

THURSDAY, 4 FEBRUARY 2016		
<i>Senate</i>		
13:20 - 15:20	K.3: Population Dynamics (Chair:)	
13:20	K.3.1: Malachowski[^]	Seasonal and Annual Survival Rates and Cause-specific Mortality of the Endangered Hawaiian Duck (Christopher P. Malachowski*, Bruce D. Dugger)
13:40	K.3.2:	
14:00	K.3.3: Messmer[^]	Associations of Western Boreal Forest Duck Populations to Indices of Spring Phenology (David J. Messmer*, Robert G. Clark, Stuart Slattery, Mark Drever, Chris Derksen)
14:20	K.3.4: Sheppard*	Vital Rates of New Zealand Mallards (Jennifer L. Sheppard*, Todd Arnold, Courtney L. Amundson, David Klee, Todd Dennis)
14:40	K.3.5: Leach*	Probability of Mate Change and Its Effects on Demographic Rates of Black Brant (Alan G. Leach*, James. S. Sedinger, Thomas V. Riecke, David H. Ward, W. Sean Boyd)
15:00	K.3.6: Riecke*	Response of Long-lived Waterfowl to Latitudinal Fitness Variation (Thomas V. Riecke*, Alan G. Leach, Jim S. Sedinger, David H. Ward, and W. Sean Boyd)

K.3: Population Dynamics (Chair:)K.3.1: Malachowski[^]**Seasonal and Annual Survival Rates and Cause-specific Mortality of the Endangered Hawaiian Duck**Christopher P. Malachowski^{1*}, Bruce D. Dugger¹¹ Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, 97331, USA, christopher.malachowski@oregonstate.edu

The Hawaiian Duck (*Anas wyvilliana*) is the only endemic dabbling duck remaining in the main Hawaiian Islands. Relatively common during the early 1900s, the Hawaiian Duck has since experienced a significant population decline because of factors that include wetland loss, overharvest, introduced predators, and hybridization with feral Mallards (*Anas platyrhynchos*). Although we know the general causes of population decline, we know nothing about the relative importance of these threats or the particular period of the annual life cycle when their impact is most severe. A critical obstacle in developing population models and effective recovery plans for Hawaiian Duck involves the lack of information on key demographic parameters, such as seasonal adult survival rates and cause-specific mortality. During November 2012 – December 2014, we radio-tagged and monitored 117 adult Hawaiian Ducks (nfemale= 50, nmale= 67) on the island of Kaua'i to estimate sex-specific seasonal and annual survival, determine causes of mortality, and identify factors influencing survival. We captured birds during November-December 2012-2013 using baited swim-in traps at Hanalei National Wildlife Refuge, and we marked birds with coelomically implanted radio-transmitters with percutaneous antennas and mortality sensors. We monitored location, status, and habitat use at least twice per week from December 2012 to December 2014. We supplemented ground-based tracking with periodic aerial telemetry. For each bird location, we recorded habitat type, and we summarized habitat use for each individual by month and life history stage. Each bird was then categorized based on their primary habitat use for each month and life history stage. When mortality signals were detected or if mortality was suspected, we attempted to recover the carcasses as quickly as possible and determine cause of mortality by necropsy and external examination. We will format survival data into a live-dead encounter history and use known-fate analyses to estimate how survival rates vary with covariates. Individual covariates will include body condition index, life history stage, and primary habitat use. Based on the a priori model set and model selection results, we will use Akaike's Information Criterion values corrected for small sample sizes (AICc) and AICc weight to select the most parsimonious models. Based on competitive models, we will determine the amount of evidence for each covariate and estimate effect sizes. Model averaging procedures will be used to estimate bi-weekly survival, and derived estimate procedures will be used to estimate seasonal and annual survival for each sex. Similar to other *Anas*, we predict that females will have lower survival than males, particularly during the breeding season when females are likely more susceptible to predation at upland nesting sites. We also predict that both sexes will have lower survival rates during remigial molt due to increased vulnerability to predation. Last, we predict that mammalian predation will be a disproportionately high cause of mortality since these island-endemic dabbling ducks evolved in mammalian predator-free environments and may lack effective non-native predator avoidance behavior. An understanding of factors influencing adult survival will help inform wetland management efforts, predator control programs, and conservation plans for the endangered Hawaiian Duck.

K.3.2:

K.3.3: Messmer[^]**Associations of Western Boreal Forest Duck Populations to Indices of Spring Phenology**David J. Messmer^{1*^}, Robert G. Clark², Stuart Slattery³, Mark Drever⁴, Chris Derksen⁵

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The western boreal forest (WBF) of North America supports 12 to 15 million breeding ducks annually, and >50% of the breeding populations of several species. The WBF's waterfowl habitat and populations were thought to be relatively stable, but this perception is changing in light of evidence that the region's climate, habitat, and duck populations are dynamic and changing. In particular, advancing spring phenology, as indexed by the duration of spring snow cover, has been shown to be correlated with population dynamics of some species like lesser scaup (*Aythya affinis*; the most abundant boreal duck). To further examine the relationship between spring phenology and duck population dynamics, we used an independent, satellite-observed, index of spring phenology, normalized difference vegetation index (NDVI), which has been successfully applied in other animal ecology studies. For each Canadian WBF survey stratum in the May/June Breeding Waterfowl Survey, we modeled the annual signal of NDVI and extracted several seasonal indices. Our objectives were to evaluate associations of these NDVI covariates to duck population dynamics. We predicted that (1) population growth of late-breeding species would be negatively related to early timing of the start and peak of NDVI-estimated growing season (as in previous studies that indexed phenology with snow cover duration), and (2) population growth rates of all species would be positively related to length of growing season, because longer growing seasons may increase time available for reneating and brood rearing. We also explored the possibility that growing season productivity (area under the NDVI-growing season curve) could be positively related to population growth, through bottom-up enrichment effects. In each case, interactions with latitude were considered, as it is expected that NDVI effects would be strongest at more northerly latitudes where mean growing season length is already very short, seasonality of prey is presumed to be stronger, and for which spring migration is the most protracted. Similar to other studies in the Canadian WBF, we did not observe overall decreasing trends in NDVI variables during the 1982 to 2013 period. For duck populations, we fit models representing Gompertz density dependent growth and controlling for mean survey date, to assess the effects of the NDVI covariates. In our preliminary analysis, estimated effects of NDVI-derived start of season and timing of peak did not clearly support the previous finding on differential responses of species based on timing of breeding. Counter to expectation, several species had negative responses to overall length of season and none were positive. Finally, variation in growing season productivity was weakly associated with only a few species' population dynamics. Overall, most statistically significant NDVI covariate effects were relatively small in magnitude and explained only a small amount of variation in population growth. Mean survey date appeared to be an important factor with a negative effect for several species. This could indicate asynchrony of survey timing and migration or nesting, or this methodological variable could be confounded with an important biological process. Species-specific responses, including implications and caveats will be discussed for the suite of NDVI covariates.

K.3.4: Sheppard[^]

Vital Rates of New Zealand Mallards

Jennifer L. Sheppard^{1*^}, Todd Arnold², Courtney L. Amundson³, David Klee⁴, Todd Dennis¹

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Effective management of wildlife populations requires knowledge of population demographics, including parameters (e.g., vital rates) that affect population size and growth rate. Furthermore, identifying critical habitats required for various stages of the annual cycle (i.e., nesting, brood rearing) is necessary to implement effective management programs. Mallards (*Anas platyrhynchos*) are widely harvested in New Zealand and the primary driver of game bird license sales throughout the country. Yet, despite evidence of pronounced population declines in several regions of the country in the past decade, information regarding demographics of breeding mallards are lacking. We radiomarked 300 female mallards during 2014 and 2015 in two study areas in New Zealand to investigate breeding ecology and survival rates of females, nests, and ducklings. During the 10-month monitoring period, pre-nesting females were tracked three times a week, nests were monitored every 7–10 days, females with broods were tracked every 2–5 days, and post-breeding females were tracked weekly. We determined female age as either after second year (ASY) or second year (SY), and examined effects of female body condition and habitat variables (e.g., nest and brood-site characteristics) in relation to breeding propensity, clutch size, initiation date of the first nest, and daily survival rates of females, nests and ducklings. Mallards laid an average of 10.5 eggs, with larger, older females initiating nests earlier but laying less eggs than HY females. Breeding propensity was 96% and only a few structurally small, HY females did not breed. Some females initiated up to 4 nests and spent as many as 81 days laying or incubating eggs ($\bar{x} = 41.6$, $SD = 17.5$). On average, 82% of females renested following failure of the first nest and 25% of females renested following brood loss. Throughout the 163-day nesting season, cumulative female survival rate was 76.5% with most deaths occurring during post-nesting (e.g., molt) or incubation. Nest survival averaged 56.1% and was positively associated with the number of surrounding roadsides. Females tended to nest along roadsides in dense nesting cover or hedgerows and along ditch banks, whereas females with broods tended to use effluent ponds, drainage ditches, and pastures. Duckling survival was low, but varied tremendously between study sites, averaging 15% in the Waikato site to 30% in the Southland site. In comparison to North American studies, New Zealand mallards had similar adult survival during the breeding season, greater nest success, but lower duckling survival. The extended breeding season in New Zealand allows for female mallards to renest frequently following failure of both nests and broods, but it is unclear whether high breeding propensity, double-brooding, and renesting efforts are enough to offset poor duckling survival rates. Future analyses will include vital rates presented here along with information pertaining to harvest rates and band returns in perturbation and population growth models to further understand factors that affect mallard productivity in New Zealand.

K.3.5: Leach

Probability of Mate Change and Its Effects on Demographic Rates of Black BrantAlan G. Leach^{1*}, James. S. Sedinger¹, Thomas V. Riecke¹, David H. Ward², W. Sean Boyd³¹ Department of Natural Resources and Environmental Science; University of Nevada-Reno, NV 89557, USA, aleach@cabnr.unr.edu² U.S. Geological Survey, Alaska Science Center, 4210 University Drive, Anchorage, AK 99508, USA³ Science and Technology Branch, Environment Canada, RR1 – 5421 Robertson Rd., Delta, British Columbia V4K 3N2, Canada

Arctic-nesting geese, including black brant (*Branta bernicla nigricans*), have a perennial socially monogamous mating system, which we hypothesize results from fitness benefits of fidelity. We hypothesized that after brant switch mates survival and breeding probability may be reduced. Further, we predicted that newly formed pairs would have lower rates of mate fidelity than those having bred together previously. To examine these questions we used longitudinal data of color marked brant breeding at the Tutakoke River brant colony on the Yukon-Kuskokwim Delta, Alaska. From 1990-2014, we encountered 3,066 adult females and 3,055 adult males who had at least one marked mate during their lifetime. Of these, 904 (29.4%) females and 237 (7.8%) males switched mates and bred after being widowed or divorced. We estimated the fitness costs of mate change, for experienced breeders (> 2 previous breeding attempts), using the Barker robust design implemented in Program Mark via RMark. To estimate the probability of mate change we used multi-strata robust design models. We found that adult female survival declined from 0.90 (95% CI \pm 0.01) for females breeding with a familiar mate to 0.85 (95% CI \pm 0.01) for those having changed mates. Males suffered similar reductions in survival and generally survived at rates that were 2% lower than females. Similarly, the probability of breeding in year t+1 for individuals breeding with a new mate was reduced by 15% for females and nearly 50% for males. Mate fidelity in year t+1 was 0.88 (95% CI \pm 0.02) for females and 0.95 (95% CI \pm 0.02) for males breeding with a familiar mate in year t. As predicted mate fidelity was reduced to 0.65 (95% CI \pm 0.14) for females and 0.80 (95% CI \pm 0.15) for males, breeding with an unfamiliar mate in year t. In conclusion we report one of the few demonstrations of long-term fitness benefits of mate fidelity in a long-lived bird. We suspect that mate change results in individuals being unpaired for at least part of the winter thereby reducing their social status in wintering flocks and thus vital rates.

K.3.6: Riecke[^]**Response of Long-lived Waterfowl to Latitudinal Fitness Variation**Thomas V. Riecke^{1,2*^}, Alan G. Leach^{1,2}, Jim S. Sedinger², David H. Ward³, W. Sean Boyd⁴¹ Program in Ecology, Evolution, and Conservation Biology, University of Nevada, Reno, Reno, Nevada, 89557, USA, triecke@cabnr.unr.edu² Department of Natural Resources and Environmental Science, University of Nevada, Reno, Reno, Nevada, 89557, USA³ U.S. Geological Survey, Alaska Science Center, Anchorage, AK 99508, USA⁴ Science and Technology Branch, Environment Canada, Delta, British Columbia V4K 3N2, Canada

When faced with declining environmental conditions, organisms have three options: move, persist, or die. We use a model organism, the Pacific black brant (*Branta bernicla nigricans*), to examine

how individuals and populations of long-lived waterfowl choose among these three options. The black brant is a small, sub-arctic and arctic-nesting goose, occurring in coastal estuaries and wetlands along the Pacific coast. Brant primarily breed on the Yukon-Kuskokwim River Delta (YKD), Alaska, where populations have declined substantially since the 1980's, and remain significantly below historic levels. Concurrently, the brant population on the Arctic Coastal Plain has increased, where gosling growth and post-fledging survival rates on the ACP are greater than those of brant fledged on the YKD. Pre-breeding, non-breeding, and failed breeders from the YKD use the ACP as molting habitat during summer, indicating knowledge of alternate habitats. Moreover, brant wintering distributions have shifted northward, potentially in response to environmental changes. A study of brant population ecology was initiated in 1984 at the Tutakoke River Brant Colony on the YKD. Since the projects inception, greater than 45,000 individual brant have been uniquely marked with tarsal bands, with greater than 100,000 subsequent recaptures, 65,000 non-breeding re-sights, and 2,000 hunter recoveries. Given the observed latitudinal fitness relationships, we used the Barker Robust Design in Program MARK to test for temporal trends in site fidelity and natal philopatry, which would potentially be indicative of an individual-choice based range shift. We did not detect temporal trends in site fidelity, which for adult females was constant, and essentially equivalent to 1. Natal philopatry was related to environmental conditions during growth. These findings have important implications for the conservation of long-lived waterfowl in the face of climate change, where life-history strategies may affect response plasticity to environmental change.