Second
North American
Sea Duck Conference

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November 7-11, 2005
Annapolis, Maryland

Program and Abstracts

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Second North American Sea Duck Conference

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Suggested Citation:
Perry, Matthew C. 2005. Second North American Sea Duck Conference, November 7-11, 2005, Annapolis, Maryland, Program and Abstracts. USGS Patuxent Wildlife Research Center, Laurel, Maryland, USA. 123 pp.

WELCOME TO THE SECOND NORTH AMERICAN SEA DUCK CONFERENCE

The Management Board and the Continental Technical Team of the Sea Duck Joint Venture are pleased to sponsor the Second North American Sea Duck Conference and hope that all attendees will be rewarded with new knowledge and enthusiasm regarding the status of sea ducks in North America. We are pleased to welcome visitors from other countries who have much knowledge to share regarding their research and management issues with sea ducks.

The mission of the Sea Duck Joint Venture is to promote conservation of North American sea ducks by providing greater knowledge and understanding to effectively manage sea ducks. This conference is a major contribution toward that mission by presenting technical papers, posters, and workshops about all aspects of sea duck biology and management. We wish to thank the planning committee for their efforts in planning and coordinating all activities to make this a successful conference.

Doug Bliss
Co-Chair (Canada)
Sea Duck Joint Venture

Brian Millsap
Co-Chair (USA)
Sea Duck Joint Venture

The Atlantic Sea Duck Team of the USGS Patuxent Wildlife Research Center welcomes you to the Second North American Sea Duck Conference. It is our pleasure to host this conference made up of the most significant sea duck researchers in the world. We chose the location of Annapolis to give you a closer and more intimate association with Maryland and its beautiful and productive Chesapeake Bay. The Bay is the largest estuary in the United States and historically has wintered millions of waterfowl, including high numbers of sea ducks. We hope you have a chance to experience the natural beauty of this area while you are attending the conference.

This conference would not be possible without the generous support of numerous sponsors in the government and the private sector including the Canadian Wildlife Service, the U.S. Fish and Wildlife Service, U.S. Geological Survey (Eastern Region and Western Region), and our own agency, USGS Patuxent Wildlife Research Center. In addition, the Argos Team, Atlantic Coast Joint Venture, Atlantic Flyway Council, Delta Waterfowl Foundation, Ducks Unlimited, Inc. (US and Canada), Friends of Patuxent, Mississippi Flyway Council, Pacific Coast Joint Venture, Pacific Flyway Council, and Sea Duck Joint Venture greatly supported our efforts to provide an enjoyable and productive conference for all. We would also like to acknowledge and thank the individuals on the conference committee that donated numerous hours of their time including Evelyn Adkins, Joyce Stinnett-Baki, Karina Blizzard, Kinard Boone, Caroline Bond, Ed Grimes, Lucy Grimes, Gary Heinz, Larry Hindman, John Holmes, Marcia Holmes, David Kidwell, Regina Lanning, Edward Lohnes, Lois Loges, Glenn Olsen, Peter Osenton, Jerry Persall, Walt Townshend, and Marilyn Whitehead. We hope that all of you enjoy your stay in Annapolis and we greatly appreciate your support and enthusiasm of sea ducks.

Alicia M. Wells-Berlin
Conference Coordinator

Matthew C. Perry
Conference Chair

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INFORMATION NEEDS FOR EFFECTIVE ENVIRONMENTAL IMPACT ASSESSMENT OF MARINE OFFSHORE WIND FARMS ON BIRDS AND THE EUROPEAN PERSPECTIVE

Anthony D. Fox, Mark Desholm, J. Kahlert, I.K. Petersen, and T.K. Christensen

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Long-distance migratory birds are an internationally shared natural resource, protected by international legislation and agreements. The recent upsurge in proposals to construct large numbers of turbines in extensive wind farms in marine offshore areas throughout the world, with their potential adverse effects on birds, has drawn attention to the need to better understand avian interactions with such structures constructed out at sea. In particular, focus will be placed upon the information gaps that need to be filled to support the effective development of environmental impact assessments drafted in association with such constructions. We attempt to define the hazards presented by turbines and to measure their ecological costs to birds. We base the review on the combined experience from two very detailed pre- and post-construction studies carried out at two Danish offshore wind farms and associated experiences from other projects around Europe. The talk will briefly review the methods developed and used to date, especially the types of data needed to measure (i) flight avoidance responses, (ii) feeding distribution avoidance responses and (iii) to estimate and subsequently measure likely collision rates under operating conditions. Emphasis will be placed on defining the problems still to be addressed and in developing the necessary survey and remote techniques to gather the required data. This is especially the case for assessing cumulative impacts from multiple windfarms (rather than the local effects of individual development projects), for example when these are scattered throughout the migratory flyway of individual populations. We shall emphasize the need to assess the energetic costs of avoidance responses and the fitness consequences of these and those of collision mortality through modeling. Such approaches are essential in order to offer mechanisms for assessing the cumulative effect of many wind farms and the combined effects of other anthropogenic factors, which affect population processes in migratory birds.

ABSTRACTS FOR HABITAT PRESENTATIONS

POPULATION DELINEATION, WINTER HABITAT USE AND TIMING OF SPRING MIGRATION OF SURF SCOTERS FROM THE SOUTHERN PORTION OF THEIR WINTER RANGE

David H. Ward[1], Daniel J. Rizzolo[1], Sharon Herzka[2], Marnie L. Shepherd[1], Eduardo Carrera-González, [3] and Daniel Esler[4]

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An estimated 60,000 surf scoters (*Melanitta perspicillata*) winter along the Pacific coast of Mexico and southern California, yet little information exist about their ecology in this region. In winter of 2004-2005, a pilot study was initiated to test the feasibility of capturing and marking scoters with VHF and satellite transmitters in Baja California to gain a more complete delineation of the winter population structure, migration routes and patterns, and breeding distribution of surf scoters in the Pacific Flyway. We present results of complimentary research on the diet, habitat use patterns, migration chronology and linkages between wintering and breeding areas for this overlooked segment of the surf scoter population. In mid-February we captured 21 surf scoters with floating mist nets and marked 5 adult females with satellite transmitters and 8 adults (3F, 5M) and 6 juveniles (3F, 3M) with VHF transmitters in San Quintin Bay, Baja California. Radio-marked scoters primarily used this bay during daylight hours and nearly all moved <3 km offshore at night. Birds fed during day (91% of the detections) in channels and intertidal eelgrass (*Zostera marina)* beds. Feeding did occur at night but only accounted for 20% of detections. Diet of the scoters will be determined from stable isotope analyses of tissue and blood and from examination of stomachs of hunter-killed and collected birds. About 70% of the population in the bay was adults and females were more abundant than males in all age classes during early spring. Unlike more northerly wintering areas where males dominate, we detected 1.5 times as many adult females as adult males at San Quintin Bay, supporting the concept of a latitudinal gradient in the age and sex composition of surf scoters. Spring migration was first detected in mid-April with the northward departure of two of the satellite-marked scoters. Other radio-marked birds followed over the next couple of weeks suggesting that the spring migration may be relatively protracted for this population. The southern portion of the winter range may support a younger more female-biased population and play a key role in the recruitment process for surf scoters of the Pacific Flyway.

PRELIMINARY CHARACTERIZATION OF MIGRATION AND BREEDING GROUNDS ASSOCIATED WITH SURF SCOTERS WINTERING IN WASHINGTON STATE FROM ONGOING TRACKING OF SATELLITE AND VHF TRANSMITTERS

David Nysewander, Joseph Evenson, Bryan Murphie, Thomas Cyra, Briggs Hall, Dyanna Lambourn, Don Kraege, Daniel Esler, Sean Boyd, John Takekawa, Susan Wainwright-De La Cruz, and David Ward

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Scoters have experienced significant declines in numbers over the last 25 years in the marine waters of Washington State; however little was known until recently of movements and population demography of either the wintering surf scoter (*Melanitta perspicillata*) or the white-winged scoter *(Melanitta fusca*) populations on the west coast and how they might relate to each other. The surf scoter makes up, on average, 65% of the scoters found in Washington during the winter and may be the largest contributor to the sea duck declines that have occurred here during this period. Large concentrations of surf scoters were historically associated with some of the large herring spawning events that occurred in Washington State in the winter and spring, even as late as early May. A number of these herring spawning events have declined drastically over the last 25 years and we wished to examine the relationship between surf scoters and these events in more detail as well as see what part of the continental population of surf scoters contributed to those that winter in Washington. Focus studies started in 2003 and are scheduled to continue until 2006 in Washington using satellite and VHF transmitters for the purpose of documenting the patterns of distribution and fidelity to winter and spring foraging areas, night concentrations, migration routes, breeding ranges, and molting areas of those surf scoters associated with wintering in Washington. Fidelity to wintering sites between years is examined to determine what proportion of surf scoters return to the marine waters of Washington. We examine what evidence for immigration or emigration of scoters might occur between the Pacific wintering areas between years. We also compare scoter population trends from the USFWS & CWS Waterfowl Breeding Population and Habitat Survey, from the strata in the Canadian interior where Washington scoters breed, with wintering trends from Washington State. Three years of a four-year project have now been completed, suggesting the following: 1) Distinct differences in distribution and movement exist between the two main scoter species, between male and female scoters within each species, and between different flyway subpopulations of surf scoters, such as those from San Francisco Bay and Puget Sound. 2) The time spent by adult (ATY) scoters in marine areas is considerable, 9-10 months for males and 8-9 for females, and often includes the molting flightless period. 3) Western Washington contains important wintering and spring staging areas used by scoters as well as summer molting areas. 4) These spring staging areas also attract a certain proportion of scoters wintering in San Francisco and Baja, Mexico. 5) Scoters return daily and yearly often to the same locations, expressing considerable site fidelity. 6) Several different patterns of scoter association with herring spawning and certain marine habitats were observed.

ENVIRONMENTAL CHANGES AND BREEDING POPULATION TRENDS OF WATERFOWL

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We modeled the impact of eutrophication, winter severity, weather conditions during breeding and water salinity on the breeding populations of ten waterfowl species in the archipelago of southwestern Finland in the northern Baltic Sea. Most studies until now only document bird population changes without connecting them with environmental changes. However, seabirds are regarded as good indicators of environmental changes, and they may help to reduce the gap in our knowledge of marine ecosystems under stress. The environmental problems of the Baltic Sea are to a great extent also faced by the other seas of the world. The main threat to the Baltic Sea is eutrophication, which is also recognized as one of the major threats to coastal marine ecosystems on a global scale. There are few studies about the effects of climate change on seabirds, but in some cases, it has been shown to affect oceanic seabirds by diminishing their food resources. In the Baltic Sea, climate change may affect the breeding performance of waterfowl by affecting the weather conditions during breeding or the condition of birds after the winter. In order to model the impacts of environmental factors on the populations of our target species, we used generalized linear models and the program TRIM (TRends and Indices in Monitoring data). We found that the goldeneye (*Bucephala clangula*), coot (*Fulica atra*) and velvet scoter (*Melanitta fusca*) decreased with increasing eutrophication. The goldeneye, coot, mallard (*Anas platyrhynchos*), mute swan (*Cygnus olor*), and eider (*Somateria mollissima*) were most vulnerable to winter severity. We did not find evidence for impacts of breeding-time weather or water salinity on the population trends. Our results suggest that eutrophication and severe winters may diminish waterfowl populations. We also discuss alternative explanations to the population trends, such as the effects of predation and disturbance. This is the first attempt to quantitatively show the connection between waterfowl population changes and several simultaneous environmental changes. If changes in bird populations and their demographic processes reflect environmental changes, bird monitoring can be used as a biological early-warning system of complex and unexpected environmental changes. An early warning, in turn, is the prerequisite of the most cost-effective and realistic management measures. In order to understand seabird population changes, there is a need for long-term environmental data, as well as data on population dynamics, such as breeding success and recruitment. More should also be known about the dynamics of marine ecosystems and the interactions between seabirds, their food resources and the environment.

HABITAT USE BY SCOTERS IN RELATION TO ENVIRONMENTAL ATTRIBUTES AND SHELLFISH AQUACULTURE IN BRITISH COLUMBIA

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Coastal British Columbia is an important wintering area for surf scoters (*Melanitta perspicllata*) and white-winged scoters (*Melanitta fusca*). We studied habitat use of scoters in three different locations of British Columbia: Baynes Sound, Barkley Sound and Malaspina Inlet. These areas represent different habitats and varying levels of shellfish aquaculture. The purpose of this study was to determine environmental features corresponding to scoter winter distributions and to assess the effects of shellfish farming on scoter habitat use. Baynes Sound is dominated by unconsolidated intertidal substrate, broad intertidal flats, and numerous estuaries with high fresh water inflow, and holds large numbers of both surf and white-winged scoters. We found that scoter habitat use in Baynes Sound was driven primarily by natural environmental attributes, although this area is heavily exploited for clam aquaculture. Scoter densities were highest in areas with wide intertidal zones, sand sediments, and high densities of clams. Shellfish aquaculture was not identified as an important factor affecting scoter habitat use in Baynes Sound. Malaspina Inlet is a well-protected area with steep rocky shores and a moderate degree of shellfish aquaculture. Oysters, and to a smaller degree, mussels are grown suspended under rafts and buoys. Surf scoters are the only scoter species numerous in this area. Their distribution was positively related to shellfish aquaculture operations, where birds were attracted by mussels fouling shellfish farming structures. Rocky shores were the dominant habitat type in Barkley Sound, which is somewhat exposed to the open Pacific Ocean. Oyster and mussel farming are the most common shellfish aquaculture activities, although shellfish farming is not extensive in Barkley Sound. Surf scoters far outnumbered other scoter species in this area, and their densities were positively associated with gravel beaches, rockweed, and eelgrass beds. Surf scoters were also associated with shellfish farming activities in this area. In summary, white-winged scoters used habitats with broad intertidal zones, sand sediments and high densities of clams. Surf scoters exploited more diverse habitats ranging from soft bottom intertidal flats with clams to steep rocky shores with mussels. We didn't detect detrimental effects of shellfish aquaculture activities on scoter habitat use in our study sites. On the contrary, surf scoters seemed to be benefiting from oyster and mussel farming, where birds were attracted by mussels fouling aquaculture structures.

HABITATS USED BY BLACK AND SURF SCOTERS IN EASTERN NORTH AMERICA AS DETERMINED BY SATELLITE RADIO TELEMETRY

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Satellite radio telemetry was used to determine the movements and habitats of black scoters *(Melanitta nigra)* and surf scoters (*Melanitta perspicillata*) in eastern North America. A total of 21 surf scoters were instrumented during five years (2001-05) and 32 black scoters were instrumented during three years (2002-04) with implanted PTT 100 satellite transmitters (39 g) with external antenna. Nesting habitat of black scoters was more open than surf scoters (44% vs. 11%), whereas nesting habitat for surf scoters was located in more forested areas (66% vs. 20%). Locations of black scoters in breeding areas on average were at significantly higher latitude and lower elevations than sites used by surf scoters. Satellite telemetry determined that James Bay was the major molting area for male black and surf scoters, although some males molted along the coast of Labrador-Newfoundland. Black scoters instrumented on the Restigouche River, which is a major staging area, were widely distributed along the Atlantic Coast from Cape Cod to Georgia during winter. Major wintering areas for black scoters were Cape Cod (Martha's Vineyard and Nantucket Island), Long Island, and New Jersey. In these northern marine wintering areas, black scoters were located farther from shore (4.2 km) and in deeper water (8.3 m) than black scoters in more southern estuarine areas, where distance from shore was 3.1 km and water depth was 5.2 m. Surf scoters instrumented in Chesapeake Bay in late winter showed a strong tendency to return to the Bay the following winter after they had migrated to and from breeding areas. In Chesapeake Bay, black scoters and surf scoters were located mostly in mesohaline areas that had similar water depths (5.1 m vs. 7.5 m) and distances from shore (3.0 km vs. 2.9 km). Distance from shore and depth of water increased over time during the winter for both species. Updated information from the ARGOS Systems aboard the NOAA satellites on scoter movements was made accessible on the Patuxent Website.

HABITAT FEATURES ASSOCIATED WITH THE DISTRIBUTION OF BREEDING PAIRS OF BARROW'S GOLDENEYE IN EASTERN CANADA

Bruno Drolet, Michel Robert, and Jean-Pierre L. Savard

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In 2000, the eastern North American population of Barrow's goldeneye (*Bucephala islandica*) was listed as being "of Special Concern" by the Committee on the Status of Endangered Wildlife in Canada, and is now on the Canadian List of Wildlife Species at Risk under the Species at Risk Act. This small population, estimated at about 1,200 pairs, faces a number of threats on its wintering and breeding grounds: maritime shipping and oil spills, contamination, and breeding habitat loss via forest exploitation. In 2001, we air-surveyed 412 lakes in a drainage basin located in the core breeding area of the eastern North American population of this species. Using logistic regressions, we examined relationships between the occurrence of Barrow's goldeneye and 20 biotic and abiotic habitat attributes determined at various scales. This species was associated with fishless lakes, lake altitude and the mean slope of the surrounding landscape (500m radius). The model performed better in the determination of absence in low potential areas (low altitude lakes) than of presence in high potential areas (high altitude lakes). This could be due to low breeding densities in optimal areas and the associated difficulty of establishing strong habitat relationships for a species at risk that is physically unable to occupy all suitable habitats. At the landscape scale, lakes used by Barrow's goldeneye (over 600 m in altitude) formed large patches that could be predicted by the proposed logistic model. Considering the importance of determining potential breeding habitats for this species in order to implement adapted forest management practices, the accuracy of the model will be tested in 2005. Survey data from 600 lakes distributed across the entire breeding range will be used. The results of this study will be presented.

ABSTRACTS FOR POPULATION DEMOGRAPHY PRESENTATIONS

POPULATION DYNAMICS OF PACIFIC COMMON EIDERS ON THE YUKON-KUSKOKWIM DELTA, ALASKA

Heather Wilson[1], Abby N. Powell[1], Paul L. Flint[2], and Tina L. Moran[3]

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Pacific common eiders (*Somateria mollissima v-nigrum*) have undergone precipitous declines in Alaska and throughout western North America, prompting management concern. We incorporated past data collected by the Yukon Delta National Wildlife Refuge (YDNWR) and USGS Alaska Science Center (ASC) with more intensive recent studies, to investigate the primary underlying processes affecting population dynamics of breeding Pacific common eiders on the Yukon Kuskokwim Delta (YKD) in western Alaska. We estimated survival and productivity of adult females and examined factors affecting these vital rates across a range of breeding areas from 1991-2004. We used 10 years of capture-recapture data, consisting of 268 recapture events from 272 uniquely marked individuals, to investigate temporal, geographic, and environmental patterns in adult female survival. Consistent with life-history predictions for long-lived species, we found little support for variability in apparent survival; mean: 88% (SE ± 2%). However, recapture rates varied markedly across years and study areas (range: 2% to 61%), averaging 38%. To examine productivity in Pacific common eiders we used data from 2114 individual nests over 14 years of study. We found productivity to be highly variable; timing of nest initiation, clutch size, and patterns of daily nest survival all varied across sites and years. Our best model suggested that daily nest survival decreased with later initiation date and increased with age of the nest. Estimated nest success ranged from 1 to 83% among study areas and years and average productivity was 0.98 female ducklings per hen per year. Based on local demographic rates, we developed a population model and calculated the population growth rate (λ) and stable age distribution. We used perturbation analyses to examine the relative effects of survival and reproduction on λ. We used viability analyses to examine probability of population persistence for 50 to 100 years into the future. Our goal was to provide local and regional managers with modeling tools for use in future studies and to aid in developing effective management strategies for the long-term viability of Pacific common eiders on the YKD.

EVIDENCE OF ENVIRONMENTAL EFFECTS ON DUCKLING SURVIVAL AND GROWTH IN SPECTACLED EIDERS

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We studied the growth and survival of spectacled eider (*Somateria fischeri*) ducklings to 30 days of age along the lower Kashunuk River on the Yukon-Kuskokwim Delta from 1995 to 2000. We replicated this study at a second site, Kigigak Island, in 1999 and 2000. Age adjusted estimates of duckling weight and survival at 30 days post-hatch were highly variable. Duckling survival was consistently higher on Kigigak Island in 1999 and 2000 averaging 67%, while survival on the Kashunuk River averaged 45% during the same time period. Duckling survival was negatively related to hatch date at both sites in all years. At the Kashunuk River site our data support models that indicate age adjusted weight varied with habitat type and hatch date. Spatial variation in age adjusted weight was inconsistent with ducklings from Kashunuk River being heavier in 1999, while ducklings from Kigigak Island were heavier in 2000. However, we found a positive correlation between 30-day duckling survival and age adjusted weight, suggesting a localized environmental effect on both parameters. We suspect that variation in wetland salinity may be influencing these relationships. Differences in predator communities and/or predation pressure may explain geographic variation in survival rates; but this explanation conflicts with the positive relationship between survival and growth. We conclude that predation may be the proximate mechanism of mortality but habitat conditions are the ultimate factors influencing survival. Geographic variation in rates of duckling growth and survival suggest that spatial heterogeneity in population vital rates is occurring at multiple levels. Our data indicate that in spite of the depressed population status of spectacled eiders, high quality brood rearing habitat appears to be limiting at some locations, in some years. Thus, management actions focused on altering predator populations may have little effect on spectacled eider recruitment.

BREEDING CONDITION AND NEST SUCCESS OF KING EIDERS: DOES BREEDING AFFECT SURVIVAL?

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Differences in fitness have lead to the evolution of trade-offs between various life history traits. If present, detection of such trade-offs is an important step toward understanding ecological pressures and the evolution of life-history traits. To investigate life history trade-offs we used multi-state models to investigate annual patterns in nest success and breeding condition of female king eiders (*Somateria spectabilis*) from 1996-2002 to (1) estimate their effects on survival and (2) measure the effects of annual nest initiation on breeding success and nutrient reserves. King eiders are a good study species to test costs associated with reproduction and nutrient reserves as they are long-lived, breed and winter in northern latitudes, and rely heavily on stored nutrients for reproduction. We found no relationship between reproduction and future survival. In contrast, our results suggest that successful nesters had higher survival and that these individuals tended to continue to breed successfully. Based on the estimated number of females in each stratum (successful vs failed nester), the proportion of the population composed of successful nesters declined with increasing population size. Importantly, the declining probability of breeding successfully did not correlate with annual nest success estimated using Mayfield's method. This has wider implications about the relative importance of considering breeding probability, vs a sole focus on nest success, in understanding waterfowl population dynamics. Further, the probability of changing states from failed nesting or poor condition to successful nesting or good condition did not improve in years of early breeding. In contrast, recapture probability declined with nest initiation date, suggesting that fewer eiders were available for capture during years of late nesting. Lastly, individuals in good condition tended to remain in good condition, and individuals that were in poor condition the previous year tended to remain in poor condition, suggesting variation in individual quality.

RECRUITMENT RATES IN HARLEQUIN DUCKS: WHEN DO WE BECOME CONCERNED?

Daniel Rosenberg and Michael P. Petrula

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Harlequin (*Histrionicus histrionicus*) ducks are generally characterized as K-selected species with variable and low annual productivity compensated by high adult survival and long life spans. Thus, population stability depends upon high adult survival and a few successful years of reproduction, generally measured as recruitment. Recruitment, the process of adding young to the population, includes natality and mortality prior to first breeding. Young harlequin ducks do not enter the breeding population until their 2nd or 3rd year and consequently have a relatively greater risk of mortality before reaching sexual maturity than r-selected species. Recruitment is difficult to measure directly and must be estimated. Estimates of recruitment are often derived from studies conducted on relatively small areas of the breeding grounds and may be different from estimates obtained from larger wintering populations. We examined sex and age ratios, and trends for a group of harlequin ducks wintering in Prince William Sound, Alaska from 1997 to 2005. We used age ratios (the number of immature males to adult males) to index recruitment and assessed recruitment rates in the context of population trends. Differences in age ratios may indicate recent differences in breeding propensity, breeding success, or juvenile or immature survival. Annually, we counted approximately 5,000 ducks along 750km of shoreline. We observed little variation in abundance and sex ratios over the course of the study. However, recruitment varied annually. Sex ratios in Prince William Sound were skewed towards males in all years, averaging 40.9 females per 100 birds (range = 39.4- 41.9). Age ratios averaged 6.8 immature males per 100 males (range = 4.5-8.6). Similar recruitment rates were reported from studies that examined age ratios of wintering ducks in British Columbia from 1994-2000. With delayed maturity actual recruitment rates would be lower than observed in either study. We observed relatively little annual variation in recruitment and interpret the recruitment rates we observed as indicative of a stable population.

ESTIMATING POPULATION ABUNDANCE AND MAPPING DISTRIBUTION OF WINTERING SEA DUCKS IN COASTAL WATERS OF THE MID-ATLANTIC

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Survey design for wintering scoters (*Melanitta sp.*) and other sea ducks that occur in offshore waters is challenging because these species have large ranges, are subject to distributional shifts among years and within a season, and can occur in aggregations. Interest in winter sea duck population abundance surveys has grown in recent years. This interest stems from concern over the population status of some sea ducks, limitations of extant breeding waterfowl survey programs in North America and logistical challenges and costs of conducting surveys in northern breeding regions, high winter area philopatry in some species and potential conservation implications, and increasing concern over offshore development and other threats to sea duck wintering habitats. The efficiency and practicality of statistically-rigorous monitoring strategies for mobile, aggregated wintering sea duck populations have not been sufficiently investigated. This study evaluated a 2-phase adaptive stratified strip transect sampling plan to estimate wintering population size of scoters, long-tailed ducks *(Clangua hyemalis)*, and other sea ducks and provide information on distribution. The sampling plan results in an optimal allocation of a fixed sampling effort among offshore strata in the U.S. mid-Atlantic coast region. Phase 1 transect selection probabilities were based on historic distribution and abundance data, while Phase 2 selection probabilities were based on observations made during Phase 1 flights. Distance sampling methods were used to estimate detection rates. Environmental variables thought to affect detection rates were recorded during the survey and post-stratification and covariate modeling were investigated to reduce the effect of heterogeneity on detection estimation. We assessed cost-precision tradeoffs under a number of fixed-cost sampling scenarios using Monte Carlo simulation. We discuss advantages and limitations of this sampling design for estimating wintering sea duck abundance and mapping distribution and suggest improvements for future surveys.

APPARENT ANNUAL SURVIVAL AND NEST SUCCESS OF PACIFIC COMMON EIDERS IN CENTRAL ARCTIC CANADA

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Between 1976 and 1996, North American population indices of Pacific common eiders (*Somateria mollissima v-nigra)* declined by more than 50% based on spring migration counts at Point Barrow, AK. Although the population trend is based on infrequent surveys (4 spring migration counts over 20 years), there is general agreement of concern for the status of Pacific common eider populations. Reasons for the decline are unknown, but are either a function of decreased annual survival, decreased recruitment, or both. In 2001, we initiated a study to estimate annual survival for breeding females, and nest success over a five year period in a core breeding area for Pacific common eiders in the central Canadian arctic. In addition, we monitored nest initiation dates, nest site selection, predation, and influences of sea ice to evaluate their effects on nest success and ultimately recruitment. Eiders were captured and marked prior to nesting between 15 - 30 June and resighted during 19 June - 30 July in years 2001-2004. Although results should be considered preliminary and interpreted with caution at this time, capture-recapture analysis based on open population models indicated a marked decline in apparent annual survival of breeding females over the available 4 years of study (2001: 0.74 ± 0.07 SE; 2002: 0.66 ± 0.06; 2003: 0.57 ± 0.07; n = 190). We conducted nest searches between 28 June and 18 August on islands in marine and freshwater environments and calculated a Mayfield nest success estimate. Nest success for all 4 years combined was consistently greater on freshwater islands (0.57 ± 0.001, n = 951) than on marine islands (0.26 ± 0.002, n = 1409), although nesting on marine islands is more typical throughout the Pacific common eider's range. Median nest initiation dates were similar among years, and were approximately 1-2 weeks earlier at the freshwater islands (27 June) than at the marine islands (6 July). The overwhelming cause of nest failure was predation, and observations suggested that mammalian predation caused greater complete nest loss on an island than avian predation. Results from our study provide valuable information to evaluate changes in population trends, however further research is necessary to determine the relative contribution of each of these population parameters to Pacific common eider population dynamics.

POPULATION DYNAMICS OF MERGANSERS: INFERENCES FROM HISTORIC AND CONTEMPORARY DATA SETS

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As with eider and scoter populations 10 years ago, little is known about the habits and ecology of common (*Mergus merganser*), red-breasted (*M. serrator*), and hooded mergansers (*M. cucullatus*). While North American trend data suggests that all three merganser species are stable, if not increasing at the continental scale, our understanding of these trends and their relation to regional scale population demography is limited. Breeding and wintering distributions of all three species differ markedly across North America, likely because of species-specific nesting habits, rates of dispersal, and responses to the most recent retreat of Holarctic glaciers 20,000 years ago. As a result, regional populations, such as the Great Lakes or south-central Alaska, may differ demographically and genetically. We used both historic (genetic) and more contemporary (mark-recapture) data collected from across North America for common and hooded mergansers. Samples were collected from across North America and screened for variation using primers that amplify domain I of the control region of mitochondrial (mt) DNA. Band recovery information was obtained from both U.S. and Canadian banders. Estimates of annual survival and recovery rates by region were summarized using Program MARK. Locations of band recoveries were plotted on maps. Initial analyses indicate geographic variation in survival and migratory tendency for available banding data. Surprisingly, band recovery rates for common mergansers were as high as documented for some species of dabbling ducks. Genetic analyses provide information on both population differentiation and historical demographic patterns. We argue that the combination of demography and genetics allows greater inference into patterns of gene flow and demography.

LIMITED FIDELITY IN HARLEQUIN DUCKS WINTERING NEAR DUTCH HARBOR, ALEUTIAN ISLANDS, ALASKA

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Dutch Harbor, on Unalaska Island, is the hub for Berring Sea and northern Gulf of Alaska fisheries and is the busiest fishing port in the United States. From November through April large concentrations of sea birds and sea ducks (including Steller's eiders *(Polysticta stelleri)*, long-tailed ducks *(Clangula hyemalis)*, black *(Melanitta nigra)* and white-winged *(Mulanitta fusca)* scoters, and harlequin ducks (*Histrionicus histrionicus*)) use the waters around Dutch Harbor. During the winters 2001-2005 we used floating mistnet sets to capture harlequin ducks at five sites near Dutch Harbor. In 2004, we fitted 32 harlequin ducks with VHS transmitters and used triangulation to follow their local movements several times daily during February - March. From a total of 373 captures across years, only 6 (1.6 %) were ever recaptured and only 4 were recaptured across years. We used 2004 telemetry data to calculate movement probabilities among broad area classifications. Twelve of our radio transmittered birds died (≥6), lost their radios (≥1), and/or emigrated and were not included in our analyses of fidelity. We used multistate mark-recapture models to estimate the transition probabilities among areas. The probability of moving between sites on sequential days ranged from 0-0.47 and the probability of using multiple sites within a single day was 0.32. Only four birds used one site exclusively through the tracking period. The mean minimum convex polygon home range was 326.5 ha (56.2 s.e.). This mean home range size may be underestimated if birds also used areas outside the range of our tracking antennas. Our results are in contrast to other studies in Prince William Sound, Alaska and British Columbia where within and across year fidelity to specific sites has been a hallmark of wintering harlequin ducks. In those studies marked birds were consistently resighted within years and recaptured across years along the same few kilometers of coastline. Reasons for these differences may be related to: intra-specific competition, the distribution of food relative to predation pressure, and inconsistent or patchily distributed food supply.

ABSTRACTS FOR POPULATION DELINEATION PRESENTATIONS

DEFINING POPULATION UNITS FOR CONSERVATION OF SEA DUCKS: WHAT ARE WE LOOKING FOR?

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Defining population segments as appropriate "management units" is a critical aspect of conservation; the Sea Duck Joint Venture recognizes this and considers population delineation a high priority as conservation efforts are directed at sea ducks. However, the concept of "management units" is imprecise, and is defined differently by varying parties, following ecological, political, or taxonomic criteria. Based on definitions from the literature, we argue that appropriate management units should be described using population biology concepts, in which management units are aggregations (or spatial scales for continuously distributed species) that are demographically independent, that is, units for which contemporary population dynamics are determined primarily by intrinsic rates of survival and productivity rather than immigration or emigration. We offer examples of these issues using sea ducks and other waterfowl to illustrate the difficulties and importance of defining management units. These issues become much more challenging for migratory species. There may be conservation concerns that require definition of management units separately for different annual cycle stages, or interest in determining whether management units can be described throughout the year. Finally, we conclude that definition of conservation units requires clear consideration of goals at the outset. For example, at what level do we consider population levels demographically independent (dispersal constitutes 1%, 5%, 10%, or 50% of numerical change)? At what geographic scale are we really interested (continental, flyway, state/provincial, local)? What a priori expectations come from our understanding of the history and biology of the species? Finally, what resources are available to address the topic? We suggest that consideration of these issues is long overdue, and hope that these ideas will lead to clarification of definitions surrounding population delineation, and appropriate interpretation of data types commonly used to address these issues.

DEFINING POPULATION UNITS FOR CONSERVATION OF SEA DUCKS: CONTRASTING GENETIC AND DEMOGRAPHIC CRITERIA

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Several tools can be used to examine population differentiation and identify appropriate conservation units, including genetic and demographic analyses. In this presentation, we discuss the benefits and challenges associated with independent and combined uses of these approaches. Many of the challenges stem from a frequent misunderstanding or misinterpretation of data that is obtained through genetic and demographic methods. Additionally, many are often frustrated when study results from one marker type is markedly different than obtained with a second marker type. In this talk, we review how genetics and demographics can be used to measure spatial and temporal variation in population differentiation. For example, if population segments show evidence of genetic differentiation, one can strongly infer that these segments also are demographically independent. Conversely, failing to reject a hypothesis of panmixia using neutral genetic markers cannot be interpreted as evidence for lack of short-term demographic independence. Because genetic data reflect both historical and contemporary exchange, genetic signatures can persist over long temporal scales. Thus, direct measurements of movement (using bands, radios, stable isotopes, etc.) can be particularly useful for disentangling historic gene flow from more contemporary levels of movement. Managers should not be surprised if genetic and demographic data show different patterns, because of the different temporal scales to which they apply. Indeed, this is a common occurrence in ornithological studies. We review recent cases that highlight the benefit of a combined marker approach, and offer some suggestions on how best to interpret studies in which only a single marker type is used. For example, one shortcoming of demographic data is the cost and methodological challenges associated with accurately quantifying movements of individuals across multiple years and study sites. Yet such data is often very useful for interpreting population genetic data. Thus, we recommend a multiple marker approach for a better understanding of population demography and delineation.

POPULATION STRUCTURE AND PHYLOGEOGRAPHY OF COMMON EIDERS

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Common eider (*Somateria mollissima*) populations have been declining throughout most of their range. Since little is known about their breeding biology, this demonstrates a need to define population structure and assess genetic variability of common eiders. Studies indicate that female common eiders exhibit high levels of breeding and natal philopatry, which may restrict dispersal among populations. However, pair formation occurs on the wintering grounds, providing a potential avenue for gene flow among populations via male dispersal. However, male dispersal among populations may be limited as molecular and banding data from the European subspecies indicates that non-random mating is occurring on wintering grounds such that males are more likely to mate with females from the same colony. Using microsatellite genotypes and sequence information from mitochondrial control region and nuclear DNA introns, we assessed population structure of common eiders breeding throughout North America and Scandinavia. Common eiders are exhibiting high levels of population structure at the mitochondrial DNA marker and moderate to low levels of differentiation at the nuclear markers. In addition to the high levels of population subdivision, we observed two haplotype and allele groups, which indicate that common eiders were separated in two separate glacial refugia during the Pleistocene. Along with the genetic structuring among populations and cline in haplotype and allelic frequencies across their distribution, there was likely a step-wise post glacial colonization of North America and Scandinavia by common eiders. Nuclear DNA data support current subspecies taxonomy, as microsatellite and intron data have the most significant pairwise population comparisons occurring among subspecies. This is consistent with the breeding biology of common eiders, as male mediated gene flow has likely had a homogenizing effect on the nuclear genome. However, mtDNA variation is better accounted for by grouping populations by geographic proximity supporting a stepwise-postglacial colonization of North America and Scandinavia.

POPULATION DELINEATION OF WHITE-WINGED SCOTERS AND APPLICATIONS TO A BREEDING POPULATION

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North American populations of white-winged scoters (*Melanitta fusca deglandi*) have declined markedly over the past several decades. The causes for decline are uncertain, but likely involve a complexity of events occurring on both the wintering and breeding areas. We attempted to delineate Atlantic and Pacific wintering scoter populations and link them to a shared breeding area using stable isotope analysis of carbon (δ13C) and nitrogen (δ15N) ratios in feathers. Naturally occurring stable isotope ratios have been successfully used for this purpose in other avian species, including king eider ducks. By applying this methodology to a marked breeding population at Redberry Lake, Saskatchewan, we assigned females to putative wintering areas and determined (1) population structure, (2) the extent of winter site philopatry, and (3) examined differences in vital rates and other variates in relation to winter origin to gain insight into potential cross-seasonal effects. Discriminant function analysis of isotopic ratios in feather samples from known wintering locations has resulted in classification probabilities of 96% (n=149) for Pacific and 78% (n=32) for Atlantic scoters. Using this methodology, the Redberry Lake breeding population is comprised of approximately 75% Pacific and 25% Atlantic wintering birds, and also exhibits a high degree of winter region philopatry, based on the classification of successive recaptures over three field seasons. Differences in relation to winter area include earlier nest initiation date for Pacific wintering birds and higher blood contaminant loads in Atlantic birds. Cross-seasonal effects have the potential to limit reproductive success and local recruitment as well as reduce survival probability, making it crucial to link breeding and wintering areas to better understand the factors influencing population dynamics and to effectively address conservation issues. Our results may be relevant to much of the continental white-winged scoter population and help direct future management strategies.

USING STABLE ISOTOPES TO DELINEATE NORTH AMERICAN WINTERING POPULATIONS OF LONG-TAILED DUCKS

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The use of feather isotope analysis allows researchers unique opportunities to utilize information collected on both wintering and breeding areas to look at migratory connectivity between years and geographic locations. Naturally occurring stable carbon and nitrogen isotopes (δ13C, δ15N) have been used successfully to delineate breeding and wintering connectivity in other sea duck species such as king eiders (*Somateria spectabilis*) (Mehl et al. 2004) and white-winged scoters (*Melanitta fusca deglandi*) (Swoboda and Alisauskas unpubl.). Linking wintering and breeding areas may provide important information on population dynamics as habitat conditions associated with winter or migration areas can directly affect reproduction (Alisauskas 2002) and survival. Results of feather analysis should reflect stable isotope composition of winter and breeding areas at the time of feather molt for specific tracts. The North American geographic distribution of long-tailed duck (*Clangula hyemalis*) populations is currently undefined. It has been suggested that there may be two or more populations separated by breeding and wintering distribution. We developed a methodology based on stable carbon and nitrogen (δ13C, δ15N) ratios in long-tailed duck feathers to delineate wintering populations from the Pacific and Atlantic coasts and the Great Lakes. Feather samples were collected at Karrak Lake, NU during 2003-2005 breeding seasons and at known wintering areas throughout North America in winter 2003 and 2004. Feathers collected from four tracts (head, back, belly and 9th primary) were used to determine which tract would provide the best classification based on Discriminant Function Analysis. Head feathers were the most successful at classifying long-tailed ducks from Pacific and Atlantic coasts and the Great Lakes. To connect breeding and wintering areas, we used isotope analysis in combination with banding data for individuals from Karrak Lake, Nunavut. Isotopic data from this central arctic breeding population may clarify the separation of geographic populations, winter philopatry and movement among winter populations of long-tailed ducks breeding at Karrak Lake.

SAMPLE SIZE CONSIDERATIONS FOR THE USE OF SATELLITE TELEMETRY IN AVIAN RESEARCH

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The design of a research study determines the strength of the inferences that can be made from that study. Sample size is one aspect of design that can often be controlled by the investigator and therefore is the most frequently targeted component of study design. Previous studies have developed sample size recommendations for estimating biological parameters from samples of uniquely marked individuals. The development of satellite monitored transmitters has greatly improved our ability to remotely monitor migratory animals or animals occupying remote habitats and we can use these data to estimate new biological parameters, particularly animal movement parameters and distributions. However, limited information is available to guide design for deploying and monitoring satellite tracked transmitters, which are relatively more expensive to purchase and monitor than most marking devices. Therefore, proper study design is essential for efficient use of these transmitters. We used simulations from theoretical models to determine the effects of population size and population variance on the sample sizes needed to make inferences about timing of movements, distribution patterns, and survival probability of avian species. We used probability distributions and measures of uncertainty to assess the quality of study results under various scenarios. Sample size demands increase with increases in the number of estimated states and increasing population variance. Our results indicate that sample sizes of 20 or more are needed to make reliable inferences for situations when potential outcomes are binomial (e.g., live or die). In situations with 3 or more states (e.g., distributions among 3 sites), samples of 75 or more individuals are needed for reliable results and studies with small samples (e.g., <10) had a high probability of providing misleading conclusions or provided little information gain. Satellite telemetry is emerging as a useful tool for making population level inferences; adequate samples should be used to assure the reliability of those conclusions.

ABSTRACTS FOR MIGRATION PRESENTATIONS

LARGE-SCALE MOVEMENTS AND HABITAT CHARACTERISTICS OF KING EIDERS THROUGHOUT THE NONBREEDING PERIOD

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Alaskan-breeding king eiders *(Somateria spectabilis)* molt wing feathers and over winter in remote areas of the Bering Sea, precluding direct observation. To characterize timing of migration and habitat used by king eiders during the nonbreeding period, we collected location data of 60 individuals (27 females and 33 males) over three years (2002-2004) from satellite telemetry and obtained oceanographic information from remotely-sensed data. Mean date of dispersal from breeding areas and arrival at wing molt sites differed by sex and among years. Males and female eiders did not show any evidence of sexual segregation on wing molt sites. Male king eiders dispersed from breeding areas, arrived at wing molt sites, and dispersed from wing molt sites earlier than females in all years. King eider wing molt locations included areas along the Chukotsk, Kamchatka, and Alaska Peninsulas, as well as St. Lawrence Island, Anadyr, Olyutor, Karagin, Bristol and Kuskokwim Bays, the Beaufort Sea, and the coast of Russia near Khatyrka. For males, earlier arrival dates at wing molt sites were correlated with higher latitudes of these sites. Winter locations were found along the Chukotsk, Kamchatka, and Alaska Peninsulas, Olyutor and Bristol Bays, and the Gulf of Alaska. Female king eiders that wintered farther south returned to breeding areas earlier the following summer. Distributions of molt and winter locations did not differ by sex or among years. We suggest that of the variables considered for analysis, distance to shore, water depth, and salinity best describe king eider habitat throughout the nonbreeding period. King eiders were located closer to shore, in shallower water with lower salinity than random locations. During the winter, lower ice concentrations were also associated with king eider locations. This study provides some of the first large-scale descriptions of king eider migration and habitat outside the breeding season.

PACIFIC COMMON AND KING EIDER SPRING MIGRATION, SITE FIDELITY AND POPULATION STRUCTURE: INSIGHTS GAINED FROM LONGER-LASTING SATELLITE TRANSMITTERS

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Satellite transmitters deployed on Pacific common *(Somateria mollissima)* and king eiders (*Somateria spectabilis*) on their breeding grounds in central arctic Canada in June 2003 lasted nearly twice as long on average as transmitters we had deployed in the previous six years. Nearly all transmitters from earlier years ceased functioning by the end of winter, whereas 21 of 28 transmitters deployed in 2003 lasted several more months, thus providing new information on timing and routes of spring migration, nesting and molting site fidelity, and population structure. For both species, all females returned to the same nesting area as in the previous year (n=9), whereas males all migrated to different locations to breed (n=11). However, despite breeding in a different area, 7 of 8 males returned to the same post-breeding molting area as in the previous year. In all years, we found that both male and female Pacific common eiders wintered in the same area off the southeastern Chukotsk Peninsula and St Lawrence Island. Therefore, the wide distribution of males during the second nesting season suggests that this wintering area is critical for Pacific common eiders throughout their entire breeding range in arctic Canada and northern Alaska. Spring migration occurred over a two-month period from mid April to mid June. Key staging areas for both species were Ledyard Bay and the polynia in southeastern Beaufort Sea. Daily locations obtained for six Pacific common eiders indicated birds heading for Canada to nest followed the shorefast ice edge rather than the Alaskan coast. They crossed the Alaskan Beaufort Sea in less than a day, although all but one stopped briefly at least once on the way. These data on spring migration have provided a better understanding of vulnerability of eiders to offshore oil and gas development in the Beaufort Sea.

THE AUTUMN MOLT AND SPRING MIGRATION PATTERN OF ARCTIC COMMON EIDER IN WESTERN GREENLAND AND EASTERN CANADA BASED ON SATELLITE TELEMETRY

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We used implanted satellite transmitters to track northern common eiders *(Somateria mollissima borealis)* during migration from breeding grounds in West Greenland and eastern Arctic Canada, and from molting and wintering areas in West Greenland. We compared distances moved, timing, duration, and patterns of movement for the spring and autumn migration. The common eiders used two main wintering areas and three major migration flyways. Eiders tracked from a colony in West Greenland migrated south to winter and back north to breed following the West Greenland coast. Some of the eiders tracked from a colony in Arctic Canada similarly migrated south to winter and back north to breed following the eastern Canadian coast. However, 60% (n=25) of the eiders we tracked from a colony in Arctic Canada, and 7 of 8 eiders from a wintering area in West Greenland, followed an east - west flyway instead of a north-south route. They migrated across the Davis Strait to winter in Southwest Greenland and back to breed in Canada, thus linking the two north-south flyways. More females than males from the Canadian colony (14 of 18 females and 1 of 6 males) followed the shorter east-west flyway. Although both in the Arctic, the climatic conditions in eastern Canada and western Greenland is very different due to the relatively warm Irminger Current maintaining open water during winter at the southwest Greenland coast, and also influencing the climatic conditions at the breeding grounds. This study showed a clear segregation in the Greenland wintering area linking local hunting areas to different eider breeding regions, and we found that this segregation corresponded to structural differences in the tracked birds. Distances moved for the tracked birds ranged from sedentary birds, breeding in the wintering area in southwest Greenland, to routes exceeding 3000 km including molt migrations along the eastern Canadian coast. The migration speed during spring migration averaged about 60 km/day, which was less than half of the migration speed during autumn. The slow spring migration put emphasis on the importance of undisturbed high quality foraging areas en route where eiders put on body reserves for a successful breeding season.

SPRING MIGRATION CHRONOLOGY AND BREEDING AREAS OF SURF SCOTERS: A SYNTHESIS OF PACIFIC COAST POPULATION STUDIES

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Surf scoters *(Melanitta perspicillata)* are distributed along the Pacific coast from Southern Alaska through Baja California, Mexico during winter. Very little is known about the migration chronology, migratory corridors, and ultimate breeding areas of individuals from major wintering areas. Over the past 3 years, we have been examining spring migration and breeding area affiliations of surf scoters wintering along the Pacific coast, including those from Baja California, Norte, Mexico, San Francisco Bay, California, Puget Sound, Washington, and Strait of Georgia, British Columbia. We compiled telemetry data from PTT-marked and VHF-marked scoters captured in 2003-2005. The spring departure period extended from mid March through early May and varied depending on wintering area. Most birds spent only brief periods at stopover sites along the lower Pacific coast. Some birds from Mexico and California used areas in the Puget Sound and Strait of Georgia area for extended periods before they continued to southeast Alaska, where birds from all wintering sites staged for prolonged periods before moving inland to breeding areas. We examined variation in routes, travel rates, and duration of stay at key stopover sites related to marking location, age, sex, and mass. Breeding areas of most marked birds were located in between Great Slave and Great Bear Lakes in the Northwest Territories; however, some birds from Puget Sound and Strait of Georgia were found in northern Alberta and Saskatchewan. We evaluated timing of arrival on breeding areas related to marking location and sex. We will present results from nearest-neighbor analyses examining breeding distributions of birds from different wintering populations. By integrating telemetry datasets from several concurrent studies we achieved the most comprehensive view of Pacific coast surf scoter migration ecology possible. Such information will be crucial for the future management of this declining species.

LATE SPRING STAGING HABITATS OF SURF SCOTERS ALONG THE PACIFIC COAST

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Although Pacific surf scoters *(Melanitta perspicillata)* have been the subject of a growing body of research during winter, little is known about their spring migration ecology. Habitat conditions during spring migration can affect nutrient reserve levels and subsequent productivity, and changes in migration habitats have been implicated as important factors affecting broad-scale and long-term population declines in some waterfowl. An important component of establishing such cross-seasonal effects is the determination of distributions and habitat requirements at critical stages over the annual cycle. As part of a collaborative study on the Pacific Coast, we are documenting late spring distributions of Pacific surf scoters, with a focus on identifying important staging areas and associated habitat attributes. Important staging areas are being identified using a combination of satellite telemetry data, conventional VHF radio telemetry, and aerial surveys. Both types of transmitters have been deployed on surf scoters wintering in Baja California (Mexico), San Francisco Bay (CA), Puget Sound (WA), and the Strait of Georgia (BC). Preliminary satellite telemetry data have indicated several areas in southeast Alaska where spring migrating surf scoters congregate, including Felice Strait and West Behm Canal near Ketchikan, Stephens Passage and Gastineau Channel near Juneau, and northern Lynn Canal. In addition, conventional VHF telemetry and survey data from this year show similar patterns in stopover habitat use. The habitat attributes of these sites will be examined using existing GIS habitat data. The timing and distribution of herring spawn events during the study years may be a particularly important habitat feature of these staging areas; observations made during this year indicate that surf scoters feed heavily on this resource when available. Other habitat features that may be particularly important include the timing and distribution of eulachon spawning events during the study years, as well as bathymetry, substrate type, and exposure.

INDIVIDUAL VARIATION IN STAGING AND TIMING OF SPRING MIGRATION OF PACIFIC COMMON EIDERS IN ALASKA

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Timing of migration and characterization of migration patterns of birds are usually based on dates of peak migration to and from staging, wintering, and breeding areas used by the bulk of a species. For Pacific common eiders *(Somateria mollissima v-nigrum)*, as well as other species, the timing of migration into and through the Beaufort Sea is based on counts of birds past land or ice-based sites and radar observations, and arrival dates to colonies determined by influxes of birds seen by ground observers. With the continued and proposed development of nearshore and offshore waters of the Beaufort Sea, there is an expanding need to manage local populations. Observations of individual Pacific common eiders can provide a more complete understanding of local populations as well as variability among populations. This study was designed to determine factors influencing migration patterns of individuals nesting in the western Beaufort Sea from their wintering locations along the Chukotka Peninsula, through the eastern Chukchi and western Beaufort seas, until their arrival to their nesting area. The Simpson Lagoon/Maguire Island nesting colonies are 1300-1400 km from the primary winter area. Eiders enter the Beaufort Sea at Point Barrow then move east 300-350 km to their nesting colonies. Nesting adult females were marked with satellite transmitters during summer then followed the next spring and early summer. Transmitters were programmed to provide location data every 3 days (2001, n = 12) or daily (2002 and 2004, n = 7 and 18, respectively) beginning 15 April. I expected the dates of arrival to the colony to vary with weather during migration (Point. Barrow to the colony) and general conditions in spring (early or late year based on differences in temperatures from the long term norm for April, May, and June). All individuals returned to the colony area they were marked the previous year. Data were consistent with other "short" distance migrants. There were no correlations of the dates of arrival to the dates birds left the wintering area, the total days spent staging, wind speed or direction, temperature, weather, or seasonal differences in temperature from the long term average, a plethora of non-significant results. However, two patterns emerged: some birds migrated about 550 km and staged in the eastern Chukchi Sea before migrating to the colonies, while others went directly either to the colony area (1300 km) or elsewhere within the western Beaufort. I will present preliminary analysis and several hypotheses regarding these two strategies.

ABSTRACTS FOR HUMAN FACTORS AND MANAGEMENT PRESENTATIONS

INTERACTIONS OF WINTERING SCOTERS AND SHELLFISH AQUACULTURE IN COASTAL BRITISH COLUMBIA

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Coastal British Columbia supports important concentrations of wintering surf *(Melanitta perspicillata)* and white-winged scoters *(M. fusca)*. Areas used by scoters overlap with shellfish aquaculture, an expanding industry in the region. From 2001 to 2005, we investigated interactions between scoter populations and the shellfish industry. Our broad suite of research activities included measurement of: changes in scoter abundance over time, habitat affiliations, diet, prey availability, foraging behavior, energetics, survival, and movements. We contrasted our findings with a priori predictions under scenarios of negative, neutral, and positive effects of aquaculture. Our main study site, Baynes Sound, is characterized by broad, soft-substrate tidal flats; shellfish farming in the area consists primarily of beach-cultured clams, with some deep-water oyster culture. We found that numbers of scoters had more than doubled since 1980-81; however, much of this increase was likely in response to the invasion of the varnish clam in the 1990s. Habitat associations of both scoter species were related primarily to environmental factors, and not to clam-farming activities. Scoters fed almost exclusively on clams, mainly varnish clams *(Nuttallia obscurata)* and the cultured manila clam *(Venerupis philippinarum)*, and scoters depleted standing stocks over winter by approximately 20 percent. Scoter foraging effort was largely independent of clam densities and estimates of average time spent foraging was less than 25%. Movement data indicated surprisingly small home ranges, with most individuals remaining on a single tidal flat through winter. Taken together, the weight of evidence indicates that clam-farming at this site was neutral or perhaps even beneficial for scoters. Although clam farmers use anti-predator netting to exclude scoters from part of the intertidal zone, overall clam availability may actually be increased through movement and reproduction of clams from under the nets. Our second study site, the Malaspina Complex, is a rocky, fjord-like inlet. Most shellfish aquaculture involves deep-water oyster culture, although off-bottom mussel culture is gaining popularity. Surf scoters, the only scoter present in large numbers, feed primarily on mussels. Scoter numbers were positively related to shellfish aquaculture operations, particularly in early winter. Scoters consumed naturally-recruited mussels from aquaculture structures, the most abundant and profitable food resource in the area. Once mussels were mostly depleted from aquaculture structures, numbers of scoters decreased as they dispersed from the study area or moved into intertidal foraging habitats. These data suggest that scoters benefit from presence of aquaculture structures in this area. We conclude that shellfish aquaculture represents a positive or, at least, neutral habitat change for scoter populations. We suspect that wintering scoters in the Strait of Georgia have redistributed as aquaculture has become more common in several areas. We caution that changes in the intensity or practices of the industry could change this relationship.

CONSERVATION OF THE NORTHERN COMMON EIDER: AN INTERNATIONAL, ECONOMIC, SOCIAL AND ECOLOGICAL CHALLENGE

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The northern common eider *(Somateria mollissima borealis)* presents a unique and unusual management challenge. Little is known about the size of the population, and its breeding, molting and wintering ecology are also poorly known. Meanwhile, it is intensively exploited by a great diversity of users. In the summer, feather down, eggs and meat are collected on the breeding colonies by Inuit from Nunavut and Nunavik. In winter, eiders are hunted for meat by Inuit from Greenland, Innu from Canada, and non aboriginal from Canada and from St. Pierre and Miquelon, France. During molt and fall migrations, eiders are hunted by Inuit from Nunavut, Nunavik and Greenland as well as Innu from Quebec and Labrador. On the breeding areas in Nunavut Canada, the impact of down harvesting, egg collection and adult harvest are poorly known due in part to the isolation and geographic scale of the breeding areas. Down harvesting provides a sustainable way of using eiders to generate local economic gains and has been part of traditional use in northern Canada. However, the transition from a sustainable traditional harvest to an intensive commercial use needs to be closely monitored. Indeed, recent conflicts between Nunavut and Nunavik Inuit over down harvesting within shared land claim settlement areas are arising. In west Greenland, hunted birds are sold commercially at public markets and the wintering population is likely over harvested there. Spring and winter legal and illegal harvests in eastern North America are poorly quantified. Tensions between aboriginal and non aboriginal hunters (especially on the St. Lawrence Lower North Shore), and ongoing negotiations with the Innu in Labrador and Quebec further complicate this. Finally, climate change may also influence northern eider ecology by modifying access to colonies by Inuit, frequency of predators on nesting islands, and access to shallow feeding areas because of variable sea ice conditions. We conclude that the management of the northern common eider must be tackled on several fronts simultaneously (local, regional, provincial, national and international), and that monitoring and research efforts must be increased. One crucial step is the education of all users about the resource they share and their potential impact on the northern eider population and other users.

INTERACTIONS BETWEEN HARVEST, PHYSICAL CONDITION, AND HABITAT USE OF COMMON EIDERS WINTERING IN GREENLAND

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Southwest Greenland constitutes an internationally important wintering area for northern common eiders *(Somateria mollissima borealis)* breeding in the eastern Canadian Arctic and west Greenland. This open water area supports a winter population of estimated 460,000 common eiders. As part of a winter ecology research program, we studied the eiders from the coastal area and the fjord-system of Nuuk, an area inhabited by 14,000 humans and estimated 57,000 eiders. With focus on the relationship between harvest, physical condition and habitat use of the eiders, we investigated: local movement and home ranges (satellite telemetry), foraging behavior, body condition (total carcass lipids), composition and origin of the eider harvest (local market survey), and birds were also X-rayed for embedded lead shot. Human activities varied considerably between the coastal area and the fjord-system. More than 90% of all eider hunting took place in the coastal area, within 20 km of the city of Nuuk. In contrast, hunting occurred rarely in fjord habitats 20-100 km away. Despite of this, satellite telemetry showed that most eiders (71-92%) at the coastal area exhibited strong site fidelity during winter, with a mean core area (50% home range) of only 5.7 km2. X-ray studies supported that coastal birds and fjord birds had been segregated for a significant period of time. Adult birds collected in fjord areas were significantly less burdened with embedded lead shot from previous shooting incidences (24.5%) compared to birds collected in the more heavily hunted coastal areas (35.0 %). Age was another significant factor influencing the risk of being wounded. Immature and adults had a yearly infliction rate of 1.8 - 3.0%, while 13.2% of the less experienced juvenile birds got inflicted during their first winter. Furthermore, juvenile birds carrying embedded lead shot had a significantly poorer body condition than non-inflicted juveniles. The latter carried on average 19% more fat. No impact on the body condition was detected for immature and adult birds. Despite the apparent advantages that juvenile eiders would gain from avoiding the more heavily hunted coastal areas, we found only few juvenile birds wintering in the fjord. This unequal age distribution probably was related to different foraging strategies. Both at the coast and in the fjord, diurnal movements peaked at dawn and dusk when birds moved between feeding areas and roosting sites. However, at coastal habitats the feeding took place during daylight hours while in the fjords birds fed only during night and twilight periods. Apparently, white-tailed sea eagles *(Haliaeetus albicilla groenlandicus)* prevented fjord eiders from feeding during daylight hours. In the fjord foraging is limited to areas very close to land, due to the lack of shallow waters elsewhere, and here eiders are very exposed to predation from the eagles. In contrast, eiders can feed in safe distance from land at most coastal habitats.

SURVIVAL OF COMMON EIDERS FROM THE EASTERN CANADIAN ARCTIC WITH CHANGING HARVEST REGULATIONS IN GREENLAND

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Most northern common eiders *(Somateria mollissima borealis)* that breed in the eastern Canadian arctic migrate to winter in west Greenland and the rest go to Atlantic Canada. Until Greenland hunting regulations were restricted in 2003, harvest levels in Greenland were very high and were suspected to be unsustainable. In this study, we are estimating survival probabilities of northern common eiders before and after the stricter hunting regulations were introduced in Greenland to assess whether these changes in harvest had an impact on survival. Survival was estimated using capture-recapture models from data collected by banding and re-sighting individuals at a large breeding colony at East Bay, Southampton Island (in northern Hudson Bay, Canada). Our field site at East Bay has the only established banded population of eiders in the eastern Canadian arctic and therefore is the only location where pre- and post-regulatory restriction data can be collected. Since 1996, over 3100 adult eiders and 1200 ducklings have been banded. Greater than 50% of banded females and 7% of males have been resighted at East Bay in subsequent years. Preliminary survival analyses from data collected from 1996 to 2002 indicate that adult female eiders had only a 73% (± 2.6%) probability of surviving each year, which means that they typically only live to be 7-10 years old. This survival rate is very low when compared to other eider populations around the world, and suggests that adult mortality was extremely high during that time period. In order to assess whether the recent restrictions in harvest in Greenland has been successful in increasing eider survival, we are deriving survival rates for before and after the changes in Greenland hunting regulations.

EIDERDOWN HARVESTING: A TOOL FOR MANAGEMENT AND RESEARCH

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Eiderdown has been harvested for centuries for use in clothing and has become a luxury item in some parts of Europe, thus providing an additional source of revenue for some northern communities. In the St. Lawrence River estuary, it has become an important conservation tool in several ways: first, all income from eiderdown sales is funneled back into habitat protection; second, trained harvesters monitor eider populations as they go (numbers, incidence of disease, condition of nesting habitat, etc.) which has provided a unique and scientifically sound database; and third, it has provided a strong incentive for protecting the resource. Eiderdown harvesting, when properly done, has minimal impacts on reproductive success and is a highly sustainable activity. Eiderdown harvest also occurs in 11 of the 14 Nunavik (northern Quebec) communities and 75% of the harvest is done in four villages (Kangirsuk, Kangiqsuqjuak, Salluit and Aupaluk). These communities are rapidly moving from a traditional to a commercial use of this resource. The quantity of down harvested in Nunavik has increased from 2,000 to 5,000 kg (raw down) between year 2000 and 2004. The average yearly harvest of Eiderdown has been 3,300-374 kg/year over the past seven years. Northern communities could draw benefits from the St. Lawrence experience and produce their own northern eider management plan. However, the task is complex because several users compete for the eider resource across its range (down harvesters, meat hunters, egg collectors). We believe that properly trained eiderdown harvesters operating in a well coordinated program can become true partners in conservation and management of eiders, improving eider breeding success, the quantity and quality of down harvested, and effectively monitoring the breeding population. The economic benefits derived from this northern resource can be a tremendous incentive for its conservation and its sustainable harvest.

ABSTRACTS FOR FORAGING AND ENERGETICS PRESENTATIONS

THE VALUE OF HERRING SPAWNING EVENTS TO SPRING CONDITIONING OF SCOTERS IN THE PUGET SOUND-GEORGIA BASIN

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Like many sea ducks, scoters have declined throughout their ranges, including substantial declines in the Puget Sound-Georgia Basin (PSGB). One potential limiting factor is the availability of herring spawn in late winter and spring. Scoters and other marine birds congregate in dramatic numbers to consume spawn in many areas along the North American Pacific Coast. However, spawning stocks in the PSGB, an important wintering and staging area for scoters, have declined substantially over recent decades. To determine whether spawn is critical to nutrient acquisition by scoters, and consequently whether changes in local herring stocks may be related to scoter numerical declines, we are addressing two questions: (1) How does variation in spawning activity affect acquisition of fat by scoters?; and (2) In years when spawn is less available, are alternative foods in key winter foraging sites adequate to meet the needs of scoters? Censuses in 2004 and 2005 at 12 spawning areas in Puget Sound indicate that surf scoters *(Melanitta perspicillata)* respond in greater numbers and likely travel greater distances to spawning events than white-winged scoters *(Melanitta fusca)*. Further, the numerical response of surf scoters to spawn appears to be influenced by several factors, including the abundance, duration, timing, location, and density of spawn. Based on samples from more than 850 scoters captured in the Strait of Georgia in 2003-2004, tissue analyses (stable isotopes, fatty acids) suggest that (1) when spawn is available, scoters consume little else, and (2) for both surf and white-winged scoters, the amount of spawn consumed is positively related to body condition (as measured by size-adjusted body mass). Also, relative to bivalves, spawn is richer in fats assumed important for meeting the energy requirements of migration (particularly 18:1 fatty acids). To evaluate the role of spawn vs. alternative prey to spring conditioning, we are modeling the energetics of scoters based on (1) seasonal comparisons of scoter distributions, foraging behavior, and prey availability from three important foraging sites, and (2) laboratory measurements of functional responses and metabolic costs of activities. Our preliminary data, as well as data from other wintering locations of scoters on the Pacific Coast, indicate that standing stocks of key bivalve prey decline over winter. Thus, spawn may be a critical supplement to alternative prey for spring conditioning of scoters, although multiple factors suggest that surf scoters may be more sensitive to variation in spawning activity than white-winged scoters.

CLAM PREDATION AND FORAGING BEHAVIORS OF SURF AND WHITE-WINGED SCOTERS

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Numerous studies have demonstrated the effects of predators on the abundance, size class, and other attributes of their prey, with subsequent consequences for community structure. Recent studies of predation by sea ducks have documented strong, top-down effects on mussel populations in rocky intertidal communities. However, the impact of these gregarious predators in soft-bottom communities remains largely unexplored. We conducted a study in Baynes Sound, British Columbia to determine the effects of predation by wintering surf *(Melanitta perspicillata)* and white-winged scoters *(Melanitta fusca)* on their primary prey, intertidal clams. Between scoter arrival in the fall and departure in the spring, density decreased by 27% for manila clams *(Venerupis philippinarum)* and 13% for varnish clams *(Nuttallia obscurata)*, the two main prey species of scoters in the study area. To determine the relative contribution of scoter predation to observed clam density declines, a simple model was constructed to estimate number of clams consumed by wintering scoters. We found that these over-winter clam decreases were largely attributable to scoter predation, as our estimate of scoter clam consumption accounted for approximately 90% of over-winter clam decreases. Variation in prey sources has important implications for an individual's energetic costs by affecting foraging effort. Waterfowl have been shown to adjust their foraging behavior in response to variation in food abundance or quality, although this relationship has not been explored for most sea duck species. To determine if the observed clam density decreases were of a sufficient magnitude to influence scoter foraging effort, we monitored a range of scoter dive-behaviors. For surf scoters, the proportion of time spent feeding and number of dives/hour increased slightly over the winter, although increases were not directly related to variation in clam density. Clam capture efficiency of surf scoters was also unrelated to variation in clam density. For white-winged scoters, spatial and temporal patterns of clam density significantly affected their foraging effort, as number of dives/hour and time spent feeding were negatively related to clam density. Also, white-winged scoter clam capture efficiency decreased over the winter, in direct relation to variation in clam density. This study corroborates a growing body of literature, indicating the important effects of sea duck predation on intertidal populations and communities. Our findings indicate that surf scoters and white-winged scoters are the major clam predators in Baynes Sound during winter, having important effects on invertebrate communities in soft-bottom intertidal habitats. For white-winged scoters, there is direct feedback from these predation effects, causing them to modify their overall foraging effort. For surf scoters, over-winter clam declines were insufficient to affect their foraging effort. The discrepancy between surf and white-winged scoters, regarding foraging effort, may be a result of different foraging strategies based on factors such as body size or prey selectivity.

NUTRIENT ACQUISITION AND ALLOCATION BY FEMALE HARLEQUIN DUCKS IN RELATION TO MIGRATION AND REPRODUCTION

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Migration and reproduction in female waterfowl requires a large amount of energy and nutrients, and strategies for acquiring and allocating resources are known to vary inter- and intra-specifically. We analyzed variation in body mass and stable isotope signatures (δ15N, δ13C) of female harlequin ducks *(Histrionicus histrionicus)* on wintering and breeding sites in Southern British Columbia, Canada, to investigate strategies of nutrient acquisition and allocation, and to determine the relative use of endogenous and/or exogenous sources for clutch formation. These birds move between isotopically distinct marine wintering grounds and freshwater breeding grounds, which makes it possible to isotopically track origins of nutrients. We found that females increased in mass by 7% on coastal sites from late-winter to pre-migration. However, the chronology of mass gain varied depending on prey type. Females feeding on superabundant roe from spawning Pacific herring *(Clupea pallasi)* became significantly heavier than females eating marine invertebrates, such as crabs, limpets, and snails, in mid-March. By mid-April, prior to migration, females at all sites had similar body masses with birds at non-spawning sites increasing significantly from mid-March and those at spawning sites maintaining their initial mass gain. These results suggest that female harlequin ducks target an optimal pre-migratory body mass, regardless of access to a superabundant food source. Although females store endogenous nutrients and energy on wintering grounds, stable isotope analysis revealed little to no evidence of marine nutrients allocated to egg formation. Both lipid and non-lipid components of the eggs revealed mostly freshwater isotopic values. Nutrients stored on coastal areas may be allocated to migration or to costs of reproduction during stages following egg formation, such as incubation or brood-rearing. With relatively little known of the breeding requirements of harlequin ducks, this study provides important insight into reproductive strategies that could influence productivity and recruitment in this species of concern.

ON THIN ICE: FORAGING ENERGETICS OF SPECTACLED EIDERS IN THE PACK ICE OF THE BERING SEA

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The spectacled eider *(Somateria fischeri)*, a threatened species, winters in pack ice of the Bering Sea. In dives to 40-70 m for benthic invertebrates, the high energy costs of foraging are offset by high benthic biomass. However, there is evidence that the dominant clam prey has changed from *Macoma calcarea* to *Nuculana radiata*, perhaps affecting the foraging energetics of the eiders. To assess the relative foraging value of *M. calcarea* vs. *N. radiata*, we studied differences in nutrient and energy content, digestibility, and intake rates for differing clam sizes, areal density, and depth in the sediments. Because sea ducks have been observed using mainly foot propulsion for short, shallow dives and wing propulsion for long, deep dives, we measured the metabolic costs of these different swimming modes with respirometry. To avoid using a Threatened species for experiments, we used common eiders *(Somateria mollissima)* for digestion studies and white-winged scoters *(Melanitta fusca)*, the same size as spectacled eiders for diving studies. For the prey size range comprising 93% of the eiders' diet (18-30 mm), *M. calcarea* including shells was lower in ash, and higher in nitrogen, lipid, and energy, than *N. radiata*. Digestibility was 76% for *M. calcarea* vs. 67% for *N. radiata*. For scoters foraging on clams buried in sand in an aquarium 1.8 m deep, intake rate (number/s) decreased by 31% when burial depth in the sediments was increased from 4 to 7 cm. Oxygen consumption during propulsion by wings plus feet vs. feet alone was measured for scoters diving to 2 m in water at 8 ºC. Total dive costs were 33% lower for mainly wing-propelled dives than for foot-propelled dives. Stroke rates were higher in foot-propelled dives; however, vertical speed (m/s) was higher in wing-propelled dives. Thus, wing propulsion lowers dive costs and increases vertical speed, yielding longer bottom time for the same total dive time. Our results show that impacts of long-term benthic change on eiders depend not only on shifts in total clam abundance, but also on differences in digestibility and intake rates for differing sizes and burial depths of clams. Required food intake is reduced by very efficient wing propulsion.

VARIATION IN ARRIVAL BODY CONDITION AND REPRODUCTIVE STATUS OF WHITE-WING SCOTER HENS AT CARDINAL LAKE, NT

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Continental scoter populations (all three species combined) declined by about 58% over the past 30 years, with local reductions approaching 70% in their core breeding area, the Northwest Territories. The reasons for these declines are unknown. However, scoter breeding, migrating, and wintering habitats are undergoing direct or indirect anthropogenic change, which could have implications for their ability to acquire nutrients for successful breeding and could contribute to population decline. Our challenge in assessing this hypothesis is that we do not know whether these populations are sufficiently nutritionally constrained and, if so, where northern scoters acquire nutrients for breeding, hence where to begin looking for factors potentially causing constraint. These knowledge gaps can in part be filled by developing an understanding of basic nutritional ecology for scoters breeding in northern latitudes. The goal of this presentation is to assess annual and seasonal variation spring body mass and condition, and determine the relationship between nutritional status and egg production for white-winged scoters *(Melanitta fusca)* captured at Cardinal Lake, about 80 km south of Inuvik, NT. From 2002 - 2004, we caught 77 females and 179 males during the prenesting and early egg laying periods. Both sexes were weighed and measured, and then hens were palpated for external indicators of reproduction and marked with nasal discs and radio transmitters for other research. In 2004, we also collected blood samples from females to determine reproductive status based on concentrations of vitellogenin, a yolk precursor. Although peak nest initiation dates varied little annually, female body condition (mass corrected for structural size) varied greatly due to a 200 g variation in body mass and no annual variation in structural size. Body condition, structural size, and mass of males did not vary annually. Within years, body condition did not covary with capture date for either sex and egg production was largely confined to hens over 1400g. Together, these results suggest that egg laying in scoters may be highly sensitive to environmental conditions on migration and breeding areas.

MODELING THE ENERGETICS OF SPECTACLED EIDERS DURING LONG-TERM CHANGE IN ICE AND BENTHOS OF THE BERING SEA

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The world population of threatened spectacled eiders *(Somateria fischeri)* winters in the Bering Sea, where they dive 40–70 m among leads in the pack ice to feed on macrobenthos. Foraging costs relative to food intake are important to the eiders' overwinter survival and prebreeding condition. Based on field, laboratory, and remote sensing studies, we are modeling effects on the eiders' energy balance of changes in benthos revealed by periodic sampling from 1950 to present. To estimate costs of deep dives, biomechanical models were developed based on other species of wing-propelled divers fitted with time-depth recorders. Mechanical costs were converted to food requirements with efficiencies derived from oxygen consumption by captive birds diving in tanks. Respirometry showed that use of "waste" heat from exercising muscles can greatly reduce thermoregulation costs of eiders. In dive tanks, the eiders' intake rates of infaunal bivalves varied with shell length and burial depth, as well as numbers/m2. Although leads frequently open and close, shifting of ice under different weather conditions had little effect on estimates of daily flight costs, except when southerly winds forced widespread closing of leads in the southward-moving pack. Eiders collected in the field had eaten mostly a narrow length class of a single bivalve species, *Nuculana radiata*. Long-term data suggest that this bivalve exhibited major recruitment in the late 1980s through early 1990s, but since then has declined to low levels similar to the 1950s. Based on transect samples during late winter 1999 and 2001, we interpolated continuous grids for different species and sizes of bivalve prey. Long-term sampling at a subset of stations indicated ranges of availability for modeling different regimes of bivalve species dominance. Estimates of dive costs and intake rates for varying prey availability and weather will indicate the potential effects of long-term changes on the overwinter survival and breeding potential of spectacled eiders.

HABITAT USE, TIME SPENT DIVING AND ENERGY EXPENDITURE DURING WING MOLT IN BALTIC COMMON EIDERS

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Molt is an elusive phase of the annual cycle of sea ducks given their offshore habits. In this study we present the first results aiming at quantifying flightlessness duration, dive budget, habitat use and energy expenditure during wing molt of female common eiders *(Somateria mollissima)*. Data loggers were implanted in the body cavity of 20 females to record heart rate and hydrostatic pressure (depth) every two seconds. The loggers were recording continuously for 220 days and were deployed on Christians' Island located in the Baltic during the nesting season of 2003. Flight frequency and duration were assessed from elevated and constant heart rate and the absence of flight was used to quantify the duration of flightlessness, which lasted 43 days in average. Using a period of three weeks before and three weeks after the flightless period, we found that depth use did not vary in the course of the study ranging from one and a half to two m in average. By cumulating all dives made during one day, we determined that flightless eiders spent about 1 h diving each day in average, which was not different from the before and after periods. Daily heart rate (in heart beats per day) increased 28% from the before period to the middle of the flightless period and remained high afterwards. Similarly, resting heart rate, defined as the minimum heart rate during the day, increased by 43% during that period but with a tendency to decrease during the after period. Our study indicates that the energetic costs of replacing flight remiges in female eiders are substantial although this was not associated with any increases in diving activity. This suggests that females in this sample were loosing mass during wing molt.

FORAGING ECOLOGY OF COMMON EIDER DUCKS WINTERING IN THE CANADIAN ARCTIC: THE ROLE OF BIOTIC AND ABIOTIC PROCESSES

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The Hudson Bay eider duck *(Somateria mollissima)* is a unique race which has abandoned long-distance migration to winter in sea ice habitats in Hudson Bay. This environment presents unique challenges for eiders attempting to balance their energy budgets in winter, particularly during heavy sea ice conditions observed in recent years (potentially associated with cooling climate trends in the eastern Canadian arctic). We show that while tidal currents are necessary to maintain persistent open water habitats (polynyas), strong currents also increase the time and energy costs of eiders diving to the sea floor to access benthic prey. Currents can exceed critical velocities (Vcrit) beyond which diving is no longer an energetically profitable activity. At velocities stronger than Vcrit, eider ducks get out of the water to rest on the ice edge. At current velocities lower that Vcrit, data from underwater video of diving eiders indicate that travel time increases while bottom time decreases with increasing current velocity. These results agree with predictions of existing oxygen balance/dive cycle models. However, surface pause durations and observed longer-term behavioral patterns cannot be explained in terms of diving behavior alone. When the entire tide cycle and the time scale over which digestive processing of benthic prey are considered in a dynamic framework, complex and seemingly counter-intuitive behavioral patterns of eiders can be understood as adaptive. Specifically, eiders appear to structure their foraging activity in a manner which allows maximizing net energy gain within the overlapping rates of the tidal cycle and digestive processing. This has important implications for understanding energy budgets and survival strategies of wintering sea ducks, elucidating potential impacts of climatic change on wintering populations, and more generally highlights the need of incorporating a multi-scale approach for measuring and understanding temporal activity patterns of sea ducks.

COMMON EIDERS DIVING IN THE DARK: HOW IMPORTANT AND EFFICIENT IS IT?

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The question of night foraging is an important one for understanding the ecology of sea ducks since many populations are wintering at high latitude and reduced daylight may severely constraint foraging. Preliminary screening of data stemming from data loggers that record depth and diving schedules showed that diving during the night is a common practice in female common eiders *(Somateria mollissima)* wintering in the Baltic. In this paper, our objectives are (1) to quantify diurnal and nocturnal diving activity for two periods varying in daylight and (2) test the efficiency of night foraging by comparing nocturnal and diurnal diving performances. Twenty data loggers were deployed on a nesting colony in the Baltic (Christians' Island, 55^{o} N) in spring 2003 and 17 were recovered one year later. The loggers were embedded with time-depth recorders recording data every two seconds. Fourteen of them recorded data continuously for 220 days. Night foraging will be quantified for the summer (>12 h) and the winter (< 12 h). In addition, nocturnal diving activity will be determined along a gradient of decreasing daylight from 12 h in September to 7 h in mid-December. Diving activity will be assessed using the number of dives, diving depth, time being submerged and time spent on the bottom. Feeding bouts will be considered as the fundamental unit for analysis. The efficiency of nocturnal diving versus diurnal diving will be compared using the relationship between bottom time and diving depth. For a same depth, a more efficient dive should result as a longer bottom time. Results of this analysis will be presented at the conference.

FORAGING ECOLOGY AND BODY COMPOSITION OF STARVING COMMON EIDERS DURING A WINTER DIE-OFF EVENT IN ARCTIC CANADA

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Winter is often an energetically stressful time of year, and birds living at high latitudes tend to either migrate or store fat reserves to avoid starvation. Occasionally, birds that remain in Arctic environments in winter are unable to meet their energetic requirements, and if poor conditions persist beyond their energetic reserves, large numbers can die simultaneously. We observed common eiders *(Somateria mollissima sedentaria)* starving to death in an ice-floe edge habitat off the Belcher Islands, Nunavut, Canada in February, 2003. Upon our arrival, 430 eiders were present in three small open water areas (1-3 ha within 800m of each other), with an average depth of 23 m, in a marine environment that was otherwise completely covered in sea ice. Over 10 days, the open water areas gradually froze over due to extreme cold (-30C), no wind, and weak tides. Despite intense foraging activity and ingestion of benthic prey, all eiders eventually starved to death. During this period, we collected the intact carcasses of starved eiders within 3 hrs of their death, and also a sample of live birds. Their carcass composition was compared to healthy eiders collected in previous years at the same location and time of year. In previous years, the average body mass of eiders was approximately 2300g whereas the body mass of eiders collected dead in 2003 was approximately1400g. All carcass components that were compared (including total protein, total lipid, total mineral, heart, gizzard, kidney, liver, spleen, large and small intestine, leg muscle, leg bone, abdominal fat, and leg fat) were significantly lower in starved birds, with the only exception being leg bone mass. Birds that were collected in the process of starving showed steep declines in lipid stores, and initial signs of protein metabolism and organ catabolism. Interestingly however, there was evidence that gizzard mass increased as eiders starved. These data are among the first to quantify the starvation threshold of waterfowl dying naturally in the wild, as well as rates of physiological change such as organ catabolism apparently invoked to avoid death.

EVALUATING VALIDITY OF USING UNTESTED INDICES OF BODY CONDITION

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Body condition is presumably linked to survival and reproduction, and subsequently population dynamics in many birds, including sea ducks. Because direct measurement of body composition is lethal, thereby limiting application to retrospective analyses, condition indices are widely used as a means of relating individual body condition to future fitness. Most indices include body mass scaled by structural size indicators calculated as simple ratios or multiple regressions. Scaled indices are often applied arbitrarily with little or no justification; which we term "blind" use. We tested the underlying assumption of these indices that there is a direct, consistent relationship between scaled indices and body condition. We examined this assumption using two approaches across five species of waterfowl: wintering Barrow's goldeneyes *(Bucephala islandica)*, molting harlequin ducks *(Histrionicus histrionicus)* and breeding greater scaup *(Aythya marila),* northern pintails *(Anas acuta)* and American wigeon *(Anas Americana)*. First, we developed predictive equations to evaluate the assumed relationship between observable condition and size-adjusted body mass. Second, we applied various scaled indices to compare their ability to predict observed values of fat and protein. Body mass was a moderate to good predictor of protein across all species examined (R^2=0.58-0.84); however, body mass predicted total fat with considerably more variability (R^2=0.27-0.81). Inclusion of structural measures in predictive equations improved precision of estimates ≤ 0.10 percentage points for protein and fat across species, with the exception of fat in wigeon (0.21). Model precision differed for each gender and between adult and juvenile goldeneye. For breeding birds, a breeding status covariate was the most important component of model structure. Across species, scaled indices predicted protein less precisely or equally well as body mass. Conversely, in most species the ability of scaled body mass to predict fat was improved, although the best index varied with species. Further, by scaling body mass to predict fat the gain in precision among species was ≤ 0.13 percentage points and reduced model fit in many cases. The underlying logic of improving condition estimation using size-adjusted body mass is generally valid, although does not translate into recommendations for globally applicable indices of live birds. The improvement in precision is highly variable between tissues and among species, as well as within species between sex/age classes. We strongly discourage the use of unverified indices; subjectively selecting indices likely does little to improve precision and often may inflate estimated variance. The benefit to using a scaled index was negligible as compared to just using field body mass. Thus, we recommend that investigators use body mass alone to estimate condition rather than "blindly" selected scaled indices. Investigators desiring increased precision may sacrifice a sub-sample of birds to build equations appropriate for their species, sex, age, annual cycle stage, etc.; however, they should recognize that this may provide little improvement over body mass alone.

A COMPARATIVE ASSESSMENT OF FOOD USE AND AVAILABILITY BY SCAUP AND SCOTERS IN THE LOWER MACKENZIE WATERSHED, NORTHWEST TERRITORIES, CANADA

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Continental populations of scaup *(Aythya spp.)* and scoters *(Melanitta spp.)* have apparently declined 41% and 58% respectively in the past 25 years. Scoters have decreased from 1.8 million to 700,000, while scaup populations dropped an average of 150,000 birds per year. While scaup and scoters winter in different locations, retrospective analyses examining correlations between the two taxa suggest that they share limiting factors in the North West Territories (NWT) of Canada, their core breeding area. Declines here approach 70%. Timing of food availability is crucially important to arctic nesting birds with highly constrained breeding seasons; a shift in this timing could result in a lack of resources for successful reproduction. The objectives of this study were to assess scaup and scoter diet selection, compare interspecific dietary preferences, and determine how food availability affects scaup and scoter distribution during nesting and brood rearing. In 2003 we examined invertebrate availability and hydrology of 31 wetlands in the Lower Mackenzie Watershed (LMW), NWT, during prenesting and brood rearing periods; and, during prenesting in 2004, we collected and preserved the ingesta of 46 lesser scaup and 50 white-winged scoters from nearby wetlands. Initial analyses indicate that invertebrate biomass and wetland chemistry affected both brood use and nesting locations. We will compare the ingesta from the collected birds to the diversity, abundance and biomass of invertebrates available in these wetlands to assess how diet selection contributed to this relationship. This research will help us to identify the importance of food availability on breeding habitat selection. Since wetland invertebrates are closely linked to water temperature, ice-free days, and photoperiod, climate change in this region has the potential to strongly influence aquatic invertebrate populations and the waterfowl that depend on them.

ABSTRACTS FOR BREEDING BIOLOGY PRESENTATIONS

BREEDING ECOLOGY OF WHITE-WINGED SCOTERS ON THE YUKON FLATS NATIONAL WILDLIFE REFUGE, ALASKA

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Breeding bird surveys indicate a long-term decline in the numbers of scoters in North America. Our objectives were to estimate nest, duckling, and adult female summer survival of white-winged scoters *(Melanitta fusca)* breeding within their primary breeding range on the Yukon Flats National Wildlife Refuge, Alaska. In addition, we measured habitat variables at nest sites and random sites in the study area to characterize nest habitat preference and investigated breeding probability with a laboratory analysis of circulating concentrations of the plasma yolk precursors vitellogenin (VTG) and very-low density lipoprotein (VLDL). We captured and radio marked paired female scoters (N=79) at the Scoter Lake Complex, early June 2002-2004, and additional brood rearing hens (N=13) in July 2003 and 2004. We searched for nests of marked and unmarked females and collected site attribute data at nests (N=39) and random points (N=62) in the study area. We monitored the fate of 127 ducklings in 2003 and 2004. We estimated daily survival rate and investigated sources of variation in survival with nest survival models in Program MARK, using AIC adjusted for small sample size (AICc) to select among models. We found nests (N=67) of marked and unmarked scoters and other duck species. Blood assays from 36 hens in 2004 indicated that 28% of the paired females we captured were not laying, and likely did not subsequently lay. We estimated nest (28 day) and female summer (87 day) survival probability from the constant survival model at 0.21 95% CI (0.08, 0.39) and 0.80 95% CI (0.64, 0.90), respectively. In 2003, duckling survival to 30 days for mean hatch date young at large wetlands was 0.01 95% CI (0.00, 0.07) and small wetlands was 0.59 95% CI (0.30, 1.00). In 2004, survival of ducklings at large wetlands was 0.33 95% CI (0.17, 0.63) and at small wetlands was 0.89 95% CI (0.77, 1.00). Scoters avoided nesting in graminoid habitat, but nested in all other shrub or forested habitat types in proportion to their availability; selecting sites with more overhead and lateral cover, higher variability in cover, which were closer to edge and water than random sites on the study area. At the habitat scale scoters are a generalist in their selection of nest sites. This lack of selectivity may improve nest survival of scoters over more selective duck species as nest predators can not search effectively for scoters. The low recruitment rates that we observed may be a reason for the observed declines in abundance if annual survival rates are not high enough to maintain stable populations. Development activities must consider the diversity of habitats and potentially long distances from wetlands used by breeding scoters.

BREEDING SUCCESS OF COMMON EIDERS IS AFFECTED BY THE CLIMATE OF PRECEDING WINTER

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Several recent studies have reported that phenology of spring migrating birds is dependent on the severity of the preceding winter and approaching spring. This severity can be measured using large scale climatic indices such as the North Atlantic Oscillation index in western Europe (NAO). These fluctuating indices may also be used as mimics of persistent climatic change, given that they prevail in one positive or negative mode for several years in a row. Despite the common knowledge that milder winters in recent years is correlated with persistently earlier migration in many birds in temperate regions, few studies have been published concerning the effect of climate on variation on spring arrival and how this relates to breeding success. In northern Europe, the extended winter NAO index correlates with the ice cover and the timing of the ice break of the Baltic Sea. Ice cover plays an important role for breeding waterfowl, since they can not arrive to their breeding areas before ice breaks and they never breed in islands as long as there is an ice bridge to the mainland and between larger islands, because of increased terrestrial predator risk. We studied the effects of the winter NAO index and ice break in Gulf of Finland on spring migration, laying date, clutch size, condition of breeding females, and fledging success of common eider *(Somateria mollissima)* in 1991-2004 (migration 1979-2004) at the southern coast of Finland, the Baltic Sea to which eiders migrate from Danish waters during winter. Body condition of breeding females showed significant positive correlations with NAO, and arrival dates showed positive correlations and clutch size and fledging success showed negative correlations with the timing of ice–break. The results suggest that climate, which also affects ice conditions, has an important effect on the fledging success of eiders. After severe winters females may be in poorer condition and can not allocate as much to breeding as much as after mild winters. Based on the results, global climate warming should increase the breeding success of eiders in the study area in the future.

FACTORS DETERMINING HERRING GULL FORAGING SUCCESS WITHIN AN ARCTIC COMMON EIDER DUCK COLONY

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Reproductive success of many colonial nesting birds is partly determined by loss of eggs and young to avian predators that nest within colonies. We investigated the ecology of herring gulls *(Larus argentatus)* foraging within a common eider *(Somateria mollissima)* colony in the Canadian Arctic. We hypothesized that predation rates of eider eggs and ducklings by gulls vary in relation to environmental conditions, prey alternatives, and risk of injury. 1) We studied gull predation of eider eggs and quantified how herring gull numbers, search rate, and attack success varied with environmental (weather, tide, available light, etc.) and behavioral (eider reproductive phenology, nest density, etc.) factors. Herring gulls did not force incubating hens off their nests, and took eggs only from unattended clutches. Consequently, gulls foraged more intensively and were most successful during eider egg-laying when hen nest attendance was intermittent. 2) We studied gull predation of ducklings during passage of eider broods from nest to sea. We assessed the effect of environmental variables on search and duckling capture rates by gulls, paying particular attention to annual variation. Capture rates were low and variable across years, but lowest when lemming abundance was high, despite consistent encounter rates between gulls and eider broods. Frequency of eider defensive response to foraging gulls was higher in low lemming years, and highest in the year following the lemming abundance peak. Otherwise, gulls searched most intensively and were most successful during windy conditions, when they could hover over broods. 3) We manipulated food availability within foraging territories actively defended by pairs of resident gulls. Territories varied in both size and in numbers of eider nests they contained. Both territory attendance and defense was largely determined by prey abundance within territories. Territorial residents were responsible for more than half of all egg depredations within the colony, and ultimately protected nesting eiders from other gulls by actively excluding them from their feeding territories. Our findings stress the importance of assessing costs, returns and risks for predators before making broad generalizations about their influence on colonial nesting prey. Our results also suggest that risk of injury may influence the foraging behavior of herring gulls as they attempt to maximize the trade-off between energy gain and foraging costs.

INCUBATION BEHAVIOR OF KING EIDERS ON ALASKA'S COASTAL PLAIN

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The patterns and constancy of incubation are unknown in king eiders *(Somateria spectabilis)*. Incubating females face conflicting selection pressures; maintaining a favorable thermal environment for embryo development, maintaining a favorable energy balance for themselves, and minimizing the risk of predation on themselves and their eggs. As a response to these discrepant demands, large waterfowl species have apparently developed the capacity to accumulate such significant fat reserves before nesting that they can rely predominantly on endogenous reserves to sustain themselves during incubation. King eiders are near the extremes of the waterfowl continuum in severity of climate and reliance on nutrient reserves and thus an interesting species in which to study the incubation behavior. We located and monitored king eider nests at two sites on Alaska's North Slope, Teshekpuk and Kuparuk, from 2002-2005. We placed artificial eggs containing HOBO data loggers in a sample of these nests (n = 10/site/year). We set the data loggers to record nest temperature every 2 minutes. Additionally, we weighed females upon arrival to the breeding grounds and again near hatch. In 2005, females were also weighed during mid-incubation. Incubation constancy was significantly higher at Kuparuk (99%) than it was at Teshekpuk (95%). Most recesses occurred between 2:26PM and 3: 37PM. Females nesting on islands in lakes took fewer, slightly longer breaks than mainland nesters. There is some indication that females may arrive on the breeding grounds in slightly better condition at the Kuparuk study site. Nest success was not significantly different between sites but tended to be higher at Kuparuk. We relate the incubation constancy of individuals to environmental and nest habitat characteristics. We examine the variation in incubation constancy, nest success, and spring condition of females between the two sites.

ABSTRACTS FOR BEHAVIOR PRESENTATIONS

MOVEMENT PATTERNS OF WINTERING SURF SCOTERS IN COASTAL BRITISH COLUMBIA: THE ROLES OF HABITAT AND PREY TYPE

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Local movement patterns are important for understanding wildlife habitat associations, resource use, and population structure. We evaluated the importance of habitat attributes, including prey type, on movement patterns of surf scoters *(Melanitta perspicillata)* wintering in coastal British Columbia. Surf scoters typically feed on mussels in rocky areas and on clams in soft-bottom areas. We hypothesized that there are trade-offs associated with each habitat, which may influence foraging and movement decisions. Radio telemetry was used to track surf scoter movements in two distinct locations with different habitat types. Baynes Sound has extensive sand and mud flats with dense clam resources (n = 106 radio-marked surf scoters). The Malaspina Complex is a rocky fjord-like inlet where mussels grow both on reefs and on shellfish farming structures (n = 74 radio-marked surf scoters). In Baynes Sound, where clams are the principal prey resource, surf scoters exhibit low levels of movement and have small winter home ranges (mean 95% khr = 5.09 km² ±1.19 SE). In this clam habitat, site fidelity was evident within and between years. Preliminary results from the Malaspina Complex indicate that surf scoters in mussel habitats display higher levels of movement and have larger home ranges (mean 95% khr = 22.45 km² ± 3.25 SE). Mussels growing on aquaculture structures were preferentially depleted and birds subsequently shifted into intertidal habitats or made long distance movements dispersing from the study area. Survey data substantiate these distribution trends; surf scoter abundance estimates within survey blocks were more consistent over time in Baynes Sound than in the Malaspina Complex. These findings indicate that surf scoter movement strategies are environmentally-mediated, i.e.: the foraging landscape dictates how scoter habitat use varies over space and time. Conclusions from our study will assist in the conservation and management of surf scoter populations in British Columbia's changing coastal environment.

MULTISTATE MODELING OF BROOD AMALGAMATION IN WHITE-WINGED SCOTERS

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Female waterfowl can lose or abandon offspring after hatch often leading to the phenomena of post-hatch brood amalgamation (PHBA). The potential fitness implications that arise from this behavior has brought about considerable debate on physiological or ecological motivations for PHBA of young, and potential costs and benefits of ducklings brooded in amalgamated broods. We explored relationships between probabilities of movements from maternal to amalgamated broods using a population of individually marked white-winged scoters *(Melanitta fusca deglandi)* (i.e., females [n = 94] and offspring [n = 664]) , at Redberry Lake, Saskatchewan, Canada, and pertinent ecological covariates utilizing multistate modeling. We tested hypotheses about movement probabilities and hatch date, brood size, female size and condition, duckling size and condition, and weather. We assigned ducklings as either (M) in broods with natal mothers, or (F) in foster broods cared for by a foster mother and conspecific non-siblings, focusing on covariates of movement probability to foster broods. Results showed that most fostering occurred within four days of hatch; additionally, likelihood of fostering was positively related to inclement weather, and negatively related to hatch date, female condition at hatch, female size, initial brood size, and duckling condition. Use of multistate modeling enabled proper estimation of relationships between likelihood of duckling adoption and numerous ecological variables. We conclude PHBA in this population appears to be consistent with several hypotheses (i.e., accidental mixing, energetic stress, and brood size and success hypotheses), although it is probably a complex function of numerous factors that vary year to year. Because the importance of predation in motivating abandonment or adoption of ducklings remains equivocal, we discuss how duckling traits, in a population located near high gull densities, may provide insights into the relative importance of predation to PHBA.

FEMALE-BASED KIN GROUPS IN THE COMMON EIDER

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The adaptiveness of social behaviors such as group living can be explained by the concept of inclusive fitness when kin relationships exist between individuals within groups. We investigated the presence of kin-based female sociality in the common eider *(Somateria mollisima)*. Previous studies of female sociality in common eiders have been restricted to observations during colony departure and brood rearing, despite the fact that females may associations occur at several previous stages including colony arrival and nest site selection. Here we provide a novel, empirical framework using molecular markers and field sampling to investigate female social groups at several stages of the common eider life cycle. Blood samples were collected from females captured in naturally occurring groups during colony arrival and colony departure. Genetic data for females was also collected during the nesting season via post-hatch collection of nesting material from monitored nests with known dates of nest initiation. When compared to mean estimates of inter-individual relatedness for the entire colony, significantly higher levels of relatedness were found between females within groups upon colony arrival, between females and nearest neighbors during nest site selection and between females within groups departing the colony with ducklings. Both full-sibling and half-sibling equivalent relationships were found within these groups at all three stages. Here we have provided the first genetically confirmed evidence of kin-based social groups in female common eiders and sea ducks in general. Further research directed at measuring fitness benefits of sociality in common eiders and other sea ducks could provide invaluable insight into the evolution of sociality in these species.

AGGRESSIVE COMMON EIDER FEMALES SEIZE CENTRAL POSITIONS AND SHOW ENHANCED PARENTAL EFFORT

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Decreased risk of predation is a key benefit of group living, and selfish herd theory predicts competition for central positions due to the relative safety of these spots compared to peripheral ones. Spatial position is also likely to affect activity patterns, as individuals adjust their behavior to mitigate the risk of predation. Female common eiders *(Somateria mollissima)* often pool their broods and share brood-rearing, and antipredatory vigilance constitutes a core parental care activity. Females are assumed to trade-off vigilance and feeding by diving; efficient condition recovery is crucial for energetically stressed post-incubating females, which do not feed during most of egg laying and incubation. Based on previous data, a female's own ducklings are closer to her than unrelated young in mixed broods, so a female's spatial position is likely to correlate with the survival prospects of her brood. We identified correlates of female spatial position within multi-female brood-rearing coalitions in a common eider population from the Baltic Sea, SW Finland, and explored how spatial position affects female activity patterns. Neither clutch size, body condition at hatching nor structural size (length of the radius-ulna) were significant predictors of spatial position; however, females showing a higher frequency of aggression occupied more central spots. The investment in vigilance increased, whereas the investment in feeding was uncorrelated with spatial centrality; instead, central females devoted less time to other activities (resting, preening, and movement). Our results demonstrate means by which socially dominant eider females may increase their reproductive share in joint broods without jeopardizing their own survival by feeding less. These findings also reveal that good body condition does not guarantee a favorable position in brood-rearing coalitions, which may help explain our previous finding that female common eiders in best body condition at hatching tend their brood alone.

ABSTRACTS FOR CONTAMINANTS AND DISEASE PRESENTATIONS

DISTRIBUTION OF MICROBIAL PATHOGENS IN FIVE SPECIES OF SEA DUCKS: LOCAL OR GLOBAL IMPLICATIONS FOR DECLINING POPULATIONS?

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We have conducted disease surveys in the Baltic, Beaufort, and Bering Sea regions since 1996 to investigate prevalences and potential effects of infectious diseases on declining populations within the Tribe Mergini. We examined the occurrence of viruses, bacteria, and fungi by screening blood samples and cloacal swabs for previously known avian pathogens and novel infectious agents among breeding, molting, or wintering populations of sea ducks. We summarize findings on host ranges, prevalences, and patterns of occurrence for potentially pathogenic agents identified in common eiders (*(Somateria mollissima)*, spectacled eiders *(Somateria fischeri)*, Steller's eiders *(Polysticta stelleri),* long-tailed ducks *(Clangula hyemalis)*, and harlequin ducks *(Histrionicus histrionicus)*. To date, we have found evidence of exposure to at least 25 genera of micro-organisms, including reoviruses, adenoviruses, influenza viruses, Newcastle disease viruses, infectious bursal disease virus, *Chlamydophila* sp., and *Aspergillus* sp. We evaluated potential effects of selected organisms using three general approaches: 1) comparisons of prevalences among sea ducks in areas where mortality events occurred with reference populations; 2) correlations between disease exposure and reproductive success; and 3) controlled experimental challenges. Some microbes were found to have wide geographic and species distributions, with potential links to sea duck declines among several populations. We found evidence linking adenovirus exposure to mortality events in molting long-tailed ducks and breeding common eiders in the Beaufort and Baltic Seas, respectively, and to reproductive problems in spectacled eiders on the Yukon-Kuskokwim Delta. Reoviruses were associated with common eider duckling mortality in the Baltic and Beaufort Seas. Findings to date suggest a more limited distribution for other potential pathogens, however, populations with declining numbers and shrinking ranges may show increased vulnerability to localized impacts. Sources of outbreaks and, therefore, potential management implications may differ between localized and widely spread diseases. For newly discovered host-microbe relationships, the mechanism and magnitude of impact on populations are unknown and often challenging to characterize - especially in remote marine environments, where most sea ducks exist. However, we found evidence of exposure to infectious agents across all geographic locations and species studied, linked infectious agents with mortality events, and documented pathogenicity in experimental studies. We conclude that diseases may be contributing to declines or hindering recovery of some sea duck populations.

EFFECTS OF DIETARY SELENIUM EXPOSURE IN CAPTIVE AMERICAN COMMON EIDERS

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We conducted two studies of Se exposure in captive common eiders *(Somateria mollissima)*. In Study 1, eiders were fed diets with added Se (as L-selenomethionine) in concentrations increasing from 10 ppm to 80 ppm. In Study 2, eiders received control, low exposure (20 ppm Se), and high exposure (60 ppm Se) diets. One duck in the high exposure group in Study 2 died after 36 days. Remaining high exposure ducks in Study 2 and ducks in Study 1 were euthanized after losing 25-30% of their body weight, which occurred after 41 days and 60-78 days, respectively. Body weights did not differ between control and low exposure ducks in Study 2. At the end of Study 1, the mean Se concentration in blood was 32 ppm wet weight (ww). In Study 2, mean blood Se reached 14 ppm ww in the low exposure group and 17 ppm ww in high exposure ducks. Mean Se concentrations in liver were 1252 ppm dry weight (dw) in Study 1, and 351 and 735 ppm dw, respectively, in the low and high exposure groups of Study 2. Oxidative stress was evidenced by Se-associated effects on glutathione metabolism, but not entirely in the same manner as with previous laboratory studies in mallards. In plasma, activities of total and Se-dependent glutathione peroxidase increased with time. As Se concentrations in liver increased, Se-dependent glutathione peroxidase, glutathione reductase, oxidized glutathione, and the ratio of hepatic oxidized to reduced glutathione increased. Total and protein bound sulfhydryl concentrations, reduced glutathione, glutathione-S-transferase, and glucose-6-phosphate dehydrogenase in liver were negatively correlated with Se concentrations in the liver. In Study 2, spleen weights were significantly lower in ducks receiving 60 ppm Se than in those receiving 20 ppm. Gross lesions associated with high Se exposure included emaciation, absence of thymus, loss of nails from digits, and alopecia. Microscopic lesions included severe depletion of lymphoid organs, hepatopathy, and necrosis of feather pulp and feather epithelium. Common eiders fed high levels of Se lost weight and developed lesions similar to findings in experimental mallards, but they accumulated greater Se concentrations in tissues, particularly liver. Field studies have shown that apparently healthy seaducks generally have higher levels of Se in liver than healthy fresh water birds, but lower than the concentrations we found in our study. We conclude common eiders and probably other seaducks have a higher threshold, or adverse effect level, of Se in tissues than fresh water species.

SELENIUM IN BOREAL WHITE-WINGED SCOTERS RELATIONSHIP WITH BODY CONDITION AND REPRODUCTION

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Recent studies report that scoters and other sea ducks carry heavy body burdens of organic and inorganic contaminants. One of these contaminants, selenium (Se), is a semi-metallic element and an essential micro-nutrient that is increasing in the environment through human activities such as burning of fossil fuels, smelting of metal ores, and irrigation of seleniferous soils. Waterfowl use many Se enriched areas; yet, our understanding of the effects of Se on waterfowl is based primarily on captive mallard studies and, to some extent, investigation of waterfowl in natural systems. So, interpreting reported levels from seaducks can be difficult. Liver Se levels from scoters sampled in Alaska exceeded levels where negative physiological and reproductive effects were observed in other waterbirds, but there were no detrimental physiological effects reported and little Se appeared to be deposited in developing eggs. The most Se-sensitive physiological process appears to be embryonic development; Se deposition in eggs can reduce egg viability, increase malformations and impair duckling growth. We studied Se in white-winged scoters *(Melanitta fusca deglandi)* in the Canadian western boreal forest, a region where scoter populations have apparently suffered the greatest decline in the past 2 decades. Our objectives were to investigate the relationship between Se concentrations in matched liver and egg/developing follicles. We collected and tested whether elevated Se levels were negatively related to body condition and female breeding status. Preliminary results from birds collected in 2003 show that female scoters (n = 14) had a mean liver Se concentration of 36 µg/g dry weight (dw), above the potentially harmful level of 33 µg/g dw suggested for mallards. There was no relationship between Se levels and either breeding status (non-RFG vs. RFG) or an index of body condition. Analyses from Se levels in livers and matched eggs/ovarian follicles of females (n = 41) collected in 2004 should reveal whether Se is removed from the body and deposited in eggs, as well as improve our analysis of the Se relationship to breeding status and body condition.

RESOURCE USE BY DIVING DUCKS DURING WINTER ON NORTHEASTERN LAKE ONTARIO: A COMPARATIVE APPROACH TO UNDERSTANDING CONTAMINANT ACQUISITION

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Populations of diving ducks using Lake Ontario during winter have increased since the 1980's. This could become problematic if ducks are acquiring unhealthy contaminant burdens by foraging on the Great Lakes throughout winter. It was hypothesized that the increase in populations of diving ducks was due to increased food resources after the introduction of dreissenid mussels *(quagga [Dreissenia bugensis]* and zebra *[D. polymorpha]* mussels), who are relatively contaminated with selenium among other metals of concern. Recently, numbers of diving ducks using Lake Ontario during winter have stabilized, possibly indicating carry capacity during winter has been reached. However, little research has been conducted on resource use and partitioning by diving ducks wintering at northern latitudes. Therefore, wildlife managers have little idea of what, if anything, limits (or will limit) numbers of diving ducks during winter on Lake Ontario. I investigated resource use and niche overlap, as well as behavior, habitat use and body condition of diving ducks to determine if food availability was limiting the number of birds using northeastern Lake Ontario during winter. Buffleheads *(Bucephala albeola),* common goldeneyes *(Bucephala clangula)*, and long-tailed ducks *(Clangula hymelis)* were studied to elucidate complex interactions between variables and reduce the number of viable alternative hypotheses. Results suggest that food is not a limiting resource to diving ducks using northeastern Lake Ontario during winter. Therefore, more birds may winter within a location where their food (dreissenid mussels) is relatively contaminated. However, while dreissenid mussels comprised approximately 85% of the invertebrate community, they were consumed at relatively low levels by birds. We are currently analyzing samples of macroinvertebrates and livers from various diving ducks collected during winter on northeastern Lake Ontario to determine contaminant levels. By using three species with different foraging habits and body size, we can assess whether or not and how birds are acquiring contaminants during winter on Lake Ontario.

POSTER ABSTRACTS

DETECTION AND CHARACTERIZATION OF A NOVEL ADENOVIRUS FROM STELLER'S EIDERS BY PCR

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The Alaskan population of Steller's eiders *(Polysticta stelleri)* has undergone drastic declines in nesting ranges and was listed as threatened under the U.S. Endangered Species Act in 1997. As part of an investigation to evaluate the role of diseases in eider declines, we are developing molecular techniques for detection and characterization of viruses in Steller's eiders. Detection and characterization of pathogens from field samples is a first step in a multi-faceted effort toward understanding disease ecology in declining sea duck populations. This effort is often hampered by a lack of reagents specific for the species or for the disease agent. A species-specific, virus-specific PCR (polymerase chain reaction) assay was developed as an additional tool to complement cell culture and serological assays to detect adenoviruses in Steller's eiders and other declining sea duck populations in Alaska. An adenovirus was isolated from a cloacal swab of a Steller's eider sampled in 2003 at the Alaska Peninsula. Preliminary identification in cell culture was followed by molecular analyses to further characterize the isolate. PCR using viral DNA and primers from conserved regions of the fowl adenovirus genome produced an approximately 900 base pair fragment, and DNA sequence analysis of the amplified fragment suggested a novel adenovirus. Four oligonucleotide primers were designed from the DNA sequence of the newly isolated adenovirus, resulting in PCR bands of predicted sizes. Using these primers a virus-specific PCR assay was developed to detect and characterize the Steller's eider adenovirus and related adenoviruses in both field samples and cell cultures. DNA extraction followed by PCR from dilutions of titrated virus stocks demonstrated a dramatic increase (over 10-fold) in sensitivity as compared to the cell culture assay. This increase may be due to detection of non-infectious virus in our stocks by PCR. To assess the sensitivity of the PCR assay on samples from wild birds, PCR was performed on the original cloacal swab that the virus was isolated from, resulting in a detectable band of predicted size. This demonstrates potential for more sensitive detection in field samples by PCR, since the virus was undetectable in the original inoculation of the cell culture assay. Additional cloacal swabs will be analyzed by PCR to determine if we can detect the presence of virus in cloacal swabs that were negative in cell culture assays. The PCR assay will be used to screen for viruses in cloacal swabs from Steller's eiders and other sea ducks that share breeding, molting or wintering grounds. PCR assays will be valuable in determining specificity to related adenoviruses from other species, and will facilitate virus tracking and determination of prevalence. PCR will also allow a fast response and characterization in case of a suspected viral outbreak.

LONG-TERM CHANGE IN LIMNOLOGY, INVERTEBRATES, AND AVIAN PREDATORS IN ALASKAN BOREAL WETLANDS

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Climate change is more pronounced at high northern latitudes, and may be affecting the physical, chemical, and biological attributes of the abundant wetlands in boreal forests. On the Yukon Flats, located in pristine boreal forest of northeast Alaska, we re-sampled water chemistry and macroinvertebrates in summer 2001-2003 from 9 wetlands where similar data were collected during 1985-1989. These wetlands lost an average 19% of surface water area between decades, results very similar to other studies over much larger areas. Total nitrogen and most metal cations (Na, Mg, and Ca, but not K) increased between these periods, while total phosphorus (TP) and chlorophyll a (Chl a) declined. These changes were greater in wetlands that had experienced more drying (decreased surface area). Compared to 1985-1989, densities of cladocerans, copepods, and ostracods in both June and August were higher in 2002-2003, while densities of amphipods, gastropods, and chironomid larvae were generally lower. The latter taxa (especially amphipods) are thought to be critical prey for lesser scaup *(Aythya affinis)*, a diving duck that nests mainly in the boreal forest and whose numbers have been declining for over 20 years. In comparisons among wetlands in 2002-2003 only, amphipod biomass was lower in wetlands with lower Chl a, which might help explain the decline of amphipods since the late 1980s when Chl a was higher. The long-term decline in Chl a corresponded to greatly increased zooplankton density in June, suggesting a shift in carbon flow from scrapers/deposit-feeders that are eaten by scaup to water-column grazers that are not. In 2003, the density of lesser scaup ducklings among wetlands was positively related to total macroinvertebrate biomass collected in sweep and core samples. Declines in benthic and epibenthic deposit-feeding invertebrates, that are key prey for lesser scaup, suggest important foodweb effects of climate change in otherwise pristine wetlands of the boreal forest. Changes in boreal wetlands may also be a factor in scoter (*Melanitta* sp.) declines, which are tightly correlated to scaup declines. These taxa largely overlap on northern staging and breeding areas but winter in ecologically and spatially different areas.

HABITAT USE BY RED-BREASTED MERGANSER BROODS AT KOUCHIBOUGUAC NATIONAL PARK, NEW BRUNSWICK

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Recruitment of juvenile waterfowl to fall populations requires that adequate brood-rearing habitat be available. Despite breeding in a variety of fresh and salt water wetlands, little is known about the brood habitat requirements of nearctic red-breasted mergansers *(Mergus serrator)* that breed in marine environments, particularly at coastal barrier island sites. The objective of the study was to determine habitat selection by red-breasted merganser broods at two scales (home range and sites within home range). We used a landscape-level approach to habitat selection where discrete coastal habitats were delineated from the Canadian Wildlife Service's Maritime Wetlands Inventory. Over three years (2002-2004), habitat use was determined for 11 radio-marked merganser broods originating from a breeding colony located on three barrier islands at Kouchibouguac National Park, New Brunswick. At both scales of study, radio-marked broods preferred continental and barrier island estuarine intertidal flats. Adjacent tidal wetlands of estuarine intertidal flat habitat provided young broods (< 10 days post-hatch) with concealed resting and loafing sites amidst emergent salt water cordgrass *(Spartina alterniflora)*. Older broods typically did not seek emergent vegetation and were often observed loafing along the sandy shores of the intertidal flats located along the barrier island complex. Preliminary fish sampling evidence suggested that the intertidal regions of the estuarine system support a large number of small fish species (e.g. Atlantic silversides *Menidia menidia*) in high abundance throughout the late summer brood-rearing period. Tidal river habitat was avoided for brood-rearing despite its proximity to the nesting islands and apparent large prey base. Interspecific competition with common merganser *(Mergus merganser)* broods at tidal river sites may be a proximate factor in the evolution of habitat selection by mergansers at Kouchibouguac National Park. Determining habitat requirements will lead to future investigations concerning impacts by foraging merganser broods on small fish populations in the estuarine system at Kouchibouguac.

AVIAN SENSITIVITY TO WIND FARM-RELATED MORTALITY: MATRIX POPULATION MODELS IN AN APPLIED CONTEXT

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The main aim of this study was to develop a general modeling framework for setting management priorities by categorizing species according to their relative vulnerability to wind farm-related mortality. To do this, I compared the elasticity patterns generated by the life tables of a finite numbers of theoretical matrix population models representing the spectra of avian values of adult survival and adult female fecundity. The comparisons were generalized by developing simplified stage-classified models (two stages: pre-breeding and breeding) parameterized by invariant values of juvenile survival, mean adult survival, and mean annual fecundity. Such generalized and relatively simple models have earlier been shown to capture the essentials of full age-classified Leslie matrices, and they may therefore represent a useful tool for a first assessment of the relative influence of wind energy related mortality on different bird populations. Thus, if prioritization between species is necessary, for either technical or economical reasons, applying relatively simple matrix population models could optimize this classification process. Estimating the absolute demographic effects (e.g., the direct impact on the population size) of wind farm related mortality necessitate the use of much more detailed matrix population models. The predictive power of such models is determined by the degree to which the estimated input-parameters reflect the true mean values and their associated variance. Furthermore, details about density dependence, population age structure, age at first breeding, number of non-breeders and environmental and demographic stochasticity must be incorporated. Especially if the researcher wants to predict what will happen through forecasting rather than just describe what would happen given certain hypotheses through population projection. Often such detailed data do not exist for the species of interest making the construction of such complex matrix population models an impossible task.

AVIAN COLLISION RISK AT OFFSHORE WIND FARMS

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In Europe, the exploitation of marine areas for wind power production has been expanding in recent years. This has caused great public concern for the potential negative impact from increased wind farm related avian mortality. At land-based installations the local effects can be assessed by carcass collection underneath the wind turbines and with simultaneous corrections for the corpse removal by scavengers. However, applying this methodology at an offshore wind farm would most probably turn out to be an overwhelming logistic and practical challenge. Consequently, novel tools, in terms of remote techniques and statistical models, are currently being developed in Europe. Firstly, the poster will focus on the importance of including evasive behavior in predictive avian collision models, since the estimated number of bird-turbine collision has been shown to be very sensitive to this factor. If the vast majority of bird species and individuals perceive off shore wind farms as a great risk and furthermore are capable of avoiding these structures, then the number of collisions will be relatively low despite high migration volumes. Secondly, the framework for such collision predictive models will be described and the pros and cons of deterministic and stochastic approaches will be discussed. Finally, the use of offshore applicable remote technologies for model parameterization and direct collision detection will be presented. Especially the use of marine surveillance radar for mapping the flight trajectories of migrating flocks of birds and measure their evasive response to man made obstacles like wind turbines. In recent years, thermal imaging has been applied for studying avian behavior in off shore areas, and the poster will present the Thermal Animal Detection System (TADS), which has been specifically developed for measuring directly the number of avian collisions at offshore wind farms.

A FIELD TECHNIQUE FOR DETERMINING REPRODUCTIVE STATUS IN FEMALE BIRDS

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During egg formation, the circulatory system transports vitellogenin and very low density lipids as yolk precursors to the ovary. The onset of this lipemia coincides with the beginning of rapid growth in the first follicle. Zinc has been used to index the amount of circulating yolk precursors in determining the breeding status of females in various avian species. Here we developed a simple field technique to determine whether a female is lipemic, and we tested the reliability of this method as an indicator of breeding status. In 2004, we collected and centrifuged 0.5 ml of cardiac blood from lesser scaup *(Aythya affinis)*, ring-necked ducks *(Aythya collaris)*, and white-winged scoters *(Melanita fusca)*. We recorded the presence and absence of a lipid layer floating above the blood serum, and in the laboratory we directly assessed the breeding status of females based on ovarian follicle characteristics. We then used binary logistic regression to model the influence of species, blood lipid index (BLI), and z-scored weights as predictors of breeding status. In all three species combined, presence of blood lipid correctly predicted the occurrence of breeding in 92% of females (n = 60) and non-breeding in 96% of females (n = 68). Results were similar among species; including standardized body weight did not improve the predictive ability of models. Error in predicting females as non-breeders was likely due to the incomplete coagulation of blood prior to sampling which prevented the formation of a lipid layer. Two of three females were misclassified as being breeders possibly because onset of breeding was defined by a minimum 0.1 g dry weight of the largest follicle. The BLI technique appears to be a simple and accurate method of determining whether a female is producing eggs and provides a method to assess breeding status before other indicators, such as brood patch presence, are available.

DISTRIBUTION OF COMMON EIDERS DURING BROOD-REARING IN THE ST. LAWRENCE ESTUARY

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Common eiders *(Somateria mollissima dresseri)* nest in colonies on islands of the St. Lawrence estuary in Quebec. After hatching, females must reach adequate habitats for rearing their ducklings. Adult birds also undertake a molt in late summer but their distribution is not well known. The aim of our study was to determine the biotic and abiotic factors that influence the distribution of these birds during the brood-rearing and molting periods. The number of common eiders was recorded by age and sex bi-weekly in 2003 and 2004 at 68 sites located along a 200-km stretch of the south shore of the St. Lawrence River. For adult females, we also noted whether they were accompanied by young or not. In 2004, we recorded the behavior of individuals and noted their locations in relation with distance to shore. We evaluated human disturbance, developed a shoreline sinuosity index, characterized the nature of the substrate, and estimated food abundance. At the scale of the estuary, common eiders did not distribute randomly and used the same sites in both years. Females without ducklings and males were further east along the estuary, but their numbers were lower than expected based on the breeding population. Broods preferred the westerly areas near the nesting islands. On a temporal scale, we observed that the densities of females without ducklings increased significantly during the summer as they move eastward. Broods spent more than half of the day time feeding while this proportion decreased through time from nearly 40% to 10% for females without ducklings. On a local scale, broods used mainly the intertidal zone, whereas adults without ducklings were distributed further off-shore. Densities of common eiders were exclusively influenced by food abundance with each age and sex category distributed according to their preferred prey. Shoreline sinuosity and human disturbance influenced the proportion of time that eiders spent in foraging activities and their location from shore. In conclusion, our study will help to identify the best brood rearing and molting sites for common eiders along the St. Lawrence estuary based on biotic and abiotic factors. Very few of these sites are currently included within conservation areas and measures should be taken to insure their protection.

PRELIMINARY CHARACTERIZATION OF MIGRATION AND BREEDING GROUNDS ASSOCIATED WITH WHITE-WINGED SCOTERS WINTERING IN WASHINGTON STATE FROM ONGOING TRACKING OF SATELLITE TRANSMITTERS

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A number of marine birds and sea ducks have experienced significant declines in numbers over the last 25 years in the marine waters of Washington State, with scoters composing one of the larger avian biomasses associated with this decline. However, little was known until recently of movements and population demography of either of the two more numerous wintering scoter species populations, the surf scoter *(Melanitta perspicillata)* and the white-winged scoter *(Melanitta fusca),* on the west coast and how they might relate to each other. The white-winged scoter makes up roughly 35% of the scoters found in Washington during the winter on average. Focus studies started in 2003 on both species, but the effort devoted to white-winged scoters involved implanting them with only satellite transmitters. Our first source of outside funding directed us to look at this species, so as to complement an ongoing similar effort by scientists in the Strait of Georgia that was looking at white-winged scoters. These initial studies are scheduled to continue until 2006 in Washington using satellite transmitters primarily for the purpose of documenting the patterns of distribution and fidelity to winter and spring foraging areas, night concentrations, migration routes, range of breeding sites, and molting areas of those adult scoters wintering in Washington. Between years wintering site fidelity was examined to determine what proportion of white-winged scoters return to the marine waters of Washington, and if white-winged scoters captured in British Columbia come to Washington the winter after capture, instead of returning to the region of capture. Though the sample size is relatively small, we wanted to evaluate if immigration/ emigration between years occurs. We also compare scoter population trends from the USFWS and CWS Waterfowl Breeding Population and Habitat Survey, from the strata in the Canadian interior where Washington scoters breed, with wintering trends from Washington State. Three years of the project have now been completed, suggesting confirmation of the following: 1) Distinct differences in distribution and movement exist between the two main scoter species, between male and female scoters within each species, and even some suggestions of differences between different but close flyway subpopulations of white-winged scoters, such as those from the Strait of Georgia and Puget Sound. 2) The time spent by scoters in marine areas is considerable, with 9-10 months for males and 8-9 for females observed, often including molting flightless periods in western Washington in late summer. 3) western Washington contains important wintering and spring staging areas used by white-winged scoters as well as summer molting areas. 4) These staging areas were often different than those used by surf scoters. These Washington spring staging areas also attract a certain proportion of British Columbia white-winged scoters. 5) The white-winged scoters we tracked tended to return daily and yearly often to the same locations, expressing considerable site fidelity.

DISTRIBUTION AND CHARACTERISTICS OF WINTER NOCTURNAL RESTING AREAS OF SURF SCOTERS, WHITE-WINGED SCOTERS, IN PUGET SOUND, WASHINGTON STATE

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The diurnal distribution of wintering marine birds in Puget Sound has been well documented (Nysewander et al. 2004), however, their nocturnal distribution is poorly understood; there is also little data documenting this throughout North America. VHF and satellite telemetry were used to identify nocturnal resting locations of surf *(Melanitta perspicillata)* and white-winged scoters *(Melanitta fusca)* in three regions of the greater Puget Sound, Washington State. After nocturnal locations were identified, vessel trips were conducted, using radar and VHF telemetry, to locate the flocks and attempt to determine species composition, flock size, and characteristics of the flocks. Scoters distributed over a wide area would congregate during nocturnal hours in resting flocks. These nocturnal flocks generally occurred in more open/exposed waters, had higher densities, and were more spatially confined than observed during diurnal hours. Nocturnal flocks also occurred in areas that typically have much lower densities during diurnal hours, and were generally centrally located near diurnal foraging areas. Nocturnal resting flocks consisted of both mixed, and segregated species. Mixed flocks included goldeneyes *(Bucephala clangula)*, bufflehead *(Bucephala albeola)*, mergansers *(Mergus merganser)*, loons *(Gavia immer)*, gulls, and horned *(Podiceps aurtius)* and red-necked grebes *(Podiceps grisegena)*. Distance traveled from diurnal to nocturnal areas ranged from <1 to 25 kilometers. Three types of nocturnal resting flocks were defined, depending on characteristics. Understanding nocturnal sea duck distribution is important in assessing and better understanding habitat use and assessing key areas of importance. Also, these nocturnal flocks potentially increase the vulnerability of scoters to oil contamination in the event of a spill. For example, containment strategies of spills that emphasize primarily near shore areas that host high diurnal bird densities run the risk of neglecting the larger concentrations of scoters that congregate from a wider area into more open waters at night. As sea duck nocturnal resting areas are poorly understood, only a handful being documented to date, it is important to continue and expand research efforts.

NEST SITE CHOICE BY ARCTIC-NESTING COMMON EIDERS

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We investigated patterns of common eider *(Somateria mollissima)* nest site use in Canada's Eastern Arctic, and conducted experiments to better understand selective processes that may underlie these patterns. We monitored 5 study plots using observation blinds, documenting successful nest establishment (i.e., laid eggs and onset of incubation) and subsequent nest fate. Following hatch, we measured physical characteristics of all available nest bowls and random sites. Higher probability of bowl use occurred in regions of greatest local nesting density, and in bowls with large adjacent rocks and organic substrates. Furthermore, bowls with these characteristics had a tendency to be used first. Available nest bowls that were not used by an incubating female (i.e., either no nest attempted, or nest loss occurring during egg laying) had intermediate characteristics between random sites and used bowls. Furthermore, we found characteristics positively associated with probability of use were also associated with increased probability of nest success. These patterns suggest that nesting eiders actively select and/or lose fewer eggs to predators in sites with certain characteristics. To investigate these patterns further, we experimentally manipulated nests prior to egg-laying and during incubation. Extraneous material (e.g. moss, down) placed within bowls prior to laying had no influence on probability of nest establishment, but bowls containing down were more likely to have nests successfully initiated in them earlier than nests containing no nesting material. We also placed artificial nest shelters and temperature probes over established nests. We found females nesting in artificial shelters experienced more moderate thermal environments, and maintained higher late incubation body weight. We speculate that it may be energetically advantageous for eiders to nest in sites with large rocks that provide shelter from strong wind and rain, whereas bowls with rock substrates likely have poorer insulative properties than those with organic substrates. Furthermore, eiders may benefit from increased detection of predators and/or reduced nest mortality by choosing bowls in areas of higher nesting density.

ATLANTIC COMMON EIDER FIELD COLLECTION AND CAPTIVE REARING AT THE LIVINGSTON RIPLEY WATERFOWL SANCTUARY

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After an exhaustive search in both the private and zoological waterfowl collections in the US, there seemed to be a dismally low number of Atlantic common eiders *(Somateria mollissima dresseri)* available to revitalize the eider population at the Livingston Ripley Waterfowl Sanctuary. Because of a lack of captive birds available, a permit from the State of Maine and the USFWS was secured to collect twenty-four eggs from islands in East Casco Bay, Maine. After a successful field collection with Brad Allen of the Maine Department of Inland Fisheries and Wildlife, the eggs were artificially incubated to hatching, and hand reared in brooders at the Livingston Ripley Waterfowl Sanctuary in Litchfield, Connecticut. The methods of hand rearing proved successful, and all twenty-four ducklings were reared to fledging. These ducks, when mature, will form the backbone of a breeding program for the species at the Livingston Ripley Waterfowl Sanctuary, which will provide genetically diverse Atlantic common eider to those organizations in need of new captive bloodlines. Such a breeding program will also ensure that a healthy number of Atlantic common eider is sustained in captivity for education and research. Field collection of twenty-four Atlantic common eider eggs was conducted to establish a captive colony. Nest site location, collection and transport methods were determined. The process of incubating and hand-rearing the ducklings to fledging, including humidity and temperature for incubation stage hand-rearing, and adult housing is described. Also recorded are feeds used and daily growth tables for captive eider ducklings from hatch to fleding, as well as images of rearing facilities, field collection, and duckling growth.

DEVELOPMENT OF METHODOLOGY FOR CAPTURING MOLTING SURF SCOTERS

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The surf scoter *(Melanitta perspicillata)* is one of the least studied ducks in North America. Within the last 10 years, we have located their principal molting areas along the coast of Labrador, Canada, and in 2004, we initiated a molting ecology study of surf scoters. During the first field season, our primary goal was to develop capture techniques. Herein, we describe the capture technique and preliminary results. Our study area was located within three large archipelagos near Nain, Labrador where 10-15,000 birds were known to molt. We refined techniques used for drive-trapping birds for use in open, deep-water areas. Flocks were first located by patrolling the coastline from 5-6 m skiffs. Once located, the flock was herded towards shore using two boats, while a third boat set a gill net in front of the flock. Nets were set perpendicular to the shore, and curved back towards the flock. All nets had 90 mm mesh size and were 4 m deep. We tested nets varying in length from 180 to 365 m. The ends of the net were marked with single scoter decoys and strings of decoys were attached to the nets' float-line about a third the length of the net from the near shore end. Once the net was deployed the third boat joined the drive and the birds were herded towards the net. When the flock was 2-5 m from the net we forced them to dive by firing 1-3 cracker shells over the birds. Birds were also hazed into the net using air horns. From 8 to 17 August, we made 29 sets and caught 661 birds (mean ± sd bird caught per set was 22.8 ± 15.6). The overall species composition was 95.6% surf scoter, 3% white-winged scoter *(Melanitta fusca),* 1.5% common eider *(Somateria mollissima)* and <1% razorbill auk *(Alca torda)*. The majority of birds (95%) were males. The direct recovery rate in 2004 was 1.1%, and we estimate that adult survival could be measured with an annual banding effort of 1-1300 birds. In 2005, we will attempt to recapture birds to evaluate the potential of mark-recapture techniques to refine survival estimates. We encourage development of a surf scoter banding program, which could generate reliable information on surf scoter population status, structure and dynamics that are currently are lacking for this species.

MEASUREMENT OF PROBABILITY DETECTION RATES FOR NEST SEARCHES IN DENSELY VEGETATED COMMON EIDER COLONIES

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The American subspecies of the common eider *(Somateria mollissima)* is an important game bird in eastern North America. Currently, this population is not regularly monitored throughout its range, and managers are considering development of a monitoring program for this population. Two general monitoring programs are being considered: spring counts of males and counts of nests at breeding colonies. Monitoring programs that utilize nest counts continue to be an attractive option because of the potential to make precise counts of nests at large colonies. But, breeding effort in eiders may vary annually which may influence effectiveness colony counts, and the precision of nest counts has not been evaluated. Throughout much of the southern portion of their range large numbers of eiders nest on islands with dense vegetative cover (up to 12000 pairs per colony) which can be difficult to search completely. We use a data set collected from a forested eider colony in the Wolves Archipelago, New Brunswick to evaluate optimal timing of nest surveys and estimate probability detection rates. Over a three-year period, the colony was searched 7-8 times annually. During each search, the fate/status of each nest was recorded and each nest was marked with a numbered marker. In 1984, 1985, and 1986, respectively, we found a total of 500, 1032 and 858 nests. We use mark-recapture analyses to estimate total breeding effort and to evaluate probability detection rates of nest searches. Initial analyses indicate that only a portion of nests initiated in the colony may be detected during single surveys of the colony. Surveys conducted late in incubation (17-23 days after the mean laying date) detected the largest proportion of the total nest counts which accounted for only 62%, 76%, and 65% of the total nests found in 1984-86, respectively. Our initial results indicate annual variability in colony counts may in part be due to variability in detection probabilities among years. We suggest that monitoring programs based on counts of eider nests should incorporate estimates of detection probabilities to improve the precision and accuracy of these surveys.

BANDING OF COMMON EIDERS IN THE ST-LAWRENCE ESTUARY - A PROGRESS REPORT

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Despite intensive management of nesting habitat in several colonies of the St. Lawrence River estuary (SLE), the population of common eiders *(Somateria mollissima)* has not increased. Recurrent epizootics of avian cholera and suspected high harvest levels are the most obvious limiting factors but their importance on the population dynamics is currently unknown. In 2003, we initiated a long-term banding program of the SLE common eiders to 1) assess survival rates of adult females and juveniles, and 2) determine the relative contribution of hunting and natural mortality including avian cholera. Ultimately, we want to test the hypothesis that hunting mortality is additive to natural mortality. In 2003 and 2004, we captured 1253 nesting females with dip nets on 13 islands that harbor the majority of the nesting population. In 2004, we recaptured 62 birds (15%) banded in the previous year (n=417). This will be useful to estimate adult female survival because the number of recoveries has been low with only 17 (1.4%) reported up to April 2005. These included 11 from Maine and Massachusetts and 5 from Quebec, a ratio that is reversed when compared with the recovery distribution from the seventies. In 2004, we double marked 222 females with stainless steel and standard aluminum bands to estimate wear and loss of aluminum bands. To our knowledge, this has not been done for any sea ducks that are probably more susceptible to band wear than other waterfowl species. This could bias any estimates of survival rate. Blood samples and swabs were collected from 103 nesting females caught in 6 colonies to assess the presence of avian cholera. Although no outbreak was detected in 2004, *Pasteurella multocida* was detected in 9 birds (8.7%) from 3 colonies. Serotyping of the bacteria is underway. We captured 46 pre-fledged juveniles and 6 females in August 2004 by driving them along the south shore of the river using nets and a catch pen. Updates with the 2005 field season will be presented.

WEIGHTS AND MEASUREMENTS OF FOUR SEA DUCK SPECIES WINTERING ON THE CHESAPEAKE BAY

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The conservation of sea ducks along the mid-Atlantic states has been hindered by a paucity of species-specific morphology and weight data. This paper presents basic weights and measurements of four species of sea ducks (white-winged scoter, *Melanitta fusca*, n=41; black scoter, *Melanitta nigra*, n=87; surf scoter, *Melanitta perspicillata*, n=139 and old squaw, *Clangula hyemalis*, n=112). A total of 379 specimens were collected from waterfowl hunters in Talbot, Queen Anne's and Dorchester counties on the Eastern Shore of Maryland, USA, during the winters (October-January) of 1987-1990. Weight, sex and age were determined for each individual, while measurements on ten additional features of the bill, sternum, wing and tarsus were made on subsets of the total sample. Weights of all adults in all years were found to exceed those of juveniles, except in 1988, where juvenile females generally exceeded those of adult females. Accumulated weights by species, age, and month demonstrated a continued loss of weight in sub-adults (HY) following arrival on the wintering grounds until November. After that date, both adults (AHY) and sub-adults gained weight until the end of the hunting season, when data collection ceased (December/January). This paper includes tables of weights and measurements for each species and compares differences and similarities both among and within species. Comparative sex and age data are tabulated, graphed, and discussed. The utility of the comparative data, however, varies with sample size in any given specie, sex, and age data block (range n=1-38). Better analysis of hunting bags will allow a more solid scientific basis for the conservation of sea ducks. We encourage further collaborations between the recreation and research communities.

WETLAND CHARACTERISTICS AND HABITAT USE BY WHITE-WINGED AND SURF SCOTERS IN THE MACKENZIE DELTA REGION

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Reasons for apparent declines in populations of white-winged *(Melanitta fusca)* and surf scoters *(Melanitta perspicillata)* in the northern boreal forest are not well understood, but some evidence suggests factors associated with events on the breeding grounds may be responsible. Breeding ground changes could adversely affect upland or wetland habitats or key food sources for breeding females or ducklings, which in turn may lower productivity or recruitment. Like most boreal-nesting ducks, virtually nothing is known about wetland habitat preferences of scoters. Determining habitat features that scoters need to breed successfully, and how habitat changes in the boreal forest affect scoters, is an important step in understanding their ecology and developing conservation initiatives. Thus, my overall goal was to look for evidence of habitat selection in scoters by characterizing features of wetlands used by scoter pairs and broods, and comparing these features with those of areas not used by scoters. Habitat characteristics and scoter use of wetlands in recently burned forest was also contrasted with unburned forest to determine whether habitat change caused by fire could affect patterns of habitat use by scoters. Scoter pairs and broods used wetlands with more abundant food, a finding that is consistent with many other waterfowl studies. However, unlike some previous waterfowl studies, I did not find a consistent correlation between total phosphorus levels and amphipod abundance or wetland use by scoters. I did not detect a difference in fine-scale features of wetlands surrounded by burned versus unburned vegetation. This study of scoters in the northern boreal forest was among the first to determine why scoters use specific wetlands or areas and not others.

DELINEATION OF SURF SCOTER HABITAT IN CHESAPEAKE BAY, MARYLAND: MACROBENTHIC AND SEDIMENT COMPOSITION OF SURF SCOTER FEEDING SITES

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Surveys of surf scoters *(Melanitta perspicillata)* along the Atlantic coast of the United States have shown population declines in recent decades. The Chesapeake Bay has traditionally been a key wintering area for surf scoters. Past and present research has shown that bivalves constitute a major food item for seaducks in the Chesapeake Bay, with surf scoters feeding primarily on hooked mussel *(Ischadium recurvum)* and dwarf surf clam *(Mulinia lateralis)*. Degraded water quality conditions in the Chesapeake Bay have been well documented and have been shown to greatly influence the composition of benthic communities. Large concentrations of feeding surf scoters (>500 individuals) in the Bay were determined through monthly boat surveys. Locations consistently lacking surf scoters were also determined. Macrobenthos were seasonally sampled at 3 locations containing scoters and 3 locations without scoters. A 1 kilometer square grid was superimposed over each location using GIS and sampling sites within the square were randomly chosen. Benthos were sampled at each site using SCUBA and a meter square quadrat. Biomass and size class estimates were determined for all bivalves within each kilometer square. Results indicated that scoter feeding sites contained significantly greater biomass of *M. lateralis, I. recurvum,* and *Gemma gemma* than locations where no scoters were present. Substrate differences were also detected, with scoter feeding sites being composed of a sand/shell mix while non-scoter sites consisted primarily of mud. This data indicates that surf scoters in the Chesapeake Bay are selecting areas with high densities of preferred food items, potentially maximizing there foraging energetics. In addition, two scoter feeding sites also contained a patchwork of eastern oyster *(Crassostrea virginica)* and oyster shell, on which much of the *I. recurvum* was attached. This suggests the possibility that surf scoters utilize eastern oyster habitat and the dramatic depletion of oysters in the Bay could be a possible factor in surf scoter decline. More research is needed into the possible relationship between surf scoters and the eastern oyster.

INTER-ANNUAL WINTER SITE FIDELITY BY SURF AND WHITE-WINGED SCOTERS

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Site fidelity and dispersal through the annual cycle have important implications for the structure and dynamics of migratory bird populations. Winter philopatry can be important because: (1) good winter foraging conditions increase over-winter survival and therefore reproductive success, and (2) because waterfowl pair formation occurs in winter, philopatry influences genetic structure of a population. Over three consecutive winters from 2002-03 to 2004-05, the movements of radio-marked surf *(Melanitta perspicillata)* (n=106) and white-winged scoters *(Melanitta fusca)* (n=143) were monitored in Baynes Sound, British Columbia, a soft-bottom habitat where scoters feed on clams. Simultaneous bi-angulation telemetry was conducted to get exact foraging locations throughout the winter. Abdominal VHF radios with an 18-month battery life were implanted, allowing us to monitor individuals over two years. Between-year return rates for both scoter species combined were 37.3% in 2003-04 and 48.8% in 2004-05. Return rates were highest for adults (46.9%), particularly adult males; fewer hatch-year scoters returned to Baynes Sound wintering sites, with a total return rate of 21%. Our estimates of return rates are a product of the probabilities that an individual survives the breeding season, returns to our study area, and is detected. Although we do not have data on breeding survival nor radio failure rates, reasonable estimates of those suggest that winter site fidelity rates in Baynes Sound are high, especially for adults. A high proportion of these scoters (76%) returned directly to their original site of capture and remained in or near their winter home range from the previous year. The average change in mean location between consecutive winters was 0.48km ±0.07 SE for surf scoters but slightly more for white-winged scoters (1.64km ±0.48 SE). We speculate that this high inter-annual winter site fidelity reflects foraging conditions; Baynes Sound clam densities are high and predictable attributes that should lead to site fidelity.

FINE-SCALE SPATIAL AND TEMPORAL SEGREGATION IN FORAGING OF BARROW'S GOLDENEYES, EASTERN POPULATION, WINTERING IN THE ST. LAWRENCE RIVER ESTUARY, QUEBEC, CANADA

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The Eastern North American population of Barrow's goldeneye *(Bucephala islandica)* is legally considered "at risk" by the Canadian and Quebec Governments. For six months a year, greater than 50% of the population, estimated at no more than 4,500 birds, congregate along 300 kilometers of coastline in the St. Lawrence Estuary, making it their major wintering ground. This important concentration of individuals and its gregarious nature in winter make this population highly vulnerable to any degradation of its coastal habitat. There is an important lack of knowledge regarding factors that may control the species distribution (e.g. macro- and microhabitats, tide levels, ice cover, and food preferences), as well as factors that may constrain survival of the population (e.g. energy content of preys, short daylight, and cold weather) in the harsh winter conditions of this area. This poster presents a first attempt to describe, at micro-scale, spatial and temporal segregation in foraging of Barrow's goldeneyes. These are the preliminary results of a multi-year study addressing winter habitat selection, diet, and time-activity budgets of the Eastern North American population of Barrow's goldeneyes. Spatial and temporal segregation in foraging are compared from January to April 2005 for two wintering sites, St-Irenee (47°34' N; 70°12' W) and Godbout (49°19' N; 67°36' W), in Quebec. Flocks were positioned by in-site observation using laser binoculars. The polar coordinates (azimuth and distance) of the birds from the observer's location (recorded with a GPS receiver) were converted by trigonometry in UTM coordinates and mapped with the help of a geographic information system. Time budgets were simultaneously quantified, using both scan and focal sampling. Categories of foraging intensity, based on a diving frequency index, were later derived and coupled with the birds' locations. Preliminary results from our first year of study show dynamics of habitat use of wintering Barrow's goldeneyes in relation to foraging, tide oscillations, and period of day.

HABITAT USE OF THE HARLEQUIN DUCK (HISTRIONICUS HISTRIONICUS) ALONG THE GASPÉ PENINSULA, QUÉBEC (CANADA)

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The eastern North-American population of the Harlequin duck *(Histrionicus histrionicus)* is in a precarious state. In this two-year study, we determined the importance of the Gaspé Peninsula (Québec) as a molting and fall staging area for this population, and examined features of the coastal habitat influencing its use by ducks. We conducted regular boat counts of ducks from early July to mid December, determined the population's numbers and sampled the habitat. More ducks used the area during the fall migration than during the molt (on average,157 vs. 65, respectively). During the molting period, ducks were most likely present in sites with higher numbers of 1-3m3 boulders, a higher slope and depth, a low anthropic presence and linearity, the presence of a cobble/gravel beach with a freshwater source and the presence of certain flora and fauna species *(Polysporina/Gammarus/ Ulva* and *Rhodomela/Zostera/Littorina)*. The number of ducks present within a site during the molt was higher with a low algi substrate cover and with a high number of ledges. During the fall migration, ducks were most likely present in sites with a high algi substrate cover, a high number of ledges and no cliffs. More ducks were present, during fall migration, when the anthropic presence and linearity was low.

IS FLIGHT BEHAVIOR OF COMMON EIDER AFFECTED BY OPERATING WIND TURBINES? - AN ON-OFF EXPERIMENT

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Offshore wind parks are erected in shallow waters (< 20 m) exactly where sea ducks feed and rest. We studied the effect of wind turbines on flight behavior of wintering common eiders *(Somateria mollissima)* to discriminate the effect of the revolving wind turbine rotors from the standing structures. The presence of the wind turbines may influence two behavioral decisions: where to fly (flight path) and whether to land (landing willingness). To address the willingness to land (reacting birds), groups of decoys were positioned within (100 and 300 m) and outside (100, 300, and 500 m) the wind park. Flight paths (flying birds) were assigned to one of the five corridors centered on a decoy group using a laser binocular. The operational state of the wind turbines were manipulated (from a remote control center) in an alternating manner during ten trials conducted during the morning flights of common eiders. Irrespective of the operational state of the turbines, the number of flying and reacting birds was significantly related to corridor location and position of the decoy group with much reduced activity close to the wind park. However, the operational state of the turbines (on and off) did neither affect the number of common eiders flying within corridors nor the number of birds reacting to decoys. These results imply that the avoidance behavior observed was caused by the presence of the wind turbines structures as such. Following from this, the indifference of common eiders to the noise (mostly aerodynamic) and movements generated by the operating turbines should increase the probability of collision during poor visibility conditions (darkness, fog, rain and snow). This was observed for common eiders during a Scottish study. When visibility is good, on the other hand, the disturbance caused by the wind turbines structures will decrease the probability of collision.

LONG-TAILED DUCKS, AND KING EIDERS : CAPITAL OR INCOME BREEDERS?

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Energy partitioning during egg-laying is fundamentally important to arctic nesting waterfowl. Many exhibit a capital breeding strategy, relying on stored (endogenous) energy sources during periods of food shortage or reproduction. Conversely, income breeders rely on external resources (local food sources) during the same periods. Research has found arctic nesting king eiders *(Somateria spectabilis*) lose up to 30% body mass during incubation (Kellett and Alisauskas 2000) suggesting they are capital breeders. In contrast, research has found long-tailed ducks *(Clangula hyemalis),* also an arctic nesting species, lose only 7% of body mass during incubation (Kellett et al 2005). These findings suggest long-tailed ducks are income breeders. We collected eggs of king eiders and long-tailed ducks at three lakes in the central Canadian arctic in 2004. Analysis of stable carbon and nitrogen isotopes (δ13C, δ15N) of egg components (albumen, yolk, and lipid-free yolk) were used to determine dietary information and to link metabolic pathways to body stores (endogenous and exogenous) and nutrient sources, from marine versus freshwater habitats. Potential food sources at these lakes were also collected for stable carbon and nitrogen analysis. Isotopic data from potential food sources may determine the local dietary contribution and allocation of exogenous resources to eggs during formation. Results indicate king eiders and long-tailed ducks, at these breeding areas, utilize predominantly exogenous (local terrestrial) resources for egg production. Analysis of lipid-free yolk (δ13C) show long-tailed ducks allocate more marine protein to their eggs than king eiders. These findings are contrary to the current view that long-tailed ducks arrive at breeding grounds without enough endogenous reserves to allocate to egg production. These findings support the notion that long-tailed ducks are primarily income breeders, whereas it contradicts the previous notion of king eiders as capital breeders. Rather, king eiders utilize a combination of capital and income breeding strategies for reproduction.

MALE ATTENDANCE AT COMMON EIDER COLONIES: A CIRCUMPOLAR REVIEW

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A species may have the genetic potential for specific traits but not exhibit them, suggesting that certain phylogenetic traits are constrained by environmental factors such as weather, habitat, conspecifics, or predators. It is often difficult to elucidate factors that may constrain individuals, populations or species, because it is rare to find behavioral variation within a species across its range necessary to identify specific environmental factors that influence these behavioral traits. The common eider, *(Somateria mollissima)*, is a colonial-nesting seaduck that inhabits both polar and temperate regions of the northern hemisphere. At some locations, males venture onto island colonies and attend nesting females, whereas at other colonies they do not. By visiting colonies, male eiders could enhance their annual reproduction by: i) guarding their mates against extra pair copulations (EPCs); ii) contributing to parental care that could enhance the survival of their own eggs and ducklings; and iii) by gaining EPCs while in close proximity to other nesting females; and these potential benefits are not mutually exclusive. However, there are also costs associated with coming onto land including lost feeding opportunities at sea and potentially higher mortality risks (e.g. particularly due to mammalian predation). Thus, a trade-off may exist between the benefits of colony attendance (parental care, mate-guarding) and the costs of doing so (mortality risk and lost feeding opportunities), and an examination of how male behaviors vary regionally could help identify which environmental factors influence this trade-off. We conducted a literature review and also distributed questionnaires to researchers in 2001-2003, from which we received 83 completed surveys from 10 countries. We found that throughout most of their range, male eiders came onto colonies to attend females, although there was regional variation. Specifically, males were most likely to attend females on larger single-island colonies and colonies within archipelagos that were both free of continuous adult predation risk and that had stunted or no vegetation. Thus, males rarely ventured onto colonies when predators had regular access to them and/or where tall vegetation conferred an advantage to the predator. We conclude that male common eiders are behaviorally constrained in some areas of their range under situations where the costs incurred by venturing onto colonies (predation risk) appear to outweigh the potential benefits gained by attending females (increased annual reproduction), and also that males have the behavioral capacity to respond to shifts in this trade-off. This latter conclusion is supported by the finding that at two locations where mammalian predators were recently removed, males visited colonies to attend females where they had not previously.

FACTORS AFFECTING, AND CONSEQUENCES OF, MALE ATTENDANCE AT A COMMON EIDER COLONY IN THE CANADIAN ARCTIC

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Typically, male sea ducks follow females to breeding grounds where they guard their mates against extra pair copulations (EPC), although they rarely follow females directly to nests. However, among common eiders *(Somateria mollissima)*, there is considerable variation in male attendance of females at nests; both between and within colonies. Why does this variation exist, and what do male common eiders gain by attending colonies? Previously, we found that males rarely attend females onto colonies under conditions where there are resident mammalian predators and/or vegetation that confers an advantage to a predator (McKay et al. submitted a). On colonies where males do attend females, we predicted that nest attendance by males may increase their annual reproductive success by, 1) contributing directly to nest site selection and hatching success, 2) protecting their paternity by defending their female against extra-pair copulations, and/or 3) by attempting EPCs themselves while in close proximity to other females on the colony. At a large eider colony near Southampton Island in the Canadian Arctic, we found that males did not participate in nest site selection or nest defense, nor did the duration of their attendance affect the number of eggs that hatched successfully (McKay et al. submitted b). We also collected observational data from over 1000 nests, between 2000-2003, to determine whether the duration of male nest attendance varied within the colony in relation to nesting density, yearly variation, and the laying phenology of females. We found that the average length of male attendance differed significantly between years and declined as the breeding season progressed. Small differences were also detected between observation plots, suggesting that the duration of male attendance was longer in areas of high nesting densities where the potential of EPCs was greatest. We also observed eider pairs interacting on the colony to determine if unattended females were more likely involved in aggressive interactions with lone males than pairs. Preliminary results follow predictions, where unattended females suffered more aggressive interactions with prospecting (lone) males whether walking or incubating, and that these interactions were greatest in areas of high nesting densities. To examine the behavioral ecology of male colony attendance, we recognized the need to acquire molecular evidence of extra pair paternity between nests with and without male attendance. We examined this by experimentally removing attending males from a random selection of eider nests in 2002 and 2003, to determine if male removal lowered the probability of hatch, while simultaneously increasing extra-pair paternity. We predicted that paired (control) females would experience greater reproductive success than experimentally widowed females, and that the paternity of eggs (no. of fathers) would increase among widowed birds. Results of this genetic analysis are ongoing, and will be discussed.

EAST COAST EIDER INITIATIVE

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Ducks Unlimited Canada's Eider Initiative is a five-year research initiative. The ultimate goal of this research is to develop a population model useful in guiding common eider *(Somateria mollissima dresseri)* harvest regulations and management decisions. We chose Newfoundland and Labrador as the focal point for this research because common eider populations in this region have experienced relatively little growth following their protection by the Migratory Birds Conservation Act, relative to populations throughout other portions of their range. To understand constraints to population growth requires a strong understanding of species-specific life history traits. This information is critical for developing and implementing management strategies that promote sustainable and harvestable populations. To reach this goal, we are using capture-mark-recapture techniques to estimate: 1) adult female survival, 2) seniority (proportion of experienced breeders in the population), 3) recruitment (proportion of first time breeders in the population), 4) local population growth rates, 5) breeding propensity (proportion of females breeding during any one season), 6) duckling survival, 7) sub adult survival; 8) age at first breeding, and lastly, 9) this research will use satellite telemetry to identify the links between breeding and wintering areas. Research sites include remote islands within Table Bay, located about 30 km SE of Cartwright, Labrador and islands near the Northern Peninsula, Newfoundland. During 2004, we banded a total of 1498 common eider ducklings (n=1079 and 419 in Labrador and on the Northern Peninsula of Newfoundland, respectively) and 180 adult females (n = 115 and 65 in Labrador and on the Northern Peninsula of Newfoundland, respectively). During 2004-2005, we received a total of 55 hunter band recoveries. All band recoveries were from eiders banded as ducklings along the shore of the Northern Peninsula, Newfoundland (n = 11) and Table Bay (n = 44). Ducklings banded in NL were shot in NL (n = 33), NS (n = 11), PQ (n = 5), St. Pierre et Miquelon (n = 5), and Maine (n = 1). We received no band recoveries of common eiders banded as adults in the same year. This research project is ongoing.

LONG-TERM TRENDS AND CHANGES IN NUMBERS AND DISTRIBUTION OF WINTERING SEA DUCKS ALONG THE SWEDISH COAST

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Regular counts of wintering waterfowl have been undertaken as a part of the International Waterfowl Census (IWC) and (later) the national Swedish Environmental Monitoring Programme since 1967. After the first years, when one important aim was to study distribution patterns etc, and more or less country-wide surveys were organized, a network of annually surveyed sites was established for the calculation of annual indices. In addition to these about 25 larger sites, a number of smaller counting units were also counted. Country-wide surveys (also including aerial counts) were undertaken 1971-74, 1987-89, 1992-93 (partial) and 2004, covering all ice-free inshore coastal waters. In this poster I will present the winter distribution patterns and changes in the distribution pattern of sea ducks in Swedish waters in relation to habitat factors also comparing the occurrence of seaducks in brackish Baltic waters in contrast to more marine North Sea water on the west coast. I will also analyze the population development in Swedish sea duck populations during the period 1967-2004. The commonest species of diving ducks in the Swedish inshore waters in January 2004 were *Aythya fuligula* (220,000), *Bucephala clangula* (73,000) and *Somateria mollissima* (49,000). For the commonest species, *Clangula hyemalis,* only 37,000 were counted in inshore waters, whereas the population wintering on offshore sea shallows in Swedish water is estimated to be at least 1 million individuals. During the survey period marked changes were noted for several of the species studied both as trends in the numbers counted and changes in the distribution. Thus a number of species showed increasing trends over the study period, e.g. *Aythya fuligula, Aythya ferina, Bucephala clangula, Somateria mollissima*,and *Mergus serrator*. Some of these trends reflect genuine population changes, whereas other trends are related to changing winter conditions, with a series of milder winters in the latter part of the study period. Some species showed marked changes in the winter distribution during the period, thus *Aythya fuligula* and *Bucephala clangula* decreased in the south and increased in the northern part of the coast.

POPULATION TRENDS OF NORTH AMERICAN SEA DUCKS BASED CHRISTMAS BIRD COUNT AND BREEDING BIRD SURVEY DATA

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Due to the difficulty of conducting range-wide surveys of either breeding or wintering populations, few data are available to assess the population trends of sea ducks with confidence. We analyze sea duck data from the Audubon Christmas Bird Count (CBC) using hierarchical modeling methods that control for varying effort among circles and over time. These procedures allow us to assess early-winter relative density patterns among states and Bird Conservation Regions (BCRs) while also assessing trends in these regions and across the species North American range. Over the interval 1966–2003, continent-wide declines were observed in 1 of 11 species. Where sufficient data exist, we compare CBC results to estimates of population change derived from the USGS Breeding Bird Survey. The CBC does not effectively sample offshore populations of sea ducks; however, the CBC data can be used to assist in development of species-specific surveys, and CBC data can be used in combination with additional offshore sampling programs to better sample sea duck species.

FORAGING ECOLOGY AND BEHAVIOR OF WILD AND CAPTIVE SPECTACLED EIDERS IN ALASKA

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Little is known of spectacled eider *(Somateria fischeri)* foraging ecology and food habits after hatch. Variation in food availability and abundance can affect the nutritional status of adult females, the growth of offspring, and the survival of adults and juveniles. Further, the foraging behavior and feeding mechanisms of eiders influence what foods are actually consumed and may put eiders at risk of exposure to environmental contaminants. To examine the food habits of adult and juvenile eiders after hatch, we collected benthic samples from brood rearing areas on the Yukon-Kuskokwim Delta, Alaska, in 1997 and 1998. Samples were collected from wetlands used by radio-marked eider broods. Potential food items we identified are primarily Chironomidae larvae, Oligochaetes, other invertebrates and various seeds. We also examined stomach samples from spectacled eiders collected between 1973 and 1978 and from spectacled eider carcasses recovered in 2001. We identified various seeds and insect parts and detected the presence of lead shot pellets in two of the samples. In addition we studied the foraging behavior of 14 captive spectacled eider adults at the Alaska Sealife Center in Seward, Alaska in the fall of 2004. During the trials, birds were offered combinations of krill, sago pondweed *(Potamogeton pectinatus)* seeds, and pea gravel in underwater trays. In all trials the birds consumed the majority of items placed in the trays and apparently did not select for specific items. The foraging ecology of adult and juvenile spectacled eiders is likely influenced by a variety of factors including the type and abundance of foods available.

MORPHOLOGICAL AND PHYSIOLOGICAL ASPECTS OF TAKEOFF APTITUDES OF FEMALE COMMON EIDERS IN PRE-LAYING PERIOD

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The pre-laying period is often associated with an improvement of body condition of females. An extreme case is observed in the common eider *(Somateria mollissima)*. The pre-laying period in female common eiders is characterized by an important increase in body mass caused by follicular growth and the accumulation of body reserves. This weight gain results in dramatic, sex-specific takeoff impairment. Heavy females are frequently observed failing attempts to take off in still air conditions. We investigated how the locomotor apparatus of females responds to this mass increase and tested the hypothesis that pre-laying female common eiders compensate in order to diminish or retard their takeoff impairment. We addressed our question at three organizational levels: i) measurement of flight morphology, ii) weight of flight musculature, and iii) measurement of the activity of key enzymes of aerobic and glycolytic capacity in two locomotor muscles and one structural muscle. All measurements were performed on individuals of both sexes collected around Bicquette island, Quebec, Canada, a large colony found in the St. Lawrence River estuary. Our results indicate that, by the means of phenotypic plasticity and physiological compensation, females adopt strategies enhancing lift production at different organizational levels. However, these strategies do not fully offset weight gain effects. Compared to the larger males, females showed a similar wing area, a hypertrophy of flight musculature, and maintenance of an energy metabolism pathway in pectoralis muscle. The pectoralis muscle of females with higher wing-loading further compensates for their weight gain. Females seem to have reached the upper limit of metabolic power, suggesting the existence of a glycolytic capacity threshold (reflected by body mass-specific pectoralis LDH activity) to takeoff aptitudes in large birds. These results demonstrate that the maintenance of flight aptitudes is an issue of tremendous importance for pre-laying female eiders.

STUDYING FLIGHT BEHAVIOR OF COMMON EIDERS USING HEART RATE DATA LOGGERS

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Bird flight is an elusive behavior because it is impossible for most species to quantify its frequency and duration. Radars or satellite telemetry can be used to analyze orientation and duration of long (migrating) flights but they do not give information about flights of shorter duration. It has been known for a long time that heart rates and respiration rates are 3 to 6 times higher than resting level for birds using flapping flight. In this study, our objectives are (1) to describe the heart rate signature associated with flights and (2) to compare heart rate during flight to heart rates recorded during other behaviors. Finally, (3) we give an example of flight budget covering eight months of recording using heart rate signature of flights. In 2003, we implanted heart rate data loggers (HRLs) in 20 females common eiders *(Somateria mollissima)* nesting on Christiansoe island (Denmark). The common eider is a good model for this study as it is characterized by short-pointed wings and excessive wing-loadings. By observing flying females with HRLs (few days after deployment around the breeding colony), we know that heart rate increases instantaneously upon take-off, remains at a very high level throughout the flight period, and then decreases suddenly upon landing. Comparison with other behaviors revealed that flight heart rate can be confounded only with heart rate associated to bathing behavior and heart rate upon surfacing from a dive. However, heart rate related to bathing behavior decreases slowly, and not suddenly, whereas all high heart rates associated with diving were discarded from the database, using hydrostatic pressure data and a homemade program, to monitor only flight behavior. We conclude that HRLs could be used (1) to quantify flight budget of free-ranging sea ducks over long periods of time, (2) to record the occurrence and duration of migrations and, possibly, (3) to identify and measure the duration of the various seasonal phases.

FOOD SELECTION AMONG ATLANTIC COAST SEADUCKS IN RELATION TO HISTORIC FOOD HABITS

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Food selection among Atlantic Coast seaducks during 1999-2005 was determined from hunter-killed ducks and compared to data from historic food habits file (1885-1985) for major migrational and wintering areas in the Atlantic Flyway. Food selection was determined by analyses of the gullet (esophagus and proventriculus) and gizzard of 860 ducks and summarized by aggregate percent for each species. When sample size was adequate comparisons were made among age and sex groupings and also among local sites in major habitat areas. Common eiders in Maine and the Canadian Maritimes fed predominantly (53%) on the blue mussel (*Mytilus edulis*). Scoters in Massachusetts, Maine, and the Canadian Maritimes fed predominantly on the blue mussel (46%*)*, Atlantic jackknife clam (*Ensis directus*; 19%), and Atlantic surf clam (S*pisula solidissima*; 15%), whereas scoters in the Chesapeake Bay fed predominantly on hooked mussel (*Ischadium recurvum;* 42%), the stout razor clam (*Tagelus plebeius*; 22%), and dwarf surf clam (*Mulinia lateralis*; 15%). The amethyst gem clam (*Gemma gemma*) was the predominant food (45%) of long-tailed ducks in Chesapeake Bay. Buffleheads and common goldeneyes fed on a mixed diet of mollusks and soft bodied invertebrates (amphipods, isopods and polychaetes). No major differences were noticed between the sexes in regard to food selection in any of the wintering areas. Comparisons to historic food habits in all areas failed to detect major differences. However, several invertebrate species recorded in historic samples were not found in current samples and two invasive species (Atlantic Rangia, *Rangia cuneata* and green crab, *Carcinas maenas*) were recorded in modern samples, but not in historic samples. Benthic sampling in areas where seaducks were collected showed a close correlation between consumption and availability. Each seaduck species appears to fill a unique niche in regard to feeding ecology, although there is much overlap of prey species selected. Understanding the trophic relationships of seaducks in coastal wintering areas will give managers a better understanding of habitat changes in regard to future environmental perturbations.

USE OF THE BEAUFORT SEA BY KING EIDERS BREEDING ON THE NORTH SLOPE OF ALASKA

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Baseline data on the distribution of king eiders *(Somateria spectabilis)* in the Beaufort Sea are critical to model potential consequences from oil spills and provide regulatory agencies with opportunities to minimize impacts. This study employed the use of satellite telemetry to determine areas used by king eiders in the sea, how distributions of used areas varied, and parameters that explained variation in the number of days spent in the sea. Sixty king eiders were implanted with satellite transmitters at two locations on the North Slope of Alaska in 2002-2004. More than 80% of our transmittered eiders spent more than two weeks staging offshore prior to beginning molt migration, suggesting that the sea is an important migration flyway and staging area for this species. Distribution of locations did not vary by sex during spring migration. Spring locations were scattered from Point Barrow to the Canadian border with over 40% of the locations found >20 km offshore. Shorter residence times of eiders and deeper water depths at locations during spring migration suggest the Alaskan Beaufort Sea may not be as critical a staging area for king eiders in spring as it is post-breeding. Spring and post-breeding distributions of king eider locations in the Alaskan Beaufort Sea overlapped very little. During post-breeding staging and migration, male king eiders had much broader distributions in the Alaskan Beaufort Sea than female eiders, which were concentrated in Harrison and Smith Bays. Significant variation in residence time in the Beaufort Sea was explained by sex; female king eiders moved into the sea almost two weeks later than males in the spring and 20 days later than males during post-breeding. We recommend managers minimize disturbance of core use areas in Harrison and Smith Bays during post-breeding and future studies examine the importance of potential spring staging areas outside the Alaskan Beaufort Sea.

DISTRIBUTION AND ABUNDANCE OF KING EIDERS, LONG-TAILED DUCKS, AND CANADA GEESE ON WESTERN VICTORIA ISLAND

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Current North American waterfowl breeding population surveys do not adequately cover breeding grounds for king eiders *(Somateria spectabilis)* and long-tailed ducks *(Clangula hyemalis)* within Canada. In recognition of this problem, combined with mounting evidence that both species were in decline, breeding waterfowl aerial surveys were conducted on western Victoria Island from 1992 to 1994 to establish a baseline for comparison in future years. These surveys were repeated in 2004 and 2005 and provide population trends for king eiders, long-tailed ducks, Canada geese *(Branta canadensis)*, and other bird species nesting on western Victoria Island. King eider population indices of 23,351 (SE 3325) and 22,662 (SE 2263) on western Victoria Island (2004 and 2005 respectively) showed nearly a 50% decrease since 1993. Long-tailed duck similarly showed a decline, but to a lesser degree. The Canada goose population index of 37,418 (SE 2448) in 2004 was very similar to that estimated in previous surveys but the index increased to 59,729 (4619) in 2005. Distribution maps generated using GIS software and survey data depict areas of highest densities and importance. Similar to previous surveys, the highest densities of king eiders were found in the Kagloryuak River valley and near Tahirhuak Lake. Dense pockets of king eiders were also found in the northern portions of Prince Albert Peninsula, while densities in the southern portions and on Diamond Jenness Peninsula were very low and appear to have decreased substantially since the surveys were last conducted. Long-tailed ducks were distributed throughout western Victoria Island in relatively low densities. Canada goose densities were highest in southwestern Victoria Island and in the Kagloryuak River Valley though moderate densities were found on Diamond Jenness Peninsula and Prince Albert Peninsula. Densities of all three species were very low in the interior of northwestern Victoria Island.

ARE FEMALE COMMON EIDERS (SOMATERIA MOLLISSIMA) CAPITAL OR INCOME LAYERS?

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One nesting phase that is particularly costly for waterfowl species is the production of the clutch. The female needs to gather a large amount of food in order to transfer nutrients (from endogenous reserves or directly from the food) to the growing follicles. In this paper, we test the idea that (1) female common eiders transfer nutrients directly from food ingested to ovary growth during pre-laying and, (2) females feed during laying. Using published information from three studies, (1) body condition of pre-laying females was assessed in relation to follicular growth, (2) body mass of females and, (3) nest attendance pattern while laying are reported. Somatic body mass and body composition of birds collected around a nesting colony, in the Baltic sea, did not change significantly in relation to three categories of ovary growth. Sixty-four percent of the females studied lost body mass, twenty-seven percent had a constant mass and nine percent gained mass while laying resulting in an average decrease of body mass of 39 g (SD ± 63), which is less than the average mass of a fresh laid egg. Attendance patterns showed that females left the nest for most of the night and a part of the day during the first days of the laying phase and that time spent off the nest decreased steadily from the first to the last egg laid in the clutch. Altogether, these results suggest that (a) the clutch produced by female common eiders nesting in the Baltic is composed of nutrients derived mainly from food collected around the breeding colony, (b) females continue to feed during laying which is consistent with the fact that (c) ample time is spent off the nest during the laying phase.

EFFECTS OF BACKPACK RADIO-TRANSMITTERS ON FEMALE BARROW'S GOLDENEYES

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Based apparently on a single study on canvasbacks *(Aythya valisineria)*, diving ducks have long been considered especially sensitive to transmitters attached with backpack harnesses. As part of a larger study, we compared time-budgets and return rates of breeding female Barrow's goldeneyes *(Bucephala islandica)* fitted, or not, with transmitters attached with backpack harnesses in 2001-2004 in southern Québec. We compared the mean proportion of time devoted to feeding, locomotion, alert, resting, preening, and maintenance i.e., resting plus preening. Brooding females (i.e., females with ducklings) with backpacks spent significantly less time feeding [25% ± 5 (SE) versus 43% ± 3] and more time in maintenance activities (51% ± 6 versus 31% ± 4) than brooding females without transmitters. Mean time devoted to other behaviors did not differ significantly. Upon release, females appeared preoccupied with the backpack and behaved in a similar way, actively bathing, preening, and/or beating wings. Of the females with transmitters observed more than 200 minutes (N = 5), three spent 4%, 8%, and 57% of their preening time at their transmitter, antennae or harness. None of the 16 females harnessed in 2001-2003 were recaptured in nest boxes or seen again on the study area in 2002-2004. For comparison, 66% of adult female Barrow's goldeneyes captured in nest boxes and marked with leg bands in 2000-2002 were recaptured or seen again in subsequent years, a significant difference. If Barrow's goldeneye females marked with nasal disks are included, the return rate is 43% and still significantly different. We do not know why none of the harnessed Barrow's goldeneyes returned to our study area, although we consider severe winter conditions and icing are probably a cause. As a result, we do not recommend the use of harnesses on diving and seaducks as it may affect their behavior and survival, at least for birds wintering in areas where conditions are particularly severe, as Barrow's goldeneyes from eastern North America.

POPULATION TRENDS AND COLONY DYNAMICS OF COMMON EIDERS

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Common eiders *(Somateria mollissima)* breeding in many northern areas are experiencing population declines. Although coastal Labrador harbors important concentrations of breeding common eiders and includes the zone of intergradation between the *dresseri* and *borealis* subspecies, there has been relatively little work done on these populations. From 1998 to 2003, ground surveys were conducted on the Labrador coast (52º - 57º N), where 117 islands were surveyed a total of 479 times in four archipelagos (Nain, Hopedale, Rigolet, St. Peter's Bay) and 13,185 nests were counted. Using the population trend software (ESTEQNINDEX) to estimate annual increases in nesting eiders over this six-year period, substantial annual increases with an overall average annual growth of 17.5% were found. Definitive reasons to explain these increases are not known, but may be related to an amelioration of environmental conditions and management strategies that have reduced late season bags in Newfoundland. In addition, the closure of Atlantic salmon *(Salmo salar)* and cod *(Gadidae)* fisheries has resulted in significant decreases in human activity in Labrador; which likely reduced bycatch in fishing gear, summer hunting, and disturbance. To further understand how common eiders were distributed spatially and temporally across islands, a metapopulation approach was used to examine colony dynamics. Smaller colonies were more prone to extinction, but colonization was not related to island isolation. Mean abundance was a positive predictor of incidence, in other words, in areas of with larger colonies, more local islands were occupied. The overall extinction rate was 0.08 ± 0.01 (SE) and colonization rate was 0.12 ± 0.02 suggesting considerable turnover in eider colonies, but these rates showed substantial variation within and across archipelagos. Eiders colony locations in northern areas are transient and their persistence is related to their size, and the presence and size of adjacent colonies. Combined, this information should aid managers in setting sustainable harvest levels and appropriate land use policies that are conducive to eiders breeding in Labrador.

USING WINTER JUVENILE/ADULT RATIOS AS INDICES OF RECRUITMENT IN POPULATION MODELS

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There is an increasing interest in using winter juvenile counts as indices of recruitment in species that show delayed plumage maturation, especially for species, such as dispersed breeders, where it is difficult to obtain good productivity estimates from the breeding grounds. For sea ducks that congregate in large flocks during winter, large amounts of productivity data could be potentially collected. To date, however, there has not been the needed mathematical work to assist in interpreting these winter juvenile/adult ratios. First, details on the precise ratios of juveniles to adults required for population models, and the influence of sex biases in the population, are presented. Next, a matrix-based population model is presented that is modified to allow the fecundity component to be measured in mid- to late winter. This model is simplified to a set of equations that relate adult survival, winter juvenile/adult ratios and population growth rates, and allows an assessment of population trend with only one survival rate and age ratio data. These models have the advantage of not requiring that age of first breeding be well known. As an example, age ratios and survival rates of harlequin duck *(Histrionicus histrionicus)* populations in British Columbia and Maine are presented. Models for both populations suggest recruitment of young is insufficient to compensate for adult mortality, which is contrary to observed trends in population numbers. Although some further methodological work is needed, such as better ways to estimate true adult survival, validation of true age and plumage for some sea ducks, and a further understanding of how to obtain unbiased estimates of juvenile/adult ratios in the field, these models may prove to be a useful tool to assess population trends when detailed demographic data are not available.

COMMON EIDER MORTALITY IN THE LATE FEBRUARY 2005 OIL SPILL OFF SOUTHEASTERN NEWFOUNDLAND

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The coastal waters off Newfoundland harbor large numbers of wintering common eiders *(Somateria mollissima)*. However, these waters are also characterized as having one of the highest incidences of chronic marine oil pollution in the world. In late February, 2005, oiled common eiders were reported by hunters along the southeastern shore of Newfoundland. Based on helicopter surveys on 2 March, approximately 42,000 eiders were counted and assumed to be at risk from the spill. Further, based on an uncorrected count, 1165 of these eiders showed atypical behavior, such as being hauled out on shore and preening heavily, indicating exposure to oil. Another survey on 6 March, which included simultaneous ground counts, estimated 580 ± 47 SE eiders to be oiled. From beached carcasses, most females were classified as *borealis* (64%; n = 25) while males were mostly *dresseri* (42%, n = 36). The discrepancy between the sexes likely relates to known weaknesses in Mendall's 1986 key and visual inspection of the carcasses suggested that most birds were *borealis* type or intergrades. Of the male sample, 65% were adults (n = 46), while the remaining 35% were subadults. All birds found showed abnormally low body masses (males: 1592 ± 94 g (SE); females: 1444 ± 54). Live oiled eiders were seen into early April, demonstrating that this species can persist when suitable haul-outs and nearby foraging habitat are available. Another 9 species were impacted, including small numbers of long-tailed ducks *(Clangula hyemalis)* and king eiders *(Somateria spectabilis)*. Although the total number of common eiders killed in this incident will never been known, based on the 1165 birds counted and reports from hunters taking oiled birds, we assume that no less than 1400 common eiders were impacted in this event. Recent estimates place the wintering common eider population in Newfoundland at approximately 120,000 wintering birds; this incident killed well over 1% of the population and was focused on older age classes.

STATUS, BREEDING BIOLOGY, AND CONSERVATION OF STELLER'S EIDER NEAR BARROW, ALASKA, 1991-2005

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The Alaska-breeding population of Steller's eider *(Polysticta stelleri)* was listed as a U.S. Federally threatened species in 1997 due to concerns over apparent declines in numbers inferred from a reduction of nesting range in Alaska. Aerial survey and observational data indicate the region surrounding the village of Barrow is the core of Steller's eiders breeding distribution in northern Alaska. In 1991, the U.S. Fish and Wildlife Service and the North Slope Borough, Department of Wildlife Management initiated breeding biology studies of Steller's eider near Barrow. Between 1991 and 2005, breeding has occurred in 53% of the years. A total of 116 viable nests have been monitored, with low nest success averaging 15.7% (95% C.I.: 10.9-20.4%). Only four out of 17 hens monitored with VHF radio-transmitters successfully fledged at least one duckling. Standardized ground-based breeding pair surveys were initiated in 1999 to estimate abundance and distribution within 3 km of the road system (total standard survey area of 135 km²). In non-nesting years (2001-2004), density has ranged between 0 and 0.16 males/km², while in the last three nesting years (1999, 2000, and 2005) density has ranged between 0.43 and 0.98 males/km². Due to the periodic non-breeding and rarity of finding nests even in good nesting years, there is still much to learn about this species' breeding biology in order to determine what management actions would be most effective in assisting recovery. While we now have an understanding that the abundance of lemmings and breeding status of lemming avian predators is positively correlated with Steller's eider breeding activity, we have not been able to predict nesting frequency and lack an understanding of how Steller's eider assess nesting conditions upon arrival. In 2005, the first nests were found since 2000 and several new management actions were implemented. These included deployment of video cameras to document causes of nest failure, localized fox control, and artificial incubation of eggs to reduce predation and egg removal to start a captive propagation program (implemented by the Alaska SeaLife Center).

USE OF NEST BOXES BY BARROW'S GOLDENEYES AND OTHER WILDLIFE IN EASTERN NORTH AMERICA

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The breeding range of the Barrow's goldeneye *(Bucephala islandica)* in eastern North America is under increasing logging pressures and availability of suitable nesting cavities may rapidly become an issue. We monitored the use of 105-133 nest boxes by goldeneyes from 1999 to 2004 and the abundance of common goldeneye *(Bucephala clangula)* and Barrow's goldeneyes on 63 lakes from 1999 to 2003. We also assessed whether location of the nest boxes (over water, on shore, or inland) influenced their use. Only three species of birds used nest boxes regularly: the American kestrel *(Falco sparverius)*, Barrow's goldeneye, and common goldeneye. The proportion of nest boxes used by goldeneyes (2000-2004) ranged from 23-43% and hatching success from 37-67%. Successful Barrow's and common goldeneye clutches averaged 6.76± 0.38 SE(n = 29) and 7.77±0.44 eggs (n = 31), respectively. Goldeneyes used all boxes independent of their location, but reproductive success was lower in boxes located 25-160 m from shore. Partial loss of eggs in clutches was frequent and causes are unknown. American kestrels however, showed a strong preference for inland boxes. The number of Barrow's and common goldeneye breeding pairs increased between 1999 and 2003, but the number of broods remained stable after an increase in 2000 suggesting that pair and brood territoriality may limit the population. Our study indicates that nest boxes are probably not ecological traps on the Laurentian Highlands of Quebec, and may be a useful recovery tool for Barrow's goldeneyes. However, their potential for increasing productivity will be limited by the availability of good quality brood rearing habitat.

ABUNDANCE AND DISTRIBUTION OF THE COMMON EIDER IN EASTERN NORTH AMERICA DURING THE MOLTING SEASON

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Like most other sea ducks, male common eiders *(Somateria mollissima)* concentrate in large groups to molt following the breeding season. Although Maine conducted surveys in the 1980s, little was known of eider molting sites in Atlantic Canada until recently, when surveys and research conducted in Quebec, Newfoundland, Labrador, Nova Scotia and Maine revealed a number of important molting sites. Sites vary in importance from a few hundred males to tens of thousands. Important sites include the western and southern coastal areas of Anticosti island (40,000 birds), Baie des Milles Vaches (9,000) in Quebec, southwestern Nova Scotia (40,000), Petit Manan Island archipelago (7,000), and Metinic Island archipelago (10,000) in Maine. Molting eider surveys conducted in Maine during the early 1980s and in the St. Lawrence in 2003-2004 revealed large flock sizes, commonly over 2,000 birds, in consistent locations annually. An estimated 40,000 males molt in Nova Scotia and 28,400 in Maine (1981 data). Surveys indicate that important sites are used consistently between years and that local movements occur. Recoveries from banded birds suggest that eiders breeding on the lower North Shore of the St. Lawrence, New Brunswick, Nova Scotia, and even Newfoundland appear to concentrate at the Petit Manan site in Maine. They also suggest inter annual movements between the Nova Scotia and Petit Manan sites. Greater understanding of the relationships between breeding, wintering, and molting sites will facilitate management of this heavily exploited sea duck.

CROSS-SEASONAL MOVEMENTS AND DISTRIBUTIONS OF PACIFIC BLACK SCOTERS

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Black scoters *(Melanitta nigra)* breeding in Alaska have undergone a steady numerical decline in recent decades. Much of their general ecology and annual distribution remains unknown, thus it is difficult to identify mechanisms leading to this decline. Broad-scale studies that describe patterns and timing of migration, critical sites throughout the annual cycle, as well as linkages among aggregations at different annual cycle stages are needed to help understand the ecology of this species and to accurately interpret population trends. To address these issues, black scoters were captured using floating mist-nets and implanted with intra-abdominal PTT satellite transmitters during spring of 2003 and 2004 or winter of 2004 and 2005. Our marking efforts were focused in two wintering locations: Kodiak Island, Alaska (5 males and 8 females) and Strait of Georgia, B.C., Canada (5 males and 10 females); and one mixed wintering/staging location: Nelson Lagoon, Alaska (22 males and 1 female). As expected, migration generally followed coastlines, although some individuals moved overland across narrow land masses, such as the Alaska Peninsula. All individuals marked in B.C. and Alaska migrated to western Alaska during spring. Birds wintering in B.C. initiated spring migration earlier than those from Alaska. Important staging areas for B.C. migrants included Rose Spit in the Queen Charlotte Islands and Kvichak and Kamishak Bays in Alaska. Kvichak and Kamishak Bays were also important staging areas for Alaska birds. Apparent breeding areas for individuals from all wintering locations included the Bristol Bay Lowlands and the Yukon-Kuskokwim Delta. Suspected non-breeding individuals resided in near-shore waters of the Kuskokwim Shoals and Bristol Bay, Alaska. Many birds likely molted along the Kuskokwim Shoals, Kvichak Bay or Nelson Lagoon, Alaska. Individuals marked in Kodiak and B.C. returned to those same locations the following winter. Birds marked in Nelson Lagoon returned to either winter or stage at that same location. Wintering aggregations of Pacific black scoters appear to be discreet, although individuals from all wintering areas overlap during the breeding season. Kvichak Bay was heavily utilized by individuals from all marking locations from spring through autumn; suggesting that this is a particularly critical area.

SPECTACLED EIDER NESTING BIOLOGY IN CHAUN-DELTA, CHUKOTKA, RUSSIA

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The first long-term study of spectacled eider *(Somateria fisheri)* nesting biology and demography in Russia has been set up on Ayopechan Island, Chaun-Delta, Chukotka in 2002. Since 2003 the field work is according to the Kigigk Island Field Protocol (YDNWR, unpublished report) for the results to be comparable with long-term data from Kigigak Island, YKD, Alaska. This aims to compare demographic parameters between declining Alaskan nesting population and seemingly stable Russian nesting population. The results on habitats, nesting density and chronology, nest success, adult female survival and site fidelity will be presented for Ayopechan Island together with the review of habitat types and nest success from other areas of the breeding range in Russia.

ARTIFICIAL NEST CONSTRUCTION FOR THE SCALY-SIDED, CHINESE, MERGANSER

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The scaly-sided merganser *(Mergus squamatus)* is among the rarest sea ducks in the world with a declining population estimated at 4,500 individuals (BirdLife International 2000) in 1990. The species is listed as "Endangered" by IUCN and is listed in the national Red Data Books of Russia, China, and South Korea. Most of the population breeds in the Far East of Russia. Known reasons of decline include habitat loss due to logging of the flood-plain forests, mortality from gill-net fishing, and shooting. Recent surveys indicated slight increase in breeding number probably up to 10,000 individuals in the world (Shohrin & Solovieva 2003). An artificial nest program for this species has been started in Primorye, Far East, Russia in 2000. We compared two different types of artificial nests for their occupancy by the scaly-sided merganser. First type was a 90 cm long eight-angle wooden tube open from above and the second type was wooden box with square flow and front entrance. Box sizes were adapted to the scaly-sided merganser: height 65 cm, flow side 30 cm, oval entrance 10x8 cm. Tube nest construction was suggested after observation over natural nests of the particular cavity nesting occupation rate is significant ($p<0.01$). This makes the species unique among other cavity nesting ducks, which are known to prefer closed boxes. Tubes and boxes for mergansers were distributed along rivers with logged and un-logged flood plain forest. Ducks were never seen occupying artificial nests along unlogged rivers sided by natural forest. In the logged flood plains ducks occupied 14-18% of tubes. This may indicate that the nest cavity deficit occurs due to previous logging.

THE COSTS OF MATE GUARDING TO MALE COMMON EIDERS

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Male Common Eiders *(Somateria mollissima)* are known to guard their mates against interference or copulations by other males during the laying period. This activity is accentuated in the archipelago of southwest Finland where the male biased sex ratio (about 56% males) means many single males approach paired ducks. We hypothesized that guarding involves a cost to mated males in less time available for foraging during this energetically stressful time of year. Unmated males may be adopting an alternative mating strategy, in which their survival is increased by feeding more and their reproductive success may benefit from occasional extra pair copulations. Scan sampling of 96 males in 2003 and 71 in 2004 showed that unmated males foraged more in 2003, but not in 2004. The number of dives per hour showed a similar pattern: in 2003, unmated males dove more than mated males. Unmated males participated in more aggressive encounters per hour than mated males, during preincubation, but spent a lower proportion of their time in aggression, suggesting that their aggressive encounters were shorter than that of mated males. In both years, mated males were clearly dominant over unmated ones, winning most aggressive encounters. These results suggest that there is no consistent feeding advantage of not being mated, and that unmated males may just be subordinate, perhaps younger males, excluded from breeding. Scan sampling omits "harassment groups" consisting of 5 to 60 unmated males that chase a mated pair for up to two hours. During this time, no foraging takes place and it appears as if large amounts of energy are expended by the mated male defending the female. The number of males participating in these harassment groups increases during the breeding season as some females leave to incubate, thereby increasing the male bias of the sex ratio. These groups may constitute an occasional, but intense cost to mated males.

HARLEQUIN DUCKS OF THE RIVER LAXA, ICELAND: BREEDING SUCCESS IN RELATION TO CONDITIONS ON THEIR BREEDING, MOLTING, AND WINTERING GROUNDS

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About 14,000 harlequin ducks *(Histrionicus histrionicus)* are found wintering in Iceland. The largest breeding concentration, accounting for about 4% of the total, is found on the River Laxa (length 61 km, surface area 750 ha of which 241 ha are turbulent water) which runs from Lake Myvatn into the Arctic Ocean at Skjalfandi Bay. Numbers and production of harlequin ducks of the River Laxa have been monitored for thirty years, as part of monitoring the Myvatn – Laxa ecosystem. In the 1970s, spring numbers of harlequin ducks were at low levels (total about 200), but an increase to about 500 occurred during the study period. Production of young fluctuated between 3 and 235 total, mean 74, corresponding to 0.49 young per female in spring. Only about 16% of females were accompanied by broods. Detailed studies of breeding biology, begun in 2005, are expected to yield information on non-breeding among females. Production of young was positively and significantly ($P < 0.001$) correlated with abundance of blackflies *(Simulium vittatum)*. Change in numbers between years was density dependent and was not associated with previous breeding success, suggesting that winter resources may be important in determining numbers. Molting and wintering harlequin ducks are found in numbers on the coast close to the mouth of the River Laxa. Color banding and radio tracking is expected to clarify the origin of these birds. A study of feeding habitat and diet at the sea coast has been started. This includes detailed mapping of feeding grounds, using total station (tachymeter) to locate feeding birds and benthic samples combined with fecal analysis to identify food remains.

THE EFFECT OF VARYING PROTEIN LEVELS ON BLOOD CHEMISTRY, FOOD CONSUMPTION, AND BEHAVIOR OF CAPTIVE SEADUCKS

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The Chesapeake Bay is a primary wintering area for scoters and the long-tailed ducks *(Clangia hyemalis)* that migrate along the Atlantic Flyway. Recently, the Chesapeake Bay had undergone an ecosystem shift and little is known about how this is affecting the seaduck populations. We are determining what are the preferred food sources of the seaducks wintering on the Bay and analyzing the factors influencing prey selection whether it is prey composition, energy assimilated, prey availability, or a combination of any or all of these factors. We have established a captive colony of surf (Melanitta perspicillata) and white-winged scoters (Melanitta fusca) as well as long-tailed ducks at Patuxent Wildlife Research Center to allow us to examine these factors in a more controlled environment. This project contains a multitude of experiments and the resultant data will be compiled into a compartmental model on the feeding ecology of seaducks wintering on the Bay. The first experiment entailed feeding groups of each species (four ducks per pen of equal sex ratio, if possible, and four pens per species) three diets varying in percent protein levels from November to February. Each diet was randomly assigned to each pen and the amount of food consumed was recorded each day. New feed was given when all existing food was consumed. Behavioral trials and blood profiles were completed on all study birds to determine the effects of the varying diets. There were no significant differences in food consumption, blood chemistry, and behavior detected at the 5% level among the diets for all three species of interest. There was a seasonal effect determined based on the food consumption data for white-winged scoters, but not for surf scoters or long-tailed ducks. The blood profiles of the surf scoters were compared to blood profiles of wild surf scoters and a there was no difference detected at the 5% level. As a health check of the ducks an aspergillosis test was run on the blood obtained during the experiment and it was found that surf scoters are more resistant to the disease than the other species. In the next two winters natural prey items available to seaducks wintering in the Chesapeake Bay will be offered on palettes to examine preference without the additional energetic costs of diving. Assimilation efficiency trials will be run on all three species to determine amount of energy the ducks obtain from each food source. Finally, using two large aquariums, prey preference will be analyzed with the additional energetic costs of diving and searching for prey. In addition, we will determine the effect of availability of a prey item on the prey selection of seaducks. We hope the model created from these experiments will allow managers to examine the effects of changes in the benthos on the seaduck populations wintering in the Chesapeake Bay.

POPULATION TRENDS OF SEA DUCKS WINTERING IN FOUR BAYS OF KODIAK ISLAND, ALASKA – A TWENTY YEAR ANALYSIS

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Shipboard surveys of marine birds wintering near shore on Kodiak Island have been conducted each February since 1986 on two western shore bays, Uyak and Uganik, and since 1991 on two eastern shore straits, Eastern and Western Sitkalidak Strait. Each survey revisited a fixed set of standardized 300 m wide strip transects, each of ten-minute duration at 9 knots running speed. The annual surveyed area covered approximately 200 km^2, or 17 percent of the surface area of the bays and 13 percent of the shore. Birds on the water were counted from the flying bridge of a 15 meter vessel using 8x40 or 10x50 binoculars (pre-1996) or 12x36 stabilizing binoculars (post-1996). The same observer conducted all surveys. Survey observations were analyzed using generalized estimating equations to account for the longitudinal study design, i.e. repeated surveys of the same transect through time. Separate analyses were conducted for eight sea duck species at each survey area, estimating annual mean density on the sample transects, temporal trend in mean density, annual mean probability of occurrence on the sample transects, and temporal trend in probability of occurrence.

The predominantly resident breeding species, Barrow's goldeneye (*Bucephala islandica)*, harlequin ducks *(Histrionicus histrionicus)*, common mergansers *(Mergus merganser)*, and red-breasted mergansers *(Mergus serrator)*, all exhibited increasing or relatively stable winter population densities and occurrence probabilities. Common mergansers' extreme rate of increase suggested a recently increasing influx of winter migrants of unknown origin. Of the winter migrant species, surf scoters *(Melanitta perspicillata)*, black scoters *(Melanitta nigra)*, and white-winged scoters *(Melanitta fusca)* all exhibited relatively stable or declining densities and occurrence probabilities, with spatially contrasting trend patterns suggesting possible differential harvest pressure. The other winter migrant species, long-tailed ducks *(Clangula hyemalis)*, exhibited increasing or relatively stable winter densities and occurrence probabilities at all survey areas.

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