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

C.3.1: Hepp

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

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

C.3.2: Dyson^

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

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

C.3.3: Hartke

A Breeding Population Survey for Western Gulf Coast Mottled Ducks

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

C.3.4: Carrlson

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

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

C.3.5: Eichholz

Area Sensitivity of Productivity in Mixed Grass Prairie Upland Nesting Ducks

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

C.3.6: Feldheim

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

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

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

D.3.1: Pöysä

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

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

D.3.2: Craik

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

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

D.3.3: Ward

Changes in Pacific Black Brant Breeding Productivity Through Space and Time

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

D.3.4: Nissley^

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

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

D.3.5: Straub

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

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

D.3.6: Stair

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

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