EVIDENCE OF RECENT POPULATION INCREASES IN COMMON EIDERS BREEDING IN LABRADOR

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Populations of several sea ducks are declining across their North American ranges (Sea Duck Joint Venture Management Board 2001), including populations of all 4 eider species (*Somateria* spp. and *Polysticta steller*; Kertell 1991, Stehn et al. 1993, Gratto-Trevor et al. 1998). Declines in common eider populations have been documented in Greenland, Hudson Bay, and Alaska (Robertson and Gilchrist 1998, Sudyam et al. 2000, Merkel 2004). Reasons behind these population decreases vary, and many are unclear. Factors identified as causing these declines include human disturbance, overharvesting, and climatic events (Robertson and Gilchrist 1998, Suydam et al. 2000, Merkel 2004). However, not all common eider populations in the north are decreasing; Christensen and Falk (2000) recently found evidence of population increase in an eider population in Northwest Greenland, while others have documented increases in Hudson Strait (Hipfner et al. 2001, Falardeau et al. 2003).

Labrador has breeding populations of the northern common eider (*S. m. borealis*), the American common eider (*S. m. dresseri*) and intergrades of the 2 subspecies (Mendall 1986). Mendall (1980) documented this zone of overlap, but the geographic extent and consequences for population structure and recruitment have not been fully explored. Most information related to eider breeding ecology in Labrador is outdated (i.e., population trend) or unknown (i.e., migration routes and wintering locations). In terms of population affinities, eiders breeding in Labrador are thought to over winter in Atlantic Canada and the Northeastern United States (Palmer 1976, Goudie et al. 2000).

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In 1998, the Canadian Wildlife Service (CWS) in conjunction with the Labrador Inuit Association (LIA), initiated surveys on the Labrador coast to collect information to estimate breeding eider population trends. These surveys were initiated in anticipation of the finalization of the LIA land claims, subsequent establishment of the Nunatsiavut land claim area and creation of natural resource co-management boards. Surveys covered approximately 750 km of the Labrador coast and were repeated annually from 1998 to 2003, but due to logistical reasons, not all islands were surveyed every year. We report the findings of these monitoring efforts and compare them with results from other studies.

Study Area

We surveyed archipelagos near Nain and Hopedale from 1998 to 2003; St. Peter's Bay was surveyed in 1999, 2001, and 2002 (Chaffey 2003); and Rigolet was surveyed from 2000 to 2003. The Nain study area was approximately 2,237 km^2 and contained 811 islands ranging in size from 0.01 to 44,800 ha. The Hopedale study area was approximately 959 km^2 and contained 838 islands ranging in size from 0.01 to 3,875 ha. The Rigolet study area was approximately 3,172 km^2 and contained 348 islands ranging in size from 0.02 to 5,204 ha. The St. Peter's Bay study area was approximately 14 km^2 and contained 20 islands ranging in size from 0.03 to 23.43 ha.

All regions shared similar environmental characteristics such as a northern maritime climate, vegetation composed primarily of mosses, lichens, forbs, grasses, and sedges. The archipelagos of Nain, Hopedale, and Rigolet were typically comprised of barren islands with sparse vegetation and very limited nesting cover. Islands in St. Peter's Bay had more ground vegetation and woody cover, such as stunted black spruce (*Picea mariana*). All 4 archipelagos

Table 1. Survey dates by year and archipelago for nesting common eiders on the coast of Labrador, Canada, 1998–2003.

Year	Nain	Hopedale	Rigolet	St. Peter's Bay
1998	6–10 Jul	30 Jun–4 Jul		
1999	13–15 Jul	4–12 Jul		22–23 Jun
2000	3–9 Jul	28–30 Jun	20–26 Jun	
2001	5–19 Jul	4–17 Jul	18–27 Jun	11 Jun
2002	13–22 Jul	3–17 Jul	17–22 Jun	5–9 Jun
2003	11–13 Jul	3–7 Jul	14–20 Jun	

were classified as coastal barrens (Lopoukhine et al. 1978) and were considered to have a high-boreal ecoclimate (Meades 1990) and a low arctic oceanographic regime (Nettleship and Evans 1985).

Methods

In all areas, we selected islands based on random or haphazard sampling (Chaulk et al. 2005). We limited our searches to islands that were estimated to be smaller than 30 ha. Since large islands require significant effort to search, we focused on smaller islands that could be easily censused by small field crews over restricted periods. We conducted ground surveys using standard search methods employed by the Canadian Wildlife Service (Nettleship 1976) and other researchers (Falardeau et al. 2003, Merkel 2004); these consisted of 2–4 people systematically walking over the islands searching for signs of eider nesting. Islands in the 4 northern archipelagos had limited cover, and hens and unattended nests were easily detected. In several instances we stopped island searches because of weather or logistical considerations. If searches were halted, the island was classed as partially searched and was not used in trend analysis. We searched islands once per year. We initiated surveys in the south, and the survey crews moved north as the summer progressed; surveys were timed to occur during mid-incubation but actual timing varied slightly by archipelago and year (Table 1).

Sample sizes for the annual monitoring effort were estimated based on data collected in Nain and Hopedale during 1998 using the software program MONITOR and its exponential model (Users Manual, J.P Gibbs). We input island nest counts and an archipelago level standard deviation and varied the number of islands, surveys, and survey occasions to produce a matrix of possible sampling schemes that would generate statistical power >0.80 with alpha = 0.10. Archipelago level standard deviation was calculated using the bootstrap method (Sokal and Rohlf 1995). The sampling scheme matrix was used to guide sampling effort in post-1999 sampling years.

For trend estimation, we used nest counts from islands that were completely searched and ran the analysis using islands searched a minimum of 2, 3, and 4 years. Trends were estimated using the program ESTEQNINDEX, which fit the mean island nest count to a 2-way model with terms for year and island. Maximum likelihood estimates of year effects were calculated assuming observed counts had a Poisson distribution. An exponential trend was then fit through the year effects, and the jackknife estimate of the standard error was computed. This procedure was originally developed for analysis of the Breeding Bird Surveys and supports trend analysis with missing data (Collins 2003).

Table 2. Sampling effort from 1998 to 2003 and summary of islands and their sizes for each archipelago surveyed on the Labrador coast from 1998 to 2003.

Archipelago	No. of islands <30 ha searched 1998–2003	No. of islands in archipelago	No. of islands <30 ha in archipelago
Nain	36	811	740
Hopedale	49	838	789
Rigolet	22	348	326
St. Peter's Bay	10	20	20
Total	117	1,995	1,875

Results

From 1998 to 2003, 117 islands (Table 2) were completely surveyed a total of 479 times in 4 archipelagos (Nain, Hopedale, Rigolet, St. Peter's Bay), and over this period, we counted 13,185 eider nests. Average nest counts per island increased from a low of 3.3 in Hopedale in 1998 to over 10.7 nests/island in 2003, while in Nain, average nest counts increased from a low of 14.5 in 1998 to over 46.3 in 2003 (Table 3). Our most comprehensive study year was 2002, in which we sampled 109 islands in 4 archipelagos and counted 3,239 nests. These 109 islands represent about 5.8% of all islands on the Labrador coast <30 ha.

Results based on islands surveyed a minimum of 4 years showed an average apparent annual increase of 21.6% for Nain, 13.4% for Hopedale, and 18.1% for all areas over the 6-year period from 1998 to 2003 (Table 4). These estimates varied slightly with the number of survey years (e.g., the value for all islands surveyed a minimum of 2 years was 17.5% compared to 18.1% for islands surveyed a minimum of 4 years [Table 4]).

Discussion

Due to logistics, not all islands were surveyed each year, and assessments based on archipelago

Table 3. Average ±SD number of nests per island by archipelago and year[a]. Data collected on the Labrador coast 1998–2003.

Archipelago	1998	1999	2000	2001	2002	2003
Nain	14.5 ± 19.6	17.6 ± 23.9	21.6 ± 26.3	32.4 ± 24.1	40.7 ± 52.4	46.3 ± 51.9
Hopedale	3.3 ± 7.1	4.3 ± 7.8	5.7 ± 9.8	4.8 ± 7.7	5.4 ± 8.4	10.7 ± 20.4
Rigolet			90.5 ± 153.9	144.9 ± 195.9	74.9 ± 86.9	141.3 ± 167.1
St. Peter's Bay		55.9 ± 57.0		81.0 ± 93.0	42.9 ± 51.1	

[a] Note that these average values do not take into account missing data (some islands were not searched every year) and are presented as general information.

level or year summaries tend to be misleading when plot or route data are missing. However the program ESTEQNINDEX allows for trend estimation with missing data (Collins 2003). Based on our analysis of average nest initiation dates, which ranged from a mean of 5 June in St. Peter's Bay to 23 June in Nain (Chaulk et al. 2004, Chaulk et al. 2005), we feel confident that our surveys were well timed to occur in mid to late incubation. On average about 71% of nests were classed as incubating, and only 10% were classed as hatched or hatching (Chaulk et al. 2005). Meanwhile, analysis of our sampling design suggests that within the subset of islands <30 ha, the sampling effort was not spatially biased (K.G. Chaulk, Labrador Inuit Association, unpublished data). We feel confident that nest detection rates were high due to the absence of obscuring ground cover.

Recent studies of northern common eider population trends have shown drastic disturbing patterns of population decline (Robertson and Gilchrist 1998, Suydam et al. 2000, Merkel 2004). In contrast, our results show positive population growth for eider populations in Labrador. The average levels of population increase that we have detected are very high (13–22%). Given the geographic coverage of our surveys and the intensity of island searches that ranged from 2 to 4 archipelagos and 45–109 islands/year, we consider that our results are representative of common eider population trends in Labrador. From 1998 to 2003, average population growth in Nain was almost twice that of Hopedale. Reasons for these regional differences are unknown but could be related to local environmental conditions and/or harvesting practices. However, we lack data for both these factors and can make no substantiated assessment at this time.

In 1980, Lock (1986) conducted aerial surveys for breeding eiders and estimated 15,000 pairs on the Labrador coast. During the mid-1990s, the Canadian Wildlife Service conducted aerial surveys on the Labrador coast and estimated 30,000 breeding pairs of eiders and an annual growth rate of 3.7% per year during the intervening period (S. Gilliland, Canadian Wildlife Service, unpublished data). However, these 2 surveys were not directly comparable given the different methodologies employed, so both the status and trend of eider populations remained unclear through the 1980s and 1990s. We are reluctant to use our data to generate population estimates, as our study was designed for trend estimation. Due to the limited quality of base maps, we have no way to determine what proportion of islands <30 ha is actually suitable for nesting eiders. Some islands might be submerged at high tide, connected to mainland at low tide, offer little shelter from ocean storms, or have cabins situated on them.

Table 4. Apparent annual change (%) in breeding common eider populations on the Labrador coast 1998–2003. Due to limited samples sizes values for Rigolet and St. Peter's Bay were not presented individually (see footnote). These values are based on an analysis conducted using the program ESTEQNINDEX, which calculates population trend with missing data (Collins 2003).

Archipelago	Minimum no. of survey years	No. of islands used in the model	Apparent annual percentage change in breeding population	95% CI	
				Lower	Upper
Nain	4	21	21.6	1.6	35.8
	3	26	21.6	6.1	39.5
	2	36	22.4	7.5	39.2
Hopedale	4	34	13.4	2.4	25.6
	3	40	13.1	2.2	25.3
	2	49	14.8	3.8	26.8
All	4[a]	58	18.1	6.7	30.7
	3[b]	79	17.5	6.7	29.4
	2[b]	117	17.5	8.2	27.5

[a] Includes Islands from Nain, Hopedale, and Rigolet.
[b] Includes islands from Nain, Hopedale, Rigolet, and St. Peter's Bay.

Previously, we found that eider island occupancy ranged from 30 to 80% of islands surveyed, but these occupancy rates varied with archipelago (Chaulk et al. 2005). In the meantime, estimates of eider population size in Labrador will be unreliable until we can quantify the number of islands that are available and suitable for breeding.

Specific factors influencing eider population growth in Labrador could include improvement of environmental conditions or changes in migration patterns and subsequent changes in harvest on the breeding and wintering grounds. Other factors that may have influenced population growth include nest shelter programs, eider conservation-education programs, and reductions in eider bag limits during the 1980s and 1990s. In addition, the commercial Atlantic salmon (*Salmo salar*) and cod (*Gadus morhua*) fisheries were closed in the early 1990s. Researchers have identified human disturbance as a key factor influencing eider distributions and reproductive performance (Blumton et al. 1988, Johnson and Krohn 2002). Closure of these fisheries could have improved conditions for breeding eiders by reducing human disturbance near colonies (Chaffey 2003), reducing hunting on the breeding grounds, and eliminating bycatch in nets as a mortality source. In addition, large gull populations in Labrador appear to be declining (Robertson et al. 2002) and may have further improved breeding conditions for eiders through a reduction in avian predation rates.

Based on this information, we think there are numerous reasons why breeding eider populations in Labrador are increasing. However, we are not certain why an adjacent population in southwestern Greenland is declining (Merkel 2004). It has been suggested that hunting is the main factor causing the decline in Greenland, where eiders are subjected to unsustainable harvest (Merkel 2004). Meanwhile, no recoveries of eiders banded in Labrador have been reported in Greenland (Lyngs 2003), suggesting little or no connection between the 2 populations. Researchers have suggested that Labrador eiders winter in Newfoundland, Quebec, and the Maritimes (Palmer 1976, Reed and Erskine 1986, Wendt and Silieff 1986, Goudie et al. 2000) and may experience lower harvest levels than eiders that winter in Greenland.

Typically, eiders have deferred sexual maturity and exhibit low rates of annual recruitment, and reproduction (Coulson 1984) and population growth is tied to adult survival (Goudie et al. 2000). However, eider populations can apparently sustain dramatic rates of increase, especially during population regrowth. Chapdelaine (1995) documented 11.3% and 23.5% annual growth for common eiders breeding in the Gulf of St. Lawrence. While a number of eider populations in the Netherlands grew at rates between 17–28%, this occurred during the early stages of colony growth and was credited to low mortality and high rates of recruitment (Swennen 2002). Meanwhile, 25–35% per year increases were observed at newly established Danish colonies due mainly to immigration (Bregnalle et al. 2002).

The extent that anthropogenic factors influenced overall eider population dynamics in Labrador in the 20th century is unknown, yet our evidence suggests significant population increases during the late 1990s and early twenty-first century. These growth patterns are similar to those recently observed in Newfoundland (S. Gilliland, Canadian Wildlife Service, personal communication) and the Gulf of St. Lawrence (Chapedelaine 1995), and it is a promising trend for a species undergoing declines throughout much of its range.

Management Implications.—If general conditions remain constant, we feel that current eider harvest levels in Labrador are sustainable, at least in the short term. Given the baseline information that is now in place, we recommend continued population monitoring on a 3- to 4-year rotation. We also suggest expanding study scope to include unsurveyed portions of the Labrador coast. A rigorous assessment of suitable breeding islands is also suggested, and once complete, we recommend that regional population estimates be generated.

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