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Evidence of Population Declines among Common Eiders Breeding in the Belcher Islands, Northwest Territories

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ABSTRACT. Information regarding the status of common eiders *Somateria mollissima* breeding in the Canadian Arctic is sorely lacking. In 1997, we surveyed five island archipelagoes in the Belcher Islands in Hudson Bay (56˚00′–57˚30′N, 79˚30′–80˚00′W) from 3 to 23 July. Our results were compared with eider surveys of the same islands completed between 1985 and 1989 using a standard protocol. We found 1416 eiders on 431 islands. Most (94.1%) were found while the female was still incubating. In all five island groups surveyed, the number of nesting eiders declined significantly (overall decline of 75.0% from 1985–88 to 1997, range: 62.3–84.0%). In 1997, nesting islands and adjacent waters were free of ice, and eiders nested early and laid large clutches (range: 4.0–4.4 ± 1.0–1.2 SD). These conditions indicate a good nesting season, and we inferred that extensive nonbreeding by female eiders in 1997 did not account for the observed decline. A large reported die-off of eiders during the winter of 1991–92, which occurred when areas of open water froze, was the most likely cause of the decline. Our results raise serious conservation concerns, because eider populations are sensitive to reductions in adult survival and this population is harvested throughout the year by subsistence hunters.

Key words: common eider, *Somateria mollissima sedentaria*, Belcher Islands, population decline, Hudson Bay

RÉSUMÉ. On a grandement besoin d’information sur le statut de l’eider à duvet *Somateria mollissima* qui niche dans l’Arctique canadien. En 1997, du 3 au 23 juillet, on a effectué des relevés dans cinq archipels des îles Belcher situées dans la baie d’Hudson (56˚00′–57˚30′N., 79˚30′–80˚00′O.) On a comparé nos résultats suivant un protocole normalisé à des relevés d’eiders effectués dans les mêmes îles entre 1985 et 1989. On a trouvé 1416 eiders dans 431 îles. La plupart (94,1 p. cent) ont été relevés alors que la femelle était encore en train de couver. Dans chacun des cinq groupes d’îles étudiés, le nombre d’eiders nicheurs avait enregistré une baisse importante (déclin global de 75,0 p. cent de 1985 à 1988, fourchette de 62,3 à 84,0 p. cent). En 1997, les îles de nidification et les eaux adjacentes étaient libres de glace; les eiders ont niché tôt et la taille des pontes était importante (fourchette: 4,0 à 4,4 ± écart-type de 1,0 à 1,2). Ces conditions sont révélatrices d’une bonne saison de reproduction, et nous en déduisons que la non-reproduction généralisée par les eiders femelles en 1997 n’explique pas le déclin enregistré. C’est très probablement la mortalité massive d’eiders enregistrée au cours de l’hiver de 1991–92, survenue quand les surfaces d’eau libre ont gelé, qui a été responsable du déclin. Nos résultats soulèvent d’importantes questions en matière de conservation, car les populations d’eiders sont sensibles aux baisses de survie adulte et que, tout au long de l’année, cette population fait l’objet de prélèvements dans le cadre de la chasse de subsistance.

Mots clés: eider à duvet, *Somateria mollissima sedentaria,* îles Belcher, déclin de population, baie d’Hudson

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INTRODUCTION

There is serious concern about the status of many sea duck populations (Kertell, 1991; Stehn et al., 1993). Sea duck populations are vulnerable to decline because they are typically long-lived and have delayed reproductive maturity and low rates of reproduction (Palmer, 1976). Consequently, even minor reductions in the survival of adults can send populations into decline (Abraham and Finney, 1986; Goudie et al., 1994), and populations are slow to recover once conditions improve (Prestrud and Mehlum, 1991).

Little is known about the annual productivity, population size, or population trends of many sea duck populations (Goudie et al., 1994). This is especially true for populations breeding in northern regions because of the logistics and financial costs associated with studying sea duck populations in the North. Existing information about

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common eiders *Somateria mollissima* breeding in the Canadian Arctic is either insufficient or too out of date to be useful in effectively managing these eider populations (Reed and Erskine, 1986; Circumpolar Seabird Working Group, 1997; Dickson, 1997).

The Hudson Bay eider *Somateria mollissima sedentaria* is a subspecies of the common eider. It breeds on the east and west coasts of Hudson and James Bays and on the Belcher, Sleeper, and Ottawa Islands (Snyder, 1941). Small numbers may also breed on Southampton, Coats, and Mansel Islands in northern Hudson Bay. The entire population of the *sedentaria* subspecies winters exclusively in Hudson Bay, restricted to polynyas and floe edges near the Belcher Islands, off the west coast of Quebec, and perhaps in Roes Welcome Sound (Abraham and Finney, 1986). This is one of the only waterfowl species in the world that spends the entire year in Arctic waters (Freeman, 1970). Very little is known about this population, including its population trends and sources of natural and human-induced mortality.

Recent reports by local hunters in the Belcher Islands suggest that eider numbers have declined (McDonald et al., 1997), but quantitative information is lacking. Eiders are very important to the residents of Sanikiluaq: they are hunted for food, their eggs are collected in the summer, and their down (and, traditionally, their skins) are used to make clothing (Reed, 1986; Nakashima, 1991). Since the status of the common eiders breeding in the Belcher Islands is uncertain, we initiated a study to address concerns for this population. In this study, we compare 1997 counts of active eider nests with data collected on the same islands, using a standard protocol, between 1985 and 1988.

METHODS

Study Area

The Belcher Islands are located in southeastern Hudson Bay (56˚00′–57˚30′N, 79˚30′–80˚00′W) (Fig. 1). The community of Sanikiluaq (650 residents) is located on Flaherty Island on the northern tip of the archipelago. Many of the male residents are subsistence hunters who travel widely throughout the region, by boat in July and August and by snowmobile in winter (Nakashima, 1991; Wein et al., 1996). Small islands in the Belcher Island group support breeding Hudson Bay eiders. Arctic foxes *Alopex lagopus* also occur in the Belcher Islands but are rarely present on small islands further than 1 km from the large islands once the sea ice is gone (Manning, 1976; Nakashima and Murray, 1988). Nesting eiders are generally found only on these small offshore islands, although some nest on islands in large inland lakes (Freeman, 1970; Manning, 1976). Nesting islands are typically low-lying, rocky, and sparsely vegetated with short grasses and sedges, small perennials, moss, and prostrate willow species *Salix* spp.; they range in area from approximately 0.01 to 500 ha.

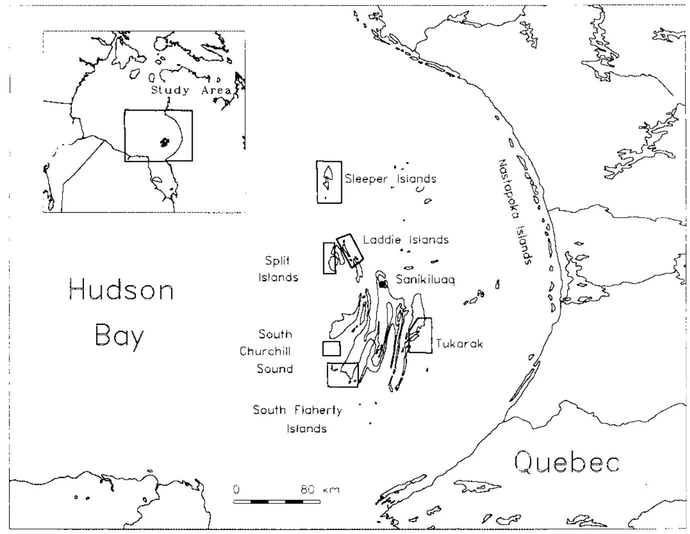

FIG 1. Location of study area in the Belcher Islands, Hudson Bay, Northwest Territories. Rectangles show the six study areas surveyed in the 1980s. All but Tukarak were resurveyed in 1997.

Herring gulls *Larus argentatus*, glaucous gulls *L. hyperboreus*, black guillemots *Cepphus grylle*, and arctic terns *Sterna paradisaea* commonly nest on islands with eiders; the first two species are significant predators of eider eggs and ducklings (Munro and Bédard, 1977; Swennen, 1989; Mehlum, 1991a).

Survey Regions

Six island groups (hereafter termed regions) within the Belcher Islands were delineated and surveyed in the 1980s (Fig. 1): 1) South Flaherty Islands, surveyed in 1986 (Fleming and McDonald, 1987); 2) South Churchill Sound, surveyed in 1988 (McDonald and Fleming, 1990); 3) Laddie Islands, surveyed in 1985 (Nakashima and Murray, 1988); 4) Split Islands, surveyed in 1985 (Nakashima and Murray, 1988); 5) Sleeper Islands, surveyed in 1985 (Nakashima and Murray, 1988); and 6) East Tukarak Islands, surveyed in 1989 (McDonald and Fleming, 1990). In 1997, the South Flaherty and South Churchill Sound Islands were surveyed first, between 3 and 8 July. We then surveyed the Sleeper Islands, between 10 and 13 July, and finally the Split and Laddie Islands, between 20 and 23 July (Fig. 1). We did not have time to survey East Tukarak before the end of the eider incubation period.

Survey Methods

We used the same survey method, developed by Chapdelaine et al. (1986), that was used by previous field crews, to ensure that our data were comparable to the results of previous surveys. In the original survey design, all islands in selected survey regions were numbered on 1:50 000 topographic maps. Only islands less then 500 ha in size were considered suitable eider nesting habitat; larger islands usually harboured arctic foxes and did not support nesting eiders. Fifty percent of islands were randomly chosen and subsequently surveyed by the original crews. In 1997, we attempted to revisit the random sample of islands. Our survey crew consisted of between 11 and 13 residents of Sanikiluaq and the senior author. We traveled between regions in a large fishing vessel and reached islands using either a freighter canoe or an aluminum boat.

Selected islands were surveyed by one of two methods. If the island was small (< 0.05 ha) and could be completely examined from the sea, we surveyed it visually from a boat; if there was evidence of eiders nesting on the island, we landed and examined the island on foot. For islands surveyed on foot, the entire island was examined by crews of 3 to 6 field workers, who walked 10 m apart from each other across each island. If an island was not covered in one sweep, the crew member at the outside of the line marked the extent of the first pass with rocks or sticks. The crew then turned around and walked back, counting only nests on the opposite side of the previously marked line. In this manner, islands were completely surveyed with little risk of missing nests or counting nests twice. Nests were easily located because there was little vegetation.

When a nest was found, its contents were reported to one crew member who recorded the information. For each nest, we recorded the species, the number of eggs, and the status of the nest: incubating, in the process of hatching, all eggs hatched, or destroyed/depredated. Nests were assumed to be incubated by females if there was down in the nest and the eggs were warm to the touch. No clutches where the female was still laying (i.e., one to three eggs in a nest cup covered with nest material) were found.

Data Analysis

We were not able to return to all islands surveyed by the original crew in the South Flaherty region (about 30 islands, 16% of original survey) and the Sleeper Islands region (about 50 islands, 32% of original survey) because of logistical constraints. Most of the islands (about 35) we missed in the Sleeper Island region were part of a complex of islands lying between the large north and south main islands. Nakashima and Murray (1988) did not find any nests on these islands and considered them unsuitable eider nesting habitat because they were too close to the large islands; therefore, we actually only missed about 15 suitable nesting islands (or 10%). To reduce the biases in comparing between the two surveys, only islands that were surveyed both in the 1980s and in 1997 were compared.

Islands with no nesting eiders in both years were removed from the data set prior to the comparative analysis. Typically, these islands either were too close to the mainland and presumably accessible to foxes or were small shoals prone to flooding at high tide. Because the distribution of nests per island was not normal, data were log transformed after adding one nest to each island; this transformation effectively homogenized the variance between the two samples. A paired t-test was used on these transformed data to detect a change in the numbers of nesting eiders between the two survey periods on each island. A critical $\alpha = 0.05$ was used throughout. In addition, because the time that had elapsed between surveys varied from 9 to 12 years, an annual population growth rate (Caswell, 1989) was calculated for each region:

$$\lambda = e^{\frac{\ln(N(T)/N(O))}{T}}$$

where lambda is the annual population growth rate, ln is the natural logarithm, *e* is the base of the natural logarithm, *N(T)* is the population size at *T* years after the first survey and *N(0)* is the population size during the first survey. Although population growth rates present a constant rate of population size change, we do not imply that any changes in population size have occurred at a constant rate.

RESULTS

1997 Survey

Summary statistics for the common eider nest survey are presented in Table 1. The number of islands surveyed within each region ranged from 27 to 153 islands, and the number of nests found within each region ranged between 110 and 468 nests. Over half of the islands in any given region did not have eiders nesting on them. The mean number of nests on each island was lowest in the Laddie, Split, and South Flaherty regions (1.6–2.8 nests/island). More nests were found on islands in the Sleeper and South Churchill Sound regions (4.4 and 10.5 nests/island, respectively). The Sleeper and Churchill Sound regions had single islands with comparatively large numbers of nests on them (over 100), increasing the mean and the variance in the number of nests found per island. Nesting eiders were most evenly distributed across islands on the South Flaherty Islands (52 of 153 islands, 34.0%) and were most restricted on the Split Islands (9 of 62 islands, 14.5%).

Most active nests (94.1%) were found during incubation (Table 1). The first hatching nest was found on 12 July in the Sleeper Islands; this was the only hatching nest found in the Sleeper Island region. The rest of the hatching or hatched nests were found in the Laddie Islands and Split Islands, the regions surveyed later in the season (20–23 July). Mean clutch size of incubated clutches was 4.4 ± 1.0–1.2 eggs/nest in South Flaherty, South Churchill Sound, and the Sleeper Islands, while in the Split and Laddie Islands, clutch size averaged 4.0 ± 1.1–1.2 eggs/nest.

Comparisons Between the 1980s and 1997

The eider population nesting in the Belcher Islands has declined dramatically since the 1980s (Table 2). The nests counted in 1997 numbered 62% to 84% less than those counted between 1985 and 1988. The number of nesting

TABLE 1. Summary statistics for common eiders nesting in the Belcher Islands, 1997.

	South Flaherty Islands	South Churchill Sound	Sleeper Islands	Split Islands	Laddie Islands	Total
Dates of surveys	3–6 July	7–8 July	10–13 July	20 July	22–23 July	3–23 July
No. of islands surveyed	153	27	107	62	82	431
No. of eider nests	422	283	468	110	133	1416
No. of nests per island (range)	2.8 ± 7.6 (0–55)	10.5 ± 31.0 (0–149)	4.4 ± 17.6 (0–146)	1.8 ± 6.4 (0–37)	1.6 ± 4.9 (0–39)	3.3 ± 13.0 (0–149)
No. of islands with nests	52 (34.0%)	7 (25.9%)	24 (22.4%)	9 (14.5%)	24 (29.3%)	116 (26.9%)
Percent of nests in status:						
– 1 (Incubating)	99.3	97.2	92.3	80.9	88.0	94.1
– 2 (Hatching)	0	0	0.2	13.7	2.2	1.3
– 3 (Hatched)	0	0	0	2.7	4.5	0.6
– 4 (Destroyed)	0.3	2.8	7.5	2.7	5.3	4.0
Mean clutch size[1] (sample size)	4.43 ± 1.03 (419)	4.40 ± 1.24 (275)	4.38 ± 1.12 (432)	3.96 ± 1.19 (89)	4.02 ± 1.06 (117)	4.34 ± 1.13 (1332)

[1] Only incubating nests were used for calculation of clutch size.

eiders declined in all regions surveyed. The most precipitous declines occurred in the northern island chains, the Laddie, Split, and the Sleeper Islands (79% – 84%). The South Flaherty and South Churchill Sound Islands experienced a lower, yet substantial, decline (62% – 69%). The population growth rates also suggest a decline (Table 2) that was fastest in the northern regions (growth rates of 0.858 – 0.879); by comparison, the South Flaherty and South Churchill Sound Islands had growth rates of 0.879 to 0.915.

The number of eiders nesting on individual islands within each region also declined significantly (Table 2). Of the 160 islands that had eiders nesting on them in either the 1980s or 1997, only 44 of them gained (34 islands, or 21.3%) or maintained (10 islands, or 6.3%) the same number of nests in 1997. On those islands where the number of nests increased, the gains were slight (mean = 5 nests; range = 1 to 22) compared to the losses on other islands (mean = 38; range = 1 to 383 nests). The mean clutch size in 1997 was similar to (Sleeper, Split, and Laddie Islands) or slightly higher than (South Flaherty Island, South Churchill Sound) clutch size in the 1980s (Table 3).

DISCUSSION

1997 Survey

Eider nests were not evenly distributed among the islands we surveyed, as many islands did not have eiders nesting on them. Islands without eiders nesting on them were usually 1) small, shallow and devoid of vegetation, 2) close to the mainland and in many cases joined to the mainland at low tide, or 3) very large (> 100 ha) (Fleming and McDonald, 1987; Nakashima and Murray, 1988; McDonald and Fleming, 1990). Eiders may perceive these larger islands as a mainland and not nest on them to avoid arctic foxes. Alternatively, they may have experienced poor breeding success on these islands and therefore moved to other islands. In fact, on one of these larger islands, we did see an arctic fox and found eight depredated nests. Foxes may be able to swim to these islands to gain access to the eider nests or they may choose to settle on these islands before the ice melts and strands them there.

Only the Sleeper and South Churchill Sound regions had islands that supported reasonably large colonies of eiders (> 100 birds). The Sleeper Islands and South Churchill Sound regions were the two areas most isolated from the community of Sanikiluaq. Furthermore, islands that supported large colonies within those regions tended to be at the periphery of the archipelago and isolated from large islands. Nakashima and Murray (1988) and McDonald and Fleming (1990) provide a detailed description of islands that support large colonies.

Since eider clutches began hatching in the third week in July, egg laying was probably initiated sometime from mid- to late June, assuming a 24 – 25 day incubation period (Erikstad and Tveraa, 1995) and an approximately 24 hour egg-laying period (Watson et al., 1993). This schedule was similar to the timing of egg laying observed by Nakashima and Murray (1988) in 1985, a relatively good year for breeding eiders. Interestingly, nesting occurred later than in populations on the west side of Hudson Bay, where egg laying began in the last week of May (Robertson, 1995). Eiders nesting in the Belcher Islands had a nesting chronology similar to that of common eiders *Somateria m. borealis* nesting over 1000 km to the north (Cooch, 1965; Prach et al., 1986): this similarity indicates the severity of conditions in the Belcher Islands, despite their southerly latitude.

In the Split Island and Laddie Island regions, clutch sizes were lower (4.0 eggs) than in the other regions (4.4 eggs). The lower clutch sizes found in the Split and Laddie Islands are probably an artifact of the timing of our surveys, because these areas were surveyed last (20–23 July), and clutches with the largest number of eggs had probably already hatched. Eiders show a seasonal decline in clutch size, so larger clutches typically hatch first (Milne, 1974; Spurr and Milne, 1976; Mehlum, 1991a; Robertson, 1995) and hatched clutches were not included in our calculation of clutch size. Partial egg predation may also have lowered clutch sizes in the regions surveyed last, as predators would have had longer to search for and consume the eggs.

TABLE 2. Comparison of survey results for mid-1980s and 1997 and tests (paired t-test, one-tailed) of whether the eider nesting population has declined from the 1980s to 1997 for each individual island.

	Number of islands[1]	Number of nests – 1980s	Number of nests – 1997	% decline	λ[2]	n[3]	t[4]	p[5]
South Flaherty Islands	150	1113	420	62.3%	0.915	63	2.81	0.0033
South Churchill Sound	27	899	283	68.5%	0.879	9	3.34	0.0052
Sleeper Islands	108	2204	468	78.7%	0.879	36	4.55	0.0001
Split Islands	61	602	110	81.7%	0.868	14	2.01	0.0329
Laddie Islands	80	833	133	84.0%	0.858	38	6.32	0.0001
Total	426	5651	1414	75.0%	–	160	7.87	0.0001

[1] Number of islands surveyed in both 1980s and 1997
[2] Annual population growth rate
[3] Only islands having nests on them in at least 1 of the 2 surveys were used
[4] Paired t-test, statistic based on log-transformed data
[5] One-tailed test

TABLE 3. Comparison of common eider clutch sizes in 1980s and 1997 in the Belcher Islands. Only incubated clutches were included in the sample.

	Clutch size			
	1980s	1997	t	p
South Flaherty Islands	4.04 ± 1.05 (1980)	4.43 ± 1.03 (419)	7.35	0.0001
South Churchill Sound	4.09 ± 1.90 (876)	4.40 ± 1.24 (275)	2.86	0.002
Sleeper Islands	4.28 ± 1.38 (2577)	4.38 ± 1.12 (432)	1.53	0.063
Split Islands	3.92 ± 1.42 (491)	3.96 ± 1.19 (89)	0.27	0.395
Laddie Islands	4.00 ± 1.18 (649)	4.02 ± 1.06 (117)	0.18	0.427
Total	4.13 ± 1.37 (6376)	4.34 ± 1.12 (1332)	5.73	0.0001

Interpretation of Survey Results

Our surveys indicate that the number of eiders nesting in the Belcher Islands has declined by 75% since 1986–88. One possible interpretation is that adult females have dispersed from the Belcher Islands archipelago to breed in other areas. This kind of large-scale dispersal is unlikely, because the nearest suitable habitat occurs in the Nastapoka Islands, approximately 160 km east of the Belcher Islands. A mass movement of breeding eiders over such a distance has never been documented. Indeed, eiders are highly philopatric to nesting areas (i.e., island groups), even following years of successive reproductive failure (Cooch, 1965; Reed, 1975; Swennen, 1976, 1990).

Another possible explanation for the observed decline is that our surveys failed to detect many of the female eiders nesting in the Belcher Islands in 1997. This could occur if there had been small-scale dispersal of adult females away from the islands surveyed. A few adult females will move to nearby nesting islands for subsequent breeding attempts (Wakeley and Mendall, 1986). Survey results may be wrongly interpreted as population declines if eiders disperse from large colonies and establish small colonies that are difficult to find (Boertman et al., 1996; D. Boertman, pers. comm. 1997). Dispersal of nesting eiders may be expected from large colonies that experience persistent human disturbance. Boertman et al. (1996) concluded that their survey coverage, which was restricted to several large islands, was insufficient to rule out such dispersal.

Our surveys covered up to 50% of randomly selected islands in five study regions. Thus, it is unlikely that we missed a sufficient number of islands with high nesting densities to account for the decline. Further, we found that 1) eider nesting densities declined in all regions irrespective of the size of the island or of the original colony; 2) there was no obvious shift in eider distribution within or between regions; and 3) few islands (< 22%) had more nests on them in 1997 than in 1986–88.

Extensive nonbreeding, a reduction in the absolute number of breeding females eiders, or both may explain the observed decline in the number of nesting eiders. Up to 65% of female eiders will not breed in years with poor conditions (Coulson, 1984). Poor years can often be detected by surveys because 1) the clutch size of females that do breed is often significantly lower (by up to one egg, Coulson, 1984; Mehlum, 1991b; Robertson, 1995); 2) the date of laying is often delayed (Mehlum, 1991b; Robertson, 1995); and 3) nesting densities are reduced at the regional level although on any given island the densities may be very high (Mehlum, 1991b; G.J. Robertson, unpubl. data).

In 1997, weather conditions favoured a good nesting season for eiders in the Belcher Islands. Nesting islands and adjacent waters were free of ice early in June, eiders laid large clutches, and they nested relatively early. Indeed, in two of the five regions, clutch sizes were actually larger in 1997 than in the late 1980s, and in the other three there was no significant difference. Clutch sizes of 4.0–4.4 eggs are normal for common eiders (Swennen, 1983;

Hario and Selin, 1988) and similar to those of Hudson Bay eiders nesting near Churchill during good breeding seasons (Robertson, 1995). It appears that 1997 was a good breeding year for eiders in the Belcher Islands, and we infer that the reduction in the number of nesting females is due to a real numerical decline in the population rather than to extensive nonbreeding by females.

Reasons for Eider Population Decline

Harvest: Common eiders are harvested extensively around the Northern Hemisphere by subsistence and sport hunters (Reed and Erskine, 1986). Several northern populations are harvested throughout the year, and it is unknown whether these levels of harvest are sustainable. The declines of several populations have been attributed to overharvesting. In Svalbard, the breeding eider population declined dramatically in the late 1800s and early 1900s because of extensive egging and down collection (Rossnes, 1991). Sanctuaries were established in 1963, and since then the population has remained stable (Mehlum, 1991b). However, this population has not recovered to numbers present at the turn of the century (Prestrud and Mehlum, 1991). In the western Canadian Arctic, the numbers of common and king eiders *Somateria spectabilis* migrating past Point Barrow have declined from approximately 1 000 000 eiders counted in the 1950s and 1960s to about 500 000 counted in 1994, and harvest may have been a contributing factor (Suydam et al., 1997). However, Fabijan et al. (1997) concluded that harvest in this region was well within sustainable levels. Cooch (1986) documented a 67% reduction over 20 years in the number of eiders nesting in the West Foxe Islands near Cape Dorset, which was apparently due to hunting and egging by the local community.

Hudson Bay eiders are harvested for their meat, and their down and eggs are collected during the summer in the Belcher Islands (Nakashima, 1991). The community of Sanikiluaq has an eiderdown industry: down comforters and garments are produced within the community and sold in Canada and Europe (McDonald and Fleming, 1990). It is unlikely that disturbance at colonies caused by down collection resulted in recent population declines, because commercial down collection ceased in the region during the 1990s because of weak market demand. Additionally, studies have shown that responsible down harvesting does not necessarily have a negative impact on eider productivity (Mehlum et al., 1991), although down collection may increase egg predation and nest abandonment (Reed, 1986).

The hunting of adult common eiders occurs throughout the year in the Belcher Islands but is concentrated in fall and winter (Reed and Erskine, 1986). The annual harvest was estimated to be approximately 6000 birds in the early 1980s (Reed and Erskine, 1986). In addition to taking birds, hunting also disturbs birds, which may impair body condition and reduce nesting success (Korschgen, 1977). Population estimates of the Hudson Bay eider are crude and now out of date (Abraham and Finney, 1986; Nakashima and Murray, 1988). Consequently, it is not possible to evaluate whether current levels of harvest are sustainable or whether harvest has contributed to the observed population declines.

Winterkill: Local residents in Sanikiluaq reported population declines of common eiders prior to this study (McDonald et al., 1997), and our findings support their observations. Residents of Sanikiluaq are very knowledgeable about the ecology and status of eider populations in the Belcher Islands (Nakashima, 1991). Residents attribute the declines to a mass die-off of eiders that they observed during the winter of 1991–92, when eiders were concentrated in polynyas and open water at the floe edges that froze over. Recurring polynyas and open water floe edges are extremely important ecologically. Marine wildlife often rely on these locations as wintering areas at a time of year when populations are severely constrained geographically and energetically (Stirling and Cleator, 1981; Stirling, 1997).

Small recurring polynyas form among the Belcher Islands in southern Hudson Bay because strong currents prevent the formation of ice. Shifting pack ice also provides temporary areas of open water around the Belcher Islands. The polynyas and open-water leads in the Belcher Islands and western Quebec are the only permanent areas of open water in southeastern Hudson Bay during winter (Smith and Rigby, 1981). Marine mammals and birds that winter in the region (e.g., walrus, seals, and common eiders; McDonald et al., 1997; Stirling, 1997) are restricted to these areas, and they are apparently vulnerable to die-offs because they cannot escape to alternative habitats if polynyas and open-water leads freeze.

The status of polynyas and the shifting ice pack in the Belcher Islands is uncertain. Since the late 1980s, long-term residents of the Belcher Islands have witnessed dramatic changes in regional ice conditions (McDonald et al., 1997). Areas that have been historically free of ice are reported to freeze during some winter months, and areas of shifting pack ice between mainland Quebec and the Belcher Islands also freeze solid. Changes in the timing of freshwater run-off from Quebec and global weather changes have been suggested as possible causes of this change (McDonald et al., 1997). It is unknown whether these events are increasing in frequency, and what impact they have on resident wildlife such as wintering eider populations.

The frequency and magnitude of die-offs in winter and the long-term impact that they have on the Hudson Bay eider population are unknown. Clearly, the relationship between polynyas and open-water leads and the mortality of eiders is an important component of eider population dynamics in Hudson Bay. Our results suggest that access to suitable wintering habitat is critical for eiders and that wintering habitat limitation or degradation may be playing a role in the decline of other eider species (Kertell, 1991; Stehn et al., 1993). Future research should focus on both the physical characteristics of the ocean that maintain open water in the Belcher Islands during winter (e.g., mapping their location, monitoring the timing of their occurrence), as well as quantifying habitat use, diet, and foraging ecology of the eiders surviving within the polynyas and at the floe edge. The potential for continued subsistence harvest in Hudson Bay to slow or prevent the recovery of eider populations following a natural catastrophe, such as a winterkill, also warrants consideration.

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