Suspected Long-Term Population Increases in Common Eiders, *Somateria mollissima,* on the Mid-Labrador Coast, 1980, 1994, and 2006

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Aerial surveys for adult male Common Eiders, *Somateria mollissima,* were flown on the Labrador coast during June 2006. This information was then compared with aerial counts of adult male Common Eiders collected in 1980 and 1994. For each survey year, data were grouped and paired by coastal block and were analyzed for population trends. Overall, the observed counts of adult male Common Eiders increased by 244% between 1980 and 2006. Much of this increase seemed to occur in the southern region of the study area.

Key Words: Common Eider, *Somateria mollissima,* aerial survey, population trends, Labrador.

In the last decade, declines in the populations of Common Eider (*Somateria mollissima*) have been documented in various regions of the north, such as Hudson Bay, the Beaufort Sea, and western Greenland (Robertson and Gilchrist 1998; Suydam et al. 2000; Merkel 2004). Factors identified as causing these declines include human disturbance, over-harvesting, and climatic events. However, not all Common Eider populations are decreasing. Christensen and Falk (2001) found evidence of population stability in north-west Greenland, and others have documented increases in Hudson Strait (Hipfner et al. 2002; Falardeau et al. 2003) and in the Gulf of St. Lawrence (Cotter and Rail 2007; Rail and Cotter 2007).

With respect to Labrador, from 1998 to 2003, Chaulk et al. (2005) documented average annual increases in Common Eider populations of 18% (range 13–22%). However, that study was limited in temporal and geographic scope, and thus the overall direction and extent of longer-term population trends for the region remained unclear. This study examines counts of adult male Common Eiders on the mid-Labrador coast over a 26-year period using data collected during three time periods, in 1980, 1994, and 2006.

Study Area

The study area, located in the sub-Arctic on the mid-Labrador coast, is approximately 19 714 km^2 (Figure 1) and contains 5296 islands and islets ranging in size from 0.01 to 7205.77 ha, with an average island size of 22.90 ha (unpublished data). All islands share similar environmental characteristics, such as a northern maritime climate and vegetation composed primarily of moss, lichen, forb, grass, and sedge. The region is considered to have a low Arctic oceanographic regime (Nettleship and Evans 1985) and is classified as a coastal barrens (Lopoukhine et al. 1978). Two subspecies of Common Eider occur in the study area: *S. m. borealis* occurs throughout, while the northern edge of the range of *S. m. dresseri* intersects the southern portion of the study area (Mendall 1980; Goudie et al. 2000; Chaulk et al. 2004). The line of demarcation between the two subspecies is not well established, and some have suggested that a hybridization zone occurs in the region of Groswater Bay (Mendall 1980), the center of which lies at about 54°20' north latitude and is adjacent to the community of Rigolet (Figure 1).

Methods

From 6 to 24 June 2006, aerial surveys were flown on the mid-Labrador coast (Figure 1) using a twin engine Normandy Islander; flight altitudes ranged between 200 and 300 m Above Sea Level and air speeds ranged between 150 and 180 km/h; sea ice was absent from all survey areas. The 2006 surveys involved one observer/navigator, one rear observer, and one pilot. Data from 2006 were then compared to surveys conducted in 1980 and 1994. The 1980 surveys (18 June to 20 July) were flown with one observer/navigator and one pilot (Lock 1986). The 1994 surveys (17 June to 8 July) used one observer/navigator, two rear observers, and one pilot (S. Gilliland, unpublished). In all cases, the pilot assisted with observations.

All coastal shorelines (mainland and island) within the study area (Figure 1) were surveyed in 1980, 1994, and 2006. The 1980 and 1994 surveys covered the entire coastline of Labrador (Lock 1986; Gilliland, unpublished), while the 2006 survey was about one-third the coverage of the previous surveys (Figure 1). All surveys started in the south and moved northwards.

In this paper, only data from the section of coast surveyed in all three years and highlighted in Figure 1 are reported. In 1980 and 1994, count data were recorded on paper maps and later compiled by coastal block (see below). In 2006, the United States Fish and Wildlife GPS Voice Survey Recording program (v. 3.1) was

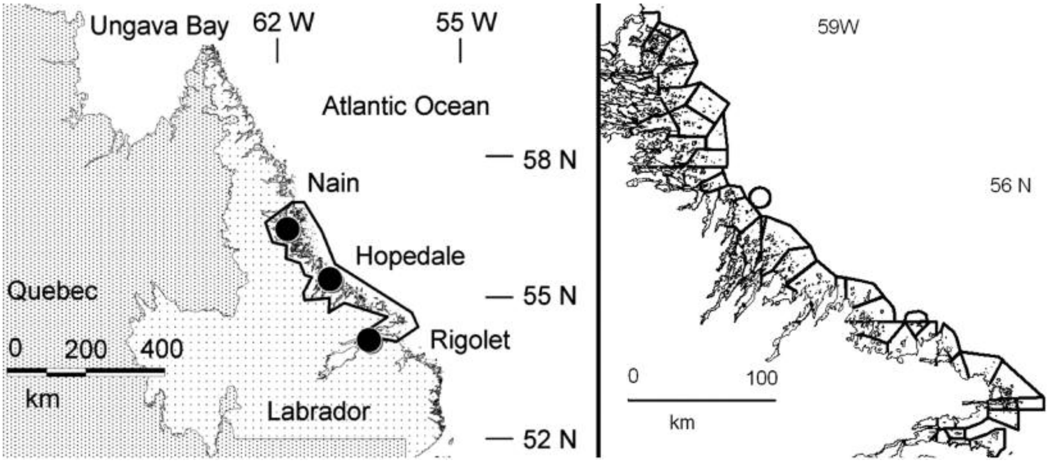

FIGURE 1. Location of the 2006 study area on the mid-Labrador coast. Left panel shows all of Labrador with the 2006 study area highlighted; right panel illustrates only the 2006 study area and the distribution of the 64 coastal blocks surveyed in all three years (1980, 1994, and 2006).

Note: the 1980 and 1994 surveys included areas north and south of the blocks illustrated; however, only data from the 64 coastal blocks (shown in right panel) (surveyed in 1980, 1994, and 2006) are presented and analyzed in this paper.

used to record all observations (Chaulk and Turner 2007), which were subsequently compiled by coastal block.

To allow the data sets across years to be summarized and compared across years, all count data were compiled by coastal block, a grid system developed by the Canadian Wildlife Service to partition the Labrador coast into discrete survey units based on prominent landscape features (Gilliland, unpublished). For purposes of statistical testing, the same 64 blocks surveyed in 1980, 1994, and 2006 were "paired" and analyzed for trends (Figure 1). The average size of these 64 coastal blocks was 308 km^2 (SD = 185.3).

Coastal blocks were then sorted from south to north by the geographic center, and adjacent coastal blocks were grouped into aggregate blocks. Each of the four resulting aggregate blocks was composed of 16 coastal blocks ($4 \times 16 = 64$). The aggregate blocks were consecutively labelled 1, 2, 3, 4, with 1 being the most southerly and 4 the most northerly. The 95% confidence interval for the mean was calculated for each aggregate block and plotted by survey year. This exercise was performed to illustrate regional and annual variations within the overall data set.

As the study team progressed northwards along the coast in 2006, approximately 20–30 nests were candled (Weller 1956) in each of the archipelagos of Rigolet, Hopedale and Nain to assess stage of incubation (Figure 1).

Throughout the paper, all reported ± values are 1 SE (except where noted). No data transformations were used, and non-parametric Friedman's test (predictors: Year and Block ID) and pair-wise *t*-tests of the count data were conducted using Minitab version 14.1.

Results

Candling revealed that the 2006 survey occurred between the first and second week of nest initiation. In 2006, total adult male Common Eider counts were 17 374 (number of flocks = 1733, mean flock size = 10.03 ± 0.63). Of these, 13 014 (i.e., 74.9%) adult male Common Eiders were associated with islands (number of flocks = 1332, mean flock size = 9.77 ± 0.69), and approximately 80% of these were associated with islands smaller than 30 ha. The average number of adult males/island was 15.6 ± 1.2 (number of colonies = 834).

The mean number of male Common Eiders per coastal block increased from a low of 111.3 ± 17.2 in 1980 to 271 ± 41.3 in 2006 (Table 1), a population increase of 244%. Using a Friedman's test, counts were found to differ significantly by year ($P < 0.001$); pair-wise *t*-tests indicated that 2006 counts were significantly higher than 1980 ($P < 0.001$). Interval plots revealed little change in counts across years in northern sections of the study area; these plots showed that most of the increases occurred in the southern portion of the study area (Figure 2).

Discussion

Based on informal interviews at the start of surveys, many local residents of Labrador stated that 2006 was an early spring, perhaps four weeks earlier than historical norms. Visual analyses of ice charts for the

TABLE 1. Left panel summarizes observations of adult male Common Eiders on the mid-Labrador coast by survey year (n = 3) and aggregate block (n = 4). Right panel summarizes pair-wise t-tests by year.

Year	Total Count	Average Count (SE)	Years	P	t-value
1980	7 120	111.3 (17.2)	1980, 1994	0.001	−3.59
1994	13 994	218.7 (39.5)	1994, 2006	0.109	−1.62
2006	17 374	271.5 (41.3)	1980, 2006	0.000	−4.60

study area support this assessment and also suggest that 1980 and 1994 were similar with respect to the timing of spring ice break-up. First indications of major open water can be found on the ice charts of 22 June 1980, 19 June 1994, and 15 May 2006 (Canadian Ice Service Online Data 2010*).

Although the 1980 surveys did not report stage of incubation, the author indicates that the surveys commenced approximately 10–12 days after the start of laying (Lock 1986). Unfortunately, the 1994 surveys did not provide any information on the timing of nesting (Gilliland, unpublished). Based on estimated nest ages (eggs in 2006 were 7 to 14 days old), the timing of the 2006 surveys was similar to the 1980 surveys. It should be noted that both Lock and Gilliland initiated their surveys several hundred kilometres to the south and took up to one week to reach the point at which the 2006 surveys started. Adjusting for the overlapping study area (Figure 1), the 2006 surveys started approximately three calendar weeks earlier than surveys in 1980 and 1994.

However, even with the earlier survey start date and earlier spring conditions in 2006, I feel that, relative to breeding, the 2006 surveys were comparable to the 1980 surveys (i.e., within 10 days) (see discussion above of ice conditions and nest ages of all three surveys). However, owing to the absence of information on nest ages at the time of the 1994 surveys, it is not possible to state with rigor how all survey years compared with respect to the nesting period.

It is very likely that across-year environmental differences influenced the start of breeding in each of the survey years and that this would consequently affect observed counts, although the direction (resulting in higher or lower counts) of these effects, relative to survey year, remains unknown. If Common Eiders nested early in 2006 due to lack of ice, adult males may have started to disperse by the time of the survey, reducing the overall count. For example, it has previously been suggested that ice influences the nesting behaviour of eiders (Lack 1933; Ahlen and Andersson 1970; Quinlan and Lehnhausen 1982; Parker and Mehlum 1991; Chaulk et al. 2007), and male Common Eiders are known to disperse from breeding islands shortly after females begin nesting (Goudie et al. 2000).

Uneven observer effort is another factor that could have influenced comparison of count data across years (Caughley 1974). Laursen et al. (2008) found that detection rates were approximately 80% for species with densities of more than 10 individuals/km^2 and that observer effects are less pronounced in species that form large flocks. It should be noted that in 2006 the average was approximately 10 Common Eiders/flock. Estimates of average flock size from other survey years were not reported, so at present this information is limited as an indicator of across-year detection rate(s). However, the 2006 flock size data could be useful comparison information in the event of future surveys. With this said, it is not clear how average flock size changes with population fluctuation. One might assume that flocks become larger as the population increases, but behavioural processes and availability of forage likely play a role in shaping the relationships between flock size and overall abundance.

As indicated in the methods, each survey year involved a different number of observers, with 1980 having the least (two), 2006 surveys having an intermediate number (three), and 1994 having the most (four). The effects that observer effort had on counts are unknown, but likely contributed to across-year differences. However, the direction (resulting in higher or lower counts) of these effects relative to each survey year also remains unknown.

Figure 2 depicts regional differences within the study area with respect to long-term population trends. Mean counts were relatively constant across years in the north, while southern sections showed larger across-year differences. Thus many of the suspected long-term increases seem to be driven by population processes in the southern portion of the study area. Within the study area, the southern section is thought to be a region of overlap and hybridization between the northern and southern subspecies of the Common Eider (Mendall 1980; Chaulk et al. 2004). It is possible that interactions between these two subspecies are influencing the overall apparent population growth.

It is true that this study suffers from several limitations with respect to the comparability of the data across years (observer effort, survey timing); however, in combination with findings presented by Chaulk et al. (2005) as well as anecdotal reports by local hunters, it seems to provide growing evidence that suggests that Common Eider populations on the mid-Labrador coast have grown since the early 1980s. The cause(s) of these apparent increases are unknown.

One explanation relates to changes in human land use during the breeding period as a result of the closure of coastal in-shore fisheries in the early 1990s.

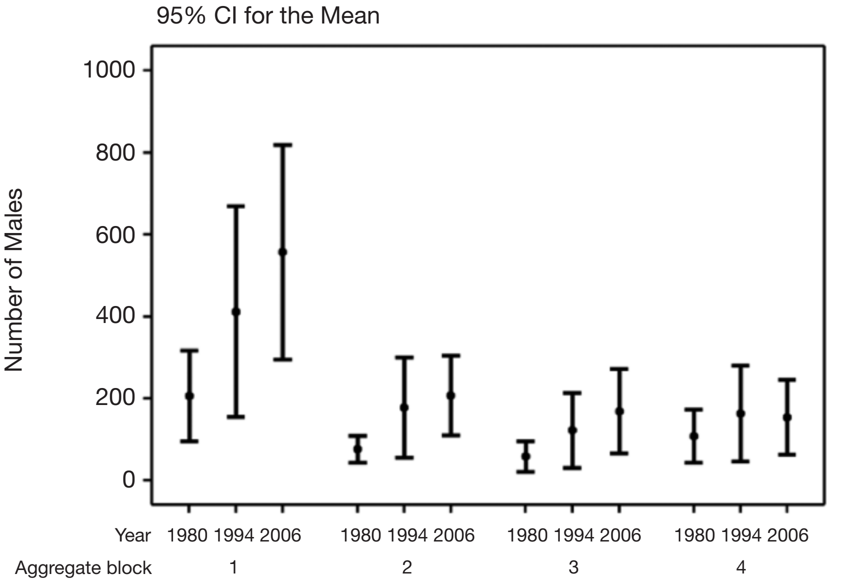

FIGURE 2. Interval plots of adult male Common Eider counts by aggregate block and year. Data means and 95% confidence intervals are based on surveys conducted on the mid-Labrador coast in 1980, 1994, and 2006. Each aggregate block (n = 4) is composed of 16 adjacent coastal blocks. Aggregate blocks are labelled 1 to 4 and are ordered from south to north, where aggregate block 1 is the most southerly and 4 the most northerly.

Note: For purposes of graphing, aggregate blocks (n = 4; by 3 years) were used instead of coastal blocks (n = 64; by 3 years) in order to reduce data clutter.

For example, a reduction in fish offal may have had an impact on local gull populations, thereby decreasing gull predation on Common Eider nests (Gotmark 1989; Mawhinney et al. 1999). In addition, the closure of the in-shore fishery likely resulted in less disturbance of breeding colonies (Gotmark and Ahlund 1984; Laursen and Frikke 2008) by fishing boats, as well as possible reductions in egging and the harvest of adult birds.

Northland Associates (1986*) report that the mean household harvest of Common Eiders in 1980 by the Inuit communities of Hopedale was 52.9 (n = 21 households) and Postville was 29.1 (n = 21 households). Felt and Natcher (*in press*) report that the mean household harvest of Common Eiders in the same communities in 2007 was 19.0 in Hopedale (n = 41 households) and 9.0 in Postville (n = 26 households). Thus harvest levels in 2007 were lower than in 1980; it is unknown whether other communities in the study area reduced their harvest of Common Eiders over this period.

Other possible, albeit undocumented, explanations for apparent increases in counts of Common Eiders include hunter education and conservation awareness programs, habitat enhancement programs (i.e., nest shelter), and/or an amelioration of environmental conditions resulting from climate change. Education and nest shelter programs were initiated in Labrador in the mid-1990s, but assessments of their effect on populations of Common Eiders have not been widely reported. With respect to the regulation of migratory bird harvest, this region of Labrador continues to have a limited enforcement presence.

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