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

D.4.1: Janke^

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

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

D.4.2: Schepker^

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

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

D.4.3: Palumbo^

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

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

D.4.4: Foth^

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

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

D.4.5: Pernollet^

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

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

D.4.6: Austin

Habitat Use of Post-breeding Female Lesser Scaup

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