nonpoint sources are now the dominant input of P to surface waters and this is also likely the case in Canada. In the Canadian prairies non-point phosphorus pollution is largely due to agriculture and agricultural intensification over the last century. One of the main mechanisms facilitating the leakage of nutrients from agricultural landscapes is surface water drainage. This is of particular concern in the North American Prairie Pothole Region (PPR), where between 50 and 70% of wetlands have been lost, with some regions experiencing rates of loss in excess of 90%. Wetlands continue be lost at an alarming rate in the Canadian prairies. In order to quantify the effects of wetland loss Ducks Unlimited Canada (DUC) has been intensively monitoring the Broughton's Creek watershed situated in southwestern Manitoba. Using automated continuous hydrometric stations we measured discharge at the sub-watershed level as well as from individual drained wetland basins. Detailed water quality sampling was also conducted across the entire basin. This information was combined with DUCs inventory of drained and intact wetland basins and basin wide elevation data to determine nutrient export coefficients at a sub-watershed level. Our results indicate that drained wetlands act as hotspots for nutrient export in the Canadian prairies and that wetland drainage substantially increased the amount of runoff from the watershed which could have implications for downstream flooding. Our research provides evidence of the environmental impacts of wetland loss and the need for wetland protection, which in turn, will protect critical waterfowl habitat in the PPR.

Q.3.5: Hidden^

**Modeling Inundation of Missouri's National Wetland Inventory Wetlands in Autumn**

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Missouri wetlands are potential stopover sites for migratory waterfowl in autumn, and when inundated, can fulfill the energetic requirements of waterfowl to complete southward migration. Despite the importance of inundated wetlands in providing energy for migrating waterfowl, information of spatial and temporal wetland availability in Missouri is relatively limited. The objectives of this study are to assess variables influencing wetland inundation in the Grand and Missouri River ecoregion and develop and analyze predictive models for autumn wetland inundation. National Wetland Inventory (NWI) wetland basins (n=27,283) were divided into three strata based on hydrology and availability of hydrologic input data. We partitioned 80% of the NWI wetlands into training data sets and 20% into validation data sets to test the top ranked models. Variables indicative of wetland inundation were associated with each NWI wetland for years 2004-2010. We used Landsat 5 Thematic Mapper imagery from November and December 2004-2010 to classify inundation status for all study wetlands. Predictive wetland inundation models were developed from the training data set using Generalized Linear Mixed Models and ranked using Akaike Information Criterion. Top models were then applied to the validation data set and plotted using a Receiver Operating Characteristic (ROC) curve to illustrate performance of model predictions. Over half (55%) of study wetlands were identified as inundated at least once during the study period, while 6% of wetlands were identified as inundated for >5 years. Mean probability of inundation (0.20) indicates a low probability of wetland inundation in autumn for the region. Reliable frameworks for wetland inundation modeling can inform wetland management decisions and potentially aid in improving sampling efficiency for aerial waterfowl surveys based on fluctuations in wetland inundation.

Q.3.6: VonBank^

**Energetic Carrying Capacity in the Upper Illinois River for Waterfowl**

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The Illinois River historically provided productive habitats for a variety of migratory birds, but management for commercial navigation, sedimentation, and increasing hydrologic variability has led to a reduction in aquatic vegetation and naturally-occurring foods foraged by waterfowl. The vast majority of aquatic vegetation disappeared between 1940 and 1960 and has not returned to most of its historical prevalence. The Dresden reach of the Illinois River is composed of the Kankakee and Des Plaines rivers which form the Illinois River at their confluence. The Dresden reach is productively different from the rest of the Illinois River because unlike other reaches, it is home to an abundance of seed-producing aquatic macrophytes important to waterfowl. Additionally, the Starved Rock reach, to a lesser extent, has also retained some of its aquatic vegetation. Energetic carrying capacities, duck energy days, and overall waterfowl food characterization have been well documented in the lower Illinois River valley, however little information exists to characterize energetic carrying capacity for waterfowl in the upper Illinois River. To determine energetic carrying capacity of seeds and tubers in the upper Illinois River, we collected benthic core samples from 20 locations in backwater lakes connected to the river, 60 random locations throughout the Dresden Reach in fall, 2013–2014, and 30 sites from the Starved Rock Reach in fall 2014. Seeds were removed from sediment samples, identified to the lowest possible taxonomic level, weighed to nearest 0.1 mg, were used to estimate the overall seed density (kg/ha; dry mass) and were assigned appropriate total metabolizable energy (TME) values to calculate duck energy days (DEDs). All sampling locations (i.e., river reaches and backwaters) had low average density (<175 kg/ha) of seeds and tubers and low duck energy day estimates (<1,200 DED/ha) when compared to managed wetlands. In river reaches, the Dresden reach had the greatest ECC in 2014 (109.0 ± 85.7 kg/ha; n = 30), followed by Dresden Reach in 2013 (47.2 ± 10.7 kg/ha; n = 28), and Starved Rock Reach in 2014 (13.7 ± 35.7 kg/ha; n = 30). Energetic carrying capacity in backwaters was also low (53.0 ± 13.7 kg/ha; n = 20). Upper Illinois River ECC estimates were -88.5 % to -94% below estimates from lower Illinois River valley wetlands, and were below waterfowl foraging giving-up density (GUD) estimates prior to peak fall migration. The Des Plaines River exhibited greater ECC estimates (95.8 ± 64.2 kg/ha; n = 40) than the Kankakee River (37.7 ± 14.0; n = 18), despite abundant commercial barge traffic and channel manipulation in the Des Plaines River. Additionally, Mallards collected from public and private hunting areas on the Illinois and Des Plaines rivers fed primarily on agricultural seeds, and low food availability coupled with significant disturbance from hunting, recreational and commercial barge traffic may limit the value of the Upper Illinois River for waterfowl. Conservation planners should consider integration of waterfowl management areas which utilize and encourage growth of remnant naturally-occurring aquatic vegetation and incorporate moist-soil management practices and water level manipulation to maximize the potential for quality waterfowl habitat the Upper Illinois River.

*Speaker; ^Student

Q.3.7: Vrtiska1

## Balancing Social and Ecological Objectives in the Platte River Watershed

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Wildlife agencies and conservation organizations in Nebraska, Colorado, and Wyoming restore, enhance, and protect wetland habitats along the Platte River to achieve conservation objectives, including those of the North American Waterfowl Management Plan (NAWMP). One goal of this partnership is to provide nonbreeding habitat for waterfowl and waterbird populations. While focused on habitat, the revised NAWMP also includes an objective of increasing financial and political support for wetland conservation by increasing numbers of "waterfowl hunters, other conservationists, and citizens who enjoy and actively support waterfowl and wetlands conservation." The partners are challenged to determine how best to allocate limited resources to maximize the value of future work along the Platte River to meet the new NAWMP objectives. Partnership representatives initiated a structured decision making process to help define a strategy and associated tactics to simultaneously maximize the value of both individually initiated and cooperative Platte River conservation efforts for 1) sustaining wetlands and wetland-reliant bird populations; 2) protecting and managing riverine and riparian habitats; and 3) increasing society's active support (e.g., hunter participation, donating funds) for wetlands conservation. The process illuminated the complexity of the decision problem which was hierarchical in nature, with 5 different levels, each potentially needing its own decision analysis. We conducted an analysis for 2 different decision problems including time allocation of habitat planners and selection of habitat projects. Four fundamental objectives, three primary management categories with various actions and a consequence table, were constructed to examine trade-offs with these two levels. The optimal allocation of time and selection of projects were influenced by the importance placed on biological versus social objectives. The decision problem required the inclusion of human dimensions parameters, but those parameters were poorly understood and difficult to quantify. The NAWMP community must decide which social parameters are needed to inform habitat delivery and assess progress towards human dimension objectives.

Q.3.8: Schepker^

**Spring Food Resource Availability in Public, Cropped, and Wetlands Reserve Program Playas**

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Despite a 90% decrease in wetland habitat and ongoing degradation from urban and agricultural land use, Nebraska's Rainwater Basin serves as a critical staging area for migratory waterfowl within the Central Flyway. In early spring, playa wetlands in the Rainwater Basin provide essential stopover habitat to ˜9 million waterfowl by presenting opportunities to acquire energy and protein needed to complete migration and initiate egg production. Given the Rainwater Basin's annual role in sustaining relatively large waterfowl densities with limited wetland habitat, it is necessary that conservation managers obtain accurate estimates of wetland derived food resource availability to calculate energetic carrying capacity. Previous efforts have been made to estimate food biomass on actively managed public wetlands, however no attempts have been made to estimate food resource availability on passively managed private wetlands that account for over 50% of the Rainwater Basins total wetland inventory. We assessed spring forage availability and depletion on public, cropped, and Wetlands Reserve Program (WRP) wetlands in the Rainwater Basin in 2014 and 2015. Our estimates included plant seed (moist-soil and agriculture) and aquatic invertebrates known to be consumed by dabbling and diving ducks (subfamilies Anatinae and Aythyinae). In both years, benthic seed samples were collected from 30 wetlands prior to migration and during a second period when it was believed that the majority of birds had left the region. In 2014 pre-migratory seed biomass was greatest in WRP ( = 504.620 kg/ha, SE= 113.81), followed by public ( = 485.633 kg/ha, SE= 97.44), and finally cropped ( = 229.117 kg/ha, SE= 46.10). We evaluated benthic and nektonic invertebrate communities bi-monthly to determine mean biomass on 20 wetlands in 2014 and 27 wetlands in 2015. Invertebrate biomass was greatest on cropped ( = 36.615 kg/ha, SE= 25.049), followed by public ( = 17.843 kg/ha, SE= 4.795), and finally WRP ( = 10.414 kg/ha, SE= 2.65). Overall, spring forage conditions in the Rainwater Basin appear to be favorable when compared to other landscape scale studies at similar latitudes in North America. Further, all but 5 (92%) of the sites sampled contained >50kg/ha of seed biomass, suggesting that most wetlands in the Rainwater Basin, regardless of classification, provide an adequate level of effective foraging habitat during this critical time. Currently there are few studies available that quantify wetland derived food resource availability in spring stopover wetlands, and to our knowledge this is the only study that has evaluated this metric on privately managed wetlands enrolled in the Wetlands Reserve Program. Given the relatively high energetic output displayed in this study, resource managers may consider WRP and cropped wetlands as viable options to increase carrying capacity in other regions.

## Q.4: Management

Q.4.1: de Sobrino

### Distribution and Derivation of California Dabbling Duck Harvests

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Documenting connections between breeding and wintering habitats is important when developing management strategies for migratory waterfowl. Harvest regulations for most species of North American dabbling ducks are based upon adaptive harvest management (AHM) frameworks developed for 3 populations of Mallards, but how well these population delineations extend to other species is unknown. We estimated harvest distribution and derivation to better understand relationships between breeding and harvest areas for 9 commonly harvested dabbling ducks in California. We were especially interested in how patterns of harvest distribution and derivation of less intensively studied species compared to population delineation for western Mallards. Ducks breeding in California were primarily harvested in California, i.e., 95% of the harvested Mallards produced in California also were harvested in California, and this pattern was similar for other species nesting in California. California banded birds recovered outside of the state were most frequently recovered in Oregon, and we suspect that much of this movement was due to molt migration. California hunters derived much of their harvest of Mallards, Gadwalls, Cinnamon Teal, and Wood Ducks from birds breeding in California or Oregon. Just over half of harvested Mallards and Gadwalls were produced locally in California or Oregon, but Alberta also contributed substantially to California's Mallard harvest. Alaska, Yukon, and the Northwest Territories contributed over half of California's harvest of Northern Pintails, American Wigeon, and Green-winged Teal, with the Prairie Pothole Region contributing most of the remainder. The Prairie Pothole Region also contributed the majority of Northern Shovelers and Blue-winged Teal. In summary, California exhibits diverse patterns of harvest derivation for dabbling ducks, with pronounced dependencies on northern portions of the Pacific Flyway, the Prairie Pothole Region, as well as local production, depending on species. Enlightened harvest and habitat management needs to recognize this diversity of connections between wintering and breeding areas.

Q.4.2: Feaga

**Waterbird Use of Catfish Ponds and Migratory Bird Habitat Initiative Wetlands in Mississippi**

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Aquaculture impoundments provide surrogate habitats for waterfowl and other waterbirds. In response to the 2010 Deep Water Horizon Oil Spill in the Gulf of Mexico, the National Resource Conservation Service implemented the Migratory Bird Habitat Initiative (MBHI) that incentivized landowners to provide wetland habitats for migrating waterfowl and other waterbirds inland from potential oil impacted Gulf coastal wetlands. We estimated and compared diversity and abundance of waterfowl and waterbirds in six production and four MBHI idled aquaculture sites in Mississippi in winters of 2011–2013. The MBHI ponds were flooded shallowly (mudflat - <30 cm) and some received vegetation or soil manipulations. We also examined the influence of surrounding land cover types on waterbird use of production ponds. Wintering waterbirds exhibited similar densities on production (~22 birds/ha) and idled (~20 birds/ha) sites. We observed 42 species using both types of wetlands combined, but there was considerable departure in bird guilds occupying the two wetland types. Production ponds were primarily used by wading birds and diving and dabbling ducks. However, idled ponds with varying water depths and emergent vegetation-water interspersion attracted nearly 40 species of waterbirds. Waders and diving species observed on production ponds were associated with adjoining aquatic landscapes (e.g., other aquaculture, permanent water bodies, rice fields, flooded fallow fields, and forested wetlands), whereas surface feeders were associated with contiguous croplands (e.g., milo and soybeans). Our results suggest production and idled aquaculture impoundments produced suitable conditions for different waterbird guilds but, without MBHI management, idled ponds would support little or no avian use, suggesting importance and value of MBHI management and active managed of idled ponds.

Q.4.3: Gue

## Effects of Oil and Gas Development on Duck Production in the Prairie Pothole Region of North Dakota and Montana

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The Prairie Pothole Region (PPR) is the most important breeding area for waterfowl in North America, supporting over 50% of the continent's dabbling ducks. The PPR overlaps substantially with the Bakken formation, which contains significant recoverable oil reserves. Predictive pair abundance models for the five most abundant breeding dabbling duck species indicate that the Bakken formation overlaps with breeding habitat for over 1 million duck pairs (i.e., 25% of pairs) breeding in the US PPR. Given the extensive overlap between important waterfowl habitat and oil and gas reserves, understanding the relationships of carrying capacity and reproduction with energy development intensity is critical for wildlife managers in the PPR to make informed conservation decisions. We are addressing this information need by assessing the impact of energy development and associated disturbance on waterfowl productivity in the PPR using pair and brood surveys. We selected 64 3.2 x 3.2 km study plots for the pair and brood surveys within the area of overlap between the PPR and the Bakken in North Dakota and Montana. Randomly selected basins on the plots were stratified across different levels of energy development within 1.6 km of the basin- Control (0 well pads), Low (1 pad), Medium (2-3 pads), and High (>3 pads). Currently, we have completed two years of brood surveys and one year of pair surveys. We surveyed pairs on approximately 3,500 basins during spring 2015. We surveyed broods on approximately 2,400 basins during summer 2014, and approximately 4,100 basins in summer 2015. While data collection is still underway, and will continue for an additional two years, here we present preliminary results and summary statistics regarding the 2014 and 2015 surveys.

Q.4.4: Krainyk^

## Validation and Refinement of a Decision Support Tool for Mottled Duck Habitat Conservation in the Western Gulf Coast

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The western Gulf Coast provides valuable habitat for migratory and resident waterfowl. The mottled duck (*Anas fulvigula*), a resident species, is highly associated with coastal marsh habitats and relies on these areas for all of its life cycle needs. Habitat loss and degradation due to urban expansion and other human activities have raised concerns for the western Gulf Coast mottled duck population. The loss and degradation of suitable nesting and brood-rearing habitat is believed to be the primary factor associated with a long-term population decline of the mottled duck. The Gulf Coast Joint Venture Mottled Duck Conservation Plan recommends priority actions for conservation of grasslands and palustrine and estuarine wetlands to address key limiting factors for the western Gulf Coast population. However, until now, there has been a lack of science-based knowledge about where, on a spatial scale, to apply these actions that would result in the greatest biological return on resource investment. Recently, we developed a decision support tool for mottled duck habitat conservation, which identifies and prioritizes habitat patches for conservation based on biological parameters at the patch scale and habitat matrices at the landscape scale. Although the decision support tool can serve as a valuable tool in the management decision-making process, managers should be aware that it is built on spatial datasets that are not inclusive of all required information and have an unknown amount of error. Thus, our goal was to assess the performance of the mottled duck decision support tool in its ability to identify suitable nesting and brood-rearing habitat as well as provide analyses to improve its performance in doing so. Specifically, we assessed the 1) validity of patch suitability as defined by the model using randomly generated points surveyed from a helicopter, 2) ability of the decision support tool to identify high priority habitat by investigating use of these landscapes by breeding ducks from the collaborative Western Gulf Coast Breeding Mottled Duck Survey during 2008 to 2014, and 3) model output using georeferenced locations from a 3-year VHF telemetry collaborative project tracking mottled ducks throughout the western Gulf Coast. Preliminary results indicate that based on our model output, mottled ducks were observed in landscapes where model-based priority scores for nesting habitat were 83% to 172% higher, and for brood-rearing habitat were 85% to 173% higher, than those of randomly generated landscapes. We are currently analyzing the predictive power of other landscape variables (i.e. wetland area, priority rank, etc.) on mottled duck density. Preliminary results from helicopter surveys of over 350 randomly generated points indicate that our decision support tool is effectively predicting true ground conditions and matrices of high quality nesting and brood-rearing habitat for mottled ducks. Additionally, we are starting model validation and assessment using georeferenced locations from the 3-year VHF telemetry project (objective 3). This product will improve confidence and/or suggest necessary refinements to an existing decision support tool that is strategically guiding conservation of wetlands and grasslands.

Q.4.5: Malanchuk^

## Characteristics of Box and Natural Cavities for Nesting Waterfowl in Northern Vermont

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Accurate population estimates are difficult to obtain for cavity nesting waterfowl. Certain species of waterfowl rely on natural tree cavities for successful reproduction. Unfortunately, very little is known regarding natural cavity abundance in the Atlantic Flyway and northeastern United States in particular. Therefore, our objectives were to estimate density of natural cavities and compare waterfowl use rates between tree cavities and nest boxes. We conducted this study at Missisquoi National Wildlife Refuge (NWR) at the northern end of Lake Champlain in Vermont. At Missisquoi NWR we studied within two forest types; a mature silver maple floodplain forest (~ 180 years old) and a regenerating red maple/green ash swamp forest (~ 70 years old). Both forest types have known populations of nesting wood ducks (*Aix sponsa*), hooded mergansers (*Lophodytes cucullatus*) and common goldeneyes (*Bucephala clangula*). To estimate cavity density, we randomly selected 60 plot centers (n = 40 in silver maple [*Acer saccharinum*] forest, n = 20 in red maple [Acer rubrum] / green ash [*Fraxinus pensylvanica*] forest). Each plot was 0.08 hectares. Within each plot we searched trees for potential cavities. When safe, we climbed to all cavities using a double rope technique. Once to the cavity entrance we took physical measurements and inspected for use by waterfowl. In the silver maple forest 44% of all trees were of suitable cavity bearing size and we encountered 8 total trees with suitable cavities. All cavities were found in silver maple trees however, none of the cavities contained evidence of nests. Tree cavities averaged 6.1 m from the ground. In the red maple/ green ash forest only 28% of trees were of suitable cavity bearing size and we found no cavities in these trees suitable for nesting waterfowl. We estimated a density of 2.2 suitable cavities per hectare in the silver maple forest which is slightly greater than most other studies. To our knowledge this estimate represents the first of its kind for cavity nesting waterfowl in the northeastern United States. Unlike natural cavities, we found active use of nest boxes where > 90% of boxes were used. Wood ducks were the most common nesters (n = 22) followed by common goldeneyes (n =4) and hooded mergansers (n = 1). Parasitic nest parasitism rates exceeded 70%. Twelve boxes had at least two species of eggs and 1 box had three species of eggs. Our results were somewhat paradoxical in that we found no active nests in tree cavities but found great rates of nest parasitism in boxes. Future work will focus on expanding our tree cavity searching to include Distance sampling and experimentally closing nest box entrances for the 2016 nesting season. Results from these two future endeavors will have significant implications for managers and other groups interested in the value and efficiency of box nests for waterfowl in the Northeastern US.

Q.4.6: McCarty

**Turning Disaster into Relief for the Greatest Habitat Crisis on the Continent**

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On April 20, 2010 the Deepwater Horizon (hereafter "the Spill") oil rig exploded and subsequently sank approximately 40 miles off the coast of Louisiana (LOSCO). Considered one of the greatest environmental impacts in US history, this Spill resulted in extensive oiling, dispersants, and response injury which has been associated with significant impacts to Gulf of Mexico coastal environments and associated natural resources (LOSCO). Due to the proximity, size, and duration of the Spill, significant and long-standing biological and ecological impacts appear likely within Mississippi River Delta and Gulf Coast areas. Therefore, Ducks Unlimited responded by identifying and promoting the implementation of priority restoration applications which would generate direct individual and species benefits (e.g., reproductive productivity, growth, and survival) for avian species impacted by the Spill. These high priority restoration projects, techniques and applications proposed will contribute to further recovery from the spill event and restoration of Louisiana's Gulf Coast ecosystem. Since the 1930s, Louisiana has lost over 1.2 million acres of coastal wetlands. It is expected that an additional 400,000 acres will be lost by 2050 without restoration action. Wetland restoration and enhancement activities by Ducks Unlimited will restore natural conditions and enhance the quality of wintering, breeding, and migration habitat available to waterfowl and other wetland-dependent migratory birds that utilize the Gulf Coast. These projects will impact the coastal prairies and marshes along the Gulf Coast, which is the single most important wintering area for waterfowl on the continent.

Q.4.7: Morissette1

## Are Boreal Waterfowl Resilient to Disturbance by Forestry and Agriculture?

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Forestry accounts for the largest human footprint in the western boreal landscape. In order to assist with the recovery of this forest ecosystem post-harvest, and minimize any detrimental effects on wildlife populations, many forestry companies are now applying lessons learned from natural disturbances to forest management. Additionally, driven partly by considerations for effects of harvesting on water quality and quantity, in some jurisdictions an upper limit is applied to the amount of recently harvested forest (e.g., 30% by area). Similar limits are not typically applied when forests are converted to agricultural uses such as pasture or annual crops; nor are most agricultural systems managed to emulate a natural analogue. To test implications of these management practices for waterfowl, we examined changes in abundance and community composition along gradients in amounts of disturbance from harvesting or agriculture at wetland and landscape scales. We applied multivariate, non-parametric techniques, to identify any species-level responses, either positive or negative, and any resulting community-level thresholds. Changes in species composition occurred earlier along the agricultural than forest harvesting gradient and communities showed less species turnover among sites in response to forest harvesting than agriculture. We discuss our results in the context of land use and forest planning.

Q.4.8: Morissette2

**Reducing Risk of Incidental Take in Canada's Boreal Forest**

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Incidental take is the inadvertent harming, killing, disturbance, or destruction of migratory birds, nests, or eggs, and is prohibited in Canada under the Migratory Birds Convention Act (MBCA 1994). Industries (e.g., forest management, oil and gas, power, and mining) found to be violating the prohibitions of the Act may be subject to enforcement and penalties and, as a result industries are looking for ways to reduce risk of incidental take and demonstrate due diligence. Ducks Unlimited Canada (DUC) believes that using Best Management Practices (BMPs) to reduce risk of incidental take of migratory birds by industry will support waterfowl conservation in the boreal forest and assist industry in meeting their regulatory (MBCA 1994) and voluntary (e.g., forest certification) requirements. DUC's Incidental Take BMP specifically targets waterfowl in Canada's boreal forest, and consists of a risk assessment approach, mitigation strategies, and guidance on how to apply the approach. The risk assessment approach combines knowledge of waterfowl ecology including: (1) nesting phenology based on Environment Canada nesting phenology calendars, (2) waterfowl abundance distribution based on DUC National Fish and Wildlife Foundation waterfowl modelling; and (3) waterfowl nest proximity to water, along with industry activity disturbance levels. This approach will help users assess their relative risk of incidental take and identify pathways to reduce that risk. Reducing incidental take is only one means of supporting waterfowl conservation and the Incidental Take BMP is intended for use in conjunction with other waterfowl friendly practices that ensure the long term availability of good quality habitat across the landscape.

Q.4.9: Smith

## The Effect of Delayed Drawdown on Moist-Soil Seed Production

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Wetland managers extensively manipulate wetlands to provide foraging habitat for wintering waterfowl. Providing information for wetland managers to maximize productivity and waterfowl carrying capacity is essential for the future viability of wintering waterfowl in California. Drawdown date is a key factor influencing germination success of wetland plants that provide forage for waterfowl. By delaying drawdown later into spring, wetland habitat is made available for breeding waterfowl and many other species. We examined the impact of delayed drawdown on seed production of several important waterfowl food plants: *Echinocloa crus-galli* (watergrass), *Crypsis schoenoides* (swamp timothy), *Leptochloa* sp. (sprangletop), and *Polygonum pensylvanicum* (smartweed). We evaluated three drawdown dates, one month apart: 15th of March, April and May. To examine the interaction between drawdown date and irrigations, half of the replicates for each drawdown date received a summer irrigation. Irrigations lasted for ten days, and were applied six weeks after drawdown. These treatments were applied to 18 research wetlands, each 1.58 acres in size. Soil cores and vegetation clippings were collected to estimate seed yield, while plant cover and height were measured to evaluate vegetation structure and composition. Undesirable plant species were present in all plots at varying densities. We found that the latest drawdown date (May 15th) in combination with a single summer irrigation resulted in the highest seed production of *E. crus-galli*. Seed production of *C. schoenoides* was found to be at its highest with the March and April drawdowns. Moreover, higher coverage of *Xanthium strumarium* (cocklebur) in spring resulted in lower seed production of *C.schoenoides*, highlighting the importance of managing undesirable species.

Q.4.10: Whitson1^

## Waterfowl Identification Skills by Duck Hunters on the Upper Texas Coast

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The Texas coast is an important destination for waterfowl hunters in the Central Flyway, attracting hunters with a variety of skill, experience, and familiarity with local waterfowl. Regionally, mottled ducks (*Anas fulvigula*) are of conservation and management concern. For example, 2014-2015 regulations allowed a single "dusky duck" (i.e., mottled duck, Mexican-like duck, black duck and their hybrids) in a daily bag, but only after the first five days of the regular season. Under such regulatory structure, hunter identification skills is magnified. We administered a post-hunt, voluntary identification survey of hunters at Anahuac and McFaddin National Wildlife Refuges, on the upper Texas coast, during the 2012-2013 hunting season. Both successful and unsuccessful hunters are required to pass through mandatory check stations, which afforded this survey opportunity. Successful hunters were asked to identify each bagged bird to common name and sex; both successful and unsuccessful hunters were asked to participate in a photographed-based identification quiz. In total, there were 442 successful hunters (89% of total participants). They correctly identified 91% of their harvested birds to species. Gadwalls (*A. strepera*) were the most frequently incorrectly identified harvested duck (33% of all incorrect identifications), whereas 10% of all incorrect identifications were of mottled ducks. However, this is tempered, as of >500 gadwalls harvested, only 8% were misidentified. Conversely, 25% (13/51) of harvested mottled ducks were misidentified as either female mallards (*A. platyrhynchos*) or American black ducks (*A. rubripes*; of which no individuals were ever observed at check stations). Identification success during the photo-quiz for successful hunters dropped to ~70%, while unsuccessful hunters identified 50% of the photographs correctly; mirroring identification success of gadwall and mottled ducks for both hunter groups. These preliminary results indicate that hunter duck identification skills are good for birds in-hand, but may be related to familiarity with commonly harvested species.

Q.4.11: Whitson2^

## Seed Bank Potential of Moist-soil Managed Fallow Rice Fields on the Upper Texas Coast

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The upper Texas coast contains vast areas of wetlands, which provide critical habitats for a large numbers of wintering waterfowl. This region has experienced significant declines in wetland quantity and quality from a variety of sources including agricultural conversion, urban expansion, saltwater intrusion, marsh subsidence, and freshwater inflow reduction. Manipulation of wetland hydrology via intentional inundation and drawdown timing and duration, referred to as moist-soil management, tends to improve wetland habitat by producing high quality food resources for wintering waterfowl. Characterizing potential vegetation community response to hydrologic variations in managed wetlands will increase management efficacy to meet existing and future habitat demands. We conducted a seed bank study using 21 fallow rice fields located on Anahuac National Wildlife Refuge in Chambers County, Texas. We collected 5 soil cores from each fallow rice field. Samples were mixed, evenly divided, randomly assigned to either moist or inundated treatments to stimulate germination, and maintained in a greenhouse for > 150 days. As seeds germinated, seedlings were removed from dishes, placed in separate growth containers, and grown until individual seedlings were identifiable. A total of 9366 seedlings from 65 plant species were identified, 65% of all seedlings were “desirable”, based upon previously published waterfowl food values and criteria. During the first 30 days of monitoring, germination rates of desirable and undesirable seedlings were similar ($P > 0.05$) in both inundated and moist treatments. Between 31-90 days, desirable species seedling emergence outpaced ($P < 0.05$) undesirable seedlings, in both treatments. Finally, 73% of all seedlings were desirable species in both treatments, between 91-150 days. Clearly, fallow rice field seed banks contained valuable waterfowl plants, and regardless of irrigation treatment, these habitats can be successfully managed and provide valuable wintering waterfowl food.

## Q.5: Techniques

Q.5.1: Fowler^

### Using Isotopic Signatures of Arctic and Sub-arctic Nesting Colonies to Determine Breeding Origin of Harvested Lesser Snow Geese

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Stable isotope analyses allow for the investigation of migratory connectivity in bird species where a single capture is more practical than mark-recapture techniques. The ability to determine the origin of individual birds through stable isotope analysis of flight feathers may prove useful for management of the superabundant midcontinent population of lesser snow geese (*Chen caerulescens caerulescens*). Two subpopulations, segregated by arctic and sub-arctic nesting areas, make up approximately 90% and 10% of the midcontinent, respectively. Of the two subpopulations, sub-arctic individuals experience harvest rates higher than their arctic counterparts. Given the large difference in the proportion of arctic and subarctic individuals, continued research on migration strategies and harvest vulnerabilities of geese from different nesting areas may help shape future management strategies to control population size. We characterized isotopic signatures (δ13C, δ15N, δ34S, δ2H) in flight feathers collected from lesser snow geese on most of the important arctic and subarctic breeding areas of the midcontinent population. Our goal was to determine if there are colony specific isotopic signatures that can be used to identifying origins of harvested individuals without leg bands using stable isotope characteristics and a Bayesian likelihood assignment technique. If successful, this method may serve as an additional tool to answer questions regarding migration phenology, proportions of subpopulation harvest during the Light Goose Conservation Order, and subpopulation patterns of connectivity between molt origins and location of fall or spring harvest.

Q.5.2: Gilbert^

**Detection Probability and Disturbance of Waterfowl During Aerial Surveys**

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Aerial surveys of waterfowl have been conducted in the Illinois and Mississippi River floodplains since 1948. These traditional surveys provide an index of waterfowl population size and are used to track migration events, set harvest regulations, and for research purposes. New methods are being evaluated to estimate population size by randomizing survey locations and estimating detection probabilities. We used double sampling to determine a correction factor for waterfowl estimates during fall aerial surveys. Immediately before an aerial survey, a ground observer conducted an intensive survey of waterfowl in predetermined locations from an elevated, unobstructed location where probability of detection was assumed to be 100%. Aerial counts were divided by ground counts for all common species and foraging guilds to determine detection probability. Preliminary results indicate that mean detection rate for all waterfowl was 100.2% (SE = 17.9). Mean detection rate was 115.1% (SE = 21.2) for ducks, 115.2% (SE = 21.5) for dabbling ducks, 95.6% (SE=36.9) for diving ducks, 50.7% (SE = 24.9) for mergansers, and 93.0% (SE = 15.4) for geese. While conducting ground surveys, observers also documented any disturbance to waterfowl caused by aerial surveys. Our preliminary findings indicated that on average 13.1% (SE = 4.1) of waterfowl, 7.5% (SE = 2.9) of ducks, 9.7% (SE = 3.9) of dabbling ducks, 3.7% (SE = 2.2) of diving ducks, 4.5% (SE = 4.5) of mergansers, and 11.1% (SE = 5.8) of geese exhibited a negative response (i.e., flew short distances, swam away, changed behavior significantly) to aerial surveys. Our preliminary findings indicated that on average 5.6% (SE = 3.2) of waterfowl, 2.7% (SE = 1.6) of ducks, 1.2% (SE = 0.8) of dabbling ducks, 2.8% (SE = 2.0) of diving ducks, 4.5% (SE = 4.5) of mergansers, and 4.8% (SE = 4.6) of geese abandoned the survey site and did not return following aerial surveys. With our findings, traditional aerial surveys conducted in the Mississippi and Illinois River floodplains can be used to minimize bias in population estimates associated with aerial survey techniques. In our presentation, we will model detection probability as a function of habitat type, month, taxa, and other factors and present data from fall 2014–2015.

*Speaker; ^Student

Q.5.3: Hill

## Enhancing Prey Availability Damaged by Oil Spill for Migratory Waterfowl in San Francisco Bay

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The November 2007 M/V Cosco Busan oil spill resulted in significant damage to wintering waterfowl, especially surf scoters (*Melanitta perspicillata*) and greater scaup (*Aythya marila*) in San Francisco Bay (SFB). To assess the potential for habitat enhancements, we deployed two types of prey enhancement treatments in SFB: 1) spawning substrates for Pacific herring (*Clupea harengus pallasi*) Eggs On Kelp (HEOK), a significant waterfowl prey item, and 2) substrates for natural mussel recruitment to increase availability and quality of prey. Three HEOK rafts were deployed in Richardson Bay Audubon Sanctuary from October 2014 to April 2015. Of the 12 separate kelp deployments, spawn was recorded on 4 deployments, but recorded 3 times on one particular raft. The total number of herring eggs deposited upon deployed kelp over study duration was estimated at 3,210,290 eggs, equating to a potential caloric energy of 15,185 – 26,003 kJ. A number of species readily colonized deployed substrates. Present in this "fouling community" were: California lyonsia (*Lyonsia californica*) at 52 individuals per m², invasive Asian Mussel (*Musculista senhousia*), which averaged 14 individuals per m², the Blue or Bay Mussel comprising multiple species of the *Mytilius* sp. Complex, which averaged 135 individuals per m² and the Carinate dove shell (*Alia carinata*) which had an average of 5 individuals per m². Bufflehead and scaup showed a dramatic increase of individuals during the spawn period compared to the pre-spawn period and a substantial decline in the post spawn time period. While restoration of eelgrass as a spawning substrate is planned to benefit herring damaged by the Cosco Busan spill, the HEOK rafts and bivalve recruitment methodologies may provide unique benefits to scoters, scaup and other wintering migratory waterbirds that utilize this food source.

Q.5.4: Kilchenstein

**An Improved Technique for Attaching Backpack Transmitters on Diving Ducks**

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Diving ducks present a challenge in reliable tagging and tracking of individuals. Early attempts to use Teflon-based harnesses to attach external transmitters to diving ducks were abandoned after researchers encountered high mortality rates, presumably caused by disruption of the waterproofing layer or other effects. Currently inter-abdominal transmitters are used to track diving ducks, but surgically implanting tags in the field can be logistically challenging, costly, invasive and involves extended hold time for birds. Further, new tracking technologies utilizing solar-rechargeable batteries for increased tag longevity cannot be utilized. Using the captive colony of diving ducks at Patuxent Wildlife Research Center, we are developing an improved technique to attach transmitters to the back of birds by means of a silicone-based harness. This material is stretchable while still maintaining high durability - allowing a degree of flexibility in harness size as birds undergo natural weight fluctuations throughout the year. Preliminary results from captive surf scoters (*Melanitta perspicillata*) show improvements over Teflon-based harnesses, including a reduced behavioral effect in feather maintenance and diving time. In addition, silicone is impermeable to water and maintained its hydrophobic properties for the length of our trials in captive birds – factors important in avoiding disruption of waterproofing. The hydrodynamic properties of transmitter design may also significantly impact diving ducks, as factors of buoyancy and drag impact birds differently than total weight and aerial drag. If successful, this technique will allow attachment of tags that collect data of higher precision, relocation rate, and tag longevity, while vastly reducing handling time and stress to captured individuals. Diving ducks present a challenge in reliable tagging and tracking of individuals. Early attempts to use Teflon-based harnesses to attach external transmitters to diving ducks were abandoned after researchers encountered high mortality rates, presumably caused by disruption of the waterproofing layer or other effects. Currently inter-abdominal transmitters are used to track diving ducks, but surgically implanting tags in the field can be logistically challenging, costly, invasive and involves extended hold time for birds. Further, new tracking technologies utilizing solar-rechargeable batteries for increased tag longevity cannot be utilized. Using the captive colony of diving ducks at Patuxent Wildlife Research Center, we are developing an improved technique to attach transmitters to the back of birds by means of a silicone-based harness. This material is stretchable while still maintaining high durability - allowing a degree of flexibility in harness size as birds undergo natural weight fluctuations throughout the year. Preliminary results from captive surf scoters (*Melanitta perspicillata*) show improvements over Teflon-based harnesses, including a reduced behavioral effect in feather maintenance and diving time. In addition, silicone is impermeable to water and maintained its hydrophobic properties for the length of our trials in captive birds – factors important in avoiding disruption of waterproofing. The hydrodynamic properties of transmitter design may also significantly impact diving ducks, as factors of buoyancy and drag impact birds differently than total weight and aerial drag. If successful, this technique will allow attachment of tags that collect data of higher precision, relocation rate, and tag longevity, while vastly reducing handling time and stress to captured individuals.

*Speaker; ^Student

Q.5.5: Lutmerding

## Bird Banding Laboratory Information and Bandit Data Entry Assistance

Jo Anna Lutmerding[1]*

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Jo Anna Lutmerding, a biologist with the Bird Banding Laboratory (BBL), will be available to provide updated information about the BBL and answer questions about its data entry program Bandit. She will also have information about the process for submitting recapture and resight data to the BBL and important changes to the newest version of Bandit, 4.0.

Q.5.6: Malachowski^

**Extrusion of Coelomically Implanted Radio Transmitters from Hawaiian Ducks**

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Radio telemetry is among the most commonly used tool in waterfowl research, particularly for studies investigating demographic rates, movements, and habitat use. Numerous attachment methods have been developed; however, surgical implantation of transmitters into the abdominal cavity has become a common attachment technique for waterfowl, and several studies suggest that implants outperform external attachment methods in terms of bird survival and breeding performance. Another benefit of abdominal implantation involves high retention rates compared to other attachments techniques (e.g., backpacks, prong and suture, subcutaneous implantation), making abdominal implants an attractive option for studies with information needs throughout the annual cycle. However, loss of abdominally implanted transmitters does occur, and while transmitter extrusion is rarely documented, few studies have tracked birds throughout the year in a setting where confirmation of transmitter extrusion was feasible. We surgically implanted radio transmitters (16.5g) with percutaneous antennas and mortality sensors into 117 adult Hawaiian Ducks (*Anas wyvilliana*; n females = 50, n males = 67) on the island of Kaua'i during November-December 2012 and 2013. Birds were tagged and monitored as part of a study of their annual and seasonal survival, habitat use, movements, and breeding ecology. A properly trained and experienced veterinarian performed all transmitter attachments using standard procedure. We did not implant transmitters in birds undergoing wing molt and females that were gravid or had brood patches. Transmitters did not exceed 3.2% of total body weight (mean = 2.59%). In addition, we banded each Hawaiian Duck with a standard USGS metal leg band and a uniquely coded, field-readable leg band. Radio-tagged birds were tracked and monitored between November 2012 and December 2014. For birds for which we detected mortality signals and/or recovered transmitters without a carcass, we confirmed transmitter extrusion by resighting individuals during band-resight surveys or recapturing individuals during trapping events.

We documented transmitter loss for 9 of the 50 radio-tagged females (18%) and 6 of the 67 tagged males (9%). The mean amount of time elapsed between transmitter implantation surgery and extrusion was 9.3 months (SE = 0.7), but time ranged from 4.9 to 13.3 months. Based on observations of radio-tagged birds in hand and in the field, we believe that transmitter extrusion is primarily occurring through the body wall at the antenna exit site. However, we documented transmitter extrusion from a non-antenna site in one case where a female was actively extruding the transmitter from the abdominal region rather than from the dorsally located antenna site. Although transmitter extrusion is an unexpected and undesirable outcome, we have no evidence to suggest that this process resulted in the injury or mortality of the bird. Of the three birds that extruded tags and that we examined in-hand, all appeared to have healed well and had little or no evidence of scarring at the antenna site or abdominal incision site. Researchers using this transmitter attachment technique are reminded that extrusion can occur at relatively high rates, and loss of transmitters may result in underestimated survival rates in studies where researchers attribute extruded transmitters to mortality events.

Q.5.7: Richmond

## Refining a Monitoring Design for the San Francisco Estuary Midwinter Waterfowl Survey: Challenges and Opportunities

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The San Francisco Estuary is among the most significant coastal wintering and migratory stopover areas along the Pacific Flyway for waterfowl and other waterbirds, and is a particularly important wintering area for diving ducks and sea ducks. Results from the annual Midwinter Waterfowl Survey are used for setting population objectives, planning boat traffic, evaluating effects of restoration, evaluating disturbance impacts, informing harvest regulations for Pacific brant, and evaluating the impacts of environmental stressors such as oil spills and climate change. Counts of wintering waterfowl are difficult to analyze statistically due to patchily distributed but concentrated flocks, resulting in many zeros and a small number of very large counts. We compared simple design-based vs. model-based approaches for estimating waterfowl densities, explored alternative approaches for stratifying the sampling frame to improve the precision of density estimates, and defined a sampling intensity that balances precision and survey cost. With declining federal budgets for migratory bird monitoring, this case study illustrates how existing survey designs can be improved to yield required information at a reduced cost.

Q.5.8: Savoy

## Successful Breeding and Egg Formation of Satellite Marked Common Eiders

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Satellite telemetry has become a widely used technique in delineating seasonal movements and identifying important staging, breeding, molting, and wintering areas of waterfowl. Sea ducks require the use of surgically implanted abdominal satellite transmitters (PTTs), with a percutaneous antenna vertically extending from the back of the duck; this technique has been well established. Studies have documented immediate post-release survival following surgical implantation of PTTs in sea ducks. However, very few studies have investigated the potential effects of PTTs on the breeding success of wild sea ducks, due in large part by the general inability to conduct follow-up surveys in their remote habitats. Studies on captive Lesser Scaup (*Aythya affinis*) and White-winged Scoters (*Melanitta fusca*) found decreased clutch size, egg malformations, and differences in egg measurements between implanted and control individuals. In Massachusetts, Common Eiders (*Somateria mollissima*) nest colonially on coastal islands and often return to the same nest site each year. In May 2015, we captured 7 incubating hen eiders on their nests and implanted them with satellite transmitters, to document seasonal movements. We re-visited the nest sites three weeks later to determine nest fate. We found 43% of the hens successfully hatched young, 43% appeared to have abandoned their nests, and 14% experienced nest depredation. Three hens radio-marked from previous seasons were captured on nest. We measured their eggs and compared measurements to eggs of hens from the same nesting colony not implanted with transmitters. Eggs of implanted hens were not visibly misshapen and measurements were not significantly different ($p = 0.55$) than eggs of unmarked hens. Our follow-up surveys documented nesting success of eider hens captured on nest and implanted with abdominal transmitters during the same season and the successful breeding and apparent normal egg-laying of eider hens implanted in previous seasons.

Q.5.9: Schummer

## Using Go-Pro Video Cameras to Estimate Differential Susceptibility Among Species-Sex Cohorts of Ducks to Capture in Montezuma Confusion Traps

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Capture and banding of ducks is an integral component of waterfowl management. In central New York, Montezuma Confusion Traps (MCTs) are used to capture ducks for banding August – September (preseason) and January – March (winter). Differences in capture among species-sex cohorts can occur because some cohorts are, 1) less available in the population, 2) excluded from capture because of behavioral dominance at trap sites, or 3) more likely to escape from duck banding traps. We viewed 153 hrs of video footage captured by Go-Pro video cameras that were located in MCTs to assess if species-sex cohorts were captured, aggressed upon, and were aggressive in similar proportions to those available in the population (expected population). Cameras were placed in the back of 2 traps 3 times per week, 7 August - 22 September 2014 (Preseason) and 10 January - 20 March 2015 (Winter) to video wood ducks (*Aix sponsa*; Preseason) and mallards (*Anas platyrhynchos*) and American black ducks (*A. rubripes*; Winter). We used Chi-square tests to determine if our observed population that 1) entered traps, 2) were aggressive, and 3) received aggressive behaviors from others were equal to species-sex ratios observed outside the trap (i.e., expected population). Female wood ducks aggressed nearly 2× their expected percentage and received aggression < half their expected percentage. Male wood ducks received more aggression than expected. Sex bias in captures of wood ducks was best explained by a lack of available female wood ducks. Similarly, species-sex bias in captures during winter was best explained by lack of available black ducks at traps. Male-male aggression was most common, but greatest difference in the ratio of entrances into MCTs to deterrence events occurred when male mallards were aggressive towards female black ducks. Combined, availability and behavioral dominance may influence capture rates of female black ducks during winter.

Q.5.10: Sedinger, B.^

**Scaling Nevada's Historical BPOP Data to Adjust for Changes in Survey Design**

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The state of Nevada instituted aerial duck breeding population surveys in 1959. Total duck abundance was determined directly from counts with no associated estimates of error. In 2009 the Nevada Department of Wildlife redesigned this survey to include random linear transects within polygons that defined suitable duck habitat. This change was made so that Nevada could contribute to the Western Mallard model and continental estimates of Mallard abundance. Additionally we were interested in developing population indices for other duck species in Nevada. In order to make the surveys comparable, the old and new methods overlapped from 2010 - 2012. A visual correction factor (VCF) flight was flown in a helicopter in 2009, 2010, and 2011. We analyzed these data sets together in a general linear mixed modeling approach in R. Survey type (old, new, VCF) was delineated by binomial covariates. Beta values for survey type were then used to scale data. We present breeding duck population trends from 1959 – 2015 for Nevada.

Q.5.11: Sheppard^

## Effects of Handling, Holding, and Surgical Times on Survival and Reproductive Performance of Female Mallards

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Abdominally-implanted radio-transmitters have been widely used in studies of waterfowl breeding ecology and habitat selection, but the invasiveness of surgical implantation and variation in the time that animals are held during capture raises important concerns about animal welfare and potential impacts on data quality. Although it is difficult to assess the impacts of handling and marking wild animals by comparing them to unmarked controls, insights can often be obtained by evaluating variation in handling or marking techniques during a given procedure in relation to subsequent survival and reproductive performance. Here, we used data for 240 abdominally-implanted radio-marked female mallards (*Anas platyrhynchos*) from two study areas in New Zealand in 2014 – 2015, to evaluate survival and reproductive effort (e.g., breeding propensity, laying date, clutch size) in response to three different attributes of handling duration and procedures: i) total holding time (first capture until release; $\bar{x}$ = 276.0 mins; range: 205.0 – 529.0); ii) processing time (pre-surgery banding, measurements, and blood sampling of unanaesthesized birds; $\bar{x}$ = 44.5 mins; range: 20.0 – 70.0), and; iii) total time of anaesthetisation (from initiation to cessation of anaesthetic; $\bar{x}$ = 21.9 mins; range: 13.5 – 33.3). We found no evidence to suggest that female survival or reproductive effort was affected by any measure of handling time. Instead, older females in better body condition had greater survival and initiated nests earlier, but had smaller clutch sizes, than younger females. Variation in handling duration and marking procedures associated with abdominal implantation did not appear to impact the quality of data obtained in this study. Our results support previous research indicating abdominally-implanted transmitters have minimal effect on waterfowl and suggest that this marking technique is suitable to use when evaluating reproductive performance and survival of waterfowl.

Q.5.12: Thimot^

**Potential Effects of Subcutaneous Transmitters on a Pursuit-diving Duck**

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Radio telemetry has been an important technique in waterfowl research for several decades. Data from telemetry studies have provided important information on habitat use, movements, and survival of radio-marked ducks throughout the annual cycle. Transmitters have often been attached externally using harnesses or glue and sutures. Despite their widespread use in waterfowl research, external transmitters have been reported to negatively influence survival, reproduction, and behavior of marked ducks. Methods to implant transmitters, such as subcutaneous implants with external antennas, have been developed to help reduce some of these negative effects. Indeed, several recent studies on dabbling- and diving ducks suggest that subcutaneous implants have little impact on survival or reproduction of marked birds, and thus these implants have been recommended for future studies requiring use of marked birds. Despite this, there has been no effort to examine potential effects of subcutaneous transmitters with external antennas on ducks that swiftly pursue their prey underwater (e.g., mergansers). We followed Red-breasted Mergansers (*Mergus serrator*), a medium-sized duck that feeds primarily on small fish, marked with subcutaneous radiotransmitters at a breeding colony in eastern New Brunswick, Canada. A total of 27 female Red-breasted Mergansers were captured at the nest approximately 7-10 days prior to egg hatching and equipped with a subcutaneous transmitter (model PD-2; Holohil Systems Ltd., Ontario) with external antenna length of 15 cm. Our objectives were to evaluate effects of these implanted radiotransmitters on nest success, hatching success, and annual survival of female Red-breasted Mergansers by comparing these parameters to those of a group of unmarked female mergansers. No significant difference was found between nest success of marked females (88%) and of unmarked females (94%). Hatching success was 69% for marked females and 74% for unmarked females. Annual survival was calculated using the Cormack-Jolly-Seber model with program MARK. Mergansers implanted with a transmitter had an annual survival of 82% and unmarked females of 75%. Our data suggest that implanting radiotransmitters subcutaneously in female Red-breasted Mergansers did not negatively impact reproduction and annual survival. We recommend that: 1) future telemetry studies focusing on Red-breasted Mergansers consider using subcutaneously implanted radiotransmitters, and 2) that new research be directed to evaluating the potential effects of these transmitters on other pursuit-diving ducks, and specifically by comparing reproductive and survival parameters between marked and unmarked birds.