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Nesting Common Eider (*Somateria mollissima*) Population Quintuples in Northwest Greenland

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ABSTRACT. Common eider (*Somateria mollissima*) populations in Greenland severely declined throughout the 20th century. As a result, in 2001, harvest regulations were changed and the length of the hunting season was reduced. Recent data suggest that these changes have been successful, and population regrowth is occurring. In the Avanersuaq District, northwest Greenland, only one systematic survey quantifying the number of nesting eiders had previously been conducted, in 1997 and 1998. Although this district had historically been identified as having the largest number of breeding eiders in Greenland, the 1997 – 98 survey results showed a relatively small estimated population of 5000 pairs. However, it is not known to what extent changes in hunting regulations have affected nesting abundance in this area. Therefore, the Avanersuaq District was systematically resurveyed during the 2009 breeding season, approximately 11 years after the previous survey. These results showed that the population had increased to 5.4 times its 1997–98 size, with an annual compounded growth rate of 15.3%. On a single island, nearly 4500 active nests were observed. Five islands had more than 2600 nests each and comprised 75% of the total nests counted. Along with historical information to account for additional nesting habitat not surveyed, the observed population growth rate from this study suggests that the overall Avanersuaq common eider breeding population size ranges from 25 000 to 30 000 pairs, or roughly half of the total estimated West Greenland breeding population. Despite the significance of the Avanersuaq District as a breeding area for common eiders, we have only limited information about this population. The effects of recent extensions of the hunting season on this population are also unknown, and the only wintering location information is based on a few individuals banded in the 1920s and 1940s. Additional research on migratory movements is suggested before any further changes are made to hunting regulations.

Key words: common eider, *Somateria mollissima*, population growth, Greenland, Avanersuaq District

RÉSUMÉ. Au cours du XX^{e} siècle, les populations d'eiders à duvet (*Somateria mollissima*) ont connu un déclin considérable au Groenland. C'est pourquoi en 2001, le règlement relatif à la chasse a été modifié et la saison de chasse a été raccourcie. Selon des données récentes, ces changements ont porté fruits en ce sens que la population s'est accrue. Dans le district d'Avanersuaq, dans le nord-ouest du Groenland, seulement un relevé systématique ayant pour but de quantifier le nombre d'eiders nicheurs a été fait, et c'était en 1997-1998. Bien qu'au fil des ans, ce district a compté le plus grand nombre d'eiders reproducteurs du Groenland, le relevé de 1997-1998 avait établi que la population était relativement petite, avec une estimation de 5 000 paires. On ne sait toutefois pas dans quelle mesure la modification du règlement sur la chasse a eu des effets sur l'abondance d'eiders nichant dans la région. Par conséquent, le district d'Avanersuaq a systématiquement fait l'objet d'un autre relevé pendant la saison de reproduction de 2009, soit environ 11 ans après le relevé d'origine. Les résultats ont permis de constater que la population s'était accrue dans une mesure de 5,4 fois par rapport à sa taille de 1997-1998**,** ce qui correspondait à un taux d'accroissement annuel composé de 15,3 %. Sur une seule île, près de 4 500 nids actifs ont été observés. Cinq îles comptaient plus de 2 600 nids par île, ce qui représentait 75 % du nombre total de nids répertoriés. Jumelé aux données historiques tenant compte de l'habitat de nidification supplémentaire et non relevé, le taux d'accroissement de la population observé à partir de cette étude suggère que la taille de la population globale d'eiders à duvet nicheurs d'Avanersuaq varie de 25 000 à 30 000 paires, ce qui correspond à environ la moitié du total estimé de la population nicheuse de l'ouest du Groenland. Malgré l'importance que revêt le district d'Avanersuaq comme aire de reproduction de l'eider à duvet, nous ne possédons que des renseignements restreints au sujet de cette population. Les effets qu'aura le prolongement récent de la saison de chasse sur cette population sont également inconnus, et la seule information concernant la localisation de l'aire d'hivernage dont nous disposons a trait à quelques individus qui avaient été bagués dans les années 1920 et 1940. Par conséquent, il est suggéré de pousser les recherches relatives aux mouvements migratoires plus loin avant d'apporter d'autres changements au règlement de chasse.

Mots clés : eider à duvet, *Somateria mollissima*, accroissement de la population, Groenland, district d'Avanersuaq

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INTRODUCTION

During the 20th century, eider populations (*Somateria* spp. and *Polysticta stelleri*) declined throughout much of their Arctic distribution (for review, see Sea Duck Joint Venture, 2003). Specifically, large decreases in common eider (*S. mollissima*) populations were observed in parts of Canada (Reed and Erskine, 1986; Robertson and Gilchrist, 1998), Alaska (USFWS, 1999, 2006; Suydam et al., 2000), and Greenland (Salomonsen, 1950; Vibe, 1967; Boertmann et al., 1996; Frich et al., 1998; Merkel, 2004a, b). Factors likely contributing to these declines include high harvest levels, human disturbance during the nesting period, and climatic changes; however, the ultimate causes remain equivocal (Robertson and Gilchrist, 1998; Suydam et al., 2000; Merkel, 2004a, b, 2010; Chaulk et al., 2005, 2007). During the past 10 years, some of these populations have shown increased abundance; these include the common eider (*S. m. borealis*) populations in the eastern Canadian Arctic (Hipfner et al., 2002; Rail and Chapdelaine, 2004; Chaulk et al., 2005) and West Greenland (Merkel, 2010).

In Greenland, Salomonsen (1950:122) reported as early as the 1940s that some common eider populations had already "decreased enormously even to the point of extermination" with annual harvests of up to 150 000 birds. The best-documented decline in Greenland is from the Ilulissat, Uummannaq, and Upernavik Districts in West Greenland (69˚15′ N to 74˚05′ N), where surveys from 1960 to 2000 showed an 81% reduction in the number of nests (Merkel, 2004a). Data suggest that the decline in this area was largely due to overharvesting pressure during the winter and early spring (Merkel, 2004b, 2010; Gilliland et al., 2009); however, it is likely that other factors, such as bycatch from gill nets (Merkel, 2004b), egg collecting (Salomonsen, 1950; Merkel, 2004a), and nest predation by sled dogs, also contributed to this decline (Burnham et al., 2005).

As a result of the dramatic decline in the eider population, Greenland hunting regulations were changed in 2001, decreasing the common eider hunting season by four months and eliminating the spring hunt (Piniarneq, 2003, 2004; Merkel, 2010). Annual harvest numbers subsequently decreased by roughly two-thirds, from an annual average of 69 653 (SD ± 11 208) eiders, reported from 1996 to 2001, to 20 169 (± 1467) from 2002 to 2005 (Piniarneq, 2004, 2006, 2009). In the Ilulissat, Uummannaq, and Upernavik Districts, a dramatic increase in eider population growth also followed these regulation changes. From 2000 to 2007, the eider population of those districts increased by 212% (Merkel, 2010). Prior to this increase, the common eider population estimates for West Greenland had ranged from 12 000 to 15 000 breeding pairs (Merkel, 2002; Merkel et al., 2002; Gilliland et al., 2009).

Farther north in West Greenland, historical accounts suggest that the Avanersuaq District (Fig. 1) possessed the largest common eider colonies in Greenland. Salomonsen (1950) estimated that some colonies in this area had more than 10 000 pairs. However, more recent surveys in 1997 and 1998 observed only 3832 active nests, providing an estimated population size of 5000 pairs for the entire district (76˚ to 78˚02′ N; Christensen and Falk, 2001). From these estimates, Christensen and Falk (2001) suggested that the population was "stable" and likely did not exhibit the large declines observed farther south in Greenland as documented by Merkel (2010); however, they did not discuss the large discrepancy between their population estimates and those reported by Salomonsen (1950).

We suspect that the Avanersuaq District eider population had also experienced a decline and subsequent recovery similar to those reported for other populations in Greenland and Canada. The nest surveys reported by Christensen and Falk (2001) were conducted during the breeding season in 1997 and 1998, before regulation changes shortened the hunting season in West Greenland. As a result of reduced winter harvest and decreased egg collecting, we expected that the number of active eider nests within the Avanersuaq District would have increased compared to 1997–98. Data on clutch size, number and density of nests, and their relationship to island size and distance to mainland were analyzed to determine whether eider breeding abundance has changed since the last survey was conducted approximately 11 years ago.

METHODS

Using information from Christensen and Falk (2001), data from the Greenland seabird colony database (Boertmann et al., 1996, 2010; D. Boertmann, pers. com. 2011), and our local knowledge of the Avanersuaq District (between 76˚ and 79˚ N), we identified potential nesting locations where common eiders had been documented previously or were likely to nest given habitat characteristics (Fig. 1). A total of 13 colonies were identified, 10 of which had also been surveyed by Christensen and Falk (2001). For consistency, we used the Greenland seabird colony database codes to represent individual islands or small archipelagos. In the case of two small archipelagos (76001 and 76022), data are presented for each individual island as well as for the entire archipelago colony (Table 1). Colonies were visited by boat from 8 July to 2 August 2009, and except for two large islands, eider nest surveys were conducted during a single visit to each island (see Table 1 for survey dates).

The number of surveyors ranged from three to five individuals, who surveyed each island systematically and counted active nests. Each nest was marked with a sugar cube to avoid double counting (see also Christensen and Falk, 2001). Surveyors documented nests systematically, each following a horizontal transect. Transects were approximately parallel and 5–15 m apart. Each entire island was surveyed using either natural or constructed landmarks (e.g., stone cairns) to assist in verifying complete coverage.

Eider hens typically did not flush from nests until approached within a few meters and often returned soon after the surveyor had passed the nest. Limited numbers

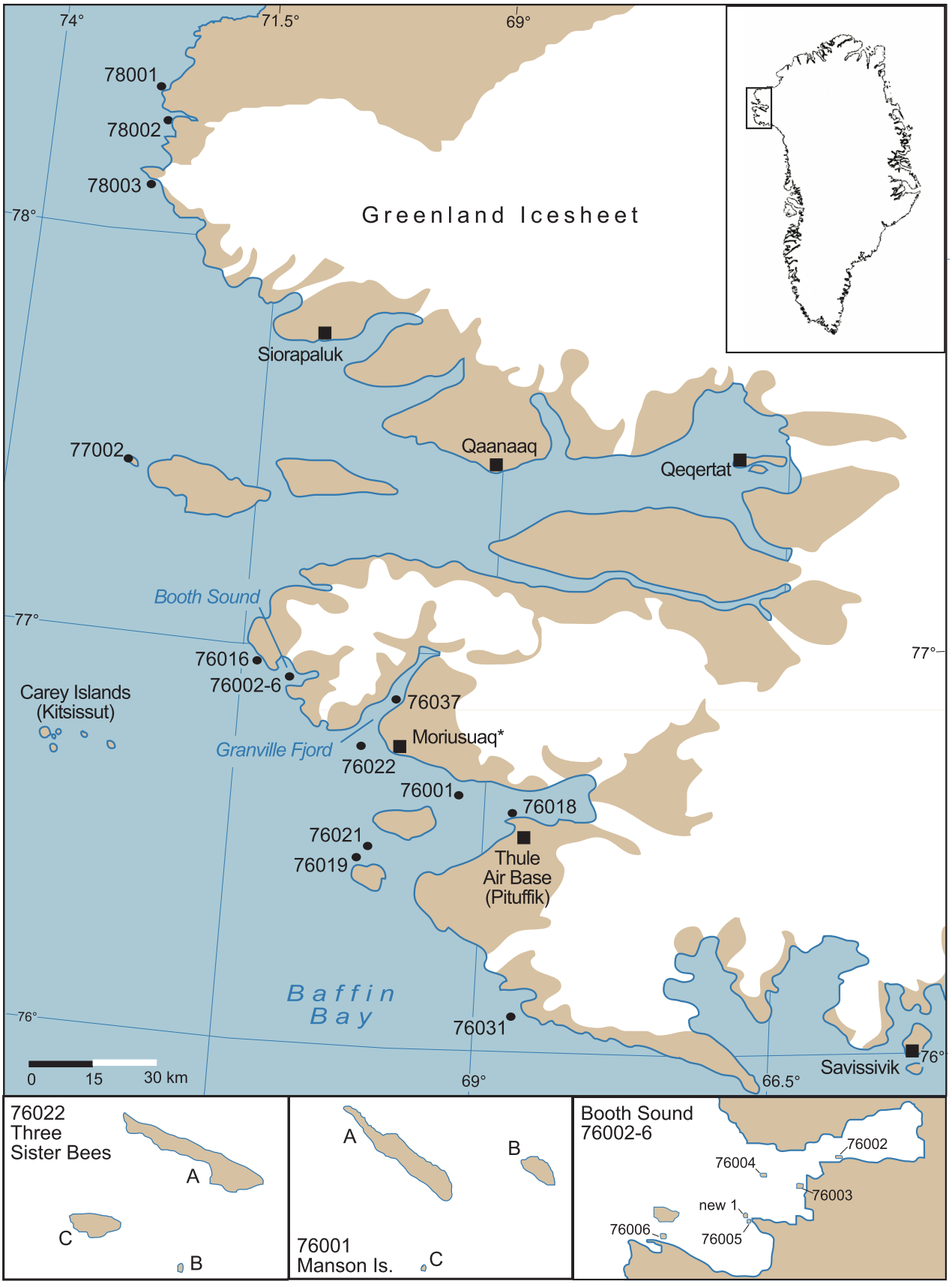

FIG. 1. Map showing common eider colonies in the Avanersuaq District, northwest Greenland, and local villages and towns inhabited year-round. Colonies are labeled with five-digit colony codes from the Greenland seabird colony database. Insets are provided for colonies consisting of more than one island. The village of Moriusuaq (*) has been uninhabited since 2011.

(1 – 3 pairs) of nesting glaucous gulls (*Larus hyperboreus*) were also documented on most islands, but gulls were observed hunting eider chicks only on the water. Therefore, our presence appeared to have minimal effect on nest predation by gulls. The exception was Island 76019, which had at least 24 pairs of nesting glaucous gulls, but surveys on this island were conducted late in the breeding season, when the majority of eggs had already hatched.

Active common eider nests were identified according to four categories: 1) nest cups containing plant material, down, or both (but no eggs), 2) nest cups containing down and eggshell fragments or membranes, 3) nest cups containing down and eggs, and 4) nests containing down and chicks (with or without eggs). Data were also collected on clutch size and the number of chicks in each nest. Nests with more than seven eggs were excluded from mean clutch size calculations because those nests were likely to contain eggs from more than one female (Robertson et al., 1992). Old nest cups without plant material or down were not counted. No indication of human-mediated down harvesting, egg collecting, or shooting was observed at any of the colonies during the study period. A few eider nests (n = 35) contained eggs of long-tailed duck (*Clangula hyemalis*). These nests were included in the study if at least one eider egg was also present; however, long-tailed duck eggs were not included in the count.

Pre-existing maps were not used to estimate total area available for nesting eiders because island size varies with the tide level, which could differ by up to 3.3 m. Instead, island size was determined using a handheld GPS (Garmin eTrex). Surveyors circumnavigated each island on foot at a rate of 1.5 to 1.8 m per second, walking approximately 2 m above high tide level. GPS locations were recorded every 10 to 20 seconds and used to calculate island size with ArcGIS 9.1 (Environmental Systems Research Institute, Redlands, California). For islands less than one hectare in size, density calculations are extrapolated to one hectare, as in Chaulk et al. (2004). Since data had a non-normal distribution, all data were log transformed, and Pearson's correlation was used to test for significant associations between variables using JMP-IN, V. 4 (SAS Institute Inc., Cary, North Carolina).

RESULTS

A total of 20 687 common eider nests were counted in the Avanersuaq District during the 2009 breeding season, an increase to 5.4 times the original number over an 11-year period, or an annual compounded growth rate of 15.3%. In each of the eight colonies surveyed in both 1997 – 98 and 2009, the number of eider nests recorded increased, with increases ranging from 17% (24 to 28 nests; colony 76018) to 1468% (255 to 3998 nests; colony 76019) (Table 1). Two colonies (77002 and 78003) included in the 1997 – 98 survey were not surveyed in 2009; in the earlier survey, they had nine and zero nesting pairs, respectively, or 0.2% of the total recorded pairs (Christensen and Falk, 2001).

The number of islands in each colony surveyed in 2009 ranged from one to six, for a total of 18 islands surveyed. Of those islands, all had either eiders actively nesting or nests with eggshell fragments or membranes (Table 1). Nesting eiders were observed on two additional islands not included in Christensen and Falk (2001). On the first island (76037), located in Granville Fjord, a 1998 survey by aircraft reported observations of arctic terns (*Sterna paradisaea*), but made no mention of eiders (Boertmann et al., 1996, 2010; D. Boertmann, pers. com. 2011). The second island (new 1) was located in Booth Sound, approximately 50 m north of island 76005. Nesting eiders were also observed in 2009 on island 76031 (Table 1), which Christensen and Falk (2001) considered uninhabitable for nesting eiders. Eiders were also observed incubating eggs on that island in 2011 (K. Burnham, unpubl. data).

Of the total nests observed on all of the islands surveyed in 2009, 0.63% contained vegetation, down feathers, or both (category 1); 24.67% had down and eggshell fragments (category 2); and 74.70% had eggs, chicks, or both (categories 3 and 4). The total number of nests per island ranged from 14 to 4444 (mean = 1149, SD ± 1579, median = 190, Table 1). Island 76031, where Christensen and Falk (2001) found no nests in 1998, had 41 total nests. Five nests were located on the northern hillside of the island, and the remaining nests were found on a small islet approximately 150 m^2 in size on the northwest side of the island. Average clutch size for nests with seven or fewer eggs was 3.3 (SD ± 1.28; n = 5028), with average clutch size among islands ranging from 2.8 to 4.0 eggs (Table 1).

The number of nests per island was negatively correlated with clutch size (r^2 = 0.21, p = 0.05, n = 15): islands with fewer nests generally had larger clutches. However, no association was found between clutch size and nest density (r^2 = -0.05, p = 0.54, n = 15). The percentage of nests containing eggs decreased throughout the breeding season, as expected, and a significant relationship was observed between Julian survey date and percent of nests containing eggs (r^2 = 0.78, $p < 0.005$, n = 17; Island 76019 was excluded because of the large range of survey dates). Peak hatching period in 2009 for the Avanersuaq District, where ~50% of the surveyed nests had eggs, was between 13 and 15 July.

While a large range in island size was observed (0.40 – 77.13 ha) for those islands with more than 2600 nests, larger islands tended to have more nests (r^2 = 0.17, p = 0.05, n = 18). Island size was negatively correlated with nest density, with nests spaced closer together on smaller islands (r^2 = 0.20, $p < 0.05$, n = 18), yet island size was not correlated with average clutch size (r^2 = 0.04, p = 0.22, n = 15). Nests were generally found throughout each of the islands, except on cliff faces or steep hillsides, and the highest densities were frequently observed in low-lying areas with dense grassy vegetation. Areas with numerous terraces approximately 1 m high (e.g., islands 76019 and 76021) also had large numbers of nests, with eiders nesting in the densely vegetated ledges between terraces.

TABLE 1. Results from a survey of nesting common eiders in the Avanersuaq District, northwest Greenland, from mid-July to early August 2009.

Colony number[1]	Site name	Survey dates	Avg. eggs per nest ± SD (n, range)	% nests with eggs	Island size (ha)	Nests/ ha	Total nests 2009	Total nests 1997–98[2]
76001(A)	Paattorfiarsuk	9–11 July	3.23 ± 1.13 (814, 1–6)	22	77.13	48.3	3725	652
76001(B)	(Manson Islands)	9 July	3.61 ± 1.33 (47, 1–7)	55	19.05	4.5	85	"
76001(C)		11 July	3.22 ± 1.33 (312, 1–7)	65	0.29	1645.7	484	"
new 1[3]	Booth Sound	12 July	3.75 ± 1.26 (4, 2–5)	100	0.09	42.6	4	–
76002	Booth Sound	14 July	3.01 ± 1.41 (485, 1–7)	50	0.57	1717.2	985	506
76003	Booth Sound	14 July	3.63 ± 1.18 (123, 1–7)	71	0.25	699.1	174	87
76004	Booth Sound	13 July	3.27 ± 1.64 (719, 1–7)	29	0.40	6488.9	2604	235
76005	Booth Sound	12 July	4.01 ± 1.39 (75, 1–7)	85	0.05	1854.2	89	20
76006	Booth Sound	12 July	2.75 ± 0.96 (4, 2–4)	29	0.29	482.2	138	18
76016	Qeqertaaraq	13 July	2.92 ± 1.11 (43, 1–5)	21	0.42	489.7	206	105
76018	Nuulliarsuit	11 July	3.61 ± 1.46 (18, 1–6)	64	0.14	200.7	28	24
76019	Igannaq (Dalrymple Rock)	15, 18, 28 July	3.06 ± 1.01 (184, 1–5)	5	14.36	278.3	3998	255
76021	Qeqertaarsuit (Eider Duck Is.)	8 July	3.34 ± 1.16 (2026, 1–7)	46	2.62	1697.1	4444	1572
76022(A)	Iterlassuup Qeqertaarsuq	25 July	3.05 ± 1.20 (75, 1–6)	3	14.14	195.6	2765	349
76022(B)	(Three Sister Bees)	25 July	fragments only	0	0.14	14.6	2	"
76022(C)		25 July	3.10 ± 0.98 (100, 1–5)	12	4.79	188.1	901	"
76031	Igannaq (Conical Rock)	2 August	fragments only	0	84.85	0.5	41	0
76037[3]	Iterlassuaq	26 July	fragments only	0	0.91	15.4	14	–
77002[4]	Appaarsuit (Hakluyt Island)	–	–	–	–	–	–	9
78003[4]	Sutherland Island	–	–	–	–	–	–	0
	Totals for Avanersuaq		**3.28 ± 1.28 (5028, 1–7)**				**20 687**	**3832**

[1] Colony number from Greenland seabird colony database (DMU-AM & OC 1999). For the Manson Islands and Three Sister Bees, letters after colony numbers are used to identify individual islands in Figure 1 inset maps.

[2] Data from Christensen and Falk (2001).

[3] Island not surveyed by Christensen and Falk (2001).

[4] Island not surveyed in 2009.

Surveyed islands that had active eider nests were located between 67 and 16 900 m from the mainland (mean = 3338, SD ± 4933 m, median = 1160 m, n = 18). No correlation was found between distance to mainland and number of nests (r^2 = 0.09, p = 0.13, n = 18), clutch size (r^2 = -0.06, p = 0.64, n = 15), or density (r^2 = -0.03, p = 0.46, n = 18).

DISCUSSION

Over the past 10 years, common eider populations have increased in size in multiple areas within the Arctic. In the areas surveyed to date, the greatest increase was observed in the Avanersuaq District, where the population has more than quadrupled since the late 1990s (this study). While no islands were documented with "more than 10 000 pairs," as reported by Salomonsen (1950), the number of nests on individual islands is among the highest ever documented for this species, with one island having more than 4000 nests. Only Mitivik Island in the East Bay Migratory Bird Sanctuary (Nunavut, Canada) has a larger colony size, with an estimated 4500 to 9000 breeding pairs each year (Allard and Gilchrist, 2002; Love et al., 2010). Within Greenland, the largest breeding colony size for a single island reported outside the Avanersuaq District, estimated at approximately 2000 pairs in 2010, is in the Upernavik District (F. Merkel, pers. comm. 2011)

The total common eider population size for West Greenland is currently estimated to be between 50 000 and 63 000 pairs (F. Merkel, pers. comm. 2011). Within the Avanersuaq District alone, we counted nearly 21 000 active nests among 18 islands. Two additional colonies (78001 and 78002) in north Avanersuaq were not included in either survey. However, data from the 1980s suggested that each of those two colonies possessed up to 1500 eider nests (Boertmann et al., 1996, 2010; D. Boertmann, pers. comm. 2011), and they should be included in future surveys. Breeding eiders have also been observed on the Carey Islands, a chain of seven islands approximately 40 km west of Booth Sound (Fig. 1) that was not included in the 2009 survey. In 2008, Burnham and Burnham (2010) reported observing common eiders as "abundant inhabitants" on all seven islands and numerous small islets. While no systematic surveys for eider nests were conducted, active nests and large groups of several thousand males were observed in the area. In fact, Salomonsen (1950) considered the Carey Islands as one of the largest eider colonies in the Avanersuaq District. Therefore, if we also consider the Carey Islands and colonies 78001 and 78002, it is conceivable that the eider breeding population in the Avanersuaq District is a minimum of 25 000 pairs, and possibly as many as 30 000 pairs, or approximately half of the breeding population of common eiders on the west coast of Greenland.

Population growth in eiders is commonly associated with increased adult survival (Goudie et al., 2000; Wilson et al., 2007), although juvenile recruitment (Coulson, 1984; Swennen, 2002; Merkel, 2010) and immigration (Bregnballe et al., 2002) have also been suggested as important

factors in population growth. Population growth rates have been documented as high as 25–35% in Denmark (Bregnballe et al., 2002), 11–24% for the Gulf of St. Lawrence (Chapdelaine, 1995), and 13–22% for the Labrador Coast (Chaulk et al., 2005). South of the Avanersuaq District, in an area extending from Nuussuaq (74˚05′ N) to Ilulissat (69˚15′ N), Merkel (2010) reported a 212% increase in the number of eider nests, or an average annual growth rate of 12.6%, from 2000 to 2007. Similarly, an increase in the number of eider nests was observed in the Avanersuaq District between 1997–98 and 2009, with an annual growth rate of 15.3%.

While large breeding populations of common eiders have been identified throughout the Arctic, the majority of these populations inhabit areas with hundreds or even thousands of islands (Robertson and Gilchrist, 1998; Chaulk et al., 2005). In West Greenland, Merkel (2010) documented 7982 eider nests on 114 islands. Farther north in the Avanersuaq District, far fewer islands were surveyed; yet a much larger number of eider nests was documented. We counted a total of 20 687 nests on 18 of the approximately 29 islands likely to be suitable for breeding eiders. In fact, a single island (76021) that is 2.62 ha in size had nearly 4500 nests, or 21% of the total population. Of the total nests recorded, approximately 75% were located on only five islands, and 99% of the total population was associated with only five colonies, a pattern strikingly different from other Arctic breeding areas. This high dependence upon a few select islands potentially increases the susceptibility of the Avanersuaq population to both disease and other density-dependent factors (Newton, 1998). In particular, large breeding concentrations of waterfowl are susceptible to avian cholera (Botzler, 1991). For example, the large eider colony on Mitivik Island experienced an avian cholera outbreak between 2005 and 2007 that killed more than 3000 adult females (Mallory et al., 2009), resulting in a 90% reduction in duckling survival (Descamps et al., 2011).

Within our study area, islands with large numbers of nests had smaller clutch sizes than islands with fewer nests, although nest density appeared to have no effect on clutch size. The smaller clutch sizes observed on islands with large numbers of nests could in part be a result of increased intraspecific competition for food caused by the extremely high number of females on these islands. Erikstad et al. (1993) showed that female eiders with higher body condition lay larger clutches, and therefore, food may be limiting on islands with greater numbers of nesting females. Christensen and Falk (2001) provide a mean clutch size estimate for only one island from their study (3.7 for island 76001), and although this figure is significantly larger ($p < 0.0001$, $t = 5.15$) than the average clutch size observed during our study for the same island (3.3 eggs), the difference could easily be a result of sampling error associated with the timing of nest surveys. No information is provided by Chaulk et al. (2005) or Merkel (2010) regarding change in clutch size associated with increasing population size.

Data from Salomonsen (1950), Christensen and Falk (2001), and our survey suggest that the eider population in the Avanersuaq District likely underwent a significant decline akin to the decline of other populations in the Arctic (see Introduction). Within the past 10 years, this population appears to have increased in abundance, like other populations in both Greenland (Merkel, 2010) and Canada (Chaulk et al., 2005). Merkel (2010) attributed the 212% increase in the number of eider nests to increased adult survival and recruitment of first-time breeders, likely the result of reduced winter harvest following changes in hunting regulations in 2001. It is likely that reduced winter hunting pressure has also played an important role in increasing eider abundance in the Avanersuaq District. With consistent yearly summer fieldwork throughout much of the Avanersuaq District from 1993 to 2011, we have observed no shooting of adult eiders and minimal evidence of egg collecting.

Aside from hunting, many additional factors influence eider breeding in the Arctic. Specifically, sea ice conditions (Mehlum, 1991; Robertson and Gilchrist, 1998; Lehikoinen et al., 2006; Chaulk et al., 2007; Chaulk and Mahoney, 2012), severity of winter (Lehikoinen et al., 2006), and temperature (D'Alba et al., 2010) have all been shown to have a significant effect on eider population size. Within the Avanersuaq District, overall sea ice coverage began to decrease in the early 1990s, and the rate of decrease has been accelerating since that time (Born et al., 2011). Additionally, mean annual ambient temperature has increased significantly since the 1980s (Born et al., 2011; Burnham et al., 2012). An ameliorating climate has been shown to be beneficial for eiders by increasing annual productivity (Lehikoinen et al., 2006; Jónsson et al., 2009). For example, D'Alba et al. (2010) documented a positive correlation between air temperature and eider abundance in southwest Iceland, with an almost fourfold increase in the number of eider nests at a breeding colony monitored from 1977 to 2006. Additionally, Melhum (2012) showed that early breakup of sea ice in the Kongsfjorden area of Svalbard was associated with more nests and larger average clutch sizes, at both regional and individual island levels. In Baffin Bay, which includes the Avanersuaq District, Stirling and Parkinson (2006) showed that sea ice breakup occurred approximately six to seven days earlier in each decade from 1979 to 2004. It is likely that this combination of increasing temperatures and earlier breakup of sea ice in the Avanersuaq District also contributed to the large increase observed in the common eider population over the same period.

Documented negative effects of climate change on eiders are limited. In Hudson Bay, Canada, polar bears (*Ursus maritimus*) have been documented earlier on shore as the date of spring ice breakup has advanced. A single polar bear traveled between multiple islands over a 96-hour period and consumed all of the eggs in 206 of approximately 325 eider nests (Rockwell and Gormezano, 2009). In Svalbard, Madsen et al. (1989) and Drent and Prop (2008) have shown that polar bear predation negatively affects abundance in local

goose populations. In the Avanersuaq District, polar bears are relatively common: 179 individuals were harvested from 2001 through September 2005 (Born et al., 2011).

Despite the previously mentioned reduction in the annual eider harvest in Greenland from 2002 to 2005, more recent changes in hunting regulations appear to be resulting in increased annual harvests. Beginning in 2005, the winter hunting season was extended to the end of February and spring hunting was opened in the Avanersuaq District until 15 June (Piniarneq, 2005). Coinciding with these extensions in the hunting season, annual harvests greatly increased, from an average of 20 169 (SD ± 1467) in 2002–05 to an average of 26 048 (SD ± 804) for 2006–10 (Piniarneq, 2009, 2011; Nanoq, 2012). Further changes were also made to the winter hunting season in 2010 and 2011, extending the season to the end of March (Piniarneq, 2010, 2011). Data are not yet available for 2011, and the full effect these changes have had on the annual harvest of eider populations breeding within Greenland is unknown.

Of further concern is human disturbance (Åhlund and Götmark, 1989; Keller, 1991; Bolduc and Guillemette, 2003); recently, personal boat activity by civilians at Thule Air Base, including a small commercial tour boat, has increased (pers. obser.). Disturbance by Inuit from local villages is likely uncommon. The village of Moriusuaq, less than 10 km from the nearest eider colony (76022), is uninhabited as of early 2011, and no eider colonies are currently within 60 km of any local Inuit villages (Fig. 1).

Given the large number of breeding common eiders in the Avanersuaq District, future monitoring of this population is warranted. Monitoring is particularly important considering that environmental conditions for nesting eiders in 2009 appeared to be ideal, and our nest counts may well have been maxima. Abundance estimates published to date suggest that the Avanersuaq District colonies may constitute about half of the breeding common eider population in West Greenland, with the majority of females nesting on relatively few islands. However, no information is known on multi-year productivity and recruitment demographics, and our current knowledge of where the population winters is based on 17 band recoveries from birds tagged in 1928 and 1948 (Lyngs, 2003). Before any further changes are made in harvest regulations, we strongly recommend that consideration be given to identifying the primary wintering area(s) for this population and determining whether the recent extensions in the duration of the hunting season have had any negative effects on eider nesting abundance. These results would provide resource managers more information concerning how harvesting pressures at specific locations influence local eider productivity.

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