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Abstracts

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STATUS AND TRENDS OF NORTH AMERICAN SEA DUCK POPULATIONS: WHAT WE KNOW AND DON'T KNOW

Timothy D. Bowman and Mark Koneff

TDB: Migratory Bird Management, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503, USA; tim_bowman@fws.gov
MK: Division of Bird Habitat Management, U.S. Fish and Wildlife Service, Merriam Bldg., 11510 American Holly Drive, Laurel, MD 20708, USA

We examined population trends for North American sea ducks on continental and regional scales using data from the Waterfowl Breeding Population and Habitat Survey and other surveys as appropriate. Available data suggest that populations of at least 10 of the 15 sea duck species have declined over the long term. All four eider species have experienced declines, and 2 species (spectacled eider and Steller's eider) are now listed as threatened in the U.S. Numbers of scoters (white-winged and surf combined) have declined steadily, with greatest percent lost in the southern portion of their range and greatest numerical drop in the northern boreal forest. Long-tailed ducks declined precipitously from the late 1970's until early 1990's, but have since stabilized. Populations of mergansers, goldeneyes, and bufflehead are clearly increasing on a continental scale. Limitations of existing surveys include inadequate survey coverage for most sea ducks, inappropriate timing, lumping of species into species groups or, for some species, no survey data at all. There is an urgent need for more intensive, precise surveys that will provide indices of population size for long term monitoring and robust detection of trends for all sea duck species.

PHYLOGENETIC RELATIONSHIPS AMONG NORTH AMERICAN MERGINI INFERRED FROM MITOCHONDRIAL AND NUCLEAR DNA SEQUENCES

Sandra L. Talbot, John M. Pearce, Barbara J. Pierson, Ray L. Fields and Kim T. Scribner

SLT, JMP, and BJP: U. S. Geological Survey, Alaska Science Center, 1011 E. Tudor Road, Anchorage, AK 99703, USA; sandy_talbot@usgs.gov
RLF: NIH-NINDO, 900 Rockville Pike, Bethesda, MD 20892, USA
KTS: Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824, USA

Sea ducks (Anatidae: Mergini) comprise a monophyletic group of diving ducks characterized by a northern distribution with close ties to the marine environment. In North America, the tribe Mergini is represented by 15 species, or species complexes. These include four species of eider ducks (common, king, spectacled, and Steller's), three species of scoters (surf, black and white-winged), two goldeneyes (common and Barrow's), the bufflehead, three mergansers (common, red-necked and hooded), and the harlequin and long-tailed ducks. Hypotheses of phylogenetic relationships among modern sea ducks, inferred from morphological characteristics compared among extant members of the tribe Mergini, have been published; however, relationships based on DNA sequence information have not been reported. Here we present a hypothesis of relationships within the Mergini of North America, based on nuclear and mitochondrial DNA nucleotide sequence characters. We compare results of our analyses with hypotheses generated from analyses morphological and behavioral characteristics of extant sea ducks, and suggest areas for further research.

FACTORS AFFECTING LOCAL DISTRIBUTION AND HABITAT SELECTION OF SEA DUCKS IN SWEDISH WATERS

Leif Nilsson

Department of Ecology, University of Lund, Ecology Building, S-223 62 Lund, Sweden; leif.nilsson@zooekol.lu.se

Sweden has a long coastline offering sea ducks a variety of different habitats from fully marine waters on the west coast to nearly fresh water in the Baltic, which together with neighbouring areas is their most important winter area in Europe. Intensive studies of sea ducks including population size (offshore surveys from aircrafts and coastguard boats), feeding ecology, local distribution and habitat selection were undertaken in the 1960s and 1970s. In recent years new extensive studies have started in relation to management issues connected with offshore windmill parks and oil spill. In the intervening years the inshore species have been monitored annually.

The dominating species in Baltic offshore waters is *Clangula hyemalis* with a total population of more than 4 mill. birds, i.e. the majority of the European population. It is spread over the entire Baltic but is especially concentrated to some offshore banks, including Hoburgs Bank in the Swedish zone with up to nearly 1 mill wintering individuals. First results from a study of its habitat selection and food choice here will be presented, comparing bird censuses from ships with the bottom topography and fauna, including analysis of food choice from birds collected on the bank.

Dominant species in Swedish inshore waters of the Baltic are *Aythya fuligula* and *Bucephala clangula.* The staging and wintering diving duck population in the Öresund (the sound between Sweden and Denmark) have been annually monitored since 1964. In addition their exploitation of the food resources were studied during 1965 – 68 and again in 1995 – 98 , the last time as a part of an environmental assessment study for the bridge between Sweden and Denmark.

The main food item for the sea ducks in the Swedish Baltic areas is *Mytilus edulis* but locally other marine organisms are important especially for the inshore feeding species. *Aythya fuligula* and *Bucephala clangula* especially during the autumn also feed on other bivalves, *Hydrobia* spp. and *Nereis*, which are dominating shallow soft bottom areas in the Öresund and the Baltic archipelagos. The food resources were sufficient for much larger numbers of sea ducks than actually present and even when the sea ducks in the Öresund were much concentrated during a hard ice-period, they only used a few per cent of the available standing crop of suitable food animals. The availability of rich food supply within an economic diving depth is the most important factor affecting the local distribution of the sea ducks, *Mytilus* being of special importance. It is suggested that one of the reasons for the dominance of *Clangula hyemalis* in the Baltic and *Somateria mollissima* on the west coast is the small size of *Mytilus* in brackish conditions of the Baltic.

WETLAND SELECTION BY BARROW'S GOLDENEYE AND BUFFLEHEAD BREEDING PAIRS AND BROOD-REARING FEMALES

Matthew R. Evans, Sean W. Boyd, and David B. Lank

MRW and DBL: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; mrevans@sfu.ca
SWB: Canadian Wildlife Service, Delta, BC V4K 3N2, Canada

Factors influencing wetland selection by waterfowl are poorly understood but are likely influenced by a complex of factors including the wetland's physical features, water chemistry, aquatic vegetation, food supply, and density of competitors and predators. Of these, invertebrate prey abundance is commonly suggested to be a main factor, due largely to the high energy and protein requirements of breeding females and developing young. Food resources on the breeding grounds can affect the timing of reproduction, clutch size, egg mass and composition, offspring body size, survival, and future reproductive output.

From 1997-2000, we compared several biotic and abiotic characteristics of wetlands used and unused by Barrow's Goldeneye (*Bucephala islandica*) and Bufflehead (*B. albeola*) in the Cariboo Parklands of Riske Creek, central British Columbia. Both species are particularly plentiful in this region and although they are known to exploit a variety of wetland habitats, they are most commonly associated with forested wetlands that provide an adequate supply of nearby cavity nest-sites. We used two of the most frequently used indicators of wetland selection by waterfowl: presence/absence comparisons, indicating wetland use, or selection, and measures of the relative density of birds present, indicating intensity of use. Each year, weekly ground-based surveys were conducted on 132 wetlands from April to August.

Use of wetlands by Goldeneye and Bufflehead breeding pairs and broods appears to be dependent on aquatic prey abundance, lake size and depth, and to a lesser degree, the amount of submergent vegetation cover. Water chemistry properties such as dissolved oxygen and specific conductivity were highly correlated to these factors and may serve as more easily measured variables for wetland managers. Other studies have found direct relationships between aquatic bird abundance and pH, but in our study, pH appeared to be unimportant in predicting wetland use by pairs and broods. These contrasting results are probably due to a lack of variation in pH levels (range: 8.4 - 9.9) among lakes in our study.

While Goldeneye and Bufflehead densities seem to be reflected by parameters that are crucial for nutrient requirements of breeding females and developing young, there likely exists trade-offs between selecting wetlands with hydrochemical levels that provide maximum invertebrate abundance, remaining within close proximity to forests and suitable cavity availability, and avoiding competition and predation. It also seems likely that waterfowl abundance has a parabolic relationship to water chemistry and submergent vegetation levels, with birds avoiding wetlands at either extreme.

Understanding the relationships between aquatic habitat features, wetland selection, and reproductive success is important for successful conservation and management of waterfowl populations. Identifying and understanding the factors related to waterfowl selection and usage of wetlands will assist managers in recognizing and maintaining productive breeding sites.

LOCAL AND REGIONAL INFLUENCES OF PREDATION RISK AND BIOPHYSICAL HABITAT ON THE DISTRIBUTION OF HARLEQUIN DUCKS IN NORTHERN LABRADOR

Joel P. Heath, Gregory J. Robertson, and William A. Montevecchi

JPH and WAM: Memorial University of Newfoundland, St. John's, NF A1B 3X9, Canada; Joel_Heath@sfu.ca
GJR: Canadian Wildlife Service, 6 Bruce Street, Mt Pearl, NF A1N 4T3, Canada
JPH [Current Address]: Centre for Wildlife Ecology / Behavioural Ecology Research Group, Dept. Biological Sciences, Simon Fraser University, 8888 University Drive, Burnaby, BC V5A 1S6, Canada

The spatial nature of the environment can play an important role in population dynamics. Spatial features can structure populations, allow metapopulation dynamics to occur, and can potentially stabilize locally unstable competitive, host-parasitoid and predator-prey interactions. These effects can, however, be scale dependent. This is particularly true for highly mobile migratory birds, as habitat selection can involve hierarchical processes from the landscape to nest site scale. In northern Labrador, glacially carved river canyons structure Harlequin Duck populations across the landscape. High natal philopatry and site fidelity, with limited dispersal among river systems provides a framework for metapopulation dynamics. Application of a metapopulation framework to Harlequin Ducks indicated differences in local demographics among river system sub-populations, and suggest Source-Sink population dynamics. Putative source and sink subpopulations did not differ in habitat availability for Harlequin Ducks, but were related to the presence of nest-site limited raptorial birds. Despite similar habitat availability, patterns of habitat use by Harlequin Ducks differed within source and sink sub-populations. These results indicate a) tradeoffs among predation risk and biophysical habitat quality indicate birds of prey can exclude Harlequin Ducks from otherwise suitable habitat, and b) limiting factors and demographics measured at a given spatial scale may not generalize to other spatial scales, or even to other demographic units within the same spatial scale. This has major implications for identifying critical habitat requirements and applying population projection and management models, particularly when parameters are estimated from areas of small spatial extent. These results emphasize the importance of being spatially explicit and incorporating multi-scale approaches in making informed conservation and management decisions for migratory birds.

CONSERVING THE SOUTHERNMOST CONCENTRATION OF SURF SCOTERS IN THE PACIFIC FLYWAY: THREATS TO OPEN WATER HABITATS IN THE SAN FRANCISCO BAY ESTUARY

John Y. Takekawa, Susan W. De La Cruz, and A. Keith Miles

JYT and SWD: U. S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field Station, P. O. Box 2012, Vallejo, CA 94592, USA; john_takekawa@usgs.gov
AKM: U. S. Geological Survey, Western Ecological Research Center, Davis Field Station, 281 Kerr Hall, University of California, Davis, CA 95616, USA

The southernmost large wintering population of surf scoters (*Melanitta perspicillata*) in the Pacific Flyway is found in the San Francisco Bay estuary. More than 80,000 scoters have been counted during midwinter aerial surveys, but the index has fluctuated widely. White-winged (*M. fusca*) and black scoter (*M. nigra*) make up less than 1% of the counts. Most scoter arrive starting in late September and stay as late as April. The estuary is highly urbanized, and elevated contaminant concentrations, including selenium, mercury, and cadmium, have been documented for several diving ducks. In the past decade, the Asian clam (*Potamocorbula amurensis*), a nonindigenous species, has greatly altered the benthic community with a remarkable population invasion. This clam concentrates contaminants up to 3-times more than other species and may increase the uptake of contaminants by diving ducks. Preliminary telemetry studies indicate that unlike other bay ducks we have radio-marked, scoter move widely in the estuary and out to the coast. However, the ecosystem is likely preferred by surf scoters because of the abundant prey and protected embayments. Increasing threats to the open water habitats used by scoter include airport expansion that may cover >3 km^2 of the bay, new ferry system routes criss-crossing the undisturbed open water, and loss of sediment in mud flat foraging habitats to extensive tidal marsh restoration efforts. Conservation of surf scoters in the Pacific Flyway would benefit greatly with a better understanding of the importance and risks of their wintering habitats in the San Francisco Bay estuary.

MODELING WINTERING SEA DUCK USE OF BC ESTUARIES TO ASSIST CONSERVATION PLANNING AND POPULATION ASSESSMENT

John L. Ryder, André Breault, Neil K. Dawe, Kathleen Moore, and Bill Dushenko

JLR: Pacific Wildlife Research Centre, Ducks Unlimited/Canadian Wildlife Service, Delta, BC V4K 3N2, Canada; john.ryder@ec.gc.ca
AB and KM: Pacific Wildlife Research Centre, Canadian Wildlife Service, Delta, BC V4K 3N2, Canada
NKD: Canadian Wildlife Service, Qualicum Beach, BC V9K 2B7, Canada
BD: Centre for Economic Development and Applied Research, Royal Roads University, Victoria, BC, V9B 5Y2, Canada

Estuaries are among the most threatened areas in British Columbia owing to continued coastal development, modification, pollution and the potential effects of climate change and they are of critical importance to tens of thousands of wintering sea ducks. In B.C., the Pacific Estuary Conservation Program (PECP) is responsible for estuarine habitat acquisition or securement of sites of conservation significance under the Pacific Coast Joint Venture. There are an estimated 440 estuaries in B.C. but they have yet to be mapped and classified according to consistent and standardized criteria, and the sea duck populations they support have yet to be fully assessed. To address these deficiencies, we are developing a spatially explicit model combining a standardized classification of estuaries at the scale of the province and site-specific sea duck surveys of individual estuaries. The objectives of this work are to: 1) develop standardized estuary classification and mapping criteria and produce a GIS layer covering all estuaries found in B.C., 2) compile the relative densities of wintering sea ducks on estuaries (birds/km^2, by species) and develop multivariate models to determine which physical and habitat attributes best predict sea duck abundance on estuaries, 3) develop simple predictive models of sea duck populations likely to occur in estuaries of variable size classifications, and 4) predict wintering sea duck population use of estuaries occurring in the province. The results will be used to standardize our definition of estuaries, provide a reference GIS layer of our conservation interests in estuaries to be used by stakeholders, provide a quantitative assessment of the importance of estuaries for wintering sea duck populations, provide recommendations for best monitoring practices for future surveys and to assist with prioritization of planning and habitat securement initiatives to be conducted under the PECP.

HABITAT SELECTION OF SEA DUCKS WINTERING IN THE COASTAL WATERS OF THE BALTIC SEA

Ramūnas Žydelis

Institute of Ecology, Akademijos 2, LT-2600 Vilnius, Lithuania; zydelis@takas.lt

The Baltic Sea is one of the most important water bodies for wintering sea ducks, where millions of these birds occur up to 6 months annually. This study aimed to determine habitat selection preferences by a few sea duck species wintering in coastal waters of the Eastern Baltic. The material was collected during four consecutive years performing regular surveys of bird distribution and examining bird food choice.

The analysis of bird spatial distribution patterns revealed that dominant sea ducks wintering in the Lithuanian nearshore zone of the Baltic Sea demonstrate species-specific strategies of habitat selection. It was found that habitat selection by benthivorous sea ducks is mainly determined by location of benthic biotopes offering different food resources, diversity of benthic biotopes and areas of different depth zones. Velvet Scoters were found wintering exclusively over sandy bottom habitats at wide range of depths, where large bivalve clams served as the main food source for this species. Common Scoter is a euritopic species, which occurred over various marine habitats, where non-selectively foraged on dominant species of benthic fauna. Long-tailed Duck is an ecologically plastic species, able to exploit different habitats at wide range of depths and utilize various food resources; however this species showed strong preference to areas with hard bottom benthic communities and foraged on bivalve *Mytilus edulis*. Steller's Eider is a strictly stenotopic species, which occurred in shallow vegetated marine areas, where it selectively fed on small crustaceans, gastropods and bivalves. Goldeneye was confined to benthic biotopes in shallow stony bottom areas. Human-induced disturbance was found to be a significant external factor limiting distribution of wintering birds in the nearshore zone of the Baltic Sea. However the sensitivity of separate sea duck species to sources of disturbance was different.

The material about habitat selection of some sea duck species could be employed in practical conservation of marine birds and habitats, since human pressure is constantly increasing to marine environment: intensifying shipping and fishing activities, development of oil industry, construction of offshore windmill parks, etc.

AUTUMN AND WINTER HABITATS OF KING EIDERS IN WESTERN GREENLAND DETERMINED BY SATELLITE TELEMETRY

Anders Mosbech, Flemming Merkel, and Annette Flagstad

AM: National Environmental Research Institute, Department of Arctic Environment, P.O. Box 358, Frederiksborgvej 399, DK-4000 Roskilde, Denmark; amo@dmu.dk
FM: Greenland Institute of Natural Resources, P.O. Box 570, DK-3900 Nuuk, Greenland, Denmark
AF: Copenhagen Royal Veterinary and Agricultural University, Institute of Clinical Studies, Bülowsvej 17, DK-1870 Frederiksberg, Denmark

West Greenland is an important moulting, staging and wintering area for king eiders (*Somateria spectabilis*). Most of these breed in eastern Canadian Arctic and some in northwestern Greenland, while king eiders do not breed in West Greenland. Surveys of moulting areas in West Greenland and a breeding area in Canada indicate a decreasing population. To locate autumn staging and winter habitats for king eiders in Western Greenland, satellite transmitters were implanted in 10 king eiders (7 males and 3 females) captured between July 31 and August 2 1999 at a moulting site in West Greenland. The king eiders were captured in floating mist nets in Umiarfik, southern Upernavik. Before the end of October two of the tracked king eiders were reported shot in southern Upernavik. One of the shot birds was frozen immediately and shipped for veterinary autopsy. The bird had increased its weight with 90 g and showed no sign of inflammation or other external or internal negative effects of the implanted transmitter. Locations from live birds (omitting the two shot birds) were received in 5.8 ± 0.3 months from three birds with 50g transmitters and in 4.0 ± 2.0 months from 5 birds with 35g transmitters. The tracked birds moulted and stayed in the vicinity of southern Upernavik until October. Six birds were tracked past October 1. Five birds went to an offshore bank (Store Hellefiskebanke) about 450 km further south and one bird stayed in southern Upernavik until February. The birds that went to Store Hellefiskebanke had median arrival date October 30 and stayed at until the last locations in January 2000. The locations from Store Hellefiskebanke were centred in areas with 23 – 35 m depth and about 50 km from the coast. The daily movements of the birds within Store Hellefiskebanke were relatively small. Ice cover on Store Hellefiskebanke from November to February were variable but never exceeded 9/10 (DMI Ice charts based on Radarsat and NOAA satellite data), and no clear relation between movements of the birds and changes in ice coverage could be seen. It is new knowledge that king eiders arrive as early as October to winter on Store Hellefiskebanke, while king eider flocks have previously been observed on Store Hellefiskebanke in the month of March. It is recommended that more king eiders from different moulting areas are tracked by satellite to supplement the small sample size in this study. Results are discussed in relation to aerial surveys of the winter population and management of the population. Hunting and disturbance are at present considered the most significant threats to king eiders in western Greenland. Further studies are planned in co-operation with CWS.

SCOTER AND SCAUP DECLINES: MUTUAL CAUSES OR MUTUALLY EXCLUSIVE?

Stuart Slattery, Llwellyn Armstrong, and Michael Anderson

Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Box 1160, Stonewall, MB R0C 2Z0, Canada; s_slattery@ducks.ca

Numbers of scoter (*Melanitta* sp.) and scaup (*Aythya* sp.) have declined rapidly during the past 22 years for unknown reasons. These birds breed primarily in the western boreal forest but largely winter in ecologically and spatially different areas. Little is known about the ecology of these birds in their core breeding areas or about associations between breeding and wintering areas. Consequently, we have difficulty prioritizing and testing hypotheses about potential population constraints, particularly those related to cross-seasonal effects. However, because these taxa mainly overlap on northern staging and breeding areas, and share some ecological traits there, analyses of correlations between population sizes may provide insight into where constraints occur. For example, high spatial and temporal correlation between sizes of breeding populations would support hypotheses about shared limiting factors occurring on the breeding grounds, while weak correlation would suggest unshared limiting factors present on breeding, staging or wintering areas. We used the North America Breeding Waterfowl Survey data from the traditional survey areas to compare spatial distribution of birds among various regions of the boreal forest and then used correlation analyses to examine covariation between scoter and scaup populations at various spatial and temporal scales. About 40% of each taxa occurred in the Northwest Territories. Continental population indices were highly correlated both over long ($r = 0.67$, $P = 0.0001$) and short ($r = 0.88$, $P = 0.0001$) terms. Populations in the NWT drove these relationships, particularly during the last 22 years ($r = 0.87$, $p < 0.001$). In addition, patterns of variation in population trends were identical across subregions of the NWT that differed in bird densities. Our results are consistent with the hypothesis that scoter and scaup populations are limited by similar factors, and that those constraints occur on breeding grounds in the boreal forest. We will examine ecological factors and survey biases that may contribute to these tight correlations.

NATAL RETURN AND SURVIVAL RATES OF BARROW'S GOLDENEYE IN BRITISH COLUMBIA

Sean W. Boyd, Matthew R. Evans, Saul Schneider, and Barry D. Smith

SWB, SS and BDS: Canadian Wildlife Service, Delta, BC V4K 3N2, Canada;
Sean.Boyd@ec.gc.ca.
MRE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

The purpose of our study was to investigate annual return and survival rates for known-age Barrow's Goldeneye, starting with HY birds. Over four years from 1995-2000, we marked 469 male and 374 female Class IIC-III ducklings with nasal disks on a study area near Riske Creek, B.C. Each year from 1996-2002, we surveyed 132 ponds on a weekly basis from April to August to record the presence of marked birds. Average first year return rate was estimated at 33% (range = 18-53%) for females but only 6% (range = 0-19%) for males. Using the program MARK, we estimated the local annual survival rate of females at 34% in three of the four years but 73% in one year (1997 to 1998). For males, survival rate was only 8% and 55% in the same years. The reason for the high variability in survival rates is unknown. Compared to marked males, females were encountered 2-3 times more often per bird on the study area in their second year and they were recorded on twice as many ponds. These observations suggest that, although young males return to their natal area, they are much more transient than females and this may partially account for their lower apparent return and survival rates. This is one of the first studies to assess return and survival rates for known-age Barrow's Goldeneye.

PHILOPATRY AND MOULT OF AFTER-HATCH-YEAR FEMALE BUFFLEHEADS IN CENTRAL BRITISH COLUMBIA

Andre M. Breault and Matthew R. Evans

AMB: Canadian Wildlife Service, Delta, BC V4K 3N2, Canada; andre.breault@ec.gc.ca
MRE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

At least 10 species of waterfowl undergo wing moult at Riske Creek, Central British Columbia. One of the most common moulting species is the Bufflehead and field surveys started in 1999 indicate the annual presence of 1,000 to 1,500 moulting individuals on ~ 30 wetlands. Approximately 1,000 moulting Buffleheads have been captured with monofilament gill nets since 1998 and tarsus measurements indicate that is primarily a female moulting area (over 90% female). Male and female Bufflehead are philopatric to the moulting area and 15 of the 43 birds recaptured in 2000 moulted on the same wetland as in 1999. May counts conducted by the Canadian Wildlife Service indicate that approximately 100 pairs of Bufflehead breed annually at Riske Creek and females from this breeding population were nasal-tagged by a Ph.D. student from 1996 to 2000. The near-absence of marked breeding females during moult suggest that local breeders do not moult on breeding areas and the origin of the large influx of moult migrants into the area is currently unknown. The capture of a local hatch-year male banded in 1998 suggest that some second-year unpaired males might return to their natal area for the first moult but this appears to be rare. A total of 53 females from 4 different wetlands were recaptured at 2-week intervals in 2000 to characterise feather growth rate and body mass changes during wing moult. Feather growth rates did not vary over the moult period but females gained weight on some wetlands and lost weight on others, suggesting that food availability during moult might affect overall body condition for fall migration. Information on wetlands used by moulting waterfowl is kept in a GIS data set and will be used to characterise the use of different habitats and wetland types by various species. This study indicates that Bufflehead moult occurs in breeding areas although breeding and moulting populations consist of different birds. There are no previous records of aggregations of moulting Bufflehead females in breeding areas and such aggregations are likely common in other early-nesting interior sea ducks (e.g. Barrow's Goldeneyes). Monitoring large aggregations of moulting sea ducks not only provides a better understanding of moult ecology but it can also offer a cost-effective way to gather information on specific cohorts of birds (specifically after-hatch-year females) poorly covered by conventional protocols.

HOMING OF YEARLING FEMALE HOODED MERGANSERS TO NATAL WETLANDS

Patrick B. Lemons, Peter Blums, and Leigh H. Fredrickson

Gaylord Memorial Laboratory, University of Missouri, Puxico, MO 63960, USA;
patrick_lemons@hotmail.com

Unlike most avian species, waterfowl exhibit female-biased natal philopatry, yet very little is known about natal philopatry/dispersal in ducks because low nesting success, high prefledging mortality, and problems associated with marking newly hatched ducklings makes it difficult to recapture or observe individuals marked at hatch. In species with delayed maturity, such as most sea ducks, yearlings do not breed and information on seasonal distribution and behavior during the first 2 years of life is lacking. For example, non-breeding yearling female common goldeneyes and buffleheads often return to natal wetlands one year before they start nesting. To investigate if hooded mergansers (Lophodytes cucullatus), another species with delayed maturity, follow the same pattern, we used 3 multi-capture nest box traps (Blums et al. 2000) and captured 87 non-breeding yearling female hooded mergansers at Mingo Swamp (Mingo NWR and Duck Creek CA), Missouri, during 1999–02. Only 22 (35%) of 63 females that were captured during 1999–01 were later recruited (29%) into the local box-nesting population or recaptured in multi-capture traps (6%) during the following years suggesting that less than a half of prospecting yearlings later emigrated permanently. Yearlings entered traps mainly after local adult (ASY) mergansers ended nest searching and laying activities (late April - early June), thus likely avoiding intraspecific conflicts with local females. Forty three (49%) of the captured yearlings were previously banded as day-old-ducklings within 7 km from the capture site. We believe that forested wetlands within Mingo Swamp attracted many young non-breeding immigrants from surrounding areas because of numerous nest boxes (annual mean = 190) and excellent brood habitats. We also discovered that siblings from one brood may prospect potential nest sites together. For example, among 10 females (3 wood ducks and 7 hooded mergansers) removed from a multi-capture trap in the morning on 8 May 2000, there were 5 yearling hooded mergansers from 3 different broods banded as day-old ducklings at the same location a year before. One of the most intriguing unanswered questions in natal philopatry is when females make a “decision” to return to the natal area? We suggest that in waterfowl with delayed maturity most surviving young females first return to their native wetlands and only then emigrate or stay depending on local habitat conditions, nest site availability and population density. However, it is unclear if females capable of breeding the following year after hatching (for example, wood ducks, and many other waterfowl) return to the natal wetlands before emigrating permanently. We encourage other researchers to use multi-capture nest box traps to study behavioral and population dynamics of cavity-nesting waterfowl.

MOVEMENT PATTERNS OF HARLEQUIN DUCKS WINTERING IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA: IMPLICATIONS FOR POPULATION STRUCTURE AND DEMOGRAPHICS

Heidi M. Regehr and Fred Cooke

Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; hmregehr@sfu.ca

Movement patterns of individuals are an important, frequently understudied component of population dynamics that have evolutionary and conservation implications and are critical to population management. Movement patterns determine the degree of genetic connectivity and demographic dependence among populations. Movements of individuals from their place of birth to their place of pairing or reproduction determine the relatedness of mates and the genetic relationships of subpopulations. Quantification of movement rates also allows separation of mortality and emigration, which are frequently confounded in demographic studies. We studied the movement patterns of Harlequin Ducks (Histrionicus histrionicus) wintering in the Strait of Georgia, British Columbia. Like most waterfowl, Harlequin Ducks pair during winter, thus movement of individuals among wintering areas are of primary importance to genetic population structure. We tested hypotheses that movement rates and distances differed by sex, as predicted by theories of male-biased dispersal for waterfowl, and by age, as is typically observed among birds and mammals. Harlequin Ducks maintain long-term pair bonds, thus movements of young birds, that have not yet paired, are most clearly related to population structure. Harlequin Ducks have been captured, marked, and resighted at a number of locations in the Strait of Georgia over several years, thus we were able to use multi-strata models in the mark-recapture program MARK to estimate movement probabilities among locations within and between wintering seasons. The use of nasal markers on a sample of birds, in conjunction with an exhaustive mid-winter boat survey in the northern Strait of Georgia, allowed us to estimate within season movement distances. Contrary to expectations, sex was not an important predictor of movement rates or distances. However, movement rates and distances were related to age, with young birds being more likely to move and moving greater distances than older ones. Movement rates were also related to distances between locations, thus isolation by distance or stepping stone models may best describe gene-flow patterns. Movement distances of young individuals suggest that, in spite of the high degree of philopatry observed for this species, the among-deme component of genetic variance, in the absence of selection, is likely to be small.

SURVIVAL RATES OF ADULT HARLEQUIN DUCKS ON THE BOW RIVER IN SOUTHWESTERN ALBERTA

Cyndi M. Smith

Parks Canada, Waterton Lakes National Park, Waterton Park, AB T0K 2M0, Canada; Cyndi.Smith@pc.gc.ca

Between 1995 and 1999, adult harlequin ducks were captured using a mist net strung across the Bow River. Each bird was marked with a uniquely-coded red band on the left leg. Resightings of banded birds were made during capture attempts, roadside surveys and random observations each year. The presence or absence of the 1995-1997 cohort of colour-marked adult females (n=31) and males (n=62) was used for survivorship analysis using Jolly-Seber model in program MARK. The most parsimonious model suggested that female survival and probability of recapture did not vary by year. The estimated annual survival rate for females was 0.712 ± 0.104 S.E. (0.478-0.870 C.I.), and recapture probability was 0.773 ± 0.140 (0.415-0.942 C.I.). Although the most parsimonious model suggested that male survival varied by year, with probability of recapture remaining constant, only the first year survival estimate is given because some males that have only been sighted once may be alive but breeding in a different area. If a male's mate dies, he will attempt to re-pair and would follow his new mate to her natal stream. Thus the annual survival rate for males was estimated as 0.808 ± 0.132 (0.442-0.957 C.I.), and recapture probability at 0.700 ± 0.096 (0.488-851 C.I.). Because of the pairing behaviour this estimate may also be low.

To investigate local survival during the breeding season 16 adult females and 4 adult males received radio transmitters in 1997 and 1998. Each year that an individual returned to the breeding stream counted as a separate local event. The breeding season was stratified into pre-nesting, nesting and post-hatching periods based on the individual's breeding chronology, rather than fixed dates. None of the four radio-marked males died on the breeding stream. Using the known fate model in program MARK the most parsimonious model suggested that female survival did not vary during the breeding season. The estimated local survival rate for females (n=21) was 0.654 ± 0.105 S.E. (0-432-0.824 C.I.).

EFFECT OF WINTER SEA ICE CONDITIONS ON SURVIVAL OF SPECTACLED EIDERS

Paul L. Flint, J. Barry Grand, and Tina L. Moran

PLF: U.S. Geological Survey, Alaska Science Center, 1011 East Tudor Road, Anchorage, AK 99503, USA; Paul_Flint@usgs.gov
JBG: Alabama Cooperative Fisheries and Wildlife Research Unit, 331 Funchess Hall, Auburn University, Auburn, AL 36849, USA
TLM: Yukon Delta NWR, Box 346, Bethel, AK 99559, USA

Spectacled Eider populations have declined and are considered threatened throughout their range. We have studied the survival and productivity of Spectacled Eiders breeding at 2 locations on the Yukon-Kuskokwim (Y-K) Delta since 1993 (i.e., Hock Slough and Kigigak Island). We marked adult female eiders in all years and 30-day-old ducklings in some years. We used mark-recapture techniques to estimate adult female survival, first-year survival, recapture rates, and breeding propensity of 2-year-old females. We included an index to sea-ice severity as a covariate in these analyses. The best model for these data had an annual survival rate of 81% that did not vary among sites. First year survival was estimated at 34%. Breeding propensity of 2-year-old females varied among sites from 88% at Kigigak Island to 15% at Hock Slough, however, this variation may be due to differences in years sampled. The second best model (Δ QAIC = 1.14), built on the same basic structure, included the sea-ice severity covariate. Including this covariate, suggests that annual survival may vary as much as 10% depending on ice conditions. Other competing models suggest differences in survival among study areas which may be due to differences in rates of lead poisoning. During years of severe sea-ice, survival of birds from Hock Slough declined more than birds from Kigigak Island and we suspect this result is due to differences in rates of lead exposure. We found little support for models in which sea ice severity influenced adult female breeding propensity (i.e., recapture rate). It appears that winter habitat may be limiting Spectacled Eiders in some years. Further, this density dependent limitation may have the greatest effect on birds stressed by exposure to lead poisoning. Given these results, we developed a simulation model to examine the effects of stochastically varying winter carrying capacity on the population viability of the 3 main sub-populations (i.e., Y-K Delta, Alaska North Slope, Arctic Russia). Stochastic variation in winter carrying capacity has the relatively largest effect on the smallest sub-population (i.e., the Y-K Delta), significantly increasing population variability. We conclude that when breeding populations compete on wintering areas, management actions targeted on one sub-population need to consider the status and trends of other sub-populations.

POPULATION BIOLOGY OF KING EIDERS IN CANADA'S CENTRAL ARCTIC: INFERENCES FROM MARK-RECAPTURE

Ray T. Alisauskas, Dana K. Kellett, and Katherine R. Mehl

RTA and DKK: Canadian Wildlife Service, Prairie and Northern Wildlife Research Centre, 115 Perimeter Road, Saskatoon, SK S7N 0X4, Canada; ray.alisauskas@ec.gc.ca
RTA and KRM: Department of Biology, 112 Science Place, University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada

Apparent declines in king eiders (Somateria spectabilis) in Canada's western and central arctic motivated our research at Karrak Lake, Queen Maud Gulf Bird Sanctuary, Nunavut. Very little published information about nesting biology of King Eiders was available. Until our study, only 72 King Eiders had been banded from 1940 to 1994. We estimated apparent survival and seniority (fraction of the population that bred in the previous year) using Program Mark from releases of 265 nesting females that were recaptured 167 times from 1995 to 2001. From direct model-averaged estimates of apparent survival (range: 80% to 84%) and seniority (range 63% to 70%), we calculated the annual rate of population growth. Our breeding population of King Eiders increased each year of the study by between 14% to 33%. Eiders marked at Karrak Lake and shot by hunters showed that they migrate to two different winter areas: Pacific waters likely near Alaska, and Atlantic waters near west Greenland. We are pursuing research to discriminate nesting females at Karrak Lake, using stable isotopes, according to whether they wintered in different areas. Thereby, we hope to estimate vital rates at one breeding location, but stratified by eastern vs. western winter areas in North America.

POPULATION GROWTH RATE OF WHITE-WINGED SCOTERS AT REDBERRY LAKE, 1975-1985

Ray T. Alisauskas, Joshua J. Traylor, Cindy J. Swoboda, and F. Patrick Kehoe

RTA: Canadian Wildlife Service, Prairie and Northern Wildlife Research Centre, 115 Perimeter Road, Saskatoon, SK S7N 0X4, Canada; ray.alisauskas@ec.gc.ca
RTA, JJT, and CJS: Department of Biology, 112 Science Place, University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada
FPK: Ducks Unlimited Canada, PO Box 818, 350 Aquaduct Drive, Brooks, AB T1R 1B7, Canada

Krementz et al (1997) estimated apparent survival rates for a population of White-winged scoters breeding at Redberry Lake using capture-recapture of birds from 1975-1985. Since then, there have been developments in the direct estimation of population growth rate using reverse-time, capture-recapture of animals. I used the same capture histories used by Krementz et al (1997) to estimate survival, seniority and capture probabilities. Seniority probability is a parameter useful for understanding the proportion of population growth rate composed of survival, i.e., seniority=survival/population growth. Thus, if seniority and survival probabilities are estimable, then population growth rate, l, can be estimated by substitution. Values of seniority approaching one suggest that there is very little recruitment contributing to population growth rate. I used Program Mark to compare 9 candidate models for estimating survival, seniority and capture probabilities; the 9 models were combinations of different time constraints (time-specific, time trend and time-invariant) imposed on each of the three latent parameters. I then used model-averaging to derive a combined estimate of each of the three latent parameters. The results suggest that this population was in decline (l = 0.78±0.02 SE) over the 11 years of previous investigation; because survival probability was constant, and seniority was very close to one, the results further suggest that population declines were the result of virtually no local recruitment (either through immigration or local production of young). These findings provide a historical baseline with which to compare current local population dynamics of White-winged scoters at Redberry Lake studied more recently (since 2000).

A STATISTICAL MODEL FOR DISCRIMINATING GRADUAL AND CATASTROPHIC MORTALITY FROM LAYING TO FLEDGING IN BARROW'S GOLDENEYE CLUTCHES AND BROODS

Barry D. Smith, W. Sean Boyd, and Matthew R. Evans

BDS and WSB: Canadian Wildlife Service, Pacific Wildlife Research Centre, 5421 Robertson Road, Delta, BC V4K 3N2, Canada: barry.smith@ec.gc.ca
MRE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

Quantitative conservation methodologies such as Population Viability Analysis (PVA) require reliable measurements of life history parameters such as breeding success. The utility of such measurements is complicated by our knowledge that the mortality of eggs in a clutch and juveniles in a brood can occur both gradually and independently over time, or catastrophically, such as in the sudden loss of a clutch or brood. Not knowing the nature of breeding mortality events caused by either or both of abiotic (weather) and biotic (predation) circumstances limits our ability to confidently assess a population's sustainability over time. Using Barrow' s Goldeneye as a example, we describe a multinomial likelihood model that measures egg and juvenile mortality rates continuously from laying to fledging based on periodic observations of individual clutches and broods. Adjunct data such as initial brood size or environmental productivity can be included as independent covariate series for evaluating their influence on the predicted survival rates. Knowledge of the effect of an environmental variable on breeding success can guide conservation strategies that manipulate that variable. The model can statistically characterize mortality between the extremes of gradual and catastrophic mortality; and can determine if unwitnessed mortalities occurred independently or were correlated (i.e., over-disperse d, where catastrophe is extreme over-dispersion). Over-dispersion is estimated as a parameter of the beta-binomial distribution of expected survival, and thus differs from its treatment in Program MARK where over-dispersion is an *a posteriori* diagnostic.

THE STATUS OF SEA DUCK RESEARCH AND MONITORING IN EUROPE

Stefan Pihl, Tony Fox, and Ib Krag Petersen

National Environmental Research Institute, Dept. of Coastal Zone Ecology, Grenaavej 12, DK-8410 Ronde, Denmark; sp@dmu.dk

The shallow water marine ecosystems of Western Europe support some 11 million wintering sea ducks of 13 species, most of which originate from remote breeding areas in Russia. Dramatic recent expansions in shipping traffic, infrastructure development, exploitation of mineral and biological resources and offshore windfarm development exert increasing pressures on these wintering populations. For example, offshore wind farms are being constructed in Danish, Irish and Swedish waters and are planned in all northern European Union Member States and Baltic Sea Accession States, while 80 ferries per day ply between Helsinki and Tallinn alone, mostly fast catamarans. European sea duck research, monitoring and conservation effort has concentrated on describing the numbers, distribution and ecology in marine areas outside of the breeding season. At present, there is relatively little international co-ordination of sea duck research and monitoring effort between the various nation states within the region, except through the informal networking of the Seaduck Specialist Group, and the research community is a small one. If we are to be in a position to effectively safeguard these populations for the future and adequately carry out environmental impact assessments relating to these poorly known species, we need to establish a major international research and monitoring initiative. The goals of this programme would be to:

1. Develop and harmonise international common standards for survey methods, analytical tools and integrated population monitoring to establish regional abundance, distribution, status and trends of sea duck populations.
2. Define discrete populations of these organisms and establish linkages between sites and areas used at different stages of the life cycle using genetic markers and telemetry methods.
3. Use the information from themes 1 and 2 above to support mapping of the most important and sensitive areas, in part to support development of site-safeguard networks (e.g. Natura 2000 sites).
4. Establish predator-prey relationships in time and space for key sea duck species to understand their patterns of abundance and distribution.
5. Define the spatial and temporal effects of human activity on the predator-prey relationships described in theme 4.
6. Model population processes and thereby predict the impacts of human activity on populations of these organisms.
7. Based on the results from the themes above, develop common tools to avoid and minimise conflict, and establish mitigation mechanisms to enable sustainable development in offshore environments.
8. Ensure widest dissemination of results and utility of recommendations arising from the integrated project throughout potential user groups and provide a knowledge base for policy formulation and decision-making in offshore environments.

Compared to the terrestrial environment, the effects of human activities and development on the marine environment remain poorly known. It is therefore essential that we exploit our existing knowledge and undertake new internationally based investigations in order to develop a better understanding of marine biodiversity and ecosystem functioning. Only in this way can we understand and minimise the effects and impacts of current and future human activities on migratory sea ducks throughout their western Palearctic flyways.

ANNUAL VARIATION IN PRODUCTIVITY OF THE HARLEQUIN DUCK: A TEST OF THE DEFERRED BREEDING PARADIGM

R. Ian Goudie

Atlantic Cooperative Wildlife Ecology Research Network, Dept. of Biology, Memorial University of Newfoundland, St. John's, NF A1B 3X9, Canada; h15rig@mun.ca

Lack (1966) proposed that food was a major limiting resource to breeding birds. Bengtson (1972) proposed that populations of Harlequin Ducks (*Histrionicus histrionicus*) are regulated by the quantity of food available on the breeding grounds. Non-breeding in Harlequin Ducks has been defined as sexually mature birds that migrate to natal rivers but do not breed (Bengston and Ulfstrand 1971). In the early part of the twentieth century, researchers were proposing a hypothesis of periodic non-breeding among Arctic bird species, notably sea ducks. Some authors speculated that eiders reduce the risk of death caused by the stress of breeding by avoiding nesting in certain years, essentially a behaviourally based system. Annual productivity of sea ducks such as Common Eiders (S*omateria. mollissima*) and Harlequin Ducks varies considerably, and some authors have proposed that a few "good" years over a decade or two are critical in stabilizing populations through time. Non-breeding has become a paradigm in the sea duck literature, and it is speculated as an important variable contributing to the K-selected life history pattern of these species (Goudie *et al.* 1994). Direct behavioural and/or physiological evidence for deferment of breeding in sea ducks are lacking. The lack of support for a decision-based system would favour an alternative hypothesis for an environmentally imposed limitation to annual productivity. I test predictions arising from the non-breeding hypothesis using data on behaviour, morphology and radio-telemetry generated from my research of Harlequin Ducks breeding in central Labrador, and additional literature in eastern and western North America. These results provided no support for a decision-based limitation on productivity. An environmentally imposed limitation similar to a reciprocal predator-prey model is suggested as an alternative to the long-held paradigm of deferred breeding in sea ducks. This alternative favours an ecosystem management approach to conservation.

NESTING ECOLOGY OF WHITE-WINGED SCOTERS AT REDBERRY LAKE, SASKATCHEWAN

Joshua J. Traylor, Ray T. Alisauskas, and F. Patrick Kehoe

JJT: Department of Biology, University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada; joshua.traylor@ec.gc.ca
RTA: Department of Biology, University of Saskatchewan and Prairie Northern Wildlife Research Centre, Canadian Wildlife Service, Saskatoon, SK S7N 0X4, Canada
FPK: Ducks Unlimited Canada, Brooks, AB T1R 1B7, Canada

Population surveys of scoters (*Melanitta spp.*) in North America suggest continental declines of 65% since the 1950s with >50% of the decline over the last twenty years. Breeding pair counts of white-winged scoters (*Melanitta fusca deglandi*) in the aspen parkland on Redberry Lake, Saskatchewan, have declined by about 55% in the last twenty years alone, while counts at Jessie Lake, Alberta, declined from 57 pairs to none in the same amount of time. White-winged scoters are among the least-studied of waterfowl so information on variation in life history traits is urgently required to understand the contributions of different vital rates to population dynamics. High annual adult survival rate (0.77), low production of $\leq$ 1 duckling/pair/year, depressed age ratios among harvested birds (series of age ratios <0.6 juveniles:adult, 1962-1992) suggest population declines may have resulted from low recruitment (e.g., nesting success, duckling survival) into the breeding population. Nesting success is a critical component of recruitment and can be affected by a number of factors, including predation, weather, female body condition, and nest-site placement. In this paper, we focus our attention on nesting ecology of white-winged scoters. Specific goals were to determine nest initiation dates, clutch size, to test for differences in nest microhabitat characteristics between successful nests, failed nests, and random locations, and to examine nest survival, using Program MARK, in relation to nest initiation dates and microhabitat variables. We also compare our results to estimates from the 1970-1980s at Redberry Lake. We found a total of 198 nest during two years. Nest initiation date averaged 21 June (95% CI: 20 - 22 June) and clutch size averaged 8.84 (95% CI: 8.61 - 9.07). Discriminant function analysis differentiated between the three groups. Lateral (0.65) and overhead (0.35) concealment were most correlated with the canonical discriminant function. Nest success from a time constant model (i.e., Mayfield estimate) was 35.3% (95%CI: 27.5 – 43.2%). Results suggest nonrandom habitat selection and on going natural selection because selected sites and successful nests had more concealment than random sites and failed nests, respectively. Nest survival showed positive relationships with nest concealment and distance to water and a negative relationship with distance to edge. Current estimates of nest survival appeared low compared to 1970-1980s. If adult survival probability has not changed from the 1970-1980s, then our results suggest that local population declines have resulted from declines in recruitment. Management actions for conservation of local populations in Saskatchewan might most appropriately focus on enhancing recruitment.

BREEDING ECOLOGY OF BLACK SCOTERS ON THE YUKON-KUSKOKWIM DELTA, ALASKA

Jason L. Schamber, Paul L. Flint, and Fred J. Broerman

JLS and PLF: U.S. Geological Survey, Alaska Science Center, 1011 East Tudor Road, Anchorage, AK 99503, USA; jschamber@usgs.gov.
FJB: Yukon Delta National Wildlife Refuge, Box 346, Bethel, AK 99559 USA

According to the North American Breeding Pairs Survey, populations of tundra nesting scoters, which in Alaska are predominantly Black Scoters (*Melanitta nigra*), have declined for unknown reasons. The timing of these surveys, however, may be too early to accurately reflect breeding population trends of Black Scoters as they do not begin nesting until late June. Furthermore, basic vital rates are relatively unknown; thus, we initiated a study in 2001 to investigate general breeding ecology of Black Scoters at Aropuk Lake on the Yukon Delta National Wildlife Refuge. Pairs began to arrive at Aropuk Lake in early May then moved onto smaller surrounding lake complexes following a substantial emergence of Chironomids in mid-June. Pairs began to dissolve and drakes departed the study area shortly thereafter; lone drakes and flocks of drakes were rarely observed. We searched for nests from mid-June until late July. We located 35 and 40 Black Scoter nests in 2001 and 2002, respectively. Most nests were found in brushy transitions between dry lichen tundra and lake basins or drainages. Spiraea, Dwarf Birch, Willow and Grass comprised approximately 80% of cover vegetation surrounding nest sites. Nests were located 4m to 300m from the nearest body of water. A small sample of nests was found during egg laying and it appears that Black Scoters may lay an egg every other day. Average clutch size across both years was 7.33 eggs. Apparent nest success was 17.14% in 2001 and 17.50% in 2002. In both years, we discovered one nest containing egg membranes from a previous year, suggesting that some successful females may be utilizing the same nest bowl across years. To assess duckling survival, we trapped females on the nest at hatch and fitted them with VHF radio transmitters. Apparent survival in 2001 was 54% and 12% in 2002 for ducklings surviving to 30 days of age. Continued research efforts are needed to expand current knowledge with the goal of developing a working population model effective in aiding managers.

ABUNDANCE, DISTRIBUTION, HABITAT USE, AND BREEDING BIOLOGY OF SPECTACLED EIDERS ON THE CENTRAL ARCTIC COASTAL PLAIN OF ALASKA: A 10-YEAR RETROSPECTIVE (1993–2002)

Betty A. Anderson, Ann M. Wildman, and Alice A. Stickney

ABR, Inc.–Environmental Research & Services, P.O. Box 80410, Fairbanks, AK 99708, USA; banderson@abrinc.com

Spectacled Eiders (*Somateria fischeri*) were listed as a threatened species under the U.S. Endangered Species Act in 1993, following significant declines in their breeding populations in western and northern Alaska. In summer 1993, we initiated a long-term study of the abundance, distribution, habitat use, and breeding biology of Spectacled Eiders in the Kuparuk Oilfield on the central Arctic Coastal Plain of Alaska, approximately 45 miles west of Prudhoe Bay. In the past 10 years (1993–2002), we have used a combination of aerial and ground-based surveys to monitor population trends of eiders on a regional and oilfield basis, identify important habitats used by pre-nesting and nesting eiders, locate nests of eiders, and monitor nesting success. Current year (2002) data are being analyzed and will be included in the presentation; otherwise results reported here are for 1993–2001. Regional trends from aerial surveys flown annually during the pre-nesting period (10–18 June) indicate that the Spectacled Eider population has remained relatively stable since 1993 (mean annual density = 0.08 birds/km^2; SD = 0.02 birds/km^2, *n* = 8 years [no aerial survey flown in 1994]). Road surveys for pre-nesting eiders within the oilfield show a disjunct distribution, with the highest numbers occurring inland from the coast where the more complex wetland habitats (basin wetland complexes, *Arctophila fulva* wetlands) that seem to be preferred by eiders are abundant. Drier tundra habitats and simpler wetlands (deep open lakes) received less use by pre-nesting eiders. Although locations of pre-nesting eiders were not always predictive of nest sites, many eiders nested in predictable habitat types and used traditional nest sites annually. Because of the low overall density of eiders and logistic constraints, nest searches were conducted only in selected locations based on knowledge of past use, or occurrence of pairs during pre-nesting surveys. Nesting success for Spectacled Eiders has fluctuated annually in the oilfield, but has been relatively poor (mean = 38.7%, range = 12.5–63.6%, 1993–2001). Spring weather conditions and predation appear to be the main factors in determining nesting effort and success for eiders in the oilfields. Disturbance from oilfield activities has not been found to be a factor in nesting success of eiders. Based on our 10-year study, Spectacled Eiders appear to be maintaining their current population on the central Arctic Coastal Plain, but the low annual nesting success and the likely low annual productivity of the population probably is inhibiting long-term recovery of this species.

BEHAVIORAL EFFECTS OF OIL EXPOSURE ON CAPTIVE HARLEQUIN DUCKS

Daniel J. Rizzolo, Daniel Esler, Robert L. Jarvis, and Daniel D. Roby

DJR, RLJ, and DDR: Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR 97331, USA; rizzolod@onid.orst.edu
DE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

Adult female harlequin ducks (*Histrionicus histrionicus*) wintering in portions of Prince William Sound, Alaska affected by the *Exxon Valdez* oil spill have shown lower winter survival through at least 1998. The link between chronic, low-level exposure to oil for individual birds and lower winter survival, however, has not been established. We conducted controlled experiments on the effects of crude oil ingestion and external oiling in captive adult female harlequin ducks at the Alaska SeaLife Center. We measured behavioral responses to oil exposure, which could potentially contribute to survival reduction in the wild. In 2000-01, crude oil ingestion treatments consisted of a 10 mL/kg high-dose group, and a 1 mL/kg low dose-group dosed twice weekly from mid-October through late February. In 2001-02, treatments consisted of a 5.71 mL/kg high-dose group, and a 0.57 mL/kg low-dose group dosed every-other-day from mid-October through early February. In 2002, an external oiling experiment was conducted consisting of a 5 mL high-exposure group, 2.5 mL mid-exposure group, and a 1 mL low-exposure group. Focal observations on birds from all treatments were used to measure time-activity budgets. Behavior of subjects in these experiments will be examined for treatment effects, which may underlie the lower winter survival found in harlequin ducks from oiled portions of Prince William Sound.

CONTAMINANTS IN SURF SCOTERS WINTERING IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA, CANADA

Laurie K. Wilson and John E. Elliott,

Canadian Wildlife Service, Delta, BC V4K 3N2, Canada; Laurie.Wilson@ec.gc.ca

Populations of several sea duck species, including surf scoters are declining along the Pacific Coast. These declines have gone largely unexplained and have raised concerns about contaminant exposure as large numbers of surf scoters winter in the Georgia Basin, often in polluted estuarine areas and harbours. They are long-lived birds and therefore have the capacity to accumulate contaminants. Scoters feed principally on molluscs and other benthic organisms, a food chain known to accumulate endocrine disrupting substances. We examined temporal uptake of contaminants by surf scoters during the winter in the Georgia Basin by collecting birds during the early winter and again in the later winter at contaminated and reference sites. Carcasses underwent complete necropsy, and tissues were collected for histology, biomarkers and contaminant analysis. Hepatic EROD activity was induced in scoters collected from the harbour compared to scoters from the reference site. Over winter, the EROD activity increased significantly in scoters from the harbour whereas levels in scoters from the reference site remained constant. This response may have been induced by exposure to PAHs as a PAH-conjugated metabolite was detected in bile. Levels of chlorinated hydrocarbons and metals (Pb, Hg, Se, Cu, Zn, Cd) in scoters were minimal. Scoters wintering in the harbour had approximately 10-fold more butyltins than scoters from the reference site. Body condition of surf scoters declined significantly over the winter at both reference and contaminated sites. Further work is needed to assess if endocrine-disrupting substance exposure on the wintering grounds is contributing to population declines recorded on breeding grounds.

AVIAN CHOLERA IN COMMON EIDERS: WHAT DO WE KNOW AND WHAT CAN WE DO?

Jean-François Giroux, Jean Bédard, Jean Huot, André Nadeau, and Bernard Filion

J-FG, JB, and JH: Société Duvetnor Ltée, P.O. Box 305, 200 Hayward, Rivière-du-Loup, Québec G5R 3Y9, Canada; giroux.jean-francois@uqam.ca
J-FG: Université du Québec à Montréal, Département des sciences biologiques, P.O. Box 8888, Station Centre-ville, Montréal, Québec H3C 3P8 Canada
JH: Université Laval, Département de biologie, Québec, Québec G1K 7P4 Canada
BF: Ducks Unlimited Canada, 710 rue Bouvier, Suite 260, Québec, Québec G2J 1A7 Canada

Approximately 32,000 pairs of Common eiders (*Somateria mollissima dresseri*) breed on about 30 islands in the St-Lawrence River estuary. Outbreaks of avian cholera (*Pasteurella multocida)* have been regularly reported on several of these islands during the last 40 years. Except in 2002, when massive die-offs occurred simultaneously in the four largest colonies, previous epizootics were observed on different islands in different years with no apparent patterns in space or time. Île Blanche, a 3.9-ha island with approximately 4 -5,000 nesting females in the early 80s, has been the most affected with up to 8 outbreaks since 1964. Poor drainage and presence of small freshwater pools acting as reservoirs for the bacteria along with a dense vegetation cover preventing water evaporation and penetration of UV rays that can kill the bacteria were suspected to contribute to the recurrence of outbreaks. In 1985, Ducks Unlimited Canada in collaboration with La Société Duvetnor and the Canadian Wildlife Service undertook major works in an attempt to prevent further outbreaks. The intensive management included cutting and burning all dead trees and shrubs, scarifying the surface with heavy machinery, draining the freshwater pools, seeding a mixture of grasses, and transplanting 1,400 3-yr old black spruce seedlings. Subsequent outbreaks in 1991, 1994, and 2002 indicate that habitat conditions were not the only factor involved with the recurrence of the disease. Similar annual fluctuations of nest numbers on a series of nearby islands with different history of cholera outbreaks indicate that either the disease acts more globally than what we can observe on each island and/or that other factors control the dynamic of this population. The occurrence of avian cholera outbreaks in breeding Common eiders remains unexplained. A better understanding of the epizootiology of this disease and its effect on the population dynamic is clearly needed.

FACTORS INFLUENCING BURDENS OF ACANTHOCEPHALAN PARASITES IN STELLER'S EIDERS WINTERING IN NORTHERN NORWAY

Jan O. Bustnes and Kirill V. Galaktionov

JOB: Norwegian Institute for Nature Research, Division of Arctic Ecology, The Polar Environmental Centre, N-9296 Tromsø, Norway; Jan.O.Bustnes@nina.no
KVG: Zoological Institute of the Russian Academy of Sciences, White Sea Biological Station, Universitetskaja nab., 1, St Petersburg, 199034, Russia

The population of the Steller's eider has declined over the last decades and it is now considered a threatened species, but the reason for this decline is poorly understood. Parasites are known to influence host survival, and the aim of this study was to document what factors that influence the abundance of acanthocephalans in Steller's eiders wintering in northern Norway. Acanthocephalans often cause detrimental effects in sea ducks. The number of acanthocephalans in the intestine of Steller's eiders varied from 2 to 1142 individuals, and juveniles in their first year contained more parasites than adults. This was related to the diets of juveniles and adults, and juveniles fed more on amphipods, the intermediate hosts of the acanthocephalans, than adults. Despite the high energetic value of amphipods, adults largely avoided this prey. This suggests that there may be a state dependent trade-off between energy maximisation and parasite avoidance in which birds accept the long-term costs of parasites to avoid short term risk of starvation. Winter survival of young birds is critical for the population growth and this study suggests that juveniles very rapidly acquire heavy burdens of acanthocephalans that may reduce survival in the adverse climate situation in the near Arctic wintering areas.

ADENOVIRUSES – A CAUSE OF MORTALITY IN LONG-TAILED DUCKS (*Clangula hyemalis*) IN ALASKA?

Tuula E. Hollmén, J. Christian Franson, Paul. L. Flint, James B. Grand, Richard B. Lanctot, Douglas E. Docherty, and Heather M. Wilson

TEH: Alaska SeaLife Center, Seward, AK 9964, USA; tuula_hollmen@alaskasealife.org
JCF and DED: U.S. Geological Survey, National Wildlife Health Center, Madison, WI 53711 USA
PLF and HMW: U.S. Geological Survey, Alaska Science Center, Anchorage, AK 99503 USA
JBG: U.S. Geological Survey, Alabama Cooperative Fish and Wildlife Research Unit, Auburn, AL 36849 USA
RBL: U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK 99503 USA

In late summer of 2000, dead long-tailed ducks were discovered at their molting grounds in the Beaufort Sea near Prudhoe Bay. Most dead birds were heavily scavenged by gulls, but carcasses that were recovered intact for necropsy had gross lesions of enteritis and an Adenovirus was later isolated from the affected intestinal tissues. Concurrent with the die-off, adenoviruses were isolated from 50% of cloacal swabs and antibody was detected in 86% of serum samples collected from long-tailed ducks trapped in the area where mortality was observed. In contrast, live viruses were present in only 6% and antibody detected in only 10% of birds trapped at a reference location about 100 km away, where no mortality was seen. The following year, no mortality was observed at either one of the locations, and virus and antibody prevalences were low. The pathogenicity of the field isolate was further characterized by orally inoculating the virus in long-tailed ducks held in indoor pools and fed *ad libitum*. We monitored behavior, immunoglobulin responses, viral shedding, subclinical changes in blood chemistries, virus tissue tropism, and tissue pathology. All ducks developed a rapid, marked antibody response to viral challenge, and shed viruses from their cloacas for approximately two weeks. Although no mortality occurred in captive ducks, they developed lesions in the upper intestinal tract and viruses showed a wide tissue distribution with re-isolations from liver, spleen, kidney, and intestinal tracts. Chronically infected individuals shed viruses intermittently throughout the study period of 4.5 months, suggesting that some birds may act as carriers and transmit viruses to susceptible individuals in the wild. Serologic evidence of adenovirus exposure has been recently detected in several species of North American sea ducks, but the interrelationships of viruses from different species and their potential to cause disease remains unknown. Viral diseases may be particularly important in wild populations that have undergone drastic declines, when even a single outbreak can have significant effects on the remaining population. Furthermore, transmission of viruses may be an important consideration when wild animals are brought into captivity or used in translocation programs.

DIET AND BODY CONDITION OF SPECTACLED EIDERS WINTERING IN PACK ICE OF THE BERING SEA

James R. Lovvorn, Samantha E. Richman, J. M. Grebmeier, and Lee W. Cooper

JRL and SER: Department of Zoology, University of Wyoming, Laramie, WY 82071, USA; lovvorn@uwyo.edu
JMG and LWC: Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN 37996, USA

From late December to early April, Spectacled Eiders (*Somateria fischeri*) live among leads in the Bering Sea pack ice, where they dive 40-60 m for benthic prey. Coincident with an oceanic regime shift to warmer conditions in 1976-77, the benthic community has changed and its density decreased. Concurrently, at least one main subpopulation of Spectacled Eiders declined over 90%, with most mortality occurring away from breeding areas; this pattern raises questions about effects of benthic changes on their winter diet and late-winter body condition. In March-April 1999 and 2001, we made the first scientific cruises via icebreakers into the eider wintering area. Esophagi of collected eiders contained only clams, almost entirely *Nuculana radiata* with no trace of the once-dominant *Macoma calcarea*. Alternative prey used elsewhere by Spectacled Eiders (snails, amphipods, other bivalves) were also available but not eaten. Eiders selected *N. radiata* of intermediate length (18-24 mm), the size containing the greatest biomass of thin-shelled clams. Whole *M. calcarea* of this length contain 62% more energy than *N. radiata*, suggesting that *N. radiata* is less profitable. Percent lipid in total body mass of eiders averaged 12 ± 3 (SD) for 26 adult males and 14 ± 3 for 12 adult females. Mean body mass (± SE) of these males in late March (1688 ± 21 g) was substantially higher than reported for 53 males soon after arrival at the Yukon-Kuskokwim (Y-K) Delta in late May (1494 ± 14 g). Mean body mass of these females (1550 ± 35 g) was somewhat lower than reported for 11 females upon arrival at the Y-K Delta (1623 ± 46 g). In 1999, the last Spectacled Eiders left the wintering area on 21 April, 4-8 weeks before their typical arrival at breeding sites; their location in the interim is unknown. Hens lose about 530 g between arrival and hatching and do not regain mass until at least 30 days later, so prebreeding reserves and habitats used to acquire them appear critical. Exceptional climate change in the arctic and subarctic, and associated changes in marine communities and ice dynamics in spring, may have had important impacts on Spectacled Eiders and three other sea duck species whose declines of 50-90% are largely unexplained.

EVALUATING THE IMPORTANCE OF ENDOGENOUS NUTRIENT CONTRIBUTIONS TO REPRODUCTION: AN ISOTOPE APPROACH USING BARROW'S GOLDENEYE

Keith A. Hobson, Matthew R. Evans, and Sean Boyd

KAH: Canadian Wildlife Service, 115 Perimeter Road, Saskatoon, SK S7N 0X4, Canada; Keith.Hobson@ec.gc.ca
MRE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada
SB: Canadian Wildlife Service, 5421 Robertson Road, Delta, BC V4K 3N2, Canada

Evaluating the relative contributions of endogenous and exogenous nutrients to reproduction is critical to our understanding of waterfowl life history strategies and their conservation. For example, it is not clear to what extent conditions on wintering grounds, including contaminant exposure, influence breeding performance. Previously, research into this question relied on indirect methods of regressing somatic reserves on reproductive output. A more direct method involves the use of naturally occurring stable isotopes (e.g. ^{13}C and ^{15}N) to directly trace endogenous and exogenous nutrient allocations to eggs in cases where these two nutrient sources differ isotopically. Many diving ducks winter in marine environments and then move to freshwater/terrestrial environments to breed. This creates a situation where endogenous reserves are enriched isotopically relative to exogenous foods. We applied this technique to examine nutrient allocations in Barrow's Goldeneye (*Bucephala islandica*) breeding in the Riske Creek region of British Columbia. We present the results of stable isotope models that generally establish little endogenous protein and lipid nutrient allocation to reproduction in these birds. However, nutrient allocations to first-laid eggs showed more marine input than those of later-laid eggs. We discuss the implications of these results in light of female reproductive strategies and suggest that a similar isotope approach be used to investigate nutrient allocations in other species of diving ducks.

MODELLING THE ENERGY BUDGET AND PREY CHOICE OF EIDER DUCKS

Albertus G. Brinkman, Bruno J. Ens, and Romke K. Kats

Alterra / Wageningen University and Research Centre, PO Box 167, 1790 AD Den Burg, The Netherlands; a.g.brinkman@alterra.wag-ur.nl

We quantified the energy budget of eider ducks under various environmental conditions and prey availability situations. By means of such an energy budget, we studied what foraging areas are preferred by eider ducks, and why.

A bird will only forage if the energy gain is larger than the costs of catching and processing the prey. The net daily energy gain has to cover the bird's basic metabolic expenditure as well.

In the model, we considered four types of costs:

- Basic costs, needed to maintain the organism.
- Environmental costs, related to heat losses. These depend on the activities and characteristics of the bird and on environmental conditions
- Feeding and prey processing costs, describing e.g. the costs of digestion and shell crushing. They depend on characteristics of the prey and environmental conditions.
- Activity costs, describing the costs of flying, diving and swimming.

Part of the energetic costs add to the heat budget and cover (at least for a part) the heat losses.

The prey contains meat, which is the only energy source; the meat content depends on the type of the prey and its size.

Based on the net profit of each prey size, a prey size preference of a duck is computed. In a next step, the number of dives per day is computed, needed to cover the energy demand of the duck. It will be quantified why this number is considerably higher in winter than in summer. The model is tuned on literature data and published field observations on food intake.

Prey availability and quality determines where a duck finds suitable foraging areas. Data on the Dutch Wadden Sea, the Easter Scheldt (SW-Netherlands), the Bay d' Oléron (West France), the Danish Limfjord and the Swedish west coast are used to check whether those regions are suitable areas for overwintering eider ducks or not.

Based on the model computations we conclude that

- eider ducks are capable to process mussel shells down to 20 mm during summer, while they have to restrict themselves to shells larger than 30 mm in winter. In summer costs are lower (especially heat losses are much lower) while the profit (meat content) per shell is higher.
- daily energetic expenditure (DEE) ranges from 2.9 106 J in winter to about 1.5 106 J in summer.
- eider ducks are probably capable to remove a significant part of the subtidal mussel stock in the Dutch Wadden Sea. Therefore, they compete with commercial mussel and cockle fishery in that specific area which has implications for the management of the area.

ECOLOGY OF COMMON EIDER DUCKS WINTERING AT POLYNYAS IN THE BELCHER ISLANDS: CONSTRAINTS IMPOSED BY ICE, TIDAL CURRENTS, AND DARKNESS

H. Grant Gilchrist, Karel Allard, Gregory Robertson, and Joel Heath

HGG: Canadian Wildlife Service, 100 Gamelin Blvd., Hull, Quebec K1A 0H3, Canada: Grant.Gilchrist@ec.gc.ca
KA: Atlantic Co-operative Wildlife Ecology Research Network, University of New Brunswick, P. O. Box 45111, Fredericton, NB E3B 6E1, Canada
GR: Canadian Wildlife Service, 6 Bruce Street, Mount Pearl, NF A1N 4T3, Canada
JPH: CWS/NSERC Centre for Wildlife Ecology, Dept. Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

Common Eider ducks wintering in the Belcher Islands are constrained by the availability of open water occurring at coastal floe edges and at recurring polynyas. Floe edge habitat varies almost edaily due to changing wind and tidal currents, and polynyas act as refuges for eiders when no floe edge habitat exists. To quantify how strong tidal currents constrain foraging eiders at polynyas, we deployed an Aquadop current flow meter at the margin of a polynya. This data logger quantified flow velocity, direction, and aspect every 5 min (placed equidistant from the sea floor to the bottom of the sea ice). When current velocities exceeded 0.3 m/sec eiders stopped diving for prey. When currents exceeded 0.8 m/sec, eiders left the water entirely to sit on the ice-edge. These behavioural changes reflected when eiders could no longer dive or maintain their position by swimming. We also observed eider flocks during dark periods using night vision optics, and found that eiders do not feed at night contrary to prediction. Instead, they gather in dense flocks along the ice edge of polynyas, presumably to conserve body heat under nightly temperatures which routinely dropped to -40^{o}C. Apparently, the energetic benefits of roosting tightly together at night exceeded the energetic gain of foraging in the dark. We integrate data on tide cycles, foraging ecology, and day length in a model and explore how these constraints may limit the latitudinal wintering range of Common Eider ducks in the Canadian Arctic.

DIVING ECOLOGY OF COMMON EIDERS WINTERING AT POLYNYAS IN THE BELCHER ISLANDS, NUNAVUT

Joel P. Heath and Grant H. Gilchrist

JPH: CWS/NSERC Centre for Wildlife Ecology & Behavioural Ecology Research Group, Dept. Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; joel_heath@sfu.ca
GHG: Canadian Wildlife Service, National Wildlife Research Center, 100 Gamelin Blvd., Hull, QC K1A OH3, Canada

We deployed an underwater video camera to record diving and foraging by Common Eiders (Somateria mollissima sedentaria) wintering at the Belcher Islands, Hudson Bay, Nunavut. Although the majority of Hudson Bay is frozen over, strong tidal currents within the Belcher Islands produce polynyas, discrete areas of open water, within which eiders can access benthic prey. We obtained >200 focal video watches of complete dives at several locations within a polynya 10-15 m in depth. These videos provide details of descent, prey search and selection, ascent, and interactions between eiders underwater. During the tidal cycle, current velocity within polynyas can increase up to 1.5 m/s. We show that increasing tidal velocity lengthened the travel time to foraging patches and increased surface swimming requirements, therefore increasing the energetic costs of foraging. We discuss how strong environmental constraints will narrow the set of foraging strategies that will allow Common Eiders to meet their energy requirements, and outline future research directions to incorporate and test predictions of foraging theory in identifying viable strategies for overwinter survival.

DO SCAUP AND SCOTERS PREFER FOREIGN FOOD IN SAN FRANCISCO BAY?

Samantha E. Richman and James R. Lovvorn

SER and JRL: Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82071, USA; cruciger@uwyo.edu

The San Francisco Bay Estuary is an important wintering area for diving ducks. In 1986, a major change in the prey community occurred with introduction of the Asian clam (*Potamocorbula amurensis*). *P. amurensis* is 5 times more abundant than the native *Macoma balthica* in the top 5 cm of sediments, and on average *P. amurensis* is 8 mm long while *M. balthica* is 16.5 mm long. Scaup currently feed heavily on *P. amurensis* while seldom eating *M. balthica*. Effects of differences in size, nutrient content, digestibility, density, and depth in the sediments on the relative value of invasive *P. amurensis* were unknown. We compared the foraging value to Lesser Scaup (*Aythya affinis*) of the exotic *P. amurensis* and the formerly dominant clam *M. balthica*. In addition, more recent data on the foraging relations of White-winged Scoters (*Melanitta fusca*) in San Francisco Bay will also be presented. We measured the nutrient content and digestibility of these species, and intake rates for different prey densities, sizes, and depths in the sediments. *P. amurensis* including shells had higher nitrogen and energy content per clam of the same length class, and higher digestibility of energy, than *M. balthica*. For scaup foraging in an aquarium, intake rates (number/s) of food items buried in sand-filled trays increased with increasing prey density up to at least 4,000/m^2. For items buried 3 cm deep, intake rate did not differ for prey <6 mm long versus 6-12 mm long; however, intake rates were much lower when prey were deeper in the sediments (6 cm *versus* 3 cm). In contrast, prey depth in the sediment did not affect the intake rates of White-winged Scoters. In tensometer measurements, shells of *P. amurensis* were much harder to crush than shells of *M. balthica*, which might partly offset the apparent energetic advantages of *P. amurensis*. When intake for scaup is expressed in terms of nitrogen and energy, the exotic *P. amurensis* appears to be a better food than *M. balthica* at the same densities. However, *P. amurensis* accumulates much higher levels of some contaminants, increasing the risk of toxicity to diving ducks. This study will assist in modeling the food requirements and contaminant exposure of diving ducks in the Bay.

SEXUAL HABITAT SEGREGATION BY SURF SCOTERS DURING WINTER: THE ROLES OF HABITAT SPECIALIZATION AND BEHAVIORAL DOMINANCE

Samuel A. Iverson

Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; sai@sfu.ca

Spatial separation of the sex or age classes is a common phenomenon among migratory birds during winter. I investigated dominance behavior and sex-specific habitat specialization as potential mechanisms underlying sexual habitat segregation by Surf Scoters (Melanitta perspicillata), in the Strait of Georgia, British Columbia. Field data on habitat-specific foraging rates, arrival and settlement patterns, and aggression within flocks were used to differentiate between the two mechanisms. Surf Scoters were studied in two habitats, a sandy beach (4.0:1 sex ratio), where birds dove for buried clams (genus Protothaca and Tapes), and a rocky shoreline (1.6:1 sex ratio), where submerged mussels (Mytilus trossulus) were the primary prey item. Foraging data suggest habitat specialization is an important mechanism leading to sexual habitat segregation. Male Surf Scoters handled clams items in less time, and spent a greater proportion of their total time budget feeding in the sandy habitat. In the rocky habitat, females completed dive cycles more quickly than males, and there were no differences between the sexes in the proportion of the time budget spent foraging. Daily energy intake projections were higher for males (1045.5 kJ/day) than females (936.9 kJ/day) in the sandy habitat. In the rocky habitat females (1099.7 kJ/day) had higher daily intakes than males (1034.8 kJ/day). Arrival and settlement data also supported the habitat specialization hypothesis. Sex ratios were biased at the time of arrival and there were no seasonal changes in Surf Scoter abundance or sex composition in either habitat. Little evidence was found supporting the behavioral dominance hypothesis. Females were found to initiate aggressive encounters more frequently in both habitats. Also, the intensity of male aggression was similar between habitats and flocks were sexually integrated at both sites. I conclude that sexual habitat segregation by Surf Scoters is more likely explained by foraging specialization than dominance interactions.

AGGREGATIVE RESPONSE OF HARLEQUIN DUCKS TO HERRING SPAWNING IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA

Michael S. Rodway, Heidi M. Regehr, John Ashley, Peter V. Clarkson, R. Ian Goudie, Douglas E. Hay, Cyndi M. Smith, and Kenneth G. Wright

MSR and HMR: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; msrodway@sfu.ca
JA: 3151 Columbia Falls Stage Rd., Columbia Falls, MT 59912, USA
PVC: Parks Canada, Box 280, Ucluelet, BC V0R 3A0, Canada
RIG: Biology Department, Memorial University of Newfoundland, St. John's, NF A1B 3X9, Canada
DEH: Fisheries and Oceans Canada, Pacific Biological Station, 3190 Hammond Bay Rd, Nanaimo, BC V9R 5K6, Canada
CMS: Parks Canada, Waterton Lakes National Park, Waterton Park, AB T0K 2M0, Canada.
KGW: 6090 Blink Bonnie Road, West Vancouver, BC V7W 1V8, Canada

We determined the scale of aggregative response of Harlequin Ducks to seasonally and locally superabundant prey at herring spawning sites in the northern Strait of Georgia, British Columbia, 1995-2001. Aggregations of 3200-5000 birds gathered at a small number of sites along the same 8 km stretch of shoreline in each year. Aggregations occurred at only a small fraction of the habitat area where spawn was available. Habitat use patterns may be related to small-scale differences in depth of spawning by herring that affect energetic costs of harvesting spawn for Harlequin Ducks, and to changes in grouping behaviour when food is superabundant. Duration of stay at spawning sites averaged 2-3 weeks and many birds returned to their wintering grounds afterwards. Birds moving to spawning sites represented 54-81% of the total winter population in the northern Strait of Georgia. Herring spawn provided direct nutritional benefits for birds, but also may have provided indirect benefits through associated changes in time budgets and spacing behaviour that facilitate courtship, mate choice, and pair formation in young birds. The proportion of local wintering populations that moved to spawning sites was negatively related to the distance that they had to travel, and was predicted to reach zero at a distance of 72 km, although one bird travelled 150 km. Declining proportions moving with increasing distance suggest that more distant individuals may be constrained by lack of information or that there are trade-offs between the benefits of exploiting spawn and the costs of movement. This raises a conservation concern because the temporal and geographic range of spawning in British Columbia is contracting and some wintering populations may be losing access to this important late-winter food.

SPATIAL STRUCTURE OF DUCKLINGS IN COMMON EIDER CRÈCHES

Markus Öst, Anette Bäck, and Mikael Kilpi

MÖ: Department of Ecology and Systematics, P.O. Box 65, FIN-00014 University of Helsinki, Finland; markus.ost@helsinki.fi
AB: Department of Biology, Åbo Akademi University, Akademigatan 1, FIN-20500 Turku, Finland
MK: ARONIA Research Center, Åbo Akademi University & Sydväst Polytechnic, FIN-10600 Ekenäs, Finland

Common eider (*Somateria mollissima*) females sometimes pool their broods and share brood-rearing duties, while other females tend their brood alone. The emphasis of current research has been on understanding the role of females in the crèching system, and practically nothing is known about the role of ducklings. One key issue is the spatial positioning of ducklings in relation to the tending females in the brood. Some authors have speculated that common eider mothers cannot keep track of their own young in a joint brood, with the outcome that ducklings often accidentally go astray and mix with other broods. On the other extreme, there is evidence among geese suggesting that parents and their offspring form family units, so that adopted goslings are located at the periphery, with a concomitant decrease in survival compared to the host's own young. Is the spatial positioning of ducklings in common eider broods and crèches random with respect to the tending females, or is the positioning characterised by family units? We set out to study this question by scan sampling the order of ducklings in relation to reference females in broods or crèches. If the spatial structure is characterised by family units, we predict that the mean rank of the reference female's own young would be lower than that of unrelated young, i.e. the mother's own young are on average closer to her than unrelated young. We discuss our results, and the evolutionary consequences of these findings for understanding the costs and benefits of coalition formation for common eider females.

HABITAT USE AND PRE-INCUBATION BEHAVIOUR OF HARLEQUIN DUCKS IN LABRADOR

Kelly A. Squires, Kathy Martin, and Ian Goudie

KAS and KM: Center for Applied Conservation Research, Faculty of Forestry, University of British Columbia, Vancouver, BC V6T 1Z4, Canada; ksquires@interchange.ubc.ca
IG: Department of Biology, Memorial University of Newfoundland, St. John's, NF, Canada

Few studies have investigated whether male partners of socially monogamous species invest in female nutritional status or survival during breeding. Male behaviours such as vigilance and aggression, usually assumed to function in paternity assurance, may protect females from conspecifics and predators during feeding and resting and may enhance their ability to form clutches. I studied the pre-incubation behaviour of Harlequin Ducks in a population of *Special Concern* (COSEWIC 2001) to determine whether male vigilance and aggression are related to female foraging and resting and to gather data that may aid conservation and management efforts. In 2000 and 2001, 226 hours of time-activity data on twelve pairs were collected on two rivers in central Labrador during the pre-incubation period. The behaviour of both members of a pair were recorded every 15 seconds throughout 30 minute observation periods. The identity and proximity of conspecifics were also recorded in order to determine behavioural effects on the focal pair. When water levels were high during the spring snow melt, Harlequin Ducks were rarely observed in river outlets. Instead, pairs were frequently observed feeding close to flooded lakeshores, likely feeding on the abundant mayfly larvae found there. The proportion of time that males were vigilant was significantly greater when pairs were observed at the lakeshore than in the river outlets (22% versus 5%) and males were most vigilant when other males were not within sight suggesting that male vigilance may be used to detect predators in 'risky' habitat. Most aggression by males was directed at other males suggesting that aggression functions to protect the pair bond and paternity. Most females initiated egg laying more than two weeks after arriving on breeding grounds, suggesting that exogenous resources on the breeding grounds may be used to form clutches. Males and females spent similar proportions of time feeding (31% and 34% respectively) and resting (29% and 34%), perhaps due to the high energy demands of diving.

STUDY AND CONSERVATION OF SEA DUCKS IN RUSSIAN PACIFIC

Alexander V. Kondratyev

Biological Institute of the St-Petersburg State University, St-Petersburg, Russia;
akondratyev@mail.ru

Sea ducks as a separate and specific group of waterfowl were first been selected for study and conservation in Russia during the 1920's, when the needs of protection of the Common Eider nesting areas were stressed. In 1932, the Kandalaksha State reserve was organized in order to protect eiders colonies at the White Sea and the Barentz Sea. No specific policy was conducted for conservation of other groups aside of general hunting regulations, but specific measures were also taken to increase number of Common Goldeneye by setting artificial nest-boxes all over boreal zone of Russia. For many years the Common Eider and the Goldeneye were the only species that received special attention, detailed study and specific conservation activity. Some other groups, such as mergansers, were considered even as harmful for fishing economy in some areas. Change of the situation has first started from the work of A.A. Kistchinski in the 1970's, when first detailed information started to come from north-east Russia and from rather unknown species, such as Spectacled Eider. Since that period, and for some species a bit earlier, more species received protected status and were federally or regionally excluded from the list of hunted waterfowl species. Among these species we may mention all four Eider species, the Smew and the Harlequin Duck.

Since that period, detailed ecological research and monitoring activities have been conducted in the north, where the majority of the species breed, and also on their migrating stopovers and passages. The main steps of these studies are given in details. Wintering areas of sea ducks are not common in Russia, and those that exist are still poorly studied. More knowledge brought more to conservation efforts and strategy. New conservation initiatives have been added to existed general hunting regulations and protected areas network. Among the most important details we may mention: the database for the North-Sea Route program with attention paid to marine birds of the Arctic. The Important Bird Areas network designating program of the Birdlife International was conducted almost all over Russia, and in Northeast Russia in more detailed way covering some of most important sea duck areas. Red data book of far-eastern Russia has also listed a set of regionally vulnerable sea duck species. New threats have come from the increase of industrial pressure in the North, especially from oil industry. Special measures have been taken for Protected areas network to be improved and cover important sea ducks areas. Some more problems are still waiting their turn and need more studies to be sharply seen and thoroughly solved. Among the latter we mention the isolated character of the Okhotskian Sea Common Eider, the overall status of the Common eider in Pacific with respect to their breeding success, study and conservation of moulting concentrations of sea ducks in the north of Russian Arctic and Pacific, and the study and conservation of wintering quarters of sea ducks in Kurile and Kommander islands.

IS IT IS POSSIBLE TO PERFORM YEAR-ROUND MONITORING OF SEA DUCK ECOLOGY USING DATA LOGGERS?

Magella Guillemette, Anthony J. Woakes, Annette Flagstad, Jean-Marc Grandbois, and Patrick J. Butler

MG and JG: Département de biologie et sciences de la santé, Université du Québec à Rimouski, 300 Allée des Ursulines, Rimouski, Quebec G5L 3A1, Canada; magella_guillemette@uqar.qc.ca.
AJW and PJB: School of Biosciences, The University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom
AF: The Royal Veterinary and Agricultural University, Department of Clinical Studies, Bülowsvej 13, 1870 Frederiksberg, Copenhagen, Denmark

Sea ducks are living offshore and the information required to describe their ecology is difficult to gather and filled with recurring logistical problems. We used miniature data logging systems measuring heart rate, body temperature and hydrostatic pressure with the aim to perform year round monitoring of diving, flight behaviour and energy expenditure of Common Eiders (*Somateria mollissima*). On nine experimental female implanted with data-loggers in spring 1998, nine were caught back in 1999 of which five (5) were caught on the same nest whereas the others were at less than 30 m from the nest used in 1998. Using a Before-After-Control-Impact approach, it was shown that such devices did not affect (effect size close to zero in all cases) their nesting success (clutch size, hatching success) and chronology (laying dates). Data were available for only four experimental females of which two were followed from July 1998 to the end of March 1999. Preliminary results are presented to show how these data could be used in a fundamental and applied context.

USE OF SHELTERS AS ALTERNATIVE NESTING COVER FOR COMMON EIDERS

Jean Bédard, Jean-François Giroux, Jean Huot, André Nadeau, and Bernard Filion

JB, J-FG, and JH: Société Duvetnor Ltée, P.O. Box 305, 200 Hayward, Rivière-du-Loup, Québec G5R 3Y9, Canada; giroux.jean-francois@uqam.ca
J-FG: Université du Québec à Montréal, Département des sciences biologiques, P.O. Box 8888, Station Centre-ville, Montréal, Québec H3C 3P8, Canada
JH: Université Laval, Département de biologie, Québec, Québec G1K 7P4, Canada
BF: Ducks Unlimited Canada, 710 rue Bouvier, Suite 260, Québec, Québec G2J 1A7, Canada

In 1985, an outbreak of avian cholera killed about 40% of the estimated 5,000 female Common eiders (*Somateria mollissima dresseri*) breeding on Île Blanche, a 3.9-ha island in the St-Lawrence River estuary. The birds were nesting underneath a dense cover of high shrubs (*Sambucus pubens*) and fir snags (*Abies balsamea*) near small freshwater pools that harboured the bacteria. Cover removal and drainage of the island were then undertaken by Ducks Unlimited Canada in collaboration with La Société Duvetnor and Canadian Wildlife Service in an attempt to prevent further outbreaks. A total of 452 plywood nest-shelters were also installed to overcome temporary loss of nesting cover. The objective of this paper is to present shelter use by nesting eiders between 1985 and 2002. Due to lack of nesting cover, more than 90% of the shelters were used in the first two years. The proportion of shelters with at least 1 eider nest fluctuated in the following years with a low of 56% in 1995 and a maximum of 93% in 2001. Number of nests/shelter averaged between 1.3 and 1.8 over the years. Nests under shelters were initiated earlier, had a larger clutch size (4.5 vs. 3.5 eggs), suffered less predation by gulls, and were more likely to be abandoned than nests under grass cover. Large shelters (108 X 72 X 17 cm) with a central divider received a greater use than narrow shelters with no divider (108 X 54 X 17 cm) but narrow shelters with a divider were the most cost-effective. The usefulness of nest-shelters was also assessed on 3 other islands varying in size and cover type. On Île-aux-Alouettes, a low gravel bar with sparse herbaceous cover, more than 95 % of the 200 shelters have been used by nesting females every year between 1991 and 2002 whereas on medium sized islands with a grassy (IÎe-aux-Pommes, n=100) and woody (Gros Pèlerin, n=50) cover, they have been largely ignored. The technique seems appropriate on small islands or reefs (< 4 ha) with high density of nesting pairs (>500 nests/ha) and a paucity of robust (wooded or herbaceous) standing vegetation that can serve as natural cover. It can also be used whenever natural cover is temporarily deficient like after a fire or following cover management, as was the case on Île Blanche.

MASS TRAPPING OF SEA/DIVING DUCKS IN ALASKA, 1960-65

James G. (Jim) King

U.S. Fish and Wildlife Service (retired) 1700 Branta Road, Juneau, AK 99801, USA; kingfarm@ptialaska.net

In the early 1960's I led duck banding projects in Alaska's Yukon Flats and Yukon Delta that processed some 22,800 diving ducks of 7 species: (Canvasback *Aythya valisineria* 788, Greater Scaup *Aythya marila* 2346, Lesser Scaup *Aythya affinis* 12,371, Goldeneye sp. *Bucephala, sp.* 3170, Bufflehead *Bucephala albeola* 1705, Long-tailed Duck *Clangula hyemalis* 1786, White-winged Scoter *Melanitta fusca* 526). These birds were caught in drive traps of ever increasing size developed over a ten-year period. Lantern slides from this time show an evolution from crude beginnings to development of techniques for processing as many as 10,000 ducks in one massive catch. Problems met and overcome are presented. These techniques have not been used in recent years. The possibility for making such catches in the future can be discussed.

TRIUMPH AND TRIBULATION: IMPLANTING SATELLITE TRANSMITTERS IN WHITE-WINGED SCOTERS

Daniel H. Rosenberg and Michael J. Petrula, Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, AK 99518, USA; dan_rosenberg@fishgame.state.ak.us

Satellite telemetry can identify migration routes, timing of movements, and connections between specific wintering, breeding and molting sites and help determine if discreet or independent population segments occur in sea ducks. Thus, it is a valuable tool for identifying management units in wide ranging species inhabiting remote areas. This type of information can improve survey design and interpretation, define functional units for effective monitoring and harvest allocations, help delineate the spatial scale of population change and provide information to focus habitat conservation programs. Before we can maximize its potential we need to develop methods that minimize effects on species we are studying.

From 1999–2002, we surgically implanted satellite transmitters (PTT's) in white-winged scoters *(M. fusca)* at wintering areas in Southcentral and Southeast, AK and breeding areas in Interior AK. Floating mist-nets were used to capture birds. We deployed PTT's in white-winged scoters as follows: 1999 and 2000, 13 and 18 respectively in Prince William Sound (Southcentral); 2001, 15 near Juneau in Southeast AK; and in 2002, 7 birds on the Yukon Flats in Interior AK. For wintering birds mortality rates ranged over the 3-year period from a low of 11% in 2000 to a theoretical maximum of 80% in 2001 (mortality rates varied within this range depending upon criteria used to determine implant related mortality). Annual differences are attributed to capture location, release date, and holding methods. Mortality rate did not vary by sex. All seven birds implanted on the Yukon Flats in 2002 survived. We tracked movements of wintering birds to breeding areas (interior Alaska and the Yukon and Northwest territories), molting (Beaufort and Bering Sea, Gulf of Alaska), and back to wintering areas. Movements of birds implanted on breeding areas will also be reported. We will discuss differences in methods and results between years and present hypotheses for high mortality rates.

SOME INSIGHTS GAINED FROM SIX YEARS OF SATELLITE TRACKING OF KING EIDERS AND PACIFIC COMMON EIDERS NESTING IN WESTERN ARCTIC NORTH AMERICA

Lynne Dickson and Timothy D. Bowman

LD: Canadian Wildlife Service, Edmonton, AB T6B 2X3, Canada; lynne.dickson@ec.gc.ca
TDB: Migratory Bird Management, US Fish and Wildlife Service, Anchorage, AK 99503, USA

Satellite transmitters were implanted in 35 King Eiders and 31 Pacific Common Eiders just prior to nesting over a 6 year period starting in 1997. Objectives were to identify migration corridors and timing, and identify important moulting, staging and wintering areas. King Eiders were captured on nesting grounds at three different locations: Victoria Island and Banks Island in Canada, and at Prudhoe Bay, Alaska. Common Eiders were all captured near a nesting colony east of Bathurst Inlet, Canada. Most King Eiders moved into the Bering Sea to moult. By contrast, the Common Eiders all stayed in arctic Canada to moult, with females moulting <50 km from the nesting colony. Whereas King Eiders from each of the breeding areas wintered at several different sites in the Bering Sea, Common Eiders all wintered at one site. Consequently Common Eiders are likely more vulnerable to unfavorable conditions (e.g. severe weather, oil spill) on a specific wintering area then King Eiders. Conversely, King Eiders are likely more vulnerable to the potential effects of offshore oil and gas development in the Beaufort Sea than Common Eiders, since they are more likely to stop in the Beaufort Sea during fall migration. All of the Common Eiders and 70% of the King Eiders moulted or wintered off Russia. Thus, when evaluating the impact of hunting on King and Common eider populations, harvest in Russia should be considered. Seven transmitters continued to provide locations for >12 months, allowing us to track eiders back to the breeding grounds. These data suggest that females return to the same nesting area each year whereas males follow females to breeding area. Observations from a blind on the colony in 2002, confirmed that Common Eiders do sometimes nest following transmitter implant.

POPULATION STRUCTURE OF PACIFIC COMMON EIDERS BREEDING IN ALASKA

Margaret R. Petersen and Paul L. Flint

Alaska Science Center, U.S. Geological Survey, 1011 East Tudor Road, Anchorage, AK 99503, USA; Margaret_Petersen@usgs.gov

We used satellite telemetry to study the migration routes and wintering areas of two allopatric breeding populations of Pacific Common Eiders (*Somateria mollissima v-nigrum*) in Alaska: the Yukon-Kuskokwim Delta, and the western Beaufort Sea coast. Only 6% (2 of 36) of females wintered within the wintering area of the other breeding population. Both breeding populations wintered in the closest available ice-free habitat, perhaps to minimize migratory distance. Two Beaufort Sea females wintered in areas used by Yukon-Kuskokwim Delta females, implying potential gene flow among breeding areas. Yet, we conclude that these two populations are largely geographically isolated throughout the annual cycle and the environmental factors influencing survival and reproduction likely differ between these groups of birds. Thus, regardless of the potential gene flow among breeding populations, we suggest that birds from these two breeding areas should be managed as separate populations.

USE OF SATELLITE TELEMETRY TO IDENTIFY MIGRATION AND WINTERING AREAS OF COMMON EIDERS FROM THE EASTERN CANADIAN ARCTIC

Myra O. Wiebe Robertson, H. Grant Gilchrist, Anders Mosbech, and Christian Sonne-Hansen

MOWR: Canadian Wildlife Service, Environment Canada, Yellowknife, NT, X1A 1E2, Canada; myra.robertson@ec.gc.ca
HGG: Canadian Wildlife Service, Environment Canada, Hull, PQ, K1A 0H3, Canada
AM and CS-H: National Environmental Research Institute, Department of Arctic Environment, Denmark

Recent evidence suggests that many Northern Common Eiders (*Somateria mollissima borealis*) breeding in the eastern Canadian Arctic migrate to Greenland for winter, but details on their migration and wintering areas were unknown. Particularly because of the high winter harvest of eiders in Greenland (>100,000 eiders annually), this information is critical for management and conservation of eiders. Canadian and Greenlandic biologists have decided that outfitting Common Eiders in both countries with satellite transmitters is a *key shared research priority*. Ten Common Eider hens were successfully equipped with satellite transmitters at a nesting colony at East Bay, Southampton Island, Hudson Bay in late June 2001. All ten hens remained in East Bay throughout the remainder of June and July. The hens returned repeatedly to visit the colony during this time and our field crew resighted many of them. In August and September, four hens molted at East Bay and the other six molted on Baffin Island (3), islands in Hudson Strait (2), or along the northern tip of Labrador (1). In late October and early November, six hens traveled to the southwest coast of Greenland and three to Atlantic Canada. Transmissions from nine hens stopped in late January and February, and from one hen in late September. Our results supplement findings from band returns that significant numbers of eiders breeding in the eastern Canadian Arctic winter in Greenland. Important information on timing and migration routes to fall-staging and winter areas was determined. Several key marine habitat sites for eiders in Hudson Strait, Baffin Island and Labrador were also identified. Findings are currently being used in the joint management of northern eider populations by Canada and Greenland.

SATELLITE RADIO TELEMETRY TRACKING OF SURF AND BLACK SCOTERS IN THE ATLANTIC FLYWAY

Matthew C. Perry, Peter C. Osenton, Glenn Olsen, Edward J. R. Lohnes, and Alicia M. Wells

USGS, Patuxent Wildlife Research Center, Laurel, MD 20708 USA; Matt_Perry@usgs.gov

The migrational pathways and critical habitats used by sea ducks in the Atlantic Flyway are in need of further research. The objective of this research was to learn the breeding and molting areas and the subsequent habitat types of black and surf scoters. During March-April 2001 and 2002, ten surf scoters (*Melanitta perspicillata*) were live-captured in Chesapeake Bay, MD, USA and each instrumented with implanted satellite transmitters. During May 2002, 13 black scoters (*Melanitta nigra*) were instrumented on the Restigouche River of New Brunswick, Canada. Initial work with floating mist nets was unsuccessful in capturing scoters in Chesapeake Bay. A net gun (Coda, Inc.) fired from a fast-moving boat at a distance of approximately 5-10 meters from the boat captured all 10 surf scoters. Black scoters were captured at night with dip nets and the aid of night-lighting equipment. Within 24 hours after capture, each scoter underwent an intra-abdominal surgery to implant PTT 100 satellite transmitters (39 g) manufactured by Microwave, Inc., Columbia, Maryland. The transmitter's configuration included an external antenna (percutaneous) that was passed through the back of the duck using a surgical catheter. Each duck was held post-surgery for 1-9 days and then released at the site of capture. Eight of the surf scoters successfully migrated to possible breeding areas in Canada and extensive data were obtained on the location of these ducks. All 13 of the black scoters migrated to suspected breeding areas and then 10 of the 11 males migrated to James Bay presumably for molting. Two black scoter females migrated from the Restigouche River to presumed nesting areas in northern Quebec. During 2001, surf scoters traveled an average of approximately 1920 km between Chesapeake Bay and their coastal molting areas. During 2002, surf scoters traveled an average of 3360 km. Black scoters instrumented on the Restigouche River in New Brunswick traveled an average of 1600 km to molting areas. Updated information from the ARGOS Systems aboard the NOAA satellites on scoter movements was made accessible on the Patuxent Website. Habitat cover types of locations using GIS (Geographical Information Systems) and aerial photographs (in conjunction with remote sensing software) are currently being analyzed to build thematic maps with varying cosmetic layer applications. This will help provide a fuller picture of the habitat used by scoters during breeding and molting.

USE OF SATELLITE TELEMETRY TO IDENTIFY MIGRATION ROUTES AND BREEDING AREAS OF COMMON EIDERS FROM A HEAVILY HUNTED WINTERING AREA IN SOUTHWEST GREENLAND

Anders Mosbech, Flemming Ravn Merkel, Christian Sonne-Hansen, and Annette Flagstad

AM and CSH: Dept. of Arctic Environment, National Environmental Research Institute, P.O. Box 358, Frederiksborgvej 399, DK-4000 Roskilde, Denmark; amo@dmu.dk
FRM: Greenland Institute of Natural Resources, P.O. Box 570, DK-3900 Nuuk, Greenland
AF: Copenhagen Royal Veterinary and Agricultural University, Institute of Clinical Studies, Bülowsvej 17, DK-1870 Frederiksberg, Denmark

Southwest Greenland is an important wintering area for common eiders (*Somateria mollissima borealis*) (winter population estimate 460,000) breeding in Greenland and the eastern Canadian Arctic. There is a substantial eider harvest in this winter area and concerns are raised that the eider harvest in Southwest Greenland is not sustainable. To improve the management basis for this shared population, Greenlandic/Danish and Canadian biologists make a joint research effort including satellite telemetry. To link a major Southwest Greenland winter area with high hunting pressure to breeding areas, Common eiders in the Nuuk area had implanted satellite transmitters to follow movements to the breeding areas.

During February and March in 2000 and 2001, 33 wintering eiders were implanted (abdominal or subcutaneous) with 50g satellite transmitters (PTTs). Birds were captured within app.100 km from Nuuk by means of floating mist net or attraction by heavy light sources. Surgery was conducted with a minimum of feather removal. On average implanted eiders were tracked for 2.4 months (range: 0.3 and 13.9 months). Seven birds were caught as by-catch in lumpsucker fishing nets or shot by hunters only 0.5 to 1.9 months after implantation, and this reduced the average tracking period. A large proportion of the eiders migrated to Canada in the spring, judged from 12 PTTs that were still active at that time. Most migrating birds went straight across Davis Strait to staging or breeding areas in Hudson Strait, Frobisher Bay or Cumberland Sound. One bird went far to the north, to Ellesmere Island. Three of the birds that migrated to Canada for the breeding season could be tracked back to Southwest Greenland in the subsequent fall. PTT performance was below the expected performance and recent satellite telemetry conducted together with CWS on Canadian breeding grounds shows higher PTT performance presumably because implantation during summer is less stressful for the birds.

USE OF STABLE ISOTOPES TO DELINEATE POPULATIONS OF KING EIDERS

Katherine R. Mehl, Ray T. Alisauskas, Keith A. Hobson, and Flemming Merkel

KRM: University of Saskatchewan, Department of Biology, 112 Science Place, Saskatoon, SK S7N 5E2, Canada; katherine.drake@ec.gc.ca
RTA and KAH: Environment Canada, Prairie and Northern Wildlife Research Center, Canadian Wildlife Service, 115 Perimeter Road, Saskatoon, SK S7N 0X4, Canada
FM: Greenland Institute of Natural Resources, P.O.Box 570, 3900 Nuuk, Greenland

North American King Eider populations are viewed as two distinct breeding populations. However, previous research suggests that birds from the two populations are not genetically distinct, suggesting that at least some population mixing occurs. Because population estimates are based on count surveys at key migration corridors, regional variation in dispersal may bias population trends. Importantly, King Eider populations appear to be declining drastically. In order to gain a better understanding of King Eider population trends, reliable methods of delineating populations are needed. We tested a novel stable isotope technique to delineate molting origins of these two populations of eiders. Naturally occurring stable isotope ratios of carbon $\delta^{13}C$ and nitrogen $\delta^{15}N$ are transferred through food webs and can reflect regional isotopic patterns. Previous research in marine foodwebs of the western Arctic has indicated an east to west gradient in $\delta^{13}C$ and $\delta^{15}N$ values of zooplankton with more enriched values occurring in the Bering Sea. We examined $\delta^{13}C$ and $\delta^{15}N$ values within King Eider (Somateria spectabilis) feathers. Head, back, chest, and primary feathers were collected from 47 individuals that wintered in the eastern (Greenland) Arctic and 94 individuals that wintered in the western Arctic. Using Discriminate Function Analysis, we correctly classified 93.8% of the birds from the eastern Arctic and 98.9% of those from the western Arctic. Results from this research are important to conservation efforts of King Eiders. Results of this study show the usefulness of the isotope tracking technique as means of 1) linking winter origins with breeding sites, and in the presence of marked birds; 2) establishing a means to evaluate extent of winter site fidelity; 3) differences in survival between wintering areas, and lastly, when both the offspring and maternal female are marked, 3) evaluating the extent that offspring winter in the similar area as the maternal female.

COMPARATIVE GENETIC STRUCTURE OF WINTERING KING EIDERS, HARLEQUIN DUCKS, AND BLACK AND WHITE-WINGED SCOTERS

John M. Pearce, Sandra L. Talbot, and Barbara J. Pierson

Alaska Science Center, U.S. Geological Survey, Anchorage, AK 99503, USA;
John_Pearce@usgs.gov

Understanding population structure of wildlife species is important for their conservation and management. Once identified through morphological or geographic criteria, population units can then be monitored for demographic changes and threats to their viability. Due to the broad and continuous nesting ranges of some sea ducks throughout boreal forest and arctic areas, population units are often easier to identify and monitor during winter when birds congregate in coastal marine areas. But what are these wintering groups? Is there any direct connectivity between a wintering and breeding area? If a wintering group declines or is impacted by an oil spill, what has been lost? Some species of sea duck demonstrate remarkable annual site fidelity to wintering areas, the site of pair formation. As a result, wintering groups may differ genetically and could be considered as population units. Using mitochondrial DNA sequence data from 500 nucleotides of the cytochrome *b* gene, we conducted a pilot study on the population genetic structure of four species of sea ducks within portions of their wintering ranges. Samples of Harlequin Ducks, White-winged Scoters, and Black Scoters were obtained from the Aleutian Islands, Kodiak Island, and south central and southeastern Alaska. King Eider samples came from the Bering Sea, Kodiak Island, and Greenland. Initial analyses for Harlequin Duck and Black Scoter indicate little evidence for genetic structure among Alaskan wintering areas. Little difference was also detected among King Eiders in the Pacific and Atlantic, even though these groups are thought to contain entirely different breeding populations. Data for White-winged Scoters is forthcoming. The use of additional genetic markers and the implications of these results will be discussed.

GENETIC CHARACTERIZATION OF THREE BREEDING POPULATIONS OF LONG-TAILED DUCKS FROM ALASKA AND CANADA

Barbara J. Pierson, Sandra L. Talbot, John M. Pearce, Judy R. Gust, Jolene R. Rearick, and Margaret Petersen

Biological Science Office, U.S. Geological Survey, Alaska Science Center, 1011 E. Tudor Rd., Anchorage, AK 99503, USA; barbara_j_pierson@usgs.gov

Long-tailed ducks (*Clangula hyemalis*) have a relatively wide breeding distribution in Alaska from the Yukon Flats westward to the coast and Bering Sea islands, and northward to the Arctic Coastal Plain. Alaskan long-tailed duck population numbers decreased dramatically (~75%) between 1977 and 1994 in contrast to the apparently stable eastern Arctic Canada portion of North American long-tailed ducks. Band recovery data alone are insufficient to delineate relationships among between breeding, molting, migrating, and wintering groups of long-tailed ducks and to assess the factors responsible for the observed decline. DNA analyses of eight biparentally inherited microsatellite markers are being used to assess the extent of differentiation among three breeding populations: Yukon-Kuskokwim Delta, Alaska; North Slope, Alaska; and Karrak/Adventure Lakes, Canada. Preliminary results from five microsatellite markers suggest that these loci are segregating independently and will be suitable for assessing population differentiation and that all three populations are in Hardy-Weinberg equilibrium. Based on sample sizes of 30, 25, and 9 for the Yukon-Kuskokwim Delta, North Slope, and Karrak/Adventure Lakes, there is little differentiation among these breeding populations and thus we cannot reject the null hypothesis of panmixia. These data are supported by preliminary data from satellite telemetry studies. Nevertheless, data from additional microsatellite loci, and the mitochondrial DNA genome, as well as increased numbers of samples, must be obtained before conclusions regarding connectivity among these populations can be made.

HARLEQUIN DUCK PHYLOGEOGRAPHY: A SPECIES-WIDE PERSPECTIVE

Kim T. Scribner, Sandra L. Talbot, Richard B. Lanctot, Barbara J. Pierson, Scot Libants, Daniel Esler, and Kathryn M. Dickson.

KTS and SL: Dept. of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824, USA; scribne3@msu.edu
SLT and BJP: Alaska Science Center, BRD/USGS, 1011 E. Tudor Rd. Anchorage, AK 99503, USA
RBL: U.S. Fish & Wildlife Service, 1011 E. Tudor Rd. Anchorage, AK 99503, USA
DE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC, V5A 1S6, Canada
KMD: Canadian Wildlife Service, 351 St. Joseph Blvd., Hull, Quebec K1A 0H3, Canada

Using molecular markers that differ in mode of inheritance and rate of evolution, we examine levels and partitioning of genetic variation within and among 11 wintering aggregations of harlequin ducks (*Histrionicus histrionicus*) from the entire species distribution. We document significant differences between eastern (Atlantic) and western (Pacific) regions, and among wintering aggregations within each region based on the frequency of mtDNA haplotypes derived using control region sequences and on variation in allele frequency at 5 bi-parentally inherited and one sex-linked (Z-specific) microsatellite locus. Analyses suggest that both historical (population fragmentation due to historical vicariance) and contemporary forces (isolation by distance and recent range expansion within regions) have been important in shaping current spatial genetic distributions. Data are discussed in light of recent conservation concerns regarding status and trends of eastern breeding and wintering populations.

PROMOTING SEA DUCK CONSERVATION THROUGH COMANAGEMENT: OLD TRADITIONS AND NEW OPPORTUNITIES

Thomas C. Rothe and Fred Armstrong, Jr.

TCR: Alaska Department of Fish and Game, 525 W. 67th Avenue, Anchorage, AK 99518; tom_rothe@fishgame.state.ak.us
FA: U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, AK 99503

Sea ducks and the Native peoples of the far north have always been strongly connected by ecology, economy, culture, and spirit. Breeding and molting sea ducks cohabit coastal tundra regions and interior river basins with rural communities; sea ducks are an important part of traditional spring and summer subsistence harvests; and aboriginal governments play an important role in ownership, management and economic development in northern sea duck habitats. Negotiated amendments to migratory bird treaties with Canada (1995) and Mexico (1997) brought to fruition longstanding efforts to legalize traditional spring harvests, but also established the basis for a more comprehensive management system through involvement of subsistence communities in all aspects of migratory bird management. Establishment of the Alaska Migratory Bird Comanagement Council in Alaska and comanagement programs in Canada provide a unique opportunity for collaboration on key elements of sea duck conservation: delineation and assessment of sea duck populations, research on population dynamics, evaluation of harvest, and habitat protection.

FALL STAGING AND FORAGING BEHAVIOUR OF DIVING DUCKS IN RELATION TO MUSSEL CULTIVATION IN P.E.I.

Mark Dionne, Diana J. Hamilton, Antony W. Diamond and Gregory J. Robertson.

MD, DJH : Atlantic Cooperative Wildlife Ecology Research Network (ACWERN) and Department of Biology, University of New Brunswick, Bag Service 45111, Fredericton, N.B. E3B 6E1; j5xma@unb.ca
AWD: ACWERN, University of New Brunswick, Bag Service 45111, Fredericton, N.B. E3B 6E1;
GJR: Canadian Wildlife Service, 6 Bruce Street, Mount Pearl, NF A1N 4T3

Blue mussels have been cultivated on Prince Edward Island since the 1970's, but the industry has greatly expanded in the last decade. Production has increased six fold, reaching 18 000 tons annually and occupying the majority of the island's bays. In recent years, especially during the fall migration period, interactions between diving ducks and cultivated mussels have increased. Habitat for some staging ducks overlaps with the expanding mussel industry, increasing the level of disturbance for waterfowl. Other ducks appear to have been drawn away from traditional staging grounds to feed on cultivated mussels, which are attractive because of their high densities, accessibility, and high tissue content relative to wild mussels. This has resulted in steadily increasing losses for mussel producers; predation and related shake-off by ducks, especially Greater Scaup (*Aythya marila*) and Long-Tailed Duck (*Clangula hyemalis*), now costs the industry $1-2 million annually. Using a series of manipulative experiments, behavioural observations, and analyses of duck survey data, we are quantifying the relationship between ducks and the industry. We are also attempting to develop non-disruptive techniques to mitigate negative effects of ducks on mussel farms and foster peaceful co-existence between ducks and mussel aquaculture. Specifically, we are assessing duck predation on mussels socked at different sizes, densities and times, quantifying effects of mussel culture on behaviour and activity patterns of ducks, identifying preferred prey sizes for ducks, and testing a protective socking material that may alleviate the problem. Preliminary results suggest that ducks prefer small mussels but are capable of taking seed of all sizes. Mussel shake-off appears to be a major issue with Greater Scaup, which knock off almost as many mussels as they eat. Behavioural data suggest that Greater Scaup are switching to night feeding on cultivated mussels, rendering the daytime scaring tactics used by growers ineffective. A survey of damage at a commercial mussel farm following two nights of Scaup predation revealed losses of 35 to 55% for small mussels and 15 to 25% for large mussels. To assess the effect of mussel culture on duck distributions, available CWS aerial counts of ducks in P.E.I. between 1960 and 2001 are being analysed relative to the expansion of the industry. Abundance of Scaup and Long-Tailed ducks (corrected for overall population trends) in specific survey blocks in the pre-aquaculture period will be compared with counts taken as mussel production started and after it intensified. This information, together with results from ongoing experiments, will be presented, and the relevance of our work to other areas experiencing the same problems will be discussed.

EFFECTS OF DISTURBANCE ON CONDITION OF LONG-TAILED DUCKS MOLTING IN THE BEAUFORT SEA

James B. Grand, Mark D. Howell, and Paul L. Flint

JBG: USGS, Alabama Cooperative Fish and Wildlife Research Unit, Auburn, AL 36849; grandjb@auburn.edu
MDH: Auburn University, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL 36849
PLF: USGS, Alaska Biological Science Center, Anchorage, Alaska 99503

We examined body mass and nutrient reserve dynamics during wing molt as indicators of impacts of industrial disturbance on long-tailed ducks at 2 study sites on lagoons in the Beaufort Sea, Alaska. Body condition and mass dynamics were of interest as disturbance may reduce the time available to feed and meet the nutritional demands of feather growth. Body mass declined initially and then stabilized, suggesting that long-tailed ducks initially relied upon stored reserves to meet the demands of feather growth. Lipid levels decreased at a constant rate, while protein levels decreased initially and then increased. Ash content remained stable throughout molt. These findings suggested that long-tailed ducks were able to meet the protein requirements for feather growth from the environment, but the period of flightlessness was energy costly. During 2000, each site was divided into control and treatment areas where birds were subjected to frequent disturbance. We found no evidence of a negative effect on carcass mass or nutrient reserves. We suggest that Beaufort Sea lagoons provide an important, protected area for molting long-tailed ducks, but disturbance may have little influence on their ability to meet the nutritional requirements of wing molt.

HARVEST AND POPULATION DYNAMICS OF THE NORTHERN COMMON EIDER IN GREENLAND AND CANADA: RESULTS OF A SIMULATION MODEL

Scott G. Gilliland, H. Grant Gilchrist, Robert F. Rockwell, Gregory J. Robertson, Jean-Pierre L. Savard, Flemming Merkel, and Anders Mosbech

SGG, GJR: Canadian Wildlife Service, 6 Bruce Street, Mount Pearl, NF A1N 4T3, Canada; scott.gilliland@ec.gc.ca
HGG: Canadian Wildlife Service, National Wildlife Research Centre, 100 Gamelin Blvd, Hull, QC K1A 0H3, Canada
RFR: American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, USA.
JPLS: Canadian Wildlife Service, 1141 Route de l'Eglise, P.O. Box 10100, Ste-Foy, QC G1V 4H5, Canada
FM: Greenland Institute of Natural Resources, P.O. Box 570, 3900, Nuuk, Greenland.
AM: National Environmental Research Institute, P.O. Box 358, DK-4000 Roskilde, Denmark.

Northern common eiders Somateria mollissima borealis are currently heavily exploited in Canada and Greenland, although the impact of this intensive use has yet to be quantified. To investigate various issues associated with the current level of harvesting and the nature of this harvest (fixed number versus fixed rate), we developed a metapopulation model. The model consisted of two breeding populations and two wintering populations (Greenland and Canada). Current fixed-number harvest levels in Greenland are not sustainable, and harvests must be reduced by at least 30% to stop projected population declines. In contrast, the Canadian fixed-number harvest is close to sustainable levels in the absence of stochasticity. Late winter fixed-number harvest has a greater impact on the population than early winter fixed-number harvest. At some low population level, we assumed that hunters could not take a fixed-number of birds and that harvest became a function of population size (i.e. a rate). Modeling harvest to be density-dependent at low population size had the expected result of stabilizing populations at very low levels. Fixed-number harvests inherently destabilize populations; we strongly recommend setting eider harvest levels relative to population size. Efforts have to be devoted to improve population and harvest estimates so that sustainable harvest levels can be determined. Current harvesting practices endanger the sustainable use of the eider resource, and management actions are urgently required.

INTERACTIONS BETWEEN HABITAT, PHYSICAL CONDITION, AND HUNTING MORTALITY OF COMMON EIDERS WINTERING IN GREENLAND

Flemming Ravn Merkel, Anders Mosbech, Christian Sonne-Hansen, Knud Falk, and Sarah Jamieson

FRM: Greenland Institute of Natural Resources, P.O. Box 570, DK-3900, Nuuk, Denmark; merkel@natur.gl
AM+CSH: Dept. of Arctic Environment, National Environmental Research Institute, P.O. Box 358, Frederiksborgvej 399, DK-4000 Roskilde, Denmark
KF: Danish Polar Center, Strandgade 100H, DK-1401 Copenhagen K, Denmark
SJ: Dept. of Biology (ACWERN), University of New Brunswick, Fredericton, E3B 6E1, Canada

From aerial surveys of southwest Greenland it is estimated that the coastal zone and the adjoining fjords of southwest Greenland support a winter population of app. 460,000 common eiders – birds that originate from breeding grounds in the eastern Canadian Arctic and west Greenland. Each year at least 57.000 common eiders are bagged in Greenland, of which app. 80% are taken during winter in southwest Greenland, and there is growing evidence that this harvest level is not sustainable. Furthermore, delayed effects caused by human disturbance may add further to this development. Various ecological constraints make common eiders highly vulnerable to human disturbances.

To achieve a more fundamental basis of the ecological constraints that eiders are faced with during winter in Southwest Greenland we have recently initiated a winter ecology research programme in Nuuk - a study site that are densely inhabited by both humans and eiders. Based on aerial surveys, visual observations, satellite telemetry, harvest surveys, X-ray-, body condition-, and diet analysis the programme focus on interactions between habitat, physical condition, and hunting mortality of common eiders wintering in Southwest Greenland.

Preliminary results indicate that wintering eiders are very sensitive to the local environment, as they are often highly philopatric to a particular wintering site. Despite the fact that there are huge differences in hunting pressure between wintering sites only 20-100 km apart, most eiders stick to the same place for long periods. For adult eiders X-ray studies show that app. every third bird carry embedded lead shots, and a preliminary analyses show that these birds have a significant poorer body condition compared with non-inflicted birds. However, not only human activities affect the fitness of the eiders. Diet and feeding conditions vary considerable between coastal habitats and fjord habitats, and visual observations show that these eiders relay on quite distinct foraging strategies.

IDENTIFYING CAUSES OF NESTING FAILURES IN SPECTACLED EIDERS, ARCTIC ALASKA, 1996–2002

Betty A. Anderson, Ann M. Wildman, Alice A. Stickney, and John E. Shook

ABR, Inc.–Environmental Research & Services, P.O. Box 80410, Fairbanks, AK 99708, USA; banderson@abrinc.com

Spectacled Eiders (*Somateria fischeri*) are declining across their breeding range in Alaska and Siberia, which prompted their listing as a U.S. Federally threatened species in 1993. Poor nesting success (mean = 38.7%, 1993–2001) probably has contributed to declines in arctic Alaska. To assess the causes of nest failures in the Kuparuk Oilfield (45 miles west of Prudhoe Bay on the central Arctic Coastal Plain of Alaska), we used time-lapse video cameras (to record predation events and incubation behavior) and thermistored eggs (to record incubation constancy and recess timing). Since 1996, we have monitored 25 nests with thermistored eggs and 11 nests with video cameras (7 also had thermistored eggs). Current year (2002) data are being analyzed and will be included in the presentation of results. Through 2001, nesting success for monitored nests was 90% (18 of 20 nests). Of 1 mammalian and 3 avian predators recorded on video, only Glaucous Gulls (*Larus hyperboreus*) visited nests. Predation by gulls was suspected at the 2 failed nests and was the predator at 1 partially depredated nest. Successful eiders defended their nests from gulls during incubation. Incubation constancy was high (range = 96.0–99.6%, *n* = 17 nests) and recess frequency was low (range = 0.5–2.1 recesses/day). Most eiders took recesses between 12:01–18:00 Alaska Daylight Time (annual mean = 50–77%, *n* = 17 nests) and most recesses (87%, *n* = 8 nests) occurred during the latter stage of incubation. Thus, poor nest attendance did not appear to be the cause of the nest failures of monitored eiders in the Kuparuk Oilfield in 1996–2001. Video monitoring of nests suggests that predation may be an important factor in the low nesting success of Spectacled Eiders in Arctic Alaska.

FALL FEEDING ECOLOGY OF SYMPATRIC BARROW'S AND COMMON GOLDENEYES IN THE ST. LAWRENCE ESTUARY

Dominique Bourget, Jean-Pierre L. Savard, and Magella Guillemette

DB and MG : Biology Department, Université du Québec à Rimouski, Quebec G5L 3A1, Canada; liliacees@hotmail.com
JPLS: Canadian Wildlife Service, Quebec Region, Quebec G1V 4H5, Canada

We studied the feeding ecology of Barrow's Goldeneyes (Bucephala islandica) and Common Goldeneyes (B. clangula) during the Fall 1999 in the St. Lawrence estuary near Rimouski, Quebec. We characterised the distribution of both species, collected 33 specimens (18 Barrow's and 14 Common) for oesophagus and gizzard contents and quantified diving behaviour (132 cycles for Barrow's and 166 for Common). Both species used different portion of shorelines with Barrow's Goldeneye being closely associated with rocky shores. Barrow's Goldeneyes fed mostly on Amphipods (100% frequency) and Gastropods (100% frequency) whereas Common Goldeneyes fed mostly on Polychetes (85.7%) and Amphipods (78.6%). Dive duration of Barrow's and Common Goldeneyes averaged 17.7 ± 0.8 and 19.7 ± 1.0 sec., and surface duration 14.1 ± 0.8 and 12.9 ± 1.0 sec. respectively. Common Godeneyes spent a larger proportion of a dive cycle underwater than Barrow's Goldeneyes. We conclude that different habitats will have to be protected to insure the needs of both species.

IDENTIFICATION OF SEA DUCK MOULTING AREAS ALONG THE MAINLAND COAST OF BRITISH COLUMBIA

Sean Boyd and Andre Breault

Canadian Wildlife Service, Delta, BC V4K 3N2, Canada; sean.boyd@ec.gc.ca

A survey of sea ducks moulting on the BC Mainland coast was flown from 6-10 August 1998 by Sean Boyd and André Breault of the Canadian Wildlife Service. The survey was done in a Cessna 185 on floats at a distance of 50-100 m from the shoreline and at an altitude of 60-80m and covered the entire mainland coast from Vancouver to Alaska. Roughly 50-60% of all inlets were surveyed. Flock sizes were estimated and large flocks were also photographed. Except for several small groups (< 20 birds) of Common Mergansers, >95% of all birds were Surf Scoters. We counted a total of 5340 scoters and all of these birds were in the north half of B.C.; the first scoters were not observed until just east of Bella Bella. Assuming that scoters were evenly distributed along the coast, these results suggest that the B.C. mainland coast might account for 9-10,000 moulting scoters in early August 1998. The North end of Observatory Inlet held the largest concentrations of scoters in B.C., and these numbers were very similar to those observed during an early August survey done12 years ago by Jean-Pierre Savard of the CWS, suggesting that moulting sites are probably highly traditional locations used year after year. Adult males constituted only ca. 16% of all flocks (range = 4-57%; n = 3048) and visual estimates accounted for about 85-90% of the true (photo) values.

ASSESSMENT OF THE DISTRIBUTION AND ABUNDANCE OF SEA DUCKS AND OTHER WATERBIRDS ON THE WEST COAST OF VANCOUVER ISLAND DURING LATE WINTER AND HERRING SPAWN

André Breault, Sean Boyd, Philippa Shepherd, and Terry Sullivan

AB and SB: Pacific Wildlife Research Centre, Canadian Wildlife Service, Delta, BC V4K 3N2, Canada; andre.breault@ec.gc.ca
PS: Parks Canada. 300-300 West Georgia Street, Vancouver, BC V6B 6B4, Canada
TS: 3977 Nicomekl Road, Surrey, BC V4P 2J9, Canada

Air surveys were conducted in the winter and spring of 1999-2000 (n=3) and 2000-2001 (n=5) to determine the abundance and distribution of sea ducks and other waterbirds on the West Coast of Vancouver Island. The coastline was divided into 285 survey segments defined from GIS base maps, each segment representing a unique marine ecological unit. Each flight covered a linear length of approximately 1,800km, the equivalent to about 50% of the length of the West Coast. Two observers recorded all birds within 50m of the aircraft while large concentrations of birds within and outside the transect boundaries were recorded as points. Bird sightings were compiled separately prior to and during the herring spawn while species-specific densities were calculated for each of the marine ecological units. An average of 30,000 waterbirds were observed per survey and abundance was greater in protected inlets and bays than on the exposed coast. Scoters accounted for 23% of the total number of birds observed. Herring spawn was observed at 12 sites and those sites accounted for 32% of all the birds sighted. For scoters, the herring spawn sites represented 49% of the total number of birds observed. Spring Herring Spawn is therefore an important event for sea ducks on the West Coast of Vancouver Island. The GIS nature of the dataset and the use of marine ecological units to delineate survey transect boundaries allow the data to be queried either spatially, by habitat type or by species of interest. These data are also being brought into a model predicting total sea duck distribution and abundance over the various ecological units found on the BC Coast. Such model will play a critical role in predicting important areas, important habitats and overall distribution of individual species or groups of species across the entire coast and it will also help better understand habitat-species relationships for wintering sea ducks.

MIGRATION ROUTES AND BREEDING AREAS OF STELLER'S EIDERS WINTERING IN NORTHERN NORWAY

Jan O. Bustnes and Margaret Petersen

JOB: Norwegian Institute for Nature Research, Division of Arctic Ecology, The Polar Environmental Centre, N-9296 Tromsø, Norway;Jan.O.Bustnes@nina.no
MP: USGS, Alaska Biological Science Center, 1011 E. Tudor Road, Anchorage, AK 99503, USA

Steller's eiders mainly winter in two separate areas: Alaska and north-western Europe. The Alaskan wintering birds are known to breed in eastern Siberia to the Taimyr Peninsula. The breeding areas and migration routes of the European Steller's eiders are not known. The aim of this project was to find key areas for the population wintering in north-eastern Norway by deploying 20 satellite transmitters. We found that the population bred as far east as Taimyr, indicating that there are two separate populations. Spring staging areas and molting areas were overlapping and mostly geographically restricted to the western side of the great island Novaya Zemlya. This study suggests that the population is restricted to small areas and is thus vulnerable to habitat loss and other potential dangers.

GULF OF ALASKA SEA DUCK SURVEY

Bruce Conant, Deborah J. Groves, and James G. King

Waterfowl Management, U.S. Fish and Wildlife Service, Juneau, AK 99801, USA; bruce_conant@fws.gov

Experimental aerial surveys were flown from May to October in 2001 and 2002 along a major portion of the shoreline of the Gulf of Alaska between Cape Spencer and Cape Suckling. Individual observations of all water birds and marine mammals were entered into onboard computers by G.P.S. latitude-longitude. Scoters (*Melanitta spp*.) comprised the most numerous waterfowl found. Maps showing the distribution and relative abundance of scoters along the survey route are presented. This is the only detailed broad scale data available for this shoreline in an area subject to potential oil spills and future petroleum exploration. More aerial surveys using this method are recommended to establish a baseline data base prior to a major ecological disturbance.

EXAMINING THE EFFECTS OF INTERSPECIFIC COMPETITION BETWEEN BARROW'S GOLDENEYE AND BUFFLEHEAD

Matthew R. Evans, Sean W. Boyd, David B. Lank

MRW and DBL: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; mrevans@sfu.ca
SWB: Canadian Wildlife Service, Delta, BC, V4K 3N2, Canada

Barrow's Goldeneye (*Bucephala islandica*) and Bufflehead (*B. albeola*) exhibit intraspecific and interspecific aggression, maintaining well delineated territories from which they exclude other individuals. Typically, the larger, more aggressive Barrow's Goldeneye successfully exclude Bufflehead and other species from these sites. Food and mates have previously been proposed as the most likely defended resources for inter- and intraspecific encounters. We still lack a comprehensive, qualitative understanding of what population effect interspecific, density-dependent interactions have on Barrow's Goldeneye and Bufflehead population numbers. We will quantitatively characterize the degree of overlap in habitat use between Barrow's Goldeneye and Bufflehead. This will allow for a descriptive summary of the behavior of a joint two-species population of *Bucephala*. If Barrow's Goldeneye competitively excluded Bufflehead, then Bufflehead abundance will be negatively correlated with Goldeneye density and Goldeneye will occupy higher quality foraging sites. If this hypothesis is true, then the experimental removal of breeding Barrow's Goldeneye (conducted by preventing their access to all nest boxes and cavities in the experimental area) will result in replacement by Bufflehead. As a result, it is predicted that numbers of Bufflehead breeding pairs, broods, and duckling survival rates will increase. Furthermore, it is hypothesized that both species influence the presence of other local waterfowl species, and thus, local community diversity. If true, then we expect to see higher species diversity on ponds of similar habitat attributes that do not contain Goldeneye or Bufflehead.

TRENDS OBSERVED FOR SEA DUCKS DURING 1993-2002 WINTER AERIAL SURVEYS IN THE INNER MARINE WATERS OF WASHINGTON STATE

Joseph R. Evenson, David R. Nysewander, Bryan L. Murphie, and Thomas A. Cyra

JRE and DRN: Puget Sound Ambient Monitoring Program (PSAMP), Washington Department of Fish and Wildlife (WDFW), 600 Capitol Way North, Olympia, WA 98501-1091, USA; evensjre@dfw.wa.gov
BLM: PSAMP, WDFW, P.O. Box 1483, Shelton, WA 98584, USA
TAC: PSAMP, WDFW, 16018 Mill Creek Blvd., Mill Creek, WA 98012, USA

Density indices of diving marine birds have been compared over a 20-year period in other reports for only selected nearshore portions of the northern inner marine waters of Washington State, where comparable aerial survey methodologies were used. The marine bird component of the Puget Sound Ambient Monitoring Program has conducted comparable winter aerial surveys each December and January 1993-2002, using a standardized methodology that has addressed portions of all parts of the inner marine waters of Washington. The primary objectives focused on monitoring temporal and spatial trends. Examination of trends over this nine-year period for the sea ducks most commonly utilizing the winter waters in Washington show the following:

1) Density indices of most species suggest that some decline is still ongoing, but degrees vary by location and species.
2) The southern and central portions of greater Puget Sound contained the highest densities and numbers for certain species like scoters, and these areas have also experienced the greater degree of decline over the last nine years.
3) The declines appear to be spread out throughout most of the areas and in most habitats, with the decline being more of a shrinking of habitat usage rather than an entire abandonment of certain areas, with a few exceptions.
4) Scoter species exhibited the largest loss of biomass over this nine-year period, even though their relative percentage of loss was less than other declining species, due to historically being one of the most numerous wintering sea duck species in this area.
5) Goldeneyes and buffleheads were thought to be stable or slowly declining when compared in the northern waters over 20 years; however, indices from 1993-2002 throughout the inner waters suggest that these species have slowly declined.
6) Harlequin ducks showed a generally stable pattern over the nine-year period, even though their low numbers make them one of the less numerous species present in these waters and their clumped distribution near oil tanker routes makes them one of the most vulnerable.
7) Factors like occurrence at the edge of their range likely minimize conclusions about long-tailed ducks.
8) Some of the three merganser species may be one of the few sea duck species that have not declined over 20 years; however, indices during 1993-2002 now suggest a gradual decline during this period. Whatever increase in biomass of mergansers that may have occurred is dwarfed, however, by the loss of biomass of the other species.

NORTHERN COMMON EIDER IN UNGAVA BAY: ABUNDANCE AND POPULATION TRENDS

Gilles Falardeau, Jean-François Rail, Jean-Pierre L. Savard, and Scott Gilliland

GG, JFR, and JPLS: Canadian Wildlife Service, 1141 route de l'Église, C.P. 10 100, Sainte-Foy, Québec G1V 4H5, Canada; gilles.falardeau@ec.gc.ca
SG: Canadian Wildlife Service, 6 Bruce Street, Mount Pearl, NF A1N 4T3, Canada

Concerns have been raised about the decline of Northern Common Eiders. The *borealis* subspecies breeds in the Arctic and is harvested in Labrador, Newfoundland, the Gulf of St. Lawrence (Quebec), and Southwest Greenland. Baseline data concerning eider population size was collected in 1980 in Ungava Bay where many breeding islands were surveyed. We resurveyed four archipelagos in 2000 to determine population trends for the 1980-2000 period and to produce population estimates for each archipelago. There were noticeable increases on three archipelagos but the only statistically significant trends were an increase in the number of breeding eiders on Payne Islands, and a sharp decrease on Eider Islands. The difference observed in nesting chronology between and even within archipelagos may have influenced both the 1980 and 2000 survey results rendering the interpretation of the data difficult. This survey highlighted the need for a greater understanding of the breeding ecology of eiders in Ungava Bay and the urgency of developing adequate survey and monitoring techniques. This is especially urgent given the importance of eiders for Inuit communities.

DENSITY AND DISTRIBUTION OF SEA DUCKS IN THE CENTRAL BEAUFORT SEA, ALASKA

Julian B. Fischer, Tim J. Tiplady, and William W. Larned

Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK 99503, USA; julian_fischer@fws.gov

We completed aerial surveys of sea ducks in the central Beaufort Sea to determine species composition and distribution patterns near offshore oil and gas developments. We conducted surveys from twin-engine aircraft between Cape Halkett and Brownlow Point, Alaska during June, July, and August 1999-2000. We expanded our effort in July 2001 to complete a single survey that included offshore waters between Point Barrow and Demarcation Point, Alaska. Nearly 80% of bird observations were sea ducks, predominantly long-tailed ducks and king eiders. Densities of most species decreased with distance from shore, whereas king eider densities were higher in deep offshore waters. Long-tailed ducks and common eiders were concentrated along the lee side of barrier islands, while king eiders, spectacled eiders, and scoters occurred in higher densities in the western half of the study area. In general, sea duck densities were higher in areas with little ice cover; however, high densities of king eiders occurred in areas with 30-60% ice cover. Shifts in sea duck distribution were apparent as summer progressed. Densities of long-tailed ducks shifted from deep offshore waters into protected near-shore lagoons at the onset of post-breeding molt in July, while densities of king eiders offshore increased in July, coinciding with peak molt migration. The timing and locations of king eider concentrations supports the idea that offshore waters provide a migration corridor for post-breeding eiders. Our results suggest that Harrison Bay was important for post-breeding king eiders while near-shore lagoon habitat was important for common eiders and long-tailed ducks. Conservation implications of this project include providing data for oil spill risk assessment models prior to further industrial development, and directing clean-up efforts to reduce sea duck mortality in the event of catastrophic oil spills.

A HABITAT SUITABILITY MODEL FOR SCOTERS AND LONG-TAILED DUCKS IN CHESAPEAKE BAY

Douglas J. Forsell

Chesapeake Bay Field Office, U.S. Fish and Wildlife Service, 177 Admiral Cochrane Dr., Annapolis, MD 21401, USA; Doug_Forsell@fws.gov

Habitat suitability models are a method for integrating different sets of data to assess habitat quality for a specific living resource group. Habitat suitability modeling software developed by NOAA was used to rank and combine physical habitat variables based on the geo-referenced sightings of three species of scoters and long-tailed ducks from systematic surveys conducted in 1993-94. The habitat characteristics used were depth, salinity, percent sand, anoxic water, and oyster beds or hard bottoms. The birds preference for these habitats were ranked by their frequency of occurrence in each habitat type. A $250m^2$ grid of the Chesapeake Bay was generated from a variety of sources for each habitat characteristic. NOAA's software working in ESRI's ArcView Spatial Analyst, generates new grids based on the birds occurrence and presumed preference for that habitat type and then combines the layers to generate a spatially explicit, quantitative assessment in the form of a GIS map in which areas are numerically rated for suitability.

Long-tailed ducks, and white-winged, black, and surf scoters inhabit the Chesapeake Bay from November through March. Precise numbers of these birds are unknown, but the combined population of the four species is probably over 300,000 individuals. This modeling effort found that scoters in Chesapeake Bay occupy slightly different habitats with respect to depths and salinity, but all three scoters preferred substrates with greater than 90 percent sand. Long-tailed ducks appear to prefer slightly deeper and lower salinity waters than scoters.

The maps generated for these birds could be used by managers to determine which areas are currently most important to waterfowl and in identifying key areas for protection. Application of the model to other mid-Atlantic coastal areas may allow us to identify habitats that should be surveyed for sea ducks prior conducting activities such as gillnet fishing, sand mining, or construction of wind turbines farms.

TRACE ELEMENTS IN COMMON EIDERS AND LONG-TAILED DUCKS SAMPLED IN THE BEAUFORT SEA

J. Christian Franson, Tuula E. Hollmén, Paul L. Flint, Richard B. Lanctot, and James B. Grand

JCF: U.S. Geological Survey, National Wildlife Health Center, Madison, WI 53711, USA; chris_franson@usgs.gov
TEH: Alaska SeaLife Center, Seward, AK 99664, USA
PLF: U.S. Geological Survey, Alaska Science Center, Anchorage, AK 99503, USA
RBL: U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK 99503, USA
JBG: U.S. Geological Survey, Alabama Cooperative Fish and Wildlife Research Unit, Auburn, AL 36849, USA

We collected blood samples from common eiders (*Somateria mollissima*) and long-tailed ducks (*Clangula hyemalis*) at two locations (n = 20 ducks of each species at each location) in the Beaufort Sea near Prudhoe Bay, Alaska, in July and August of 2000. Each sample was tested for 19 trace elements; all results are expressed on a wet weight basis. Although few interpretive data are available for trace elements in blood of sea ducks, concentrations of most elements that are potentially toxic for waterfowl were relatively low. The exception was selenium, with mean concentrations at the two study sites of 6.9 and 8.0 ppm in eiders, and 11.1 and 12.1 ppm in long-tailed ducks. Our findings of high selenium levels in the blood, accompanied by low mercury concentrations (less than 0.2 ppm in both species), agree with the results of earlier studies of sea ducks and emperor geese (*Chen canagica*) in Alaska. Lead was detected in each sample, but none of the eiders or long-tailed ducks had = 0.20 ppm in their blood, the threshold concentration commonly used as an indication of exposure to metallic lead. Barium and boron were above detectable limits in approximately half of the samples, cadmium was detected in nearly all of the eiders, but fewer than half of the long-tailed ducks. Arsenic, aluminum, nickel, and beryllium were detected in less than half of the samples of both species. Our findings indicate that common eiders and long-tailed ducks sampled in the Beaufort Sea exhibit lower concentrations of lead in their blood than the levels that have been reported from sea ducks in some other areas in Alaska, particularly the Yukon-Kuskokwim Delta. Selenium concentrations may be naturally higher in tissues of marine birds than those that inhabit fresh water environments. However, the effects of selenium exposure on sea duck survival and reproduction, as well as the physiological mechanisms by which these birds tolerate high selenium burdens, deserve further study.

FISHERIES HABITAT TYPES AND HARLEQUIN DUCK USAGE OF THE MCLEOD RIVER, WHITEHORSE CREEK, AND MACKENZIE CREEK OF WEST-CENTRAL ALBERTA

Barry W. Godsalve

Department of Geography, University of Calgary, Calgary, AB T2N 1N4, Canada; bwgodsal@ucalgary.ca

The Harlequin Duck is a small sea duck that breeds in fast flowing mountain streams. The McLeod River and its tributaries, Whitehorse Creek and Mackenzie Creek, have been identified as Harlequin Duck breeding streams. Portions of the streams have been classified as Pre-incubation (areas where adults mate and feed in the spring prior to incubation initiation) and Brood-rearing (areas where young are raised from hatching to fledging) (Bighorn 1999).

Stream reaches with similar habitat characteristics have been classified and mapped for the McLeod River and Mackenzie Creek (Allen et al. 1995). Habitat types were identified using water depth, surface smoothness, flow turbulence, substrate size, and water velocity. Whitehorse Creek was not classified.

The purpose of this poster is to display habitat features associated with Harlequin Duck use of the stream reaches. It may be possible to identify Harlequin Duck breeding streams based on existing stream habitat classifications and vice versa.

A PHYSIOLOGICAL APPROACH TO DETERMINE REPRODUCTIVE STATUS OF WATERFOWL: APPLICATIONS FOR SEA DUCK RESEARCH AND CONSERVATION

Kristen B. Gorman, Tony D. Williams, Daniel Esler, and Paul L. Flint

KBG, TDW, and DE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; kgorman@sfu.ca
PLF: Alaska Science Center, U.S. Geological Survey, Anchorage, AK 99503, USA

Conservation of North American sea ducks is inhibited by a lack of knowledge regarding basic biology, as well as effective population monitoring techniques. We describe a non-lethal method to determine reproductive status of waterfowl, based on elevated blood plasma concentrations of the two main yolk precursors, vitellogenin (VTG) and very-low density lipoprotein (VLDL), during rapid follicle growth (RFG). To test the applicability of this method for waterfowl, we characterized the dynamics of VTG and VLDL concentrations in female Greater Scaup (*Aythya marila*) during the breeding cycle on the Yukon-Kuskokwim Delta, Alaska. From 19 May to 21 June, 2002, 58 females were collected, resulting in a data set comprised of individuals representing all reproductive stages including: *Prebreeding*, *RFG*, *Laying*, and *Incubating*. Yolk precursor concentrations were evaluated in relation to follicular development determined by dissection. Circulating concentrations of VTG and VLDL were significantly different between discrete reproductive stages. Mean concentrations were low in prebreeding birds (0.71 *µ*g/ml and 3.96 mg/ml, respectively). VTG concentrations increased rapidly during RFG to a mean of 3.35 *µ*g/ml for birds with a full follicle hierarchy, while VLDL concentrations increased only slightly during RFG to a mean of 6.75 mg/ml for birds with a full follicle hierarchy. Yolk precursor concentrations remained high through the laying stage and then decreased rapidly at clutch completion with the onset of incubation. Our results for VTG are consistent with other studies in passerines, although our results for VLDL dynamics indicate that at full follicle development concentrations are almost threefold lower in scaup than has been reported for passerines. Our work indicates that the dynamics of plasma VTG are a more reliable index of egg production than VLDL in waterfowl. This technique is a potentially powerful tool that can be used to develop a more detailed knowledge of factors related to sea duck productivity.

STATUS AND TRENDS OF SEA DUCK POPULATIONS BREEDING IN ALASKA, 1964-2002

Deborah J. Groves, Bruce Conant, John I. Hodges, and James G. King

Waterfowl Management, U.S. Fish and Wildlife Service, Juneau, AK 99801, USA; debbie_groves@fws.gov

The North American Waterfowl Breeding Population Survey has been conducted annually by the U.S. Fish and Wildlife Service and Canadian Wildlife Service since 1957 to obtain breeding population-size estimates and to monitor annual population-size changes of most duck species in North America. We analyzed sea duck population data collected within the 11 Alaska survey areas from 1964-2002. These areas contain the major waterfowl summering habitats in Alaska with the exception of the Arctic Coastal Plain and the small wetlands along the Pacific Coast from the Aleutian Islands through southeast Alaska. We fit exponential curves to the data from 1978-2002 to estimate current population sizes and to examine population-size changes during that time period. Since 1978 the same specially-modified turbine-beaver aircraft was used, which provided increased visibility over survey platforms used previously. Also, the second author was an observer every year starting in 1978, which improved standardization of the data among those years. Our estimates of the 2002 breeding populations from the fitted curves were 8,700 eiders (*Polysticta* and *Somateria* spp.), 63,300 long-tailed ducks (*Clangula hyemalis*), 235,700 scoters (*Melanitta* spp.), 54,200 goldeneyes (*Bucephala clangula* and *B. islandica*), 37,300 buffleheads (*Bucephala albeola*), and 28,500 mergansers (*Mergus serrator* and *M. merganser*). Substantial population-size changes since 1978 were detected for eiders (-59%, R^2=0.2149), long-tailed ducks (-67%, R^2=0.6812), scoters (-41%, R^2=0.3953), and mergansers (+244%, R^2=0.4641). While the decline of eider populations is currently being addressed, we believe that the declines in long-tailed ducks and scoters are also cause for concern and warrant further investigation.

HABITAT REQUIREMENTS OF WHITE-WINGED AND SURF SCOTERS IN THE MACKENZIE DELTA REGION, NORTHWEST TERRITORIES

Shannon L. Haszard and Robert G. Clark

SLH: Department of Biology, University of Saskatchewan, 112 Science Place, Saskatoon SK S7N 5E2, Canada; shannon.haszard@ec.gc.ca
RGC: Prairie and Northern Region Wildlife Research Centre, Canadian Wildlife Service, 115 Perimeter Road, Saskatoon, SK S7N 0X4, Canada

Habitat requirements of surf and white-winged scoters (*Melanitta perspicallata* and *M. fusca*, respectively) were evaluated in Canada's western boreal forest, where scoter populations may have declined by ~75% since the 1950s. Reasons for the decline are not well understood; few studies have been conducted, particularly in northern portions of scoters' breeding range, and to our knowledge none has attempted to determine why scoters use specific areas or wetlands, and do not use others. This study begins to address this deficiency by examining how specific wetland characteristics affect abundance, distribution, and productivity of scoters in part of their core breeding range.

In June 2001, scoter pairs and broods were counted during helicopter surveys of 220 wetlands in the Mackenzie Delta (n = 15 plots), NT, and adjacent upland areas (n = 16 plots). Spatial features were determined for all surveyed wetlands; water chemistry data, amphipod abundance estimates, and other habitat characteristics were acquired for a subset (n = 42) of wetlands. Pairs of both species occupied upland lakes more frequently than delta lakes, but there was no difference in the number of lakes in each region occupied by broods of either species. Lakes occupied by pairs and broods tended to be larger than unused lakes. Unlike some previous studies of boreal-breeding ducks, no association was found between total phosphorus concentration (or relative abundance of amphipods) and scoter occurrence on wetlands. In 2002, ~300 wetlands were surveyed, including 75 surveyed in 2001; water chemistry, amphipods, and molluscs were sampled in ~80 randomly-selected wetlands to determine whether scoter use is related to these wetland characteristics.

SEA DUCKS: A CALL FOR SOPHISTICATED HARVEST MANAGEMENT TO INTEGRATE DIFFERENTIAL VULNERABILITY

Nancy J. Hillstrand; bear@alaska.net

An Adaptive *Collaborative* Management Criteria based on the complexity and variability of individual Sea duck life histories; biology, ecology, and ethology is essential for wise sustainable harvest on species we do not fully understand. Adaptive Harvest Management measured on land based mallard modeling is not adequate to reveal the distinct requirements of the diverse Tribe Mergini who live in dynamic oscillating oceanic and ice conditions foraging on marine invertebrates. The perception of underutilization of individual Sea duck species has not been qualified or quantified to promote biologically based bag limits and seasons. Overall population status overlooks the consequence of humans' innate ability to anticipate predictable stereotypical bird behaviours of animals that exhibit strong site fidelity or other differential vulnerabilities. Hunting regulations must hold a preventative mechanism that anticipates localized depletions, or loss of unknown subpopulations *before* cumulative damage from undetected dwindling occurs. They must integrate our incomplete understanding of the complexity of a dynamic world.

Sea duck specialists are urged to collaborate and submit important biological parameters into the Supplemental Environmental Impact Statement that permits the hunting of migratory birds. This SEIS88 contains no Sea duck biology and is presently being amended, (2002-2003), This SEIS is revised only every ten to fifteen years so the window of opportunity to carefully inject vulnerabilities of Tribe Mergini into hunting regulations is now.

Contact: Jonathan Andrew, Chief, Division of Migratory Bird Management, U.S.F.W.S., Department of the Interior, 1849 C street, N.W., Washington DC 20240 or Ron W. Kokel Division of Migratory Bird Management (703) 358-1714.

CHLORINATED FATTY ACIDS: OCCURRENCE AND EFFECTS IN SEA DUCKS IN THE ALEUTIAN ISLANDS NEAR AREAS OF ANTHROPOGENIC NUTRIENT INPUT AND ORGANOCHLORINE CONTAMINANTS

Christopher Hoffman, Lilian Alessa, John Kennish, and Paul Flint

CH and LA: Department of Biology, University of Alaska, Anchorage, 3211 Providence Dr., Anchorage, AK 99508, USA; cjhoffman@gci.net
JK: Department of Chemistry, University of Alaska, Anchorage, 3211 Providence Dr., Anchorage, AK 99508, USA
PF: Biological Resources Division, United States Geological Survey, Anchorage, AK 99508, USA

We have found elevated levels of chlorinated fatty acids (CFAs) in blue mussels collected near areas of anthropogenic nutrient input and organochlorine contamination in Dutch Harbor, Alaska. Sea ducks, and Steller's eiders preferentially, spatially co-localize with seafood-processing outfalls in nearshore habitat. Organochlorine contamination in the nearshore marine habitat near Dutch Harbor is well documented. While seafood-processing waste may increase the concentration of sea duck prey species, sea ducks may be negatively impacted if the resulting abundant prey is contaminated with CFAs. These compounds, identified both in fish from Alaskan and Scandinavian waters, are major contributors of extractable, organically bound chlorine in animal lipids and may have toxic effects at higher trophic levels through bioaccumulation. While CFAs may occur naturally, anthropogenic sources may raise their concentration in living tissue. Unlike traditional contaminants, CFAs are not recognized by the organism with a biomarker response and are not eliminated; this represents a different class of contaminants we have termed "stealth xenobiotics".

Currently, no data exist on the levels of CFAs in sea duck populations in the wintering grounds of the eastern Aleutian Islands. Harlequin ducks (HADU) have been selected as a model sea duck species for examining the effects of CFAs at the cellular and organismal levels. Thus, this project has the following goals:

1. To determine the levels of CFAs in HADU wintering near Dutch Harbor.
2. To determine the degree of organismal partitioning and diversity of CFAs in HADU using radiolabeled fatty acids.
3. To determine if CFAs alter cell membrane fluidity and transboundary processes.

Since we do not yet understand aspects of trophic transfer, loading, and thresholds it is not possible to develop an ecological risk assessment model to predict the conservation implications of current and future CFA levels. While CFAs are not acute contaminants, significant detrimental effects are expected when threshold levels are attained.

MASS DYNAMICS IN RELATION TO FLIGHT PARAMETERS FOLLOWING REMIGE MOLT OF MALE LONG-TAILED DUCKS

Mark D. Howell, James B. Grand, and Paul L. Flint

MDH: Auburn University, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL 36849, USA; howelmd@auburn.edu
JBG: USGS, Alabama Cooperative Fish and Wildlife Research Unit, Auburn, AL 36849, USA
PLF: USGS, Alaska Biological Science Center, Anchorage, AK 99503, USA

We examined mass dynamics of summer molting male long-tailed ducks in the near-shore waters of the Beaufort Sea along the North Slope of Alaska in 1999-2000. Protein, lipid, and ash levels were analyzed along with carcass mass to determine how mass dynamics affected flight performance parameters. Additionally, we examined changes in mass that may occur in breast muscle and leg muscle mass. Wing loading, power loading, and wing-power loading all increased substantially with the onset of molt and sudden loss of wing area. As remiges began to re-grow, the various flight performance parameters returned to pre-molt levels. While body mass decreased initially and eventually stabilized, lipid levels decreased throughout molt and contributed the least to wing loading as birds returned to flight. Conversely, protein levels decreased initially during molt and eventually began to increase in the latter half of feather re-growth, thus increasing the contribution of protein levels (i.e. muscle mass) to wing load. Leg-power loading showed nominal change, which was expected given the ecological adaptations of long-tailed ducks to swimming and diving. While breast muscle mass decreased initially, it also increased during the latter half of feather re-growth, and was not correlated to leg muscle mass (R^2 = 0.01). We suggest that given the dynamics of flight parameters, mass dynamics of male long-tailed ducks are the result of regulated changes, energetic costs associated with molt, and an adaptive strategy to minimize the flightless period.

USE OF WINTER AGE RATIOS AS AN INDEX OF RECRUITMENT BY SURF SCOTERS

Samuel A. Iverson and Fred Cooke

SAI: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; sai@sfu.ca
FC: Larkin's Cottage, 6 Lynn Rd, Castle Rising, Norfolk PE31 6AB, United Kingdom

Few reliable population indices or estimates of productivity are available for sea ducks (Anatidae: Mergini) in North America. In British Columbia, Surf Scoters (Melanitta perspicillata) are the most numerous wintering sea duck, however, population data collected over the past 50 years indicate that their numbers are declining. I used age-related plumage variation to estimate male age ratios for Surf Scoter flocks censused in the Strait of Georgia, BC. During midwinter surveys conducted between 2000 and 2002, the male age ratio was estimated at 10.2% (range = 6.0-13.5%) first year males / total male. Data on migration phenology, movement, and winter distribution patterns indicate that the age structure estimates obtained in this study were representative of the population as a whole. By January/February, when these surveys were conducted, first year and adult male Surf Scoters had arrived on the wintering grounds and there was little movement between geographic areas. Habitat association patterns were also similar for the age classes, and first year males did not segregate into sub-adult flocks. Annual survival rates among adult males as high as 90% are unlikely, suggesting low recruitment may be a cause for conservation concern. However, the extent of annual fluctuations in recruitment rates can only be assessed using long-term studies. An integrated monitoring approach, which incorporates shore-based age ratio estimation with aerial or boat surveys to assess demographic parameters and abundance for Surf Scoters and other sea duck populations is recommended.

ENERGETIC RESERVE DYNAMICS OF NORTHERN COMMON EIDERS DURING THE NON-BREEDING SEASON

Sarah E. Jamieson, H. Grant Gilchrist, Flemming R. Merkel, Knud Falk and Antony W. Diamond

SEJ, FRM & AWD: Atlantic Co-operative Wildlife Ecology Research Network, Bag 45111, University of New Brunswick, Fredericton, NB E3B 6E1, Canada; duck_guts@hotmail.com
HGG: Northern Conservation Division, Canadian Wildlife Service, National Wildlife Research Centre, 100 Gameline Blvd., Hull, QC K1A 0H3, Canada
KF: Danish Polar Center, Strandgade 100H, DK-1402 Copenhagen K, Denmark.

In waterfowl, endogenous reserves have been shown to influence survival, recruitment, hunting vulnerability, and productivity. Despite this, there is little known about the energetics of Northern Common Eider Ducks. Our research focused on the energy reserve dynamics of a population that over-winters along coasts of southwest Greenland, migrates through Hudson Strait and breeds on Southampton Island, Nunavut. Birds were collected throughout the winter in Nuuk, Greenland and in spring in Cape Dorset, Nunavut by Inuit hunters. Male and females eiders were also trapped alive at East Bay, Southampton, Nunavut. Total lipid reserves were estimated from body mass, abdominal and femoral fat using equations derived from total carcass analyses of a sub-sample (n=92). Adult males and females had different energy reserve dynamics. The endogenous reserve levels of males were stable throughout the winter, then decreased during migration, and remained low upon arrival to the breeding grounds. Females showed greater fluctuations during the winter. Like drakes, hens also showed a decline in reserves during migration, however they substantially and quickly increased upon arrival to the breeding grounds. We suggest that, a) eiders in this population do not require large fat reserves during winter because reliable food sources exist throughout the winter; b) eiders maintain low reserves during migration to maximize flight efficiency; and c) at the beginning of the breeding season, females acquire reserves for egg production and incubation while males utilise energy reserves during mate guarding activities.

NESTING ECOLOGY OF LONG-TAILED DUCKS IN QUEEN MAUD GULF BIRD SANCTUARY, NUNAVUT

Dana K. Kellett, Ray T. Alisauskas, and Katherine R. Mehl

RTA and DKK: Canadian Wildlife Service, Prairie and Northern Wildlife Research Centre, 115 Perimeter Road, Saskatoon, SK S7N 0X4, Canada; dana.kellett@ec.gc.ca
RTA and KRM: Department of Biology, 112 Science Place, University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada

Very little is known of the nesting ecology of long-tailed ducks (Clangula hyemalis). During 1998-2002, we studied long-tailed ducks nesting in Queen Maud Gulf Bird Sanctuary, Nunavut. Generally considered to be dispersed nesters on mainland habitat, we found 27-57 nests per year on islands of several lakes in the Sanctuary. Densities of nests on islands were as high as 343 nests per square kilometre. We will report on clutch size, habitat selection, nesting success, and female mass loss during incubation.

ON THIN ICE: NATURAL HISTORY OF COMMON EIDERS BREEDING IN THE BEAUFORT SEA IN ALASKA.

Deborah L. Lacroix, Richard B. Lanctot, John R. Reed, and Paul L. Flint

Alaska Science Center, U. S. Geological Survey, Anchorage, AK 99503, USA

Current Addresses:
DLL: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC Z5A 1S6, Canada; dlacroix@sfu.ca
RBL: Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK 99503, USA

Along the Beaufort Sea of Alaska, the Pacific race of the Common Eider, *Somateria mollissima v-nigra*, nests and raises their broods almost exclusively on barrier islands. Compared to other populations of *v-nigra*, those breeding along the Beaufort Sea face relatively harsher environmental, biological, and physiological obstacles during breeding. During 2000-2002, we studied nesting effort and success, and brood survival of eiders nesting on islands near Prudhoe Bay, Alaska. Sixteen islands, covering over 80 linear km, were searched for nests and monitored to determine hatching success. Females were captured and banded, and a subsample of hens was equipped with radio transmitters. Daily survival rates of nests were determined by repeated but irregular visits, and brood survival was estimated by following radio-equipped females using aerial and ground searches. Nesting effort decreased throughout the 3-year study period, due in part to a large storm in August 2000 that reduced the available nesting sites in subsequent years. Also low nesting propensity in 2002 may have resulted from a late ice breakup and associated poor physiological conditions of adult females. Nests were lost to (1) predation, (2) drifting sand that covered nests, (3) wave action that flooded nests or eroded islands, and (4) wind-blown ice that crushed nests. Arctic Fox, *Alopex lagopus*, accessed islands via temporary ice bridges connected to the ice pack, and depredated virtually all nests present on a given island. Glaucous Gulls, *Larus hyperboreus*, breed on the islands and depredated eggs when females were not attending nests (i.e., during egg laying, when birds were on breaks, or when disturbed by people). These factors have resulted in near total nest failure on most islands during two of the three study years. Other research groups also observed large-scale nest failure on many other islands along the Beaufort Sea during these years. Even when nests hatched, tracking of radio-equipped hens in 2000 and 2001 indicated most (>95%) lost their broods. In 2000, mortality was due to the previously mentioned storm and potentially a reovirus isolated from dead ducklings, whereas in 2001 the explanation is less clear. Compared to other sub-populations, v-nigra breeding along the Beaufort Sea appear to suffer lower breeding propensity, lower nesting success and lower duckling survival. We concluded that these eiders may be breeding at their physiological extreme or in marginal habitats. Our results support aerial survey data that suggest the Beaufort Sea population of Common Eiders is declining. Active management during the breeding season, perhaps through fox removal or aversive training of gulls, may be necessary to allow this population to stabilize and eventually grow.

SPRING MIGRATION OF STELLER'S EIDERS IN SOUTHWEST ALASKA: A DECADE OF AERIAL SURVEYS

William W. Larned

Waterfowl Management, U.S. Fish and Wildlife Service, Soldotna, AK 99669, USA; william_larned@fws.gov

Most of the world's population of Steller's eiders winter in southwest Alaska, a vast, storm-swept range extremely difficult and dangerous to survey. The breeding population is centered in the central arctic coast of Russia, which also presents extreme challenges for monitoring the population trend of this threatened species. Our office initiated an aerial survey in1992 to census the Alaska-wintering population of Steller's eiders during their migration northward. This shoreline- and estuary-based survey works well for Steller's eiders because they favor shallow near-shore habitats for staging during migration. The survey design, consisting of visual flock estimates along a consistent nearshore search, includes no measure of precision, but data so far suggests a steady downward trend of 8 percent per year. The survey has also revealed a pattern of persistent use of important staging/feeding habitats enroute for Steller's eiders and other sea duck species, and helped us to delineate migration routes. This information is critical to minimize impacts of future anthropogenic changes in this coastal region on Steller's eider and other sea duck species.

INFORMATION TRANSFER FOR THE ATLANTIC SEA DUCK STUDY

Edward J .R. Lohnes and Matthew C. Perry

USGS, Patuxent Wildlife Research Center, 11410 American Holly Drive, Laurel, MD 20708 USA; Edward_Lohnes@usgs.gov

The Atlantic Sea duck Study has focused on the Chesapeake Bay in Maryland and other key areas used by sea ducks in the Atlantic Flyway. Initial studies have been conducted on scoters (black, surf, and white-winged) and the long-tailed duck. The delineation of breeding and molting populations and habitats has been a concern of the SDJV. Satellite tracking has taken place with surf scoters instrumented in late winter on the Chesapeake Bay, and black scoters instrumented in early spring on the Restigouche River of New Brunswick. This has provided new information, beneficial in protecting critical breeding and molting habitat of these species, and improving future management of their populations. Information from the ducks can be updated on a regular basis. Service Argos, Incorporated, a satellite-based location and data collection system, sends information, via e-mail, and this contains both coordinates and statistics of the PTT transmitters. Locations on the scoters can be determined up to an accuracy of 150 m and maps can then be constructed showing scoter movements, often less than 24 hours after the location of the duck is determined. These maps can then be posted onto the Patuxent Wildlife Research Center sea duck website for the public and research community. In 2002, a New York based organization 'Signals of Spring' funded by NASA, selected the Atlantic Flyway Sea duck Project as a case study for a student project. This project selected schools in New York and Washington, D.C., which enabled those involved to obtain skills in both wildlife and technology. Habitat cover types of locations using GIS (Geographical Information Systems) in conjunction with aerial photographs, and remote sensing data, are currently being analyzed. This will help to build thematic maps with varying cosmetic layer applications, providing a fuller picture of the habitat used by scoters during breeding and molting. Film work has also been carried out in both Canada and the USA, and footage has been edited, to provide viewers with a short program, highlighting techniques and field conditions. Information transfer of these data, presented to other scientists, managers, students, and the public in a multitude of forms (posters, film, and computer presentations) will provide a better understanding to assist the conservation effort to improve the status of sea ducks on a continental basis.

STATUS OF HARLEQUIN DUCKS IN THE KILBUCK MOUNTAINS, ALASKA

Brian J. McCaffery and Christopher M. Harwood

Yukon Delta National Wildlife Refuge, U. S. Fish and Wildlife Service, P. O. 346, Bethel, AK 99559, USA; brian_mccaffery@fws.gov

Since 1994, we have conducted annual helicopter surveys of breeding Harlequin Ducks in the Kilbuck Mountains in southwest Alaska. In 1994, we completed a comprehensive spring inventory along 19 streams totaling 546 km. We detected 403 Harlequin Ducks on 16 of 19 streams, or 0.74 ducks/km surveyed. Limited ground truthing suggests that we may have detected only about 50% of the ducks using the surveyed streams. Each spring from 1995 to 2002, we surveyed a 181-km subset of the streams surveyed in 1994, 73 km along the Kisaralik River and 108 km along 4 nearby streams. Since 1995, we have also conducted an annual fall brood survey along these same streams to estimate annual productivity. From 1994-2000, the spring population in the 181-km study area increased at an annual rate of 8%, then declined in 2001 and 2002. Over the course of the entire study period (1994-2002), the population increased at an annual rate of 5%. The factors contributing to these population growth rates are unknown. In our study area, spring population size did not predict annual production, nor did production predict changes in population size 1, 2, or 3 years later. These data lead us to hypothesize that annual variation in adult survival, rather than productivity, may have the strongest effect on breeding population growth rates. Up to a few dozen parties of recreational rafters floated the Kisaralik River annually during the breeding season, while little or no rafting occurred along the other 4 streams. Observed densities along the Kisaralik River, however, exceeded the mean density along the other 4 streams in every year of the study. In addition, the overall population growth in the study area from 1994-2002 was strictly a function of increasing numbers along the Kisaralik; total numbers along the unrafted streams showed no net change over the same interval. Our data suggest that recent levels of recreational activity have not adversely affected the local Harlequin Duck breeding population.

BREEDING BIOLOGY AND HABITAT USE BY KING EIDERS AT TESHEKPUK LAKE AND KUPARUK OILFIELDS ON THE NORTH SLOPE OF ALASKA

Rebecca L. McGuire, Laura Phillips, Robert Suydam, and Abby Powell

RLM and LP: University of Alaska, Fairbanks, AK, USA; ftrlm@uaf.edu
AP: Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska, Fairbanks, AK, USA
RS: Department of Wildlife Management, North Slope Borough, Barrow, AK, USA

Little is known about the breeding biology of King Eiders since they typically nest in remote areas in low densities. The western North American population of King Eiders declined by more than 50% between 1979 and 1996 for unknown reasons. During 2001 and 2002 we studied the breeding biology and habitat use of King Eiders in an area to the southeast of Teshekpuk Lake, on the North Slope of Alaska. This study will provide valuable information for evaluating and modeling the population decline. In each season, 40-45 nests were located and monitored. Additionally, 45 King Eider nests were monitored in the Kuparuk oil fields in northern Alaska in 2002. Avoiding nest predators is likely the most important factor in nest site choice by King Eiders. Tundra nesting birds that do not have the ability to defend their nests from predators have two main options, concealed breeding and/or secluded breeding. It appears that King Eider make use of both of these strategies and may also benefit from nesting in association with birds that do have the ability to deter potential predators. Which strategy is most effective may vary between sites depending on predator density and type.

We present a preliminary examination of clutch size, reproductive success and habitat use, between a relatively undisturbed site at Teshekpuk Lake and an area that has considerable human activity at Kuparuk. The Mayfeild estimate of nest success on islands at Teshekpuk was 35.7% (95% CI: 20.8-60.4%) and at Kuparak was 34.8% (95% CI: 17.7-67.2%), the estimate of nest success for the mainland nests at Teshekpuk was 3.5% (95% CI: 0.5-21.0%) and at Kuparak 20.5% (95% CI: 8.3-48.5%). Mean clutch size at Teshekpuk was 4.103 ± 0.25 (SE n=39) nests and at Kuparak was 4.162 ±0.26 (SE n=37) nests. Eiders nesting at Teshekpuk on islands had greater nest success than those on the mainland whereas those at Kuparak did not. This difference in success based on location may vary between the two because of varying concentrations and types of predators. A preliminary analysis of habitat indicated that there were few differences between Kuparak and Teshekpuk.

ROLE OF MALE ATTENDANCE AMONG COMMON EIDERS WITHIN AND AMONG NESTING COLONIES

Kerrith McKay, H. Grant Gilchrist, and T.D. Nudds

KM and TDN: Zoology Department, University of Guelph, Guelph, ON N1G 2W1, Canada; kmckay@uogeulph.ca
HGG: Canadian Wildlife Service, National Wildlife Research Centre, 100 Gamelin Blvd., Hull, Quebec, K1A 0H3, Canada

Birds display a variety of mating systems (promiscuity to monogamy) which involve varying degrees of male attendance. At a Common Eider duck colony in the eastern Canadian arctic, males are seasonally monogamous but appear to exhibit behavioural variations within this mating strategy. First, unlike at other colonies within the circumpolar range of eiders, males come ashore, post-copulation, and attend females during nest searching, laying and early incubation. Second, because reproductive success varies among pairs throughout the colony, theory suggests that individual males should adjust their attendance behaviour to maximize reproductive success. I am investigating whether and why attendance behaviour varies among colonies and among males within a single colony. Two working hypotheses guide this research: namely that male attendance behaviour varies due to the need for mate guarding (assuring paternity) and/or nest guarding (helping the female search for a quality nest cup and secure it). These hypotheses predict that, in observational and experimental studies, attendance behaviour by males should (1) vary with the quality of the nest site, the probability of nest failure, and time elapsed during laying (as more eggs are laid and incubation starts) and (2) female reproductive success should decrease when males are experimentally removed. Together, the results of these studies at different scales, will allow an assessment of the function of variable male attendance of laying and incubating female eiders.

EVALUATING POST-SURGERY MORTALITY AND RADIO PERFORMANCE FOR SEVERAL RADIO-ATTACHMENT METHODS ON WHITE-WINGED AND SURF SCOTERS

D. Archie McLean, Sarah C. Coulter, Daniel Esler, W. Sean Boyd, Daniel M. Mulcahy, and Timothy D. Bowman

DAM, SCC, and DE: Center for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; archie.mclean@ec.gc.ca
DAM, SCC, and WSB: Canadian Wildlife Service, Pacific and Yukon Region, Delta, BC V4K 3N2, Canada
DMM: Alaska Science Center, U.S. Geological Survey, Anchorage, AK 99503, USA
TDB: Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK 99503, USA

Previous studies have shown high post-surgery mortality for surf and white-winged scoters with satellite transmitters implanted abdominally. We contrasted post-surgery mortality rates of scoters with several conventional VHF radio attachment methods, to determine whether the documented high mortality rates were related to the radio attachment procedure. We captured 95 scoters (37 surf scoter and 58 white-winged scoters) during 10-20 December 2001, using a floating mist-net setup, in Baynes Sound on Vancouver Island. Each bird was marked with one of four transmitter types, as follows: abdominal implants with external antennae (AB-EXT; n=39 birds), abdominal implants with coiled internal antennae (AB-INT; n=19), transmitters implanted subcutaneously and dorsally (i.e., no invasion of the abdominal cavity; SUBCU; n=19), and transmitters mounted dorsally and attached with a subcutaneous prong and glue (PRONG; n=18). Mortality rates in the 30 days post-surgery were similar among radio types: AB-EXT = 0.08, AB-INT = 0.11, SUBCU = 0.11, and PRONG = 0.11. This suggests that neither the invasion of the abdominal cavity nor the external antenna associated with the AB-EXT attachment method were directly related to scoter mortality. However, the mortality rates in our study, even with the least invasive protocols, were considerably higher than in other study species with AB-EXT radio attachment (e.g., harlequin duck 14-day post-surgery mortality = 0.03), suggesting that scoters may be particularly sensitive to handling.

We also compared the performance of the different transmitter types from January 22 to April 23, in terms proportions lost or missing and signal strength. After the approximate 3 month period, similarly high proportions of PRONG and SUBCU radios were either missing (0.44 and 0.41, respectively) or known to be shed (0.25 and 0.18, respectively). None of the AB-EXT or AB-INT were shed, and proportions missing were 0.19 and 0.11, respectively. Signal strength was similar among radio types, with the exception of the AB-INT radios, which had markedly reduced signal strength. Thus, for long-term studies of scoter winter ecology, survival rates and potential use of satellite technology, the AB-EXT appears to be the most appropriate radio type. However, for studies < 3-month duration (*e.g.*, breeding biology, short-term movements), the PRONG and SUBCU types are suitable and logistically easier to deploy. AB-INT radios are limited due to their short detection distances and may only be useful in very specific circumstances.

USE OF HELICOPTER TO CAPTURE MOLTING COMMON EIDER

G. Randy Milton, Michael O'Brien, Robert Moody, Michael Boudreau, and George R. Boyd

GRM, MOB, MB: Wildlife Division, Nova Scotia Department of Natural Resources, 136 Exhibition Street, Kentville, Nova Scotia B4N 4E5, Canada; miltongr@gov.ns.ca
RM: Aviation Services, Nova Scotia Department of Natural Resources, 43 Creighton Road, Shubenacadie, Nova Scotia B0N 2H0, Canada
GRB: 1895 Brooklyn Street, Kings County, Nova Scotia B0P 1R0, Canada

The population dynamics of sea ducks (Tribe *Mergini*) are among the most least understood of North American waterfowl. Information on survival rates of Common Eider has to-date relied primarily on the effort directed at banding nesting hens on breeding colonies. Other age and sex cohorts are not being captured and banded in sufficient numbers to permit estimation of survival rates. From July through August, male Common Eider congregate in molting flocks off the Atlantic coast of Nova Scotia. We report on a technique which has captured 1,365 molting male Common Eider in exposed coastal waters.

KEY SITES FOR SEA DUCKS IN THE EAST ASIAN FLYWAY

Yoshihiko Miyabayashi and Evgeny E. Syroechkovski, Jr.

YM: Japanese Association for Wild Geese Protection, Wakayanagi 989-5502 Japan; yym@mub.biglobe.ne.jp
EES: Institute of Ecology and Evolution, Moscow 110000 Russia

The *Action Plan for the Conservation of Migratory Anatidae in the East Asian Flyway* was developed as a component of *Asia Pacific Migratory Waterbird Conservation Strategy: 2001-2005* (Wetlands International 2001). "Effectively managed networks of sites that are internationally important for migratory waterbirds" was identified as a key element of the *Strategy*, and a network of key sites for Anatidae in the East Asian Flyway (*Anatidae Site Network*) has been developed and it has been promoting and delivering conservation efforts in those key sites with participation of management authorities of the sites and under international cooperation. Wetlands International published an *Atlas of Key Sites to the Anatidae in the East Asian Flyway* (Miyabayashi & Mundkur 1999), where 337 sites were identified as of international importance for Anatidae species in the flyway on criteria of (1) a site supports more than 1% of a (biogeographical) population of Anatidae species; and (2) a site supports more than 20000 individuals of Anatidae populations. Sea duck species were least known group in the Anatidae in the flyway with only 32 key sites identified in the *1999 Atlas*. Promoting the identification of important sites for Anatidae populations as one of priority actions in the *Action Plan*. A series of joint surveys in the breeding areas of Anatidae populations in northeastern Russia in cooperation with Russia - United States, and Russia - Japan in recent years has confirmed more important sites. The wintering conditions of sea ducks have not been surveyed sufficiently in Okhotsk Sea, Japan Sea, Yellow Sea, China Sea or Pacific coast from Kamchatka to Japan. Here we report up-to-date information of key sites in the East Asian Flyway. Further efforts to realise the status of sea duck species and to identify more key sites in the East Asian Flyway are needed in the international cooperation for the enhancement of conservation of them.

SITE FIDELITY OF SPECTACLED EIDERS ON THE YUKON-KUSKOKWIM DELTA, ALASKA

Christine L. Moran, James S. Sedinger, Paul L. Flint, and James B. Grand

CLM: U.S. Fish and Wildlife Service, Selawik National Wildlife Refuge, Kotzebue, AK 99752, USA; tina_moran@fws.gov
JSS: Environmental and Resource Science, University of Nevada, Reno, NV 98557, USA
PLF: U.S. Geological Survey, Alaska Science Center, Anchorage, AK 99503, USA
JBG: U.S. Geological Survey, Alabama Cooperative Fish and Wildlife Unit, School of Forestry and Wildlife Sciences, Auburn University, AL 36849, USA

In response to a recent decline in Spectacled Eiders (*Somateria fischeri)* and resulting listing as Threatened under the Endangered Species Act, we studied nest site fidelity and distance moved between nesting attempts in two subpopulations on the Yukon-Kuskokwim Delta, Alaska. Fidelity of individuals to natal and breeding areas affects the distribution and size of populations and has implications for their genetic structure. This behavior has implications for protecting and recovering specific local populations. The two study sites, Kigigak Island and Kashunuk River, were separated by 56 km. We examined relationships between nest site fidelity and breeding performance, including nest success, nest initiation, and clutch size in both areas. We also examined the relationship between measures of reproductive success and nest site fidelity using pooled data from the two areas. Spectacled Eider females were trapped on nests, marked with nasal markers and leg bands, and identified in subsequent years. Data were log transformed due to the skewed distribution of dispersal distances. Nest success and return rates of females were higher at Kigigak Island in comparison to Kashunuk River. Females returning to Kashunuk River moved farther between consecutive nest sites than females returning to Kigigak Island. Successful females tended to move farther between consecutive years at Kashunuk River. Variability in nest locations combined with relatively small samples of unsuccessful nests may have reduced our power to assess the effect of nest fate on site fidelity. When data were pooled from both sites, unsuccessful females moved farther between consecutive years than successful females. We also did not observe a relationship between clutch size, nest initiation, and distance moved. We found no exchange of marked females between the two study areas. In conclusion, differences in quality of nesting areas as measured by nest site availability, habitat stability, and reproductive success may affect dispersal strategies and local population growth.

BASELINE AND CIRCADIAN PATTERNS OF STRESS HORMONE LEVELS IN FEMALE HARLEQUIN DUCKS

Peter Nilsson, Shannon Atkinson, Tuula E. Hollmén, Kendall Mashburn, Pamela A. Tuomi, Daniel Esler, and Daniel Rizzolo

PN, SA, TEH, KM, PAT: Alaska SeaLife Center, Seward, AK 99664, USA; peter_nilsson@alaskasealife.org
DE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada
DR: Oregon State University, Corvallis, OR 97331, USA

Little is known about baseline concentrations of adrenal hormones and hormonal responses to stress in sea ducks, although significant population declines documented in several species within the tribe Mergini suggest that sea ducks may be exposed to increased levels of environmental stress. Such declines also have been observed in geographically distinct harlequin duck populations, including those in eastern North America, and in areas oiled by the *Exxon Valdez* in Prince William Sound, Alaska. We characterized baseline corticosterone concentrations in captive harlequin duck females with the goal of developing methods to evaluate stress levels in individuals and populations in the wild. We determined natural circadian patterns of circulating corticosterone, performed an adrenocorticotropic hormone (ACTH) challenge to evaluate adrenal function, and investigated correlations between fecal and serum hormone concentrations to evaluate if fecal samples could be used as an indicator of stress levels in wild harlequin ducks. Cosyntropin, a synthetic ACTH, was used in the challenge studies with an intramuscular dose of 0.25 mg per bird. Results of serial bleeds indicate that female harlequin ducks exhibit circadian patterns of circulating corticosterone, with highest concentrations observed during the morning hours. Harlequin ducks responded to the ACTH challenge with an average of three-fold increase in serum corticosterone concentration approximately 90 min post injection.

COMPARISONS BETWEEN OBSERVED DENSITIES DURING 1978-79 AND 1993-99 SURVEY EFFORTS FOR DIVING DUCKS AND OTHER MARINE BIRD SPECIES IN THE NEAR SHORE STRATA OF NORTHERN INNER MARINE WATERS OF WASHINGTON STATE

David R. Nysewander, Joseph R. Evenson, Bryan L. Murphie, and Thomas A. Cyra

DRN and JRE: Puget Sound Ambient Monitoring Program (PSAMP), Washington Department of Fish and Wildlife (WDFW), 600 Capitol Way North, Olympia, WA 98501-1091, USA; nysewdrn@dfw.wa.gov
BLM: PSAMP, WDFW, P.O. Box 1483, Shelton, WA 98584, USA
TAC: PSAMP, WDFW, 16018 Mill Creek Blvd., Mill Creek, WA 98012, USA

Winter aerial surveys of marine birds have been conducted by the marine bird component of the Puget Sound Ambient Monitoring Program (PSAMP) annually 1992-2002 during December and January, sampling nearly every portion of the inner marine waters of Washington State. Survey effort was stratified by two depth strata: nearshore (<20m) and offshore (>20 m). These surveys annually covered approximately 15% to 19% of the nearshore and 4% to 6% of the offshore strata. Nearshore transects from winter aerial surveys during 1978-79, during the Marine Ecosystem Analyses (MESA) program, in the northern portion of inner marine waters were duplicated by a subset of the PSAMP winter nearshore aerial transects (1993-99). Density indices from these nearly identical transects were compared and trends were examined for 18 species or species groups observed on these transects: scoters, scaups, goldeneyes, bufflehead, oldsquaw, harlequin ducks, mergansers, all loons combined, common loon, western grebe, red-necked grebe, horned grebe, all cormorants combined, double-crested cormorant, brant, all gulls combined, pigeon guillemot, and marbled murrelet. The results include a mixture of changes that range from significant decreases (grebes, cormorants, loons, pigeon guillemot, marbled murrelets, scoters, scaup, oldsquaw, and brant) to stable or more slowly decreasing patterns (goldeneyes, buffleheads, and gulls) or increasing patterns (harlequin ducks and possibly mergansers). Documentation of these trends is essential to the prioritization of management decisions and the direction of future research and harvest levels regarding these marine resources or portions of their prey base.

Bird species that either eat fish or depend upon certain spawning events of Puget Sound forage fish appear to have declined more than species that emphasize feeding on other parts of the food chain like crustaceans and invertebrates. The declines in scoters and scaup in Washington State have also been seen in other marine areas throughout the Pacific Flyway, suggesting that they have not moved from Washington to some other part of their wintering range. This aspect needs to be examined for other species that have declined. We similarly examined northern and south-central portions of the PSAMP survey area, looking for evidence of movement. The southern area (south and central Puget Sound) has contained both higher densities and higher overall numbers of either western grebes or scoters, for example, than those found to the north during the 1992-2002 PSAMP surveys, but comparisons during the 10-year PSAMP period do not capture any exchange of numbers between these regions for either species.

SURGERY CONDUCTED TO INSTRUMENT SURF AND BLACK SCOTERS FOR SATELLITE TELEMETRY

Glenn H. Olsen and Matthew C. Perry

USGS, Patuxent Wildlife Research Center, Laurel, MD 20708, USA; Glenn_Olsen@usgs.gov

Satellite telemetry is being used in the Atlantic Sea duck Project to learn more about the breeding and molting areas of scoters in northern Canada. Scoters were captured on wintering grounds of Chesapeake Bay, Maryland or migrational staging areas of New Brunswick, Canada. Scoters captured in the Chesapeake Bay were transported in crates to the veterinary hospital at the USGS Patuxent Wildlife Research Center. In the case of the ducks caught in New Brunswick, they were taken to a local veterinary clinic for surgery. A PTT100 transmitter manufactured by Microwave, Inc., Columbia, Maryland was surgically implanted into the duck's abdominal cavity following general anesthesia procedures with halothane. Transmitters measured approximately 5 x 3.8 x 0.6 cm and have a nominal weight of 39 grams. This weight is slightly heavier than normal because of potting required to allow the transmitters to withstand pressures accompanying diving to depths of 30 m. The transmitter's antenna was external (percutaneous) and passed through the back of the duck using a surgical catheter. Because of recent problems with extrusion of cylindrically-shaped implant transmitters through the antenna perforation, transmitters used in this study were wide-bodied with no abrupt edges. Each duck was held post-surgery for 1-9 days, banded, and then released at the site of capture. Initially ducks were given pain reduction medication, but this was curtailed when it was observed that it made the ducks lethargic and slowed the preening process. Ducks were also initially tube fed to reduce loss of weight in captivity due to the cessation of normal feeding. This also was curtailed when two ducks died from regurgitation and inhalation of the liquid food supplement. The current techniques used to instrument scoters have been modified and improved. This technique has now minimized mortality to levels similar to other telemetry procedures. These procedures will greatly aid the conservation effort for sea ducks presently being conducted throughout the world.

TECHNIQUES TO CAPTURE SEA DUCKS IN THE CHESAPEAKE BAY AND RESTIGOUCHE RIVER

Peter C. Osenton and Matthew C. Perry

USGS, Patuxent Wildlife Research Center, 11410 American Holly Drive, Laurel, MD 20708 USA; Peter_Osenton@usgs.gov

Satellite telemetry tracking of scoters instrumented in late winter on the Chesapeake Bay in Maryland and the Restigouche River in New Brunswick is providing new information that will be beneficial to protecting critical breeding and molting habitat of scoters and improving future management of their populations. Scoters were captured alive using several techniques that have been successful in other areas. Mist nets were specially designed to be used in deep waters. Mist nets have a mesh size of 121 mm, measure 12 m by 2.6 m, and have two shelves. Mist nets were set vertically over water on telescopic poles installed in floating support bases. Nets were continually monitored closely to minimize mortality from drowning. Unfortunately, no ducks were captured with mist nets in spite of extensive efforts during the winter of 2000-01 and 2001-02. A capture net gun was obtained and finally in March 2001 the first scoter (a male surf scoter) was captured from a fast-moving boat at a distance of approximately 10 m from the boat. A total of 15 surf scoters have been captured with the net gun. This technique is very labor intensive and often 5-10 shots are necessary for each duck captured. Thirteen black scoters in New Brunswick, Canada were captured at night with long-handled dip nets from a slowly-moving boat equipped with flood lights. Lights were mounted on the bow of the boat and powered by a 12-volt battery or generators. Both techniques (net gun and night-lighting) worked most successfully when water conditions were very calm. It also is beneficial to have cloudy, foggy, or rainy conditions. All captured scoters were banded with USGS bands.

DISTRIBUTION AND FOOD HABITS OF WINTERING SEA DUCKS IN CHESAPEAKE BAY AND THE ATLANTIC FLYWAY

Matthew C. Perry, Peter C. Osenton, Edward J. R. Lohnes, David Kidwell, Nicole Barondeau, and Alicia M. Wells

USGS, Patuxent Wildlife Research Center, Laurel, MD 20708, USA; Matt_Perry@usgs.gov

Numbers of scoters (black, surf, and white-winged) and long-tailed ducks wintering in Chesapeake Bay have noticeably declined in recent years. Common goldeneye populations have also declined, but bufflehead populations have increased in numbers. Changes in the location of Bay sea duck populations have also been observed and have given managers new concerns. Many factors related to human population increases have been implicated in causing changes in the distribution and abundance of sea ducks. Anthropogenic factors that could effect the distribution and food habits of sea duck populations include direct and indirect causes, such as excessive development of Bay tributaries, increased year-round boat traffic, and increased levels of contamination. In addition, the focus of guided hunts has changed due to declines in Canada goose populations putting increased pressure on sea ducks. Analyses of the gullet (esophagus and proventriculous) and the gizzard of sea ducks are currently being conducted to determine if changes from historical data have occurred. The predominant foods of common goldeneye are the hooked mussel (*Ischadium recurvum*; 55%) and the Baltic clam (*Macoma balthica*; 38%). Bufflehead feed on the Baltic clam (49%), but also feed on the dwarf surf clam (*Mulinia lateralis*; 42%). Scoters in the Bay feed on the hooked mussel (45%) and several species of clams. The long-tailed duck appears to select the gem clam (*Gemma gemma*) in greater amounts (58%) than other sea ducks, but exhibits a diverse diet of other mollusks and crustaceans. Sea duck food habits in the Maritimes are decidedly different, where all three species of scoters feed extensively on the blue mussel (*Mytilus edulis*; 51%). Other species of mollusks that are important to scoters in the Maritimes include the Atlantic dogwinkle (*Nucella lapillus*) and the little cockle (*Cerastoderma pinnulatum*). Understanding the feeding ecology of sea ducks in wintering areas such as the Chesapeake Bay and the Maritimes will provide managers with a better understanding of the changes in the distribution and abundance of these ducks, which will help in the conservation of these species.

ATLANTIC SEA DUCK PROJECT

Patuxent Sea Duck Team

USGS, Patuxent Wildlife Research Center, Laurel, MD 20708, USA; Matt _Perry@USGS.GOV

Atlantic Sea Duck Project is being conducted to learn more about the breeding and molting areas of sea ducks in northern Canada and more about their feeding ecology on wintering areas, especially Chesapeake Bay. Satellite telemetry is being used to track surf scoters wintering in Chesapeake Bay, Maryland and black scoters on migrational staging areas in New Brunswick, Canada to breeding and molting areas in northern Canada. Various techniques used to capture the scoters included mist netting, night-lighting, and net capture guns. All captured ducks were transported to a veterinary hospital where surgery was conducted following general anesthesia procedures. A PTT100 transmitter (39 grams) manufactured by Microwave, Inc., Columbia, Maryland was implanted into the duck's abdominal cavity with an external (percutaneous) antenna. Eight of the surf scoters from Chesapeake Bay successfully migrated to possible breeding areas in Canada and all 13 of the black scoters migrated to suspected breeding areas. Ten of the 11 black scoter males migrated to James Bay presumably for molting. Updated information from the ARGOS Systems aboard the NOAA satellites on scoter movements was made accessible on the Patuxent Website. Habitat cover types of locations using GIS (Geographical Information Systems) and aerial photographs (in conjunction with remote sensing software) are currently being analyzed to build thematic maps with varying cosmetic layer applications. Many factors related to human population increases have been implicated in causing changes in the distribution and abundance of wintering sea ducks. Analyses of the gullet (esophagus and proventriculous) and the gizzard of sea ducks are currently being conducted to determine if changes from historical data have occurred. Scoters in the Bay feed predominantly on the hooked mussel and several species of clams. The long-tailed duck appears to select the gem clam in greater amounts than other sea ducks, but exhibits a diverse diet of other mollusks and crustaceans. Sea duck food habits in the Maritimes are decidedly different, where all three species of scoters feed extensively on the blue mussel. Understanding the feeding ecology of sea ducks in wintering areas such as the Chesapeake Bay and the Maritimes will provide managers with a better understanding of the changes in the distribution and abundance of these ducks. Future studies will attempt to determine the effects of experimental diets varying in protein and energy levels on the physiology and behavior of captive sea ducks. An attempt will be made to determine if sea ducks exhibit an endogenous rhythm in regard to body weight and condition during the winter. Foraging energetics in relation to different food sources found in the Chesapeake Bay will be measured in the two large aquariums (dive tanks) with scoters and long-tailed ducks. The combined studies being conducted in the Atlantic Sea Duck Project will greatly aid the conservation effort for sea ducks presently being conducted throughout the world.

USING AERIAL LINE TRANSECT COUNTS TO SURVEY OFFSHORE SEA DUCKS

Ib Krag Petersen

National Environmental Research Institute (NERI), Grenaavej 12, DK-8410 Roende, Denmark; ikp@DMU.dk

Since early 1999, NERI has conducted more than 350 hours of aerial seabird surveys in four shallow offshore areas. The aim was to establish baseline information for a study of impacts on avian distribution from planned offshore windfarms.

Surveys were performed as aerial line-transect counts from an altitude of 250 feet. One observer on each side of the aircraft recorded observations using a Dictaphone. All observations were assigned to three transect bands, defined within perpendicular distance classes from the flight track (and confirmed using inclinometers). A GPS logged aircraft position and time every 5 seconds, allowing for high geographical precision in positioning observations.

All bird observations, track effort data and survey condition data (e.g. light, weather and sea state) were entered into a GIS platform. The GIS platform made it possible to combine further environmental information, including for instance water depth, seabed slope and distance to nearest coast.

Data on Common Scoter *(Melanitta nigra)* from 13 surveys in a 5000 km^2 study area will be presented to illustrate survey method and some results. The data showed within year distribution changes, which appear consistent between years from this, the most important moulting and wintering area in the Western Palearctic for Common Scoters.

IMPORTANCE OF THE ALASKAN BEAUFORT SEA TO KING EIDERS DURING FALL MIGRATION

Laura M. Phillips, Abby N. Powell, and Eric J. Taylor

LMP: AK Cooperative Fish and Wildlife Research Unit, Dept. of Biology and Wildlife, University of Alaska, Fairbanks, AK 99775, USA; fslmp@uaf.edu
ANP: AK Cooperative Fish and Wildlife Research Unit, Dept. of Biology and Wildlife, University of Alaska, Fairbanks, AK 99775, USA
EJT: Migratory Bird Management, US Fish and Wildlife Service, Fairbanks, AK 99701, USA

Indication of declines in the North American population of king eiders (*Somateria spactabilis*) has increased interest in this species. Impending oil and gas development in areas where king eiders breed, stage, molt and over-winter has also highlighted the need for basic life history information. Few data are available about fall migration for western arctic king eiders (but see Dickson et al. 2000), and the biology of king eiders in the Beaufort Sea is poorly understood. This study will provide baseline data on the use of the Beaufort Sea by king eiders to better understand potential impacts from offshore oil development. We trapped 21 pre-breeding king eiders (11 females and 10 males) at Kuparuk, Alaska in June 2002 using mist nets and decoys. Satellite platform transmitting terminal (PTT) transmitters were surgically implanted into the abdominal cavity of the eiders following the techniques described by Korschgen et al. (1996) and Petersen et al. (1995). The transmitters were programmed to transmit for 6 hours every 48 hours during fall migration. Transmitter locations are processed by Service ARGOS (Landover, Maryland) and then plotted using ArcView. Preliminary fall migration data will be mapped and presented. Location data will be analyzed to determine possible staging and molting areas. Locations will also be overlaid using bathymetric and ice data to quantify distance offshore, water depth and proximity to ice edge.

HABITAT USE AND FEEDING ACTIVITY OF LONG-TAILED DUCKS IN THE BEAUFORT SEA

John A. Reed, Richard B. Lanctot, and Deborah L. Lacroix

Alaska Science Center, U.S. Geological Survey, 1011 E. Tudor Rd., Anchorage, AK 99503, USA; john_reed@usgs.gov

Long-tailed duck (*Clangula hyemalis*) populations are in an unexplained long-term decline. During the summers of 2000 and 2001, we tracked the movements and feeding behavior of flightless long-tailed ducks at 3 sites along the Beaufort Sea coast. One ('industrial') site was adjacent to on-shore and near-shore oil development areas, the other 2 ('control') sites were located in presently undeveloped areas. We fitted 175 male ducks with VHF transmitters and through triangulation we monitored their movements and feeding activity hourly with remotely located receivers. We classified duck locations into 3 habitats: near barrier islands, near mainland, and in lagoons. Generally, we saw a diurnal pattern of feeding activity and habitat use, with ducks feeding in the lagoons during the day and roosting near islands at night. We found no evidence of an effect of oil development on habitat use or feeding activity on the ducks. One of the industrial sites and one of the control sites showed similar patterns, while activity and habitat use in the other control site were distinctive. Our data also suggest that as the ducks regained flight capability, they left the lagoons daily to feed elsewhere and returned at night to roost.

SURVIVAL AND MOVEMENT OF JUVENILE HARLEQUIN DUCKS IN THEIR FIRST WINTER

Heidi M. Regehr

Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; hmregehr@sfu.ca

Age-specific survival and movement rates are important components of demography and population structure and quantification of these rates is vital to management and conservation, however, information on the post-fledging ecology of waterfowl species is frequently unavailable to managers. Although age-ratios can provide a measure of production for hunted species and for species with identifiable first-year plumage, age-specific survival rates are needed to estimate recruitment into the breeding population. Information on age-specific movement patterns is needed to separate true mortality from emigration, which is an important distinction for large-scale management of populations, and to aid in our understanding of the genetic and demographic relationships of subpopulations. I studied the survival and movements of juvenile Harlequin Ducks (Histrionicus histrionicus) in their first winter in the Strait of Georgia, British Columbia. At least eight of nine radio-marked females survived the winter; three of six radio-marked males died in their first two months at the coast. Female movement distances ranged from less than 5 to 48 km from their capture site. Resightings of leg-banded individuals indicated that males and females were equally likely to be seen at their capture location in their second winter. CMR analysis indicated that juvenile males had lowest local survival rates of all sex-age classes, probably reflecting greater dispersal distances, and possibly higher true mortality of male than female juveniles. High survival of juvenile females suggested that winter survival rates do not differ among female age classes. Movement by juveniles of both sexes during their first winter suggests that males and females both likely contribute to gene flow among populations.

MONITORING NOCTURNAL DIVING ACTIVITY OF HARLEQUIN DUCKS ON THEIR WINTERING GROUNDS USING RADIO TELEMETRY

Daniel J. Rizzolo, Daniel Esler, Robert L. Jarvis, and Daniel D. Roby

DJR, RLJ, and DDR: Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR 97331, USA; rizzolod@onid.orst.edu
DE: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

We monitored the radio-signal pulse rates of 10 radio-marked harlequin ducks wintering in Resurrection Bay, Alaska from November 2001 through February 2002 for evidence of nocturnal foraging. Pulse rate was measured for each detected signal as an indicator of diving behavior. Direct daytime observation of radio-marked birds confirmed that no pulses were detected during dives. Average pulse rate was lower during diurnal than during nocturnal detections. Signal reception remained constant for all nocturnal detections (n=164), while reception remained constant in 30% of diurnal observations (n=76). These observations support the hypothesis that harlequin ducks forage only during daylight. Foraging only during the diurnal period greatly restricts available foraging time and suggests that harlequin ducks wintering in Alaska have little flexibility in winter time-activity budgets to accommodate additive stresses from anthropogenic disturbance.

SEX AND AGE DIFFERENCES IN DISTRIBUTION, ABUNDANCE, AND HABITAT PREFERENCES OF WINTERING HARLEQUIN DUCKS: IMPLICATIONS FOR CONSERVATION AND ESTIMATING RECRUITMENT

Michael S. Rodway, Heidi M. Regehr, and Fred Cooke

Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; msrodway@sfu.ca

We determined sex- and age-specific distribution, abundance, and habitat preferences of wintering Harlequin Ducks, and evaluated potential biases in measuring ratio s of immature to adult males to estimate recruitment. Comparing occurrence of birds to habitat availability at a 1-km scale indicated a preference for wide intertidal habitat with cobble-gravel or boulder-rock substrates, for small, offshore islets and shoreline with attached or nearby reefs and islets, for areas without streams, and for areas with greater historical abundance of spawning by herring. Where substrate was boulder-rock, birds preferred areas with tidal rapids. Highest densities of birds occurred along linear and complex shorelines with reefs or islets where intertidal habitat was >100 m wide and substrate was cobble-gravel or rock-boulder. Patterns of habitat use among sex and age classes were the same at a 1-km scale, but differed at smaller scales with adult and immature males occurring further offshore than females. Age ratios differed among areas and were biased by survey method and by misidentification of offshore birds. Correcting for detected biases gave a male-age-ratio estimate of 9.8%. Calculated estimates of female recruitment suggest a declining population, but adult survival estimates need to incorporate emigration before demographic trends can confidently be inferred.

THREE YEARS OF VOLUNTEER-COLLECTED SEA DUCK DATA FROM THE BRITISH COLUMBIA COASTAL WATERBIRD SURVEY

Jeanne Roy

Bird Studies Canada, 5421 Robertson Road, Delta, BC, V4K 3N2, Canada;
jeanne.roy@ec.gc.ca

Bird Studies Canada (BSC) is a not-for-profit conservation organization dedicated to the study of wild birds and their habitats. BSC currently draws over 6,000 volunteers annually to participate in local, regional, national and international programs of research and education in support of bird conservation. From a need to collect baseline data on the abundance and distribution of waterbird species on the coast of BC, Bird Studies Canada, in partnership with the Canadian Wildlife Service, launched the first regional program in BC – the BC Coastal Waterbird Survey - in 1999. The survey is now approximately 230 volunteers strong. These intrepid volunteers walk their designated beaches once per month from September through April counting waterbirds. Data collected will ultimately be used to detect distribution patterns, estimate wintering population sizes, assess annual and long-term trends in population size and distribution of coastal waterbirds, and advance our understanding of the ecology and the effects of human activity on coastal waterbirds in BC. Three years of data have been collected to date with another two years proposed. Presented herein are three years of sea duck data collected from these monthly surveys from beaches throughout BC.

MOULTING SURF SCOTERS: CHRONOLOGY, LOCATION AND BEHAVIOUR

Jean-Pierre L. Savard

Canadian Wildlife Service, Quebec Region, Quebec, G1V 4H5, Canada; jean-pierre.savard@ec.gc.ca

Until recently, little was known of the ecology of Surf Scoters, especially during the moulting period. The distribution of moulting Surf Scoters is now fairly well known on the west and east coasts with several important moulting areas having been located. However much is still unknown about the chronology of moult among sex and age classes, habitat selection and behaviour during that period. Aerial and ground surveys and observations of scoter flocks in the St. Lawrence estuary in the last five years have shed some light on the chronology of moult, the composition and the behaviour of moulting flocks. Although Surf Scoters are less widely distributed during moult than in either the spring and fall, some moulting sites cover areas of several kilometres. At one site in early August (1-4), species composition was 94% Surf Scoter, 5% White-winged scoter and 1% Black Scoter (n = 2180 scoters distributed in 19 flocks). Sex ratio for Surf Scoter was 91.5% males and 5.6% females (n = 2054 Surf Scoters). Age ratios for males was 90.9% adult and 9.1% sub adults (n = 757 males in 8 different flocks). Preliminary observations indicated that moulting flocks were quite dynamic, splitting and aggregating throughout the day. Feeding was the most frequent activity and diving synchrony varied among flocks. Most feeding was in the subtidal zone. Flocks were distributed along at least 7 km of shoreline in flocks ranging from 10 to 500 scoters, totalling more than 5,000 birds. Moult chronology varied within male's flocks and females moulted later than males. Better understanding of the requirements (habitat, food) of moulting Surf Scoters will greatly help reduce potential conflicts with shellfish fisheries, aquaculture and recreational activities, and gill net fisheries.

DUCKLING SURVIVAL IN COMMON GOLDENEYES (*BUCEPHALA CLANGULA*) IN ALASKA: PRELIMINARY RESULTS

Joshua H. Schmidt, Department of Biology and Wildlife, University of Alaska, Fairbanks, USA; jschmidt444@hotmail.com

An established nest-box population of common goldeneyes (*Bucephala clangula*) was surveyed to determine occupancy of 150 available nest-boxes. Of the 47 successful nesting females, 19 were fitted with VHF radio transmitters. Ducklings were banded with metal leg bands and cheek patches were color-coded to aid in brood identification. Broods were relocated approximately every 2-3 days. Of the 19 radioed birds, 3 were never relocated and at least 14 radios were dropped within 3 weeks of attachment. Using a combination of radio tracking and color-codes, survival data for 2-4 weeks of age were obtained for approximately 20 broods. Most duckling loss occurred during the first two weeks after hatch. Known-fate analysis will be used to examine the influence of hatch date and nesting wetland type on brood survival.

COMPARATIVE BROOD-REARING ECOLOGY OF COMMON GOLDENEYES AND HOODED MERGANSERS IN A RIVER HABITAT

Hélène Sénéchal, Gilles Gauthier and Jean-Pierre L. Savard

HS: Département de Biologie and Centre d'études nordiques, Université Laval, Ste-Foy Québec G1K 7P4, Canada; h_senechal@hotmail.com
GG: Département de Biologie and Centre d'études nordiques, Université Laval, Ste-Foy, Québec G1K 7P4, Canada
JPLS: Canadian Wildlife Service, Quebec Region, 1141, Route de l'Église C.P. 10100, Sainte-Foy, Québec G1V 4H5, Canada

Populations of Common Goldeneyes (*Bucephala clangula*) and Hooded Mergansers (*Lophodytes cucullatus*), two sea duck species nesting in tree cavities, are designated of special concern in eastern North America. Nevertheless, nest boxes installed along the Ste. Marguerite River in Quebec have been used extensively by these two species since 1999, even if they are not known to use rivers with such a strong current. Since this type of river is common in the boreal forest, we wanted to identify the brood-rearing habitats used by the two species in this unusual environment. Using nasal markers and harness radio-transmitters fitted on incubating females (goldeneye: n = 26; merganser: n = 11), we followed brood movements and habitat use by broods. We found that the river itself received little use by the broods of the 2 species, whereas lakes and ponds were the main habitats used. Some goldeneye broods used river meanders for rearing, but the river served primarily as a travel route for broods. Distances travelled were generally less than 2 km (43% of goldeneye broods and 80% of merganser broods), but some goldeneye broods travelled long distances on the river (up to 10 km). Finally, the fact that many duck families left the river for rearing suggests that the use of the river as a nesting site is an opportunist strategy related to the low density of natural cavities in the environment (0.92 cavity / ha), rather than to the quality of the river as a breeding site.

STRAIT OF GEORGIA, BRITISH COLUMBIA – WINTERING AREA FOR HARLEQUIN DUCKS THAT BREED THROUGHOUT THE PACIFIC NORTHWEST

Cyndi M. Smith and Constance M. Smith

CMS: Parks Canada, Waterton Lakes National Park, Waterton Park, AB T0K 2M0, Canada; Cyndi.Smith@pc.gc.ca
CMS: Centre for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

It is very difficult to track individual migratory ducks between breeding and wintering areas. Since 1992 various researchers have been banding harlequin ducks in western Canada and the USA with uniquely coded colour leg bands. Many of these birds have been resighted at breeding streams and wintering areas. We show that the Strait of Georgia, in particular the area on the east side of Vancouver Island from Qualicum Beach to Quadra Island, is an important wintering area for harlequin ducks from breeding streams throughout the Pacific Northwest. Birds that were banded on breeding streams in Alberta, British Columbia, Idaho, Montana, Oregon and Washington have been resighted in the Strait of Georgia, and birds that were banded in the Strait have been resighted inland. These connections have been made possible through the cooperation of many researchers and volunteers.

IS AN EIDER GROUP HOMOGENOUS IN THE BREEDING STRATEGY?

Diana V. Solovieva

Lena-Delta State Reserve, Fiodorova st., 28, Tiksi, 678400, Yakutia, Russia;
diana@DS3902.spb.edu

Eider breeding strategy is known as unique among ducks. Eider female relies upon internal fat resources for the clutch formation. Necessary fat resources should be built long prior to nesting by the intensive exploitation of the marine food. *Somateria* eider females are unable for efficient feeding on the fresh water on the breeding grounds. Their feeding on the breeding ground serves for subsistence only. However, the Steller's Eider of the *Polysticta* genera illustrates different breeding strategy. Steller's eider female build the clutch from the exogenous resources, which are gathered on the fresh water bodies of the breeding grounds. *Somateria* eiders stably lost body mass after departure of marine environment and arrival of the breeding grounds. *Polysticta* eider increases body mass in the period between arrival and egg laying. The clutch size, egg mass and newly-hatched duckling mass is significantly higher in *Polysticta* comparing to *Somateria*. The benefit of both strategies is discussed.

SEA DUCKS ON SIBERIAN POLYNYA OF THE ARCTIC OCEAN

Diana V. Solovieva

Lena-Delta State Reserve, Fiodorova st., 28, Tiksi, 678400, Yakutia, Russia;
diana@DS3902.spb.edu

Pacific wintering sea ducks come for breeding to the Russian Arctic tundra, situated as far as 5,000 km from the Pacific. Their spring migration occurs in March – May and, thus, passes over ice-covered Arctic Ocean. The Great Siberian Polynia is a stable lead between fast and drift ice of the Arctic Ocean. This open lead is latitudinally oriented and serves as a fly-way and a stopover site for a number of sea ducks, migrating westward from the Pacific. King Eider and Oldsquaw were found to pass west along the Siberian Polynia (Laptev Sea) in spring 1996. Between years mass variation of the arriving King Eiders seemingly depends on the situation along the Polynia. The diet of arriving King Eiders indicates the use of the Polynia bottom communities. The methodological gap in our knowledge on sea duck thermoregulation should be filled to understand the energy balance of high Arctic living eiders.

POPULATION STRUCTURE OF COMMON EIDERS NESTING ON COASTAL BARRIER ISLANDS ADJACENT TO OIL FACILITIES IN THE BEAUFORT SEA

Sarah A. Sonsthagen, Sandra L. Talbot, Kim T. Scribner, Richard B. Lanctot and Kevin McCracken

SAS and KGM: Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, AK 99775, USA; ssonsthagen@yahoo.com
SLT: U. S. Geological Survey, Alaska Science Center, 1011 E. Tudor Road, Anchorage, AK 99503, USA
RBL: U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503, USA
KTS: Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824, USA

Populations of common eiders breeding on the North Slope of Alaska have declined approximately 30% since the 1970s. Although little is known about their breeding biology, increased offshore drilling activities demonstrate the need to assess the importance of individual barrier islands to breeding eider populations in the event of development and/or oil spills. Recapture data suggest that some individuals nest on different islands, depending upon year, potentially maintaining gene flow throughout the North Slope. No data are available for levels of genetic variability of eiders across their range in the North Slope and how this variability relates to levels in historic populations. Using microsatellite DNA markers, we will characterize genetic population parameters and gene flow within common eiders breeding on the North Slope and compare these population parameters to individuals sampled in Alaska, Russia, and historic North Slope populations. While we expect to see relatively high levels of gene flow within the North Slope population, it is important to assess the genetic uniqueness of this population and each barrier island relative to common eiders across their range.

WINTERING GROUND EFFECTS ON VITAL RATES OF WHITE-WINGED SCOTERS AT REDBERRY LAKE, SK

Cindy J. Swoboda, Ray T. Alisauskas, and F. Patrick Kehoe

CJS: Department of Biology, University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada; cindy.swoboda@ec.gc.ca
RTA: University of Saskatchewan and Canadian Wildlife Service, Prairie and Northern Wildlife Research Centre, Saskatoon, SK S7N 0X4, Canada
FPK: Ducks Unlimited Canada, Brooks, AB T1R 1B7, Canada

White-winged scoter duck (*Melanitta fusca delgandi*) populations have declined markedly in the prairie parklands and boreal forests of Canada in the last four decades. Recent declines have resulted in a northwestward retraction of the southern breeding limit and extirpation of local breeding populations in southern Alberta and Manitoba. Local populations in Saskatchewan are presently declining at a rate similar to the decline observed in North Dakota earlier in this century. The causes for decline are unknown, however, it may not be limited to the breeding grounds. Little is known on how the wintering grounds affect white-winged scoter vital rates on the nesting grounds. Nevertheless, it may have a strong influence on population dynamics by limiting reproductive success, survival and local recruitment. Research to determine wintering ground influence on various vital rates of nesting white-winged scoters began in June 2002, and will continue into the fall of 2003. Band recoveries show scoters nesting at Redberry Lake migrate to both Atlantic and Pacific coasts to winter. Delineation of coastal wintering populations will be attempted using stable isotope analysis of feathers. Samples from scoters on the wintering grounds will provide the reference to stratify the population nesting at Redberry Lake by winter origin. Primary objectives are to determine wintering ground philopatry as well as differences in morphology, body condition, adult female survival rates, clutch size and nest success. If wintering populations can be distinguished, differences in contaminant loads may be studied. This research will provide background knowledge needed to implement management strategies to arrest or reverse declines in the North American population of White-winged scoters.

WHITE-WINGED SCOTER COUNTS IN WEST-CENTRAL SASKATCHEWAN

Cindy J. Swoboda, Ray T. Alisauskas, F. Patrick Kehoe, and Joshua J. Traylor

CJS: Department of Biology, University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada; cindy.swoboda@ec.gc.ca
RTA: University of Saskatchewan and Canadian Wildlife Service, Prairie and Northern Wildlife Research Centre, Saskatoon, SK S7N 0X4, Canada
FPK: Ducks Unlimited Canada, Brooks, AB T1R 1B7, Canada
JJT: Department of Biology, University of Saskatchewan, Saskatoon, SK S7N 5E2, Canada

White-winged scoters (*Melanitta fusca delgandi*) once bred throughout the prairies and parklands of North America. However, the southern extent of their former range has retracted northwestward. Populations have become locally extinct within the prairie region during the last 50 years, and this has resulted in the southern limit presently terminating in the aspen parkland region. Local populations in parkland Saskatchewan are presently showing patterns of decline similar to those noted in North Dakota earlier in this century. To compare local population estimates with historic data we conducted annual pair counts at several lakes in west-central Saskatchewan. Some local populations are experiencing declines, such as Redberry Lake, where the population has declined by approximately 44% in the last 20 years, while other areas, such as Iroquois Lake, have already become locally extinct. Preliminary results from pair count data suggest the northwestward breeding range retraction is continuing. This underscores the need for scientific research to gain a better understanding of the factors influencing population dynamics of this species.

POPULATION STATUS AND SUBSISTENCE HUNTING ON EIDERS IN EASTERN RUSSIAN ARCTIC

E.E.Syroechkovski, Jr. and E.G.Lappo

Institute of Ecology and Evolution, Moscow 110000, Russia; rgg@eesjr.msk.ru

Studies on eider distribution and subsistence hunting pressure where curried out in 1994-2002 along North Yakutia and Chukotka coasts as part of general waterfowl inventory and monitoring projects. Four eider species are breeding and migrating along 6000 km of Yakutia and Chuktoka coasts. King, Steller's and Spectacled Eiders are breeding mainly in Yaktuian Lowlands. Spectacled Eider up to Cahun Bay and King Eider a bit further more east and has a separated part of breeding range in Anadyr Estuary. Common Eider breeds in Chukotka lowlands and only little penetrates eats to Yakutia. Recent surveys had improved knowledge on distribution of breeding range and non breeding concentrations of and corrected range maps where created based on GIS Data Base. Important are discoveries for Steller's Edier: new molting site of Steller's Eiders at Koliuchin Bay and number of locations of intensive migration at Chukotka coasts, including migration across mainland Chukotka in spring.

Eider subsistence hunting is going on in 55 coastal villages (less then 100 km from the ocean coast). Eiders make bout 40 to 70 % of hunting bag in the villages. Total of about 12-15 thousands of both native (Dolgans, Yakut, Even, Yukagir, Chukchi and Eskimo) and Russian settlers and nomadic reindeer people are hunting eiders for 4 to 7 months. Current Russian Hunting Law and Decree of 1992 by Boris El'tsin on the rights of indigenous peoples to hunt anytime they need for surviving of their families are in strong contradiction. So regulation of hunting in villages is difficult. There are several tendencies which bring to increase of Eider hunting pressure in last 10 years: (1) economic stagnation, delayed salaries and bad food supply in shops; (2) decrease of control by hunting inspectors; (3) continuous decline of geese population in East Asia, which bring to switch from Geese to Eider hunting in many places. Some factors may decrease hunting pressure: (1) decrease of human population - emigration of about 30% of hunters (mainly Russians); (2) increase of prices on ammunition and worse supply of villages by cartridges. Quantitive estimation of role of these factors is not made yet. Information on hunting bags was collected mainly by interviewing hunters but quantative estimation of total numbers of eiders shot was made first time in 2002 in village of Neshkan (North Chukotka), using adapted methodology from Yukon-Kuskokvim Delta Harvest Survey. More then 50% of 200 hunters (13-65 years old) had filled in the forms. Eiders make 34% of whole bag, geese - 33 %, and other ducks - 19%. Total of 2400 Eiders where shot in 2001 (Common - 60%; King – 26%; Spectacled - 11% and Stellers - 3%). In other villages this proportion can be different and there are many villages in Yakutia and North Chukotka, where Steller's and Spectacled Eiders are dominating in harvest. Catching of molting birds is still made when possible. Main known place – Mechigmen Bay, where at least 1000 Spectacled Eiders are captured every year. Interviews with hunters show very low level of environmental education: nearly nobody had heard about led poisoning and Eiders as threatened species. For estimation of total numbers of different species intensive project on estimation of Eider harvest is planned. Preliminary estimation of hunting bag of total Eider hunting bag along the Northern coasts of Russia may make about 50 – 80 000 birds a year.

BIOMARKER RESPONSES IN NESTING, COMMON EIDERS IN THE CANADIAN ARCTIC IN RELATION TO TISSUE CADMIUM, MERCURY AND SELENIUM CONCENTRATIONS

Mark Wayland, Judit E.G. Smits, Grant Gilchrist, Tracy Marchant and Jonathan Keating

MW, JK: Environment Canada, Prairie & Northern Region, Prairie & Northern Wildlife Research Centre, 115 Perimeter rd., Saskatoon, SK S7N 0X4, Canada; Mark.Wayland@ec.gc.ca
JEGS: Dep't. of Veterinary Pathology, Western College of Veterinary Medicine, University of Saskatchewan, 42 Campus Dr., Saskatoon, SK S7N 5B3, Canada
GG: Canadian Wildlife Service, Prairie & Northern Region, c/o 100 Gamelin Blvd., Hull, Quebec, K1A 0H3, Canada
TM: Department of Biology, University of Saskatchewan, 112 Science Place, Saskatoon, SK S7N 5E2, Canada

Populations of many North American sea ducks are declining. Biomarkers may offer valuable insights regarding the health and fitness of sea ducks in relation to contaminant burdens. In this study we examined body condition, immune function, corticosterone stress response, liver glycogen levels and vitamin A status in relation to tissue concentrations of mercury, selenium and cadmium in female common eiders during the nesting period. The study was conducted in the eastern Canadian arctic during July, 2000. Hepatic mercury and selenium and renal cadmium concentrations ranged from 1.5-9.8, 6.5-47.5 and 74-389 $mg \cdot g^{-1}$, dry wt, respectively. Mercury concentrations were negatively related to dissection body mass, heart mass and fat mass. Cadmium concentrations were negatively related to mass at capture and dissection mass after controlling for the mercury concentration-dissection mass relationship. Cell-mediated immunity was assessed by the skin swelling reaction to an injection of phytohemagglutinin-P, and was unrelated to metal concentrations. After adjusting the corticosterone concentration to account for the time between capture and sampling, there was a negative relationship between the residual corticosterone concentration and selenium. Liver glycogen concentrations were not significantly related to metal concentrations. Mercury concentrations were positively related to those of hepatic retinol and retinyl palmitate and the ratio of the retinol to retinyl palmitate in liver. They were negatively related to the ratio of plasma to liver retinol. Our findings do not indicate that exposure to metals may have adversely affected the health of these birds. They do, however, suggest that more research is required to elucidate mechanisms by which exposure to these metals could impact body condition.

NEW INITIATIVE WITH NUTRITION AND PHYSIOLOGY OF SEA DUCKS AT PATUXENT WILDLIFE RESEARCH CENTER

Alicia M. Wells, Matthew C. Perry, and Mary Ann Ottinger

AMW & MCP: USGS, Patuxent Wildlife Research Center, 11410 American Holly Drive, Laurel, MD 20708, USA; Alicia_Wells@USGS.GOV
MAO: Department of Animal and Avian Sciences, University of Maryland, College Park, MD 20742, USA

Winter feeding ecology of sea ducks is difficult to study because of the remote location of these ducks in the Chesapeake Bay and other areas of the Atlantic coast. Changes in the Bay due increasing human use present concerns to managers in regard to how changes in the distribution and abundance of food resources could effect populations of sea ducks. A new study is being conducted on captive sea ducks at USGS-Patuxent Wildlife Research Center (PWRC) to learn more about their physiology and behavior in relation to different diets varying in protein and energy levels. Eggs of sea ducks will be collected in 2003 in northern Canada with the aid of satellite and VHF telemetry to locate nesting females. This study will establish techniques and protocols to obtain and maintain a captive colony of several species with initial focus on the three species of scoters (black, surf, and white-winged) and long-tailed duck. Other species that will be considered for captive colony research are the bufflehead and the common goldeneye. Data on growth, energetics, and blood physiology will be collected on young birds to establish background information on these species during their formative years. The studies to be conducted in future years will attempt to determine the effects of experimental diets varying in protein and energy levels on the physiology and behavior of captive sea ducks. Also, we will attempt to determine if sea ducks exhibit an endogenous rhythm in regard to body weight and condition during the winter. Two dive tanks have been constructed and will be used to analyze the influence of depth of water, density of food, and depth of substrate on the feeding performance of sea ducks in a large aquarium (dive tank). We will measure how a shift between food sources influences the foraging energetics and we will evaluate each food type in terms of profitability (energy intake – cost of diving). We will measure the assimilation efficiency (fraction of ingested energy absorbed by the gut) of different food sources found in the Chesapeake Bay and the "functional response" (food intake rate for different prey sizes, densities, and depth in substrate). With this information we will attempt to model the foraging energetics of these species in response to changes in prey density, prey size, and depth in substrate. Changes in distribution and abundance of food resources will be important in relation to changes in the distribution and abundance of sea ducks, which is an important factor in managing sea duck populations on wintering habitats. This paper discusses the past research conducted with sea ducks in captivity and the hypotheses that we will be testing in the future.

CONCENTRATIONS OF TRACE ELEMENTS IN BLOOD OF SPECTACLED AND KING EIDERS IN NORTHERN ALASKA

Heather M. Wilson, Margaret R. Petersen, and Declan Troy

HMW and MRP: Alaska Science Center, U.S. Geological Survey, Anchorage, AK 99503, USA; hw_chickaree@hotmail.com
DT: Troy Ecological Research Associates, 2322 E. 16th Ave., Anchorage, AK 99508, USA

In 1996 we measured concentrations of arsenic, barium, cadmium, lead, mercury, and selenium in the blood of king (*Somateria spectabilis*) and spectacled (*S. fischeri*) eid ers breeding in northern Alaska, USA. We sampled adults from both species and duckling spectacled eiders. In spectacled eiders lead was found at levels consistent with clinical toxicity. In both spectacled and king eiders, selenium was also found at high levels compared to concentrations considered toxic in freshwater birds. However, the significance of these high selenium levels for eiders is still unclear. Concentrations of cadmium and mercury varied between species, and concentrations of barium, cadmium, mercury, and selenium varied between sexes. Elevated lead levels in one duckling and two adult female spectacled eiders suggest that lead was available on the breeding grounds. Mercury concentrations were positively correlated with date, and detectable mercury was found in 100% of spectacled eider adults and 42% of ducklings. This suggests that mercury was also available on the study area. Barium and selenium levels decreased through the breeding season and selenium declined at 2.25% 0.9% per day. Selenium levels were lower in eiders arriving to the breeding grounds in northern Alaska than in western Alaska; this could be due to different elimination times along respective migration routes and variation in exposure at spring staging areas. Most trace elements and heavy metals for which we tested were not at concentrations currently considered toxic to marine birds. However, potential exposure to mercury and lead on the breeding grounds warrants further attention.

BREEDING ECOLOGY OF COMMON EIDERS ON THE YUKON-KUSKOKWIM DELTA, ALASKA

Heather M. Wilson, Tina L. Moran, Paul L. Flint and Abby N. Powell

HMW & ANP: Deptartment of Biology and Wildlife, University of Alaska, Fairbanks, AK 99775, USA; hw_chickaree@hotmail.com
TLM Yukon Delta National Wildlife Refuge, P.O. Box 346, Bethel, AK 99559, USA
PLF: Alaska Science Center, U.S. Geological Survey, Anchorage, AK 99503, USA

Indices of pacific common eider (*Somateria mollissima v-nigra*) populations in western North America have declined by approximately 50% in the past 25 years, and common eiders are currently considered a "species at risk" by the U.S. Fish and Wildlife Service (Region 7). Over the past 10 years, the Yukon Delta National Wildlife Refuge and the Alaska Science Center have conducted common eider research focusing on adult female survival, reproduction, and duckling survival at two sites (Kigigak Island and the Tutakoke River) on the Yukon-Kuskokwim Delta (YKD) in western Alaska. In 2002, I began the first of a multi-year study on the survival and reproduction of common eiders on the YKD. My project combines historical data from the previous studies, with new survival and breeding ecology information from both locations. I report preliminary results, including nest initiation dates, nesting chronology, average clutch size, apparent nest success, and marked to unmarked ratios of captured females. In the 2002 season, we monitored 333 nests; 201 at Kigigak Island and 132 at the Tutakoke River. The ratio of marked to unmarked individuals was 50% (n=70) at Tutakoke River and 13% (n=64) at Kigigak Island. Recapture histories will be used to examine variation in survival among years, among study areas, and across a range of covariates. Nesting data will be used to evaluate variation in breeding success by nest initiation date, geographic area, and among years. Estimates of female survival and productivity will be combined with previously published estimates of duckling survival, for use in a common eider population model, similar to that developed for sympatric breeding spectacled eiders. This model will compare and contrast life-history parameters among geographic areas on the YKD, thereby assisting managers in defining the necessary steps required to achieve breeding population objectives.

POTENTIAL HUNTER CAUSED REDUCTION OF A RESIDENT HARLEQUIN DUCK POPULATION IN UYAK BAY, KODIAK ISLAND, ALASKA?

Denny Zwiefelhofer

Kodiak National Wildlife Refuge, 1390 Buskin River Rd., Kodiak, AK, USA;
denny_zwiefelhofer@fws.gov

Shoreline surveys of Uyak Bay were conducted from 1994-1997 during August to document distribution and abundance of molting harlequin ducks. A sub-section of the survey area consisting of the inner portion of Uyak Bay, south of Amook Island had an average of 498 harlequin ducks observed over the 4-year period. Survey counts ranged from a high count of 589 harlequin ducks in 1996 to a low of 427 harlequins in 1997. The sub-section shoreline surveys were completed on August 24 and August 25 of 2001 and 2002 in the inner Uyak Bay area covered during 1994-97 period. The survey totals were 217 and 237 harlequins (2001) and 279 and 298 (2002), respectively from the consecutive survey days (August 24 and 25). The molting harlequin duck population from in the inner Uyak Bay area appears to have been reduced by 42 to 54% during the period August, 1996 through September, 2002. Molting surveys conducted during August 1998 through 2000 on the east side of Kodiak produced highly stable counts ranging from 1244 to 1301 harlequin ducks. As part of a large scale harlequin duck genetics study of the North Pacific, a total of 225 harlequin ducks were captured and banded from the inner Uyak Bay area during August 1996 to August 1999. Band returns from October 1996 through January 2002 indicated that a minimum of 23 (10.2%) harlequin ducks (22 males, 1 female) banded during the 1996-99 capture efforts had been killed by hunters. All of the harlequin kill locations came from Kodiak Island, with a minimum of 20 of the 23 banded harlequins were shot <20 kilometers from the banding site within Uyak Bay. Prior to the early 1990's, the village of Larsen Bay, air charter tent camps, 5 private cabins, and the 3 big game hunting guides permitted to operate in Uyak Bay were responsible for the majority of the waterfowl hunting effort. Currently, 6 hunting lodge outfitters, approximately 25 private hunting and fishing cabins, plus the 3 original big game guides and the Larsen Bay village (150^{+} people) sport and subsistence hunt for waterfowl within a 20 kilometer radius of the capture/banding location. Additionally, six or more tent camps may be transported to Uyak by air charter operators plus four or more marine charter boat operations, can also be present at any one time during the hunting season. Given the amount of hunting effort and band returns from this area, hunting mortality would appear the most likely reason for the reduced number of harlequin ducks found in the Uyak Bay.

POPULATION TRENDS OF SEADUCKS WINTERING IN TWO BAYS OF WESTERN KODIAK ISLAND, ALASKA - A TWENTY THREE YEAR STUDY

Denny Zwiefelhofer and Douglas J. Forsell

DZ: Kodiak National Wildlife Refuge, U.S. Fish and Wildlife Service, 1390 Buskin River Road, Kodiak, AK 99615; denny_zwiefelhofer@fws.gov
DJF: Chesapeake Bay Field Office, U.S. Fish and Wildlife Service, 177 Admiral Cochrane Dr., Annapolis, MD 21401.

We have conducted shipboard surveys of marine birds in Uyak and Uganik Bays on the western shore of Kodiak Island each February since 1980. Birds were counted from the flying bridge of a 15 meter vessel within a 300m wide strip transect run from shore to shore. The same cruise tracts were censused each year resulting in about 135 ten minute duration transects covering about 110 km^2 or 19 percent of the surface area of the bays and 15 percent of the shore.

Population increases were seen in Barrow's goldeneye, harlequin ducks, common mergansers, and red-breasted mergansers. A large component of these four species are resident populations. Relatively stable or slightly declining numbers were found for surf scoters, black scoters, and long-tailed ducks. White-winged scoters have shown a slight decline over the past 23 years.

Declines in Barrow's goldeneye, long-tailed ducks and all scoters were seen following the Exxon Valdez oil spill, but not in harlequin ducks, mergansers, or buffleheads. Little oil actually entered these bays and many birds had departed for breeding areas by the time the oil arrived.

For the past eight years we have collected bird observations with latitudes and longitudes, allowing us to map their distributions and look for consistency in habitat usage.