C.4: Climate Change (Chair: Lena Vanden Elsen)

C.4.1: Guillemain

Combined Effects of Climate Change and Fluctuating Habitat Quality on the Distribution of Ducks in Southern Europe

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Changes in waterfowl ranges over the last decades are increasingly reported, both in North America and in Europe. The relative importance of different winter quarters may fluctuate under the influence of changing local habitat conditions, as well as according to general trends caused by global climate change. Several European duck species have shifted their winter range to the North-East, i.e. the distance between breeding and wintering grounds was reduced, in a pattern consistent with a global temperature increase. In northern countries, this could also indicate an increasing proportion of sedentary birds. We compared the geographic distribution of recoveries of bands fitted to Mallard (*Anas platyrhynchos*) and Common Teal (*A. crecca*) in Camargue, southern France, over the last 60 years. Close to 75,000 ducks were banded since the early 1950s. Band recoveries occurred to a much greater extent in the Camargue area than in other parts of the flyways during the last decade compared to earlier years: as opposed to earlier studies, recoveries of Camargue-ringed ducks are increasingly made to the South-West. For migratory Teal, this indicates an increased faithfulness to the Camargue winter quarter. For Mallard, though, some birds may have become around-the-year residents: while the distance from banding site to recovery location was >400 km between the 1950s and 1970s, it is <75 km nowadays. Several hypotheses are proposed to explain these changes in European duck distributions. Survival analyses are also carried out, which help assessing whether changes in geographic distribution have also translated into altered demographic rates. Besides the overriding effects of climate change in the long-term, the present results suggest that local habitat management practices still have the potential to greatly affect the distribution of waterfowl.

C.4.2: Nilsson

Changes in Numbers and Distribution of Wintering Waterbirds in Sweden 1966 – 2015

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During the last fifty years marked increases have been noted in the national wintering populations of most waterbird species in Sweden according to a national monitoring program started in 1966 (from 1967 as a part of the International Waterfowl Counts, IWC). The counts were undertaken by volunteers on about 600 counting units in the southern part of the country each year (areas further north were ice-covered) with country-wide aerial surveys in some years. Inshore species increased from about 174 000 at the first country-wide survey in 1971 to about 600 000 in January 2015. On the other hand the most common wintering species in Sweden, the Long-tailed Duck, decreased from about 1.4 million to 600 000 in 2009-2011. Comparison with the counts in other European countries show that the increases in Swedish waters were to a large extent due to a northwards shift in the distribution of the different species, a pattern that was also apparent within Sweden. The decrease in the number of Long-tailed Ducks was on the other hand part of an all-Baltic pattern. Shifts in the distribution of different waterbird species was related to changes in the hardness' of the winters with smaller ice-coverage in the Baltic in later years. Similar changes were also found in goose numbers in Sweden, but these counts started later (1977/78). For the geese less snow coverage in later milder winters was probably an important driver. During the survey period a number of species established new wintering traditions in the country: the Wigeon, Greylag Goose and Barnacle Goose.

C.4.3: Vanden Elsen^

Factors Influencing Autumn-Winter Distributions of Dabbling Ducks in the Atlantic and Mississippi Flyways

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As climate changes, wildlife managers would benefit from a better understanding of how weather influences autumn-winter distributions of dabbling ducks throughout the Atlantic and Mississippi Flyways of North America. These two flyways include 70% and 73% of hunters in the United States and Canada respectively and winter 50% of the dabbling ducks in North America. Changing climates may influence the availability of dabbling ducks to hunters and other waterfowl enthusiasts that contribute financially and politically to wetlands conservation. Our aim was to determine which weather factors had greatest influence on autumn-winter distributions of gadwall; *Anas strepera*, American wigeon; *A. americana*, American black duck; *A. rubripes*, mallard; *A. platyrhynchos*, blue-winged teal; *A. discors*, northern shoveler; *A. clypeata*, northern pintail; *A. acuta*, and green-winged teal; *A. crecca carolinensis*. Based on dabbling duck life history strategies, we hypothesized that weather-based models would best predict changes in abundance for all study species except for blue-winged teal and northern pintails, which we predicted would be best explained by day length models. We used standardized waterfowl survey data from 25 waterfowl concentration areas and local weather data to model rate of change in relative abundance with weather and photoperiod for each species. We included latitude in models to determine if effects of weather differed by geographic location. Species-specific Weather Severity Index (WSI) thresholds (i.e., the WSI value where duck abundance is neither increasing nor decreasing) were determined. Variation in rate of change in relative abundance of ducks was best explained by weather models that incorporated temperature and snow for all species except blue-winged teal, which was best explained by photoperiod. Variation in models were in agreement with anecdotal observations by waterfowl enthusiasts. Mallards and American black ducks migrated following freezing conditions (at approximately -5°C) that often included snow accumulation, while other dabbling ducks generally migrated prior to the onset of these freezing conditions. Temperature thresholds predicted to cause migration were least for green-winged teal and American wigeon (weekly mean = 10°C), followed by northern shoveler (9°C), gadwall (7°C), and northern pintail (4°C). All study species were also influenced by latitude, indicating a change in response to weather severity and photoperiod dependent on where dabbling ducks were located. Based on these results, dabbling ducks using weather severity as their primary cue for autumn migration will likely experience a northward shift in distribution with increasing temperatures and decreasing snow depth. We suggest using developed WSI thresholds with historical weather data to estimate how dabbling duck distributions may have changed (e.g., 1980 – present). We also suggest that species-specific WSI thresholds be combined with future climate change scenario models to predict future dabbling duck distributions in the Atlantic and Mississippi Flyways.

*Speaker; ^Student

C.4.4: Schummer

Weather Severity Indices for Estimating Influences of Climate on Autumn-Winter Distributions of Waterfowl and Hunter Opportunity and Satisfaction

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Each year, millions of waterfowl migrate from their breeding grounds in Arctic, northern and mid-latitudes to more southern locales to exploit abundant food and wetland resources as freezing wetlands and snowfall progress from north to south in North America. These migrating birds consume and distribute an abundance of plants and seeds, are a cultural resource for waterfowl watchers and hunters (hereon waterfowl enthusiasts), and provide substantial economic benefit through the activities of waterfowl enthusiasts. Recognition of the tangible and intangible importance of this diverse group of birds by waterfowl enthusiasts also gave rise to substantial international efforts to conserve wetlands and associated upland habitats throughout North America. Because of the importance of waterfowl, inter-annual variation in their distribution during the non-breeding season can influence ecological, environmental, cultural, and economic relationships. We developed weather severity indices (WSIs) to estimate autumn-winter distributions of gadwall (*Anas strepera*), American wigeon (*A. americana*), American black duck (*A. rubripes*), mallard (*A. platyrhynchos*), blue-winged teal (A. discors), northern shoveler (*A. clypeata*), northern pintail (*A. acuta*), and green-winged teal (*A. crecca carolinensis*) based on contemporary weather conditions (1980–2000), describe historic changes to weather known to influence migration by these ducks (September – March 1979 – 2013), and forecast their future spatial distributions based on dynamically downscaled climate change scenarios (mid-21st [2046–2065], late-21st [2091–2100]). For all species, the WSI models with the greatest explained variance in the timing of migration included combinations of temperature and snow depth thresholds that predicted decreased abundances of these ducks at northern and mid-latitudes with increasing WSI. Our models predict that the arrival of these ducks from Canada into the U.S. and on to more southern latitudes may become delayed by at least a month by the late 21st century; such a shift would have substantial ecological, cultural, and economic consequences, and necessitate changes to North American-wide conservation efforts.

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C.4.5: Beaman^

Implications of Climate Change for Land Use and Waterfowl Productivity in Prairie Canada

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North America's Prairie Pothole Region (PPR) is both a highly productive agricultural region and a crucial breeding ground for Nearctic waterfowl. Spanning three Canadian Provinces and six U.S. states, this 176 million acre mosaic of native prairie, wetlands, and cultivated crops produces 50-80% of North America's duck population each year. Conversion of native grassland to intensive agriculture, however, continues to fragment and degrade productive breeding habitat for waterfowl and other wildlife. On the Canadian prairies, nearly 60% of native mixed grass prairie and 70% of wetlands have been lost due to the expansion of agriculture. Given the importance of the PPR to North American duck production, continued habitat fragmentation poses a threat to continental waterfowl populations. Moreover, since 90% of land in the Canadian Prairie Provinces is privately owned, it is important that waterfowl conservation organizations understand how private landowners respond to price and policy changes to effectively target habitat conservation. We use an econometric land-use shares model to predict the proportion of total farm area in eight agricultural land-use categories for each of the 39 Census Agricultural Regions in Alberta, Saskatchewan, and Manitoba. Modeled land uses include spring wheat, winter wheat, oats and barley, canola, flaxseed, fall rye, hay, and pasture. The model predicts shares of land devoted to each land use based on expected revenue, landscape characteristics, and climate variables. We project future (2030, 2060, and 2090) distributions of land cover under three International Panel on Climate Change emission scenarios (Representative Concentration Pathways 4.5, 6.0, and 8.5). We then integrate the econometric land-use shares model with Ducks Unlimited Canada's five-species Waterfowl Productivity Model to yield production estimates for Mallard (*Anas platyrhynchos*), Blue-winged teal (*A. discors*), Northern Shoveler (*A. clypeata*), Gadwall (*A. strepera*), and Northern pintail (*A. acuta*) in the PPR given predicted land-use change. Results suggest that warmer, wetter future climates in Prairie Canada will favor intensive row-crops, leading to increased rates of prairie conversion and higher cropland acreage. Preliminary results from integrating the land-use change model with the waterfowl productivity model suggest that climate-driven land-use change is likely to be an important driver of waterfowl distribution and production. Predicted expansion of intensive row crops will generally reduce the availability of productive breeding habitat and thus reduce the ability of the region to produce waterfowl. The ultimate effect of climate and land-use change on waterfowl productivity, however, depends on the climate scenario examined and species considered.

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C.4.6: Baranyuk

Current Status of Lesser Snow Geese on Wrangel Island, Russia

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Wrangel Island snow geese (WISG) are an internationally recognized population of the Lesser Snow Goose.   They winter primarily in British Columbia, Washington, Oregon, and California. Surveys of snow geese on Wrangel Island were initiated in 1969 by Russian scientists and through cooperative Russia and United States government agency efforts, and were conducted annually for over 45 years. During this period, the WISG population declined significantly in the 1970s but increased to about 155,000 in 2011. The increase in this population is due to natural reduction of predation pressure on the Tundra River colony and general warming patterns of the arctic and subarctic. The ratio of Wrangel Island arctic foxes to snow geese nests decreased tenfold (from 1:500 to less than 1:5,000), and foxes on Wrangel Island are no longer a limiting factor for snow geese. As a result of the change in age structure, the population has become more mobile and expanded its distribution. Until recently, WISG was a closed population, with very limited exchange of males occurring mainly in the California wintering grounds shared by geese from the western Arctic population. In 2015 on the Tundra River snow goose colony, there were $107,800 \pm 2,600$ nests and the total spring population increased to 240,000 birds, which does not match intra-population dynamics. We believe that there was a significant proportion of migrants on Wrangel Island, as indicated by a sevenfold increase in the number of blue geese compared to 2011(this year, about 200 blue geese were nesting on Wrangel Island). On the northern wintering area (Fraser-Skagit flock) in 2014-2015, there were 65,000 birds and about 10 were blue geese. On Wrangel Island it appears we are witnessing a sharp increase in the influx of geese from California, possibly from the western Arctic population. In this regard, we propose to renew mass marking of WISG using the latest technology. In 2015, we used satellite images to investigate the possibility of monitoring the colony, and according preliminary results, estimates were close to those of our traditional ground transects.