EVALUATING THE RELATIONSHIP BETWEEN LOCAL FOOD AVAILABILITY AND WETLAND LANDSCAPE STRUCTURE IN DETERMINING DABBLING DUCK HABITAT USE DURING SPRING MIGRATION

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THESIS ABSTRACT

Wetlands in the Nebraska's Rainwater Basin (RWB) have decreased by 90% over the past two centuries and are subject to on-going degradation of quality from urban and agricultural land-use practices. Losses in wetland habitat quantity and quality are important because the RWB serves as a critical spring staging area to ~7 million dabbling ducks, including approximately 50% of North America's mid-continent mallard (*Anas platyrhynchos*) population, and 30% of North America's total Northern pintail (*A. acuta*) population. During spring, waterfowl depend on wetland habitat for aquatic invertebrates and plant materials to accumulate the energy and protein needed to complete migration and initiate egg production. If demands for quality food resources are not met, waterfowl may arrive at breeding grounds in poorer body condition, and consequently be less likely to achieve reproductive success. This cross-seasonal effect is believed to be driven by excessive habitat loss at mid-latitudes, introduction of invasive plant species, and depletion of food resources by fall migrants. Given the importance of food resource acquisition at mid-latitude stopover sites and subsequent effects on recruitment, the goal of this study was to improve understanding of food resource availability in wetlands and the relationship to habitat use by spring-migrating waterfowl.

I conducted weekly waterfowl surveys and quantified local habitat characteristics including seed density (kg/ha), invertebrate density (kg/ha), energy derived from food resources (kcal/ha), water depth, wetland area, vegetative cover, and several water quality parameters at 32 wetlands in spring 2014 and 35 wetlands in spring 2015. Additionally, I quantified wetland habitat surrounding each study site by assessing wetland area and number of wetlands (>1ha) within 2.5km and 5km of a study site. Study sites were located on public lands managed by the Nebraska Game and Parks Commission and the U. S. Fish and Wildlife Service, private

conservation easement lands enrolled in the Wetlands Reserve Program (WRP), and on private lands managed for agriculture (cropped and non-cropped).

A set of species distribution models were developed to explain spring dabbling duck density and species richness in the RWB. I hypothesized that a combination of local (food density, energy, water depth, wetland area, and vegetative cover) and landscape variables would explain the greatest amount of variability in dabbling duck density. In 2014 (a dry year), energy, seed density, water depth, wetland area, and wetland density in the surrounding landscape were positively associated with dabbling duck density; however, invertebrate density and vegetative cover had no influence on dabbling duck density. In 2015 (wet year), seed density and energy were positively associated with dabbling duck density; however, water depth, wetland area, vegetative cover, invertebrate density, and wetland area in the surrounding landscape had no influence on dabbling duck density. Wetland area and water depth were the only useful explanatory variables for explaining species richness in 2014, whereas in 2015 dabbling duck species richness was best explained by wetland area and vegetative cover.

I used non-parametric analyses to compare seed density, and true metabolizable energy (TME) at three wetland types; public, WRP, and cropped wetlands. Seed density did not vary among wetland types in 2014 or 2015. Median seed density estimates during both years at public, WRP, and cropped wetlands were 593kg/ha ($\bar{x}$ = 621kg/ha), 561kg/ha ($\bar{x}$ = 566kg/ha), and 419kg/ha ($\bar{x}$ = 608kg/ha) respectively. Seed density was consistent between years for public and WRP wetlands, but varied between years for cropped units ($p < 0.05$). Variation in seed density between years at cropped wetlands was likely influenced by the presence/absence of agricultural waste grains. Cumulative TME varied among wetland type in 2014 and 2015, with greater TME at cropped wetlands (median = 2431kcal/kg) than public (median = 1740kcal/kg) and WRP wetlands (median = 1781kcal/kg), however TME did not differ between WRP and public wetlands. TME was consistent among wetland types between 2014 and 2015. Seed density estimates from this study were statistically greater than estimates currently used for management planning in the RWB, however, TME estimates were statistically less than estimates currently assumed for WRP and public wetlands in the region. My estimates for mean aquatic invertebrate density were approximately 40-fold less than estimates for mean seed density. Benthic communities accounted for 68% of the total invertebrate density, however invertebrate diversity was greater in nektonic communities.

Neonicotinoid synthetic insecticides are believed to have a deleterious effect on aquatic invertebrate communities in agricultural areas, although their occurrence in RWB wetlands were previously unknown. I detected trace levels of neonicotinoids in 92% of water samples collected in wetlands sampled in the RWB during the spring of 2015. I predicted a relatively high detection rate given the intensity of row crop production in the region, though concentrations were lower than expected. Concentrations at 26 wetlands sampled fell below toxicity benchmarks proposed by the Canadian Environmental Quality Guidelines, and only 11% of wetlands sampled had concentrations exceeding the most conservative benchmark proposed by the Environmental Protection Agency. Neonicotinoids concentrations were minimal at wetlands with vegetative buffers strips $\geq$50m between a wetland and a cropped field, relative to wetlands with vegetative buffers strips <50m. Although neonicotinoid levels were below lethal concentrations for all aquatic invertebrates identified in this study, I observed a negative association between neonicotinoid concentrations and aquatic invertebrate density (g/m^2).