

HISTORICAL AND PRESENT BREEDING SEASON DISTRIBUTION OF STELLER'S EIDERS IN ALASKA

LORI T. QUAKENBUSH, School of Fisheries and Ocean Sciences, University of Alaska, Fairbanks, Alaska 99775-7220 (current address Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701-1599)

ROBERT H. DAY and BETTY A. ANDERSON, ABR, Inc.— Environmental Research & Services, P. O. Box 80410, Fairbanks, Alaska 99708-0410

FRANK A. PITELKA, University of California, Museum of Vertebrate Zoology, Berkeley, California 94720-3160

BRIAN J. McCAFFERY, Yukon Delta National Wildlife Refuge, P. O. Box 346, Bethel, Alaska 99559

ABSTRACT: The Alaska breeding population of the Steller's Eider (*Polysticta stelleri*) occurs as two subpopulations, one on the Arctic coastal plain of northern Alaska, primarily near Barrow, and the other on the Yukon-Kuskokwim Delta of western Alaska. In 1997, the Alaska breeding population was listed under the Endangered Species Act as threatened because the nesting range and population were thought to have decreased substantially. The historical (pre-1970) and recent (1970-present) breeding distribution and abundance of Steller's Eiders, however, are not well known. We compiled and evaluated the historical and recent records of breeding-season distribution, confirmed nesting for northern and western Alaska, and found that the overall sizes of the breeding ranges have not changed substantially; however, the frequency of breeding has decreased in both regions, except near Barrow. Causes of this reduction in breeding frequency of Steller's Eiders in Alaska are unknown, but changes in predator populations, lead poisoning, and interspecific nesting associations with Snowy Owls (*Nyctea scandiaca*) and Pomarine Jaegers (*Stercorarius pomarinus*) may be contributing factors.

Three geographically distinct breeding populations of Steller's Eiders (*Polysticta stelleri*) are recognized, two in arctic Russia and one in Alaska, with the greatest numbers occurring in the eastern Russian Arctic (Nygård et al. 1995; Figure 1). The Alaska breeding population is the smallest of the three and comprises two geographic subpopulations, one on the Arctic coastal plain of northern Alaska, the other on the Yukon-Kuskokwim Delta of western Alaska. The Alaska breeding population was listed as threatened under the Endangered Species Act in 1997 because it was thought that the species' nesting range in Alaska had decreased substantially and that the overall number of birds nesting in Alaska probably had decreased substantially as well (U.S. Federal Register 62:31748-31757). That decision, however, was based on little information. In this paper, we summarize and evaluate the historical (pre-1970) and recent (1970-present) breeding distribution and frequency of Steller's Eiders in Alaska and discuss possible reasons for changes.

METHODS

We compiled both positive (presence) and negative (absence) observations on the breeding-season distribution and breeding frequency of Steller's Eider in Alaska from published and unpublished literature, museum records,

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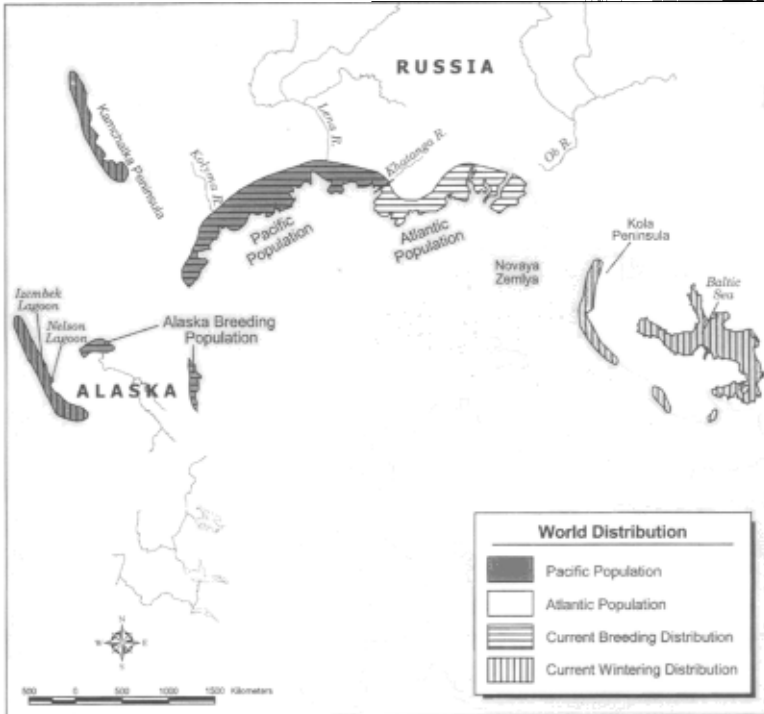


Figure 1. The current breeding and wintering ranges of Steller's Eider. The bar at the mouth of the Khatanga River in Russia marks the boundary between Pacific and Atlantic populations.

personal communications, and field notes (also see Boarman and Coe 2000). We used daily or seasonal bird lists when they existed because study reports did not always report on nonfocal species. Positive records included Steller's Eiders seen during the breeding season (May–September) and only on land or fresh water; known migrants and molting concentrations were excluded. Negative records included visits to a specific location within the historical range of Steller's Eider, during the breeding season, in which no Steller's Eiders or evidence of nesting were observed. Because Quakenbush and Suydam (1999) found that Steller's Eiders did not nest annually near Barrow in the 1990s, despite being present, we made a distinction between sightings ("occurrence") and evidence of nesting ("breeding"). We did not include observations from aerial surveys because these surveys do not yield evidence for nesting, but we did summarize the distribution of aerial-survey observations to compare them with those made from the ground.

To compare the past and present data sets for possible declines in either the occurrence or breeding frequency of Steller's Eiders, we divided the records into historical (pre-1970) and recent (1970–present). We chose

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1970 as the division between periods because of the increase in multiyear ornithological studies that began on the Arctic coastal plain in conjunction with oilfield development and studies in the Yukon-Kuskokwim Delta that expanded and intensified about that time.

We tabulated numbers of site-years of occurrence and breeding during each period. A site-year reflects data for one year at a particular location (site) during the breeding season. Observations ranged from single-day site visits to multi-month studies. Potential problems exist because of the greater effort in a longer-term study and because few sites have been visited with equal effort in both periods. To reduce the effects of this possible bias, we compared pooled data from all sites with data from a subset of sites that had been visited in both periods.

A compilation of site data by period allows a qualitative estimate of distribution and breeding frequency of Steller's Eiders in Alaska. Because of the qualitative nature of these data, these frequencies are not estimates of absolute change but reveal trends of occurrence and breeding.

RESULTS

Northern Alaska

Historical data suggest that Steller's Eiders formerly occurred across much of the Arctic coastal plain [Anderson 1913, Brooks 1915, Bailey 1925, 1948, Bent 1925, Bee 1958, Fiscus 1952 in Gabrielson and Lincoln 1959, Gill et al. 1985, Quakenbush and Cochrane 1993; egg collections in the Western Foundation of Vertebrate Zoology, Camarillo, California (WFVZ), and Denver Museum of Natural History, Denver, Colorado (DMNH; Figure 2)]. They also were recorded in northwestern Canada as far east as Cape Bathurst, Northwest Territories, and in four of five pre-1970 site-years between Kaktovik and Cape Bathurst, Northwest Territories, suggesting that the species formerly occurred there regularly (Anderson 1913, Brooks 1915, Dixon 1943).

Although the species apparently ranged widely over the Arctic coastal plain and into northwestern Canada, unequivocal historical evidence of nesting is available only from Wainwright to Cape Halkett in Alaska (Bailey 1925, 1948, Stone 1900 in Gabrielson and Lincoln 1959, Bee 1958; egg collections in WFVZ, DMNH, and Museum of Vertebrate Zoology, University of California, Berkeley; Figure 2). Verbal accounts of nesting include locations as far east as the Colville River Delta (P. Sovalik in Myres 1958) and Collinson Point near Kaktovik (W. Patkotak in Quakenbush and Cochrane 1993), but there are no definitive historical records of nesting east of Cape Halkett. Regardless of the eastern limit of nesting, the species occurred and nested with greatest frequency in the vicinity (within 20 km) of Barrow (Myres 1958, Gabrielson and Lincoln 1959, Pitelka 1974, Quakenbush and Suydam 1999) and, secondarily, elsewhere within the Arctic coastal plain at least as far east as Cape Halkett (Figure 2).

Recent occurrence extends from Wainwright to the Sagavanirktok River, with one record from Herschel Island, Yukon Territory, Canada (Talarico and Mossop 1986); however, there are no recent sightings between the Sagavanirktok River and the Alaska-Canada border (Figure 3). In addition,

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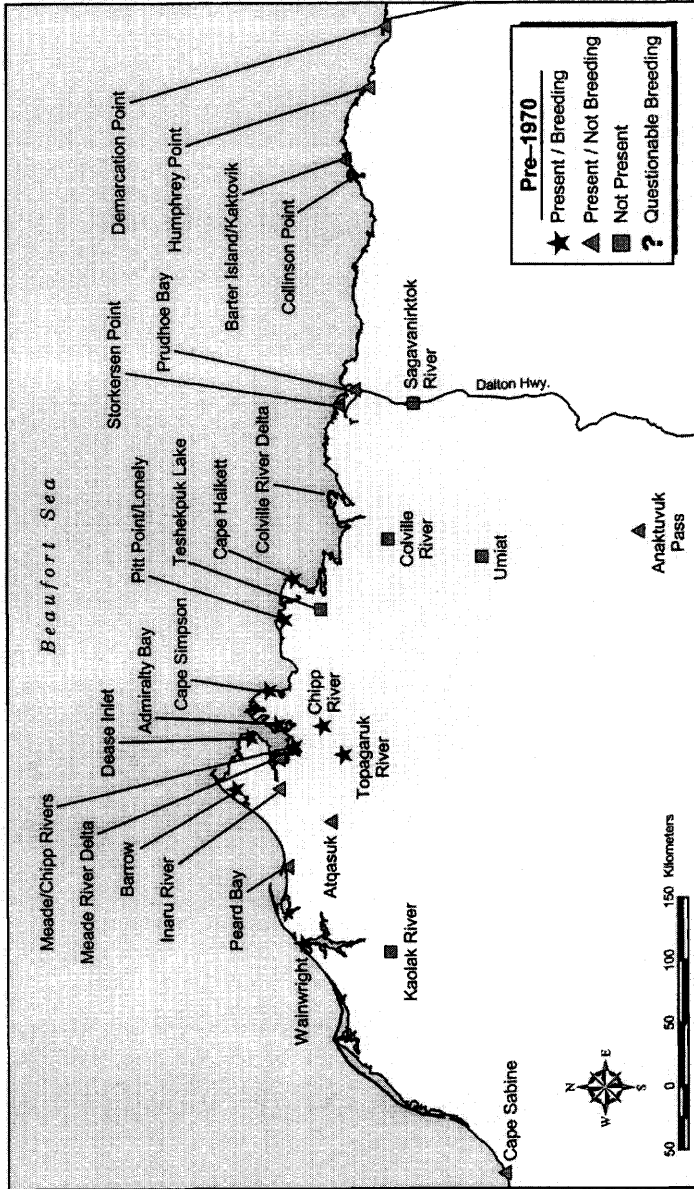


Figure 2. The occurrence and breeding distribution of Steller's Eider in northern Alaska (May-September) before 1970.

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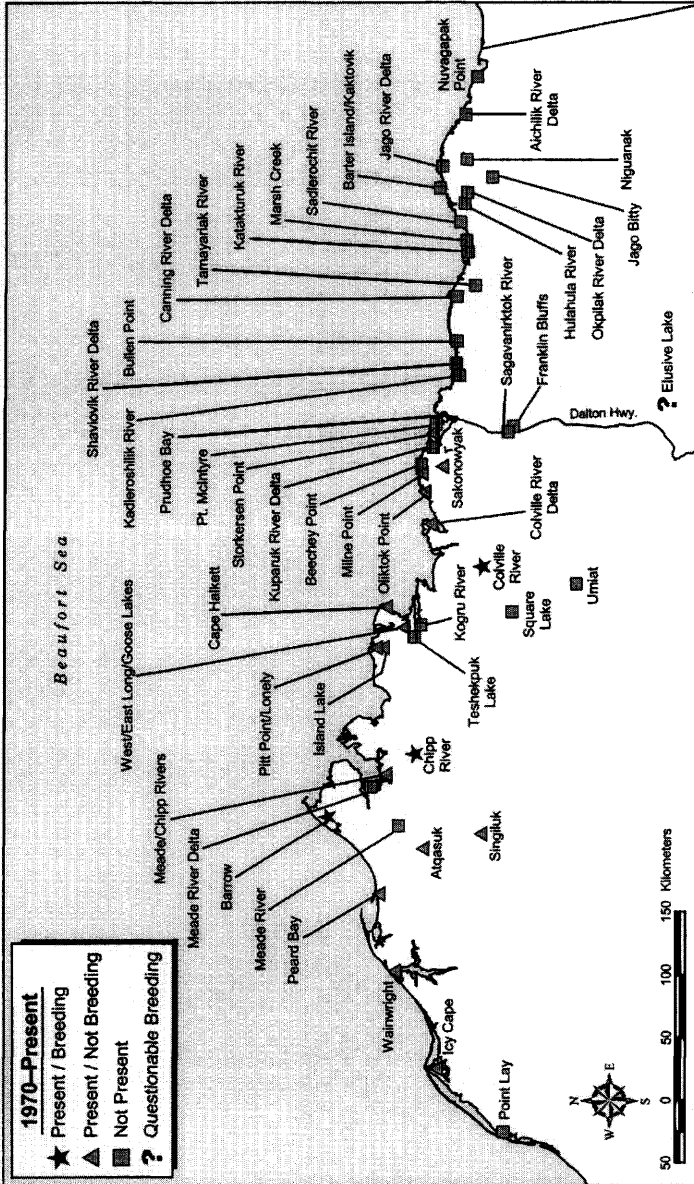


Figure 3. The occurrence and breeding distribution of Steller's Eiders in northern Alaska (May-September) since 1970.

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aerial surveys flown annually between 1989 and 1999 have accumulated sightings of 436 Steller's Eiders at 180 locations on the Arctic coastal plain (Larned et al. 1993, Brackney and King 1993, 1994, Balogh and Larned 1994, Larned and Balogh 1994, King and Brackney 1995, King and Dau 1997). These surveys found that Steller's Eiders were widely distributed between Point Lay and the Sagavanirktok River, with only three sightings between the Colville and Sagavanirktok rivers and the highest densities near Barrow. An aerial survey flown near Barrow, Admiralty Bay, and Meade River in 1999 and 2000 also found Steller's Eiders to be most common near Barrow (Ritchie and King 2001).

Recent unequivocal nesting records range from Barrow to inland on the Colville River (Figure 3), with the Barrow area still being the center of abundance and primary nesting location in northern Alaska. There is no unequivocal evidence of recent nesting east of the Colville River, despite extensive fieldwork in this region. M. M. Johnson (Univ. of Calif., Davis, pers. comm.) saw a flight-capable brood on Lake Colleen, near the Sagavanirktok River, and K. Russell [U.S. Fish and Wildlife Service (USFWS), Fairbanks, pers. comm.] saw a flight-capable brood on Elusive Lake in the Brooks Range; however, these birds may have flown considerable distances from their breeding sites.

Occurrence and breeding status are available from the Arctic coastal plain for 106 historical and 151 recent site-years. Steller's Eiders were recorded during 75% of historical site-years but only 36% of recent site-years (Figure 4). Breeding frequency, based on years of occurrence, was 49% of historical site-years but 33% of recent ones (Figure 5). Fourteen sites between

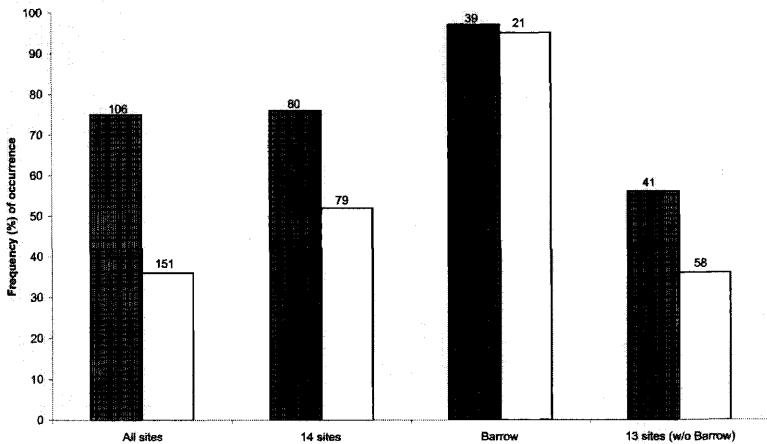


Figure 4. Percentage of site-years that Steller's Eiders were present before (shaded bars) and after (white bars) 1970 in northern Alaska. The number of site-years appears above bars.

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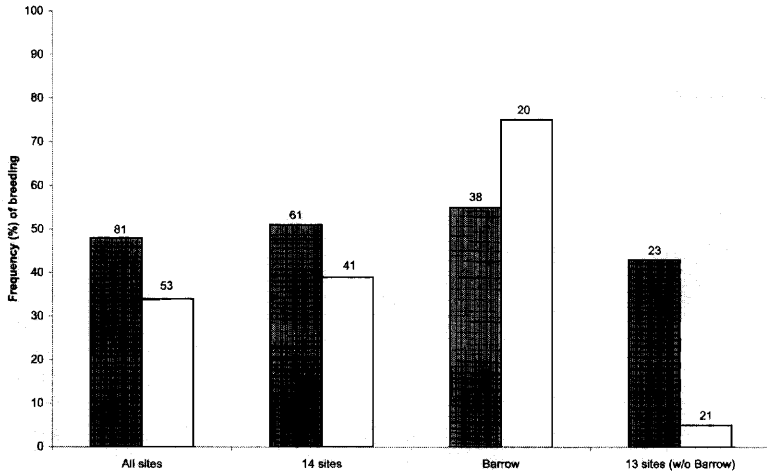


Figure 5. Percentage of site-years that Steller's Eiders were breeding when present before (shaded bars) and after (white bars) 1970 in northern Alaska. The number of site-years appears above bars.

Wainwright and the Sagavanirktok River have both historical and recent data for comparison (Table 1). These data indicate declines in occurrence (from 76% of historical to 52% of recent site-years; Figure 4) and breeding frequency (from 51% to 39%; Figure 5), as do all records east of the Sagavanirktok River. During 12 years of recent studies on the Colville River Delta, there was only one record of occurrence and no evidence of breeding.

Data on occurrence and breeding within 10 km of Barrow for 39 historical and 21 recent site-years (1881–2000), however, do not suggest declines (Figures 4 and 5). Steller's Eiders were recorded during 97% of historical and 95% of recent site-years, and they bred in 55% of historical and 70% of recent site-years (Figures 4 and 5).

If the Barrow data are omitted from the subset of sites with both historical and recent records, the frequency of occurrence still declines from 56% to 36% of site-years (Figure 4). The decline in breeding frequency, however, is much greater—from 43% to 5% (Figure 5). These data clearly indicate a reduction in both occurrence and breeding frequency for the Arctic coastal plain, except near Barrow (Figures 4 and 5).

Western Alaska

There are only four historical breeding records for the western Alaska subpopulation north of the central Yukon–Kuskokwim Delta (Figure 6). A brood of three was seen in 1879 at Port Clarence, on the Seward Peninsula (Portenko 1972, Kessel 1989), five eggs were collected from a nest at St. Michael (WFVZ), and there were two reports of nesting for St. Lawrence Island (Nelson 1887, Fay and Cade 1959); however, only the report by Fay and Cade (1959) was substantiated.

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Table 1 Distribution of Steller's Eider Observations in Northern Alaska during the Breeding Season (May–September)^a

Location ^b	Time period ^c	Total site-years ^d	Site-years present	Site-years breeding
Cape Sabine	H	4	3	0
Point Lay	R	10	0	0
Icy Cape	R	1	1	0
Wainwright ^e	H	10	7	1
	R	2	1	0
Kaolak River	H	2	0	0
Peard Bay ^e	H	1	1	0
	R	2	1	0
Barrow ^e	H	39	38	21
	R	21	20	15
Meade/Chipp Rivers ^e	H	6	2	2
	R	2	1	0
Meade River	R	2	0	0
Atkasuk ^e	H	1	1	0
	R	4	1	0
Inaru River	H	3	2	0
Meade River Delta ^e	H	2	1	0
	R	1	0	0
Admiralty Bay	H	1	1	1
Dease Inlet	H	1	1	1
Singilik	R	1	1	0
Topagaruk River	H	1	1	1
Chipp River	H	4	4	2
Cape Simpson	H	4	2	2
Pitt Point/Lonely ^e	H	6	4	4
	R	1		0
West/East Long, Goose Lakes	R			
	R	5	1	0
Island Lake	R	2	1	0
Teshkepuk Lake	H	1	0	0
Square Lake	R	1	0	0
Cape Halkett ^e	H	3	3	2
	R	1	1	0
Kogru River	R	1	0	0
Colville River ^e	H	2	0	0
	R	1	1	1
Colville River Delta ^e	H	3	3	1?
	R	12	1	0
Umiat area ^e	H	4	0	0
	R	1	0	0
Anaktuvuk Pass	H	1	1	0
Milne Point	R	1	1	0
Oliktok Point	R	5	2	0
Sakonowyak River	R	3	1	0
Beechey Point	R	2	0	0
Kuparuk River Delta	R	1	0	0
Storkersen Point ^e	H	1	1	0
	R	8	4	0

(continued)

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Table 1 (Continued)

Location ^b	Time period ^c	Total site-years ^d	Site-years present	Site-years breeding
Pt. McIntyre	R	1	0	0
Prudhoe Bay ^e	H	1	1	0
	R	21	13	1 ^f
Sagavanirktok River ^e	H	1	0	0
	R	2	0	0
Franklin Bluffs	R	1	0	0
Elusive Lake	R	1	1	1 ^f
Kadleroshilik River	R	2	0	0
Shaviovik River Delta	R	2	0	0
Bullen Point	R	1	0	0
Canning River Delta	R	6	0	0
Tamayariak River	R	3	0	0
Katakturuk River	R	3	0	0
Marsh Creek	R	1	0	0
Sadlerochit River	R	3	0	0
Collinson Point	H	1	1	?
Hulahula River	R	1	0	0
Okpilak River Delta	R	3	0	0
Jago Bitty	R	2	0	0
Jago River Delta	R	2	0	0
Nuguanak	R	1	0	0
Barter Island/Kaktovik	H	1	1	0
	R	1	0	0
Humphrey Point	H	1	1	0
Aichilik River Delta	R	2	0	0
Nuvagapak Point	R	1	0	0
Demarcation Point	H	1	0	0
Totals	H	106	80	39
	R	151	54	18
Herschel Island, Yukon	R	1	1	0
Cape Bathurst, Northwest Territories	H	1	1	0

^aSurveys that failed to record Steller's Eiders are included.

^bArranged geographically, from west to east.

^cH, historical (before 1970); R, recent (since 1970).

^dA site-year reflects data for a particular location during one year.

^eOne of 14 sites with both historical and recent data.

^fLocation of flight-capable brood, origin unknown.

South of the Yukon-Kuskokwim Delta, three reports, none substantiated, suggest breeding by Steller's Eiders. Notes from Chase Littlejohn, published by Bent (1925) and later by Gabrielson and Lincoln (1959), indicated that a few Steller's Eiders nested at Morzhovoi Bay on the Alaska Peninsula, but no evidence of nesting was provided. In 1872, Dall (1873) collected an egg reported to be from a Steller's Eider nest in Unalaska Bay. The bird collected

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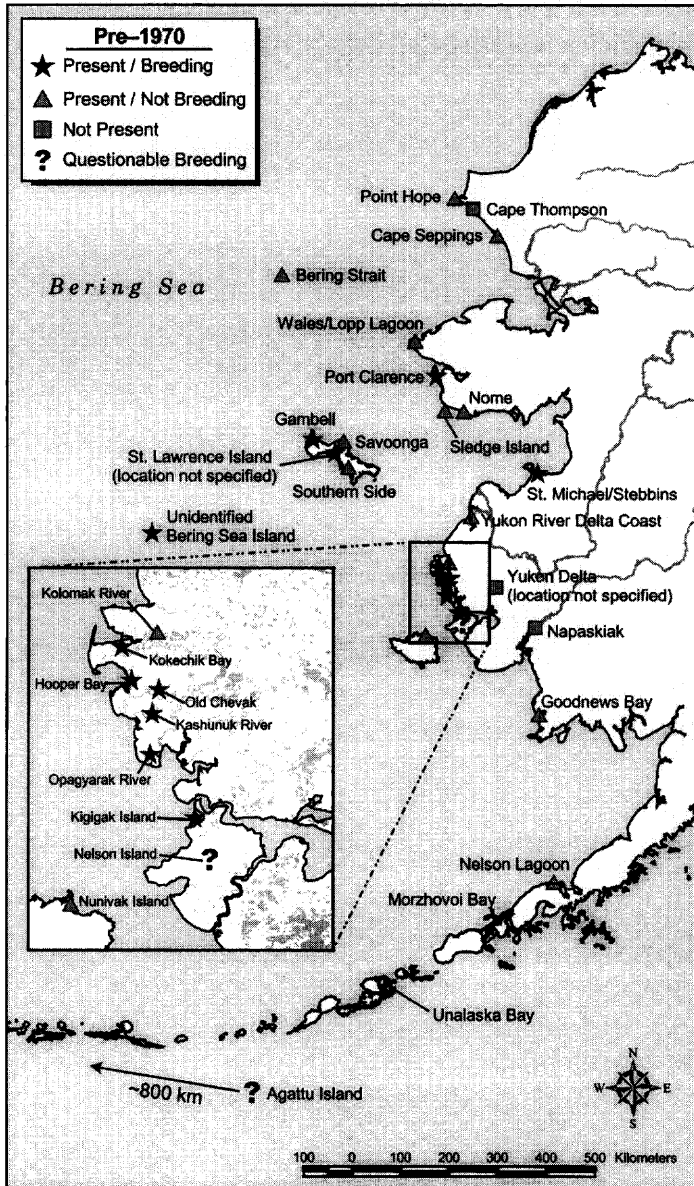


Figure 6. The occurrence and breeding distribution of Steller's Eider in western Alaska (May–September) before 1970.

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with the egg, however, was an adult male Steller's Eider, although it was recorded as a female on the data card (J. Dean, National Museum of Natural History, Washington, D.C., in litt.) and was published that way (Dall 1873). The egg's dimensions are within the range of Steller's Eider eggs measured near Barrow (Quakenbush et al. 1995, Quakenbush, unpubl. data); unfortunately, so are those for 10 of 13 species of waterfowl that breed regularly in the Alaska Peninsula/eastern Aleutian Islands region (data from Bellrose 1978). Turner (1886) wrote that the species "breeds sparingly on Agattu Island," according to local Natives. Murie (1959) did not find any nesting along the Aleutian Islands, and Natives at Attu did not recognize pictures of Steller's Eiders, saying that they did not occur there, even in winter. Murie (1959) found no evidence of breeding on the Alaska Peninsula or the Aleutians in 1936 or 1937, and none has been reported since then, despite many visitors.

Although suggestive of sporadic breeding in low numbers, these records should not be regarded as conclusive evidence that Steller's Eiders were regular breeders in the Aleutians or on the Alaska Peninsula in historical times. This region includes the major wintering area for the species, and immature or nonbreeding birds could summer there. Pair formation also occurs on the wintering grounds (Metzner 1993), so courting behavior prior to migration may have suggested nesting to early observers, such as Dall and Littlejohn.

Historically, the greatest number of breeding Steller's Eiders in western Alaska occurred on the Yukon-Kuskokwim Delta, where they nested in the outer coastal zone from Kokechik Bay south to possibly Nelson Island (Conover 1926, Brandt 1943, Gabrielson and Lincoln 1959, Shepherd 1963, Kertell 1991; Figure 6). Steller's Eiders were reported (but were not breeding) as far inland as 150 miles from the coast (Gillham 1941). No historical records are available from the Yukon-Kuskokwim Delta south of Nelson Island, and historical midsummer records from Nunivak Island appear to be of Steller's Eiders that were molting, not breeding (Dau 1987).

As of 1990, Steller's Eiders were thought to have been extirpated as a breeding species from the Yukon-Kuskokwim Delta because no nests had been found there since 1975 (Kertell 1991). Between 1991 and 2000, however, six nests were found (Flint and Herzog 1999; M. Herzog, Univ. of Alaska, Fairbanks, pers. comm.), indicating that Steller's Eiders continue to nest there in extremely low numbers. The recent nesting distribution appears to be restricted to the Kashunuk, Tutakoke, and Opagyarak rivers of the central portion of the delta (Table 2, Figure 7; Kertell 1991, Flint and Herzog 1999, C. J. Lensink in litt.). Although the species nested historically at Kokechik Bay, it now occurs there only rarely and has not been seen nesting since 1969 (Table 2; Kertell 1991). No recent data are available to determine whether Steller's Eiders breed south of Nelson Island. Away from the Yukon-Kuskokwim Delta, recent surveys for nesting Spectacled Eiders (*Somateria fischeri*) on St. Lawrence Island recorded many Steller's Eiders but no evidence of breeding (S. Stephenson, USFWS, Anchorage, pers. comm.).

Overall in western Alaska, Steller's Eiders were recorded during 80% of historical site-years but only 47% of recent site-years (Figure 8). During years

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Table 2 Distribution of Steller's Eider Observations in Western Alaska during the Breeding Season (May–September)^a

Location ^b	Time period ^c	Total site-years ^d	Site-years present	Site-years breeding
Cape Lisburne	R	2	0	0
Point Hope	H	1	1	0
Cape Seppings	H	2	2	0
Cape Thompson	H	2	0	0
	R	2	1	0
Cape Krusenstern	R	2	0	0
Kotzebue	R	1	0	0
Bering Strait	H	1	1	0
Wales/Lopp Lagoon	H	11	11	0
	R	1	0	0
Tin City	R	1	0	0
Nome	H	3	3	0
Sledge Island	H	1	1	0
Port Clarence	H	1	1	1
St. Lawrence Is., general	H	3	3	1
North side	R	1	1	0
South side	H	2	1	0
	R	1	1	0
Gambell	H	15	14	1
	R	1	1	0
Savoonga	H	3	3	0
Yukon Delta coast	H	2	2	0
Yukon-Kuskokwim, general				
	H	2	1	0
St. Michaels/Stebbins	H	1	1	1
	R	3	1	0
Kolomak River	H	5	3	0
Kokechik Bay ^e	H	2	2	2
	R	11	1	0
Hooper Bay	H	2	2	2
Chevak	R	1	1	0
Keoklevik River	R	1	1	0
Old Chevak ^e	H	2	1	1
	R	3	3	0
Kashunuk River ^e	H	12	8	5
	R	18	10	3
Punoarat Point	R	2	2	0
Tutakoke River	R	15	9	2
Opagarak River ^e	H	1	1	1
	R	11	5	2
Anerkochik River	R	8	1	0
Naskonat Peninsula	R	1	1	0
Kigigak Island	H	1	1	1/
	R	8	5	0
Nelson Island	H	2	1	1/
Napakiak area	H	2	0	0
Nunivak Island	H	2	2	0

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Table 2 (Continued)

Location ^b	Time period ^c	Total site-years ^d	Site-years present	Site-years breeding
Goodnews Bay	H	1	1	0
Unknown Bering Sea island	H	1	1	1
Nelson Lagoon	H	1	1	0
Morzhovoi Bay	H	1	1	1 ^f
Aleutian Islands, general	H	3	0	0
Unalaska Island	H	1	1	1 ^g
Umnak Island	R	1	1	0
Agattu Island	H	1	1	1 ^f
Totals	H	90	72	21
	R	95	45	7

^aSurveys that failed to record Steller's Eiders are included.

^bArranged geographically, from north to south.

^cH, historical (before 1970); R, recent (since 1970).

^dA site-year reflects data for a particular location during one year.

^eOne of four sites with both historical and recent data.

^fNesting reported at this location without substantiation.

^gPossible misidentification of the one egg found at this location (see text).

when they were present, breeding frequency declined from 29% of historical site-years to 16% of recent ones (Figure 9). In the core of the species' western Alaska breeding range on the central Yukon-Kuskokwim Delta from Kokechik Bay to Nelson Island (excluding Nunivak Island), the data also indicate that Steller's Eiders were recorded more frequently before 1970 (70% of site-years) than more recently (49%; Figure 9). During years of occurrence, breeding frequency declined, from 68% of historical site-years to 18% of recent ones (Figure 9). Data from four sites with historical and recent records (Kokechik Bay, Old Chevak, Kashunuk River, and Opagyarak River; Table 2) also indicate declines in occurrence and breeding frequency (Figures 8 and 9), suggesting that the recent declines are not caused by greater numbers of samples from unoccupied or marginal habitat.

DISCUSSION

Breeding Season Distribution and Breeding Frequency

This comparison of historical and recent sightings of Steller's Eiders demonstrates a reduction in the breeding-season distribution of this species in northern Alaska. Apparently, it formerly occurred regularly to the Alaska-Canada border, and possibly into northwestern Canada. Currently, it occurs only as far east as the Sagavanirktok River. Historical and recent nesting records of Steller's Eiders in northern Alaska, however, do not indicate a contraction of the breeding range. The northwestern Arctic coastal plain,

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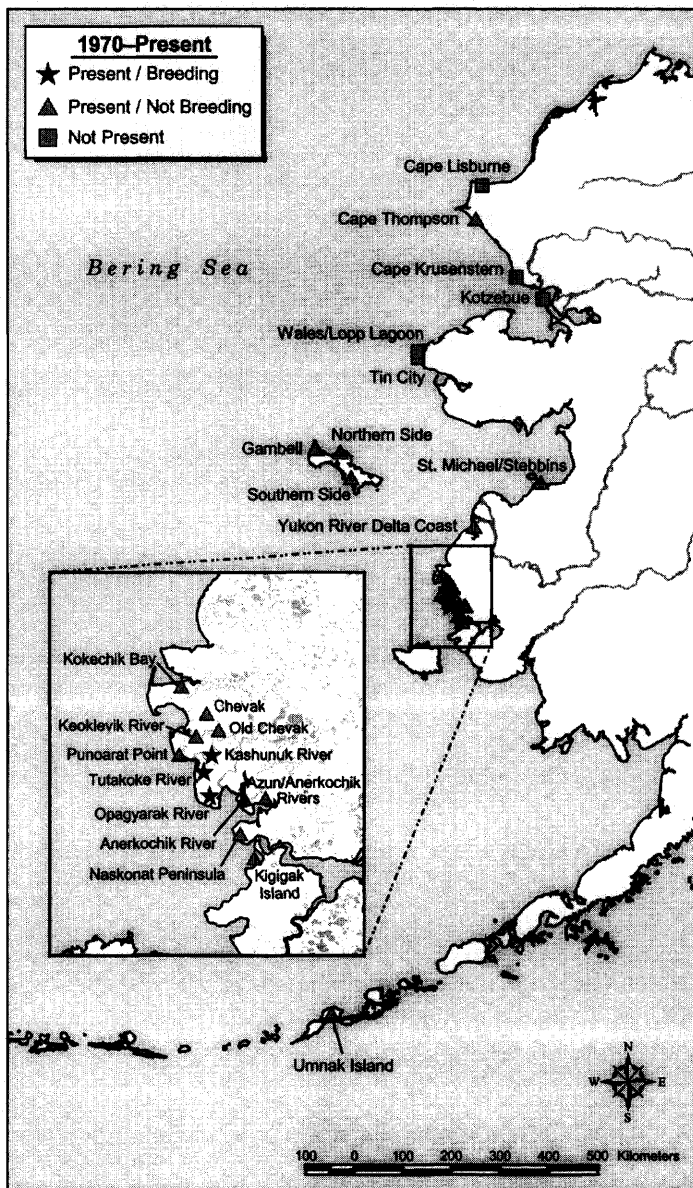


Figure 7. The occurrence and breeding distribution of Steller's Eider in western Alaska (May–September) since 1970.

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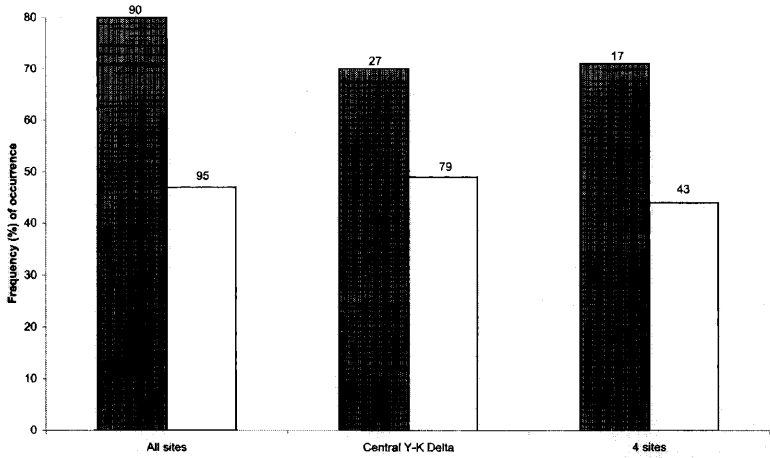


Figure 8. Percentage of site-years that Steller's Eiders were present before (shaded bars) and since (white bars) 1970 in western Alaska. The number of site-years appears above bars.

especially the Barrow area, remains the primary nesting area for Steller's Eiders, and historical records do not reflect a broader breeding distribution. Oral accounts, however, suggest that breeding was regular farther east at the Colville River Delta and near Kaktovik. Breeding frequency has decreased east of Barrow from Admiralty Bay and its drainages to the Colville River. In

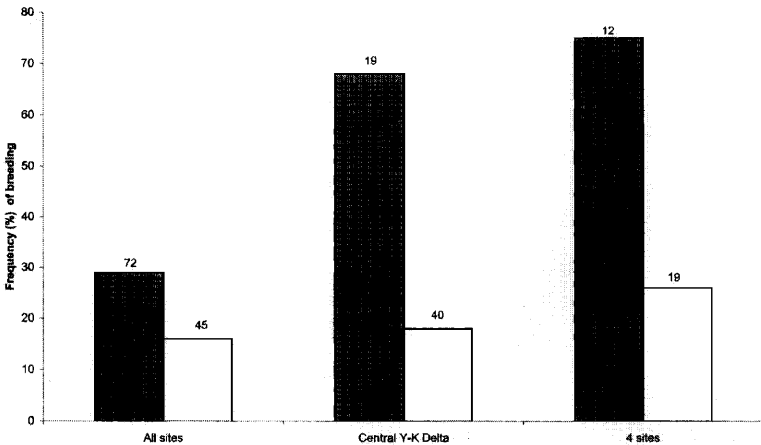


Figure 9. Percentage of site-years that Steller's Eiders were breeding when present before (shaded bars) and after (white bars) 1970 in western Alaska. The number of site-years appears above bars.

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contrast, occurrence and breeding frequency at Barrow, the most important nesting area for the species, are stable or increasing.

We found that, in historical times, Steller's Eiders probably did not nest regularly in western Alaska outside of the central Yukon-Kuskokwim Delta. Both occurrence and breeding frequency on the Yukon-Kuskokwim Delta have decreased since 1970, but nesting continues there in low numbers (Flint and Herzog 1999), *contra* Kertell (1991). We believe that nesting on the Seward Peninsula and St. Lawrence Island was sporadic and no longer occurs there. We also believe that nesting may have been occasional in the Aleutian Islands-Alaska Peninsula region but emphasize that there is no conclusive evidence.

Causes for Reduced Breeding Frequency

Causes for reductions in the breeding frequency of Steller's Eiders on the Arctic coastal plain away from Barrow are not clear. Myres (1958) noted that Native children were effective egg collectors within 16 km of Barrow. This area, however, is the one location where the frequency of occurrence has been stable and the frequency of breeding has actually increased. Hunting pressure on this species across Alaska has been minimal (Wentworth 1994, Wentworth and Seim 1996, Paige et al. 1996), and sport and subsistence hunting for Steller's Eiders has been illegal in Alaska since 1991. Habitat loss for this species across the state has also been minimal, although recent housing developments in the Barrow area have resulted in the loss of a few known nest sites.

Causes for reduction in the occurrence and breeding frequency of Steller's Eiders in western Alaska are unknown. Kertell (1991) presented an extensive list of possible reasons, none of which have been discounted. In addition, lead poisoning from ingested lead shot may be a source of mortality for Steller's Eiders in both of the Alaska subpopulations. Lead poisoning has been determined to be the cause of death in both the Spectacled and Common (*Somateria mollissima*) eiders on the Yukon-Kuskokwim Delta (Franson et al. 1995) and is suspected in the death of one Steller's Eider from near Barrow (Trust et al. 1997). On the Yukon-Kuskokwim Delta, significant numbers of Spectacled Eiders and Long-tailed Ducks (*Clangula hyemalis*) are exposed to lead during the breeding season (Flint et al. 1997), and female eiders exposed to lead survive at lower rates than unexposed females do (Grand et al. 1998). The slow settlement rate of lead shot in tundra wetlands suggests that lead will remain accessible to feeding eiders for many years (Flint 1998).

Possible increases in numbers of predators such as Arctic Foxes (*Alopex lagopus*), Glaucous Gulls (*Larus hyperboreus*), and Common Ravens (*Corvus corax*) across the Arctic coastal plain have become a concern as anthropogenic food sources have become more available with increased community and industrial development (Day 1998). An increase in predator numbers or distribution may have decreased the survival and/or productivity of Steller's Eiders; on the Yukon-Kuskokwim Delta, the removal of Arctic Foxes has been shown to increase the nesting success of Brant (*Branta bernicla*; Anthony et al. 1991).

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The breeding frequency of Steller's Eiders also may be affected by cycles in small-mammal populations, as has been seen elsewhere for arctic nesting birds (e.g., Pehrsson 1986, Summers 1986, Underhill et al. 1993, van Impe 1996, Spaans et al. 1998, Summers et al. 1998, Sittler et al. 2000). Between 1991 and 2001, Steller's Eiders studied near Barrow nested only in years when Brown Lemmings (*Lemmus trimucronatus*) and/or Collared Lemmings (*Dicrostonyx groenlandicus*) were abundant: 1991, 1993, 1995, 1996, 1999, and 2000 (Quakenbush and Suydam 1999, Obritschkewitsch et al. 2001). Between 1975 and 1980, other studies near Barrow found a similar pattern of irregular breeding that corresponded with years of lemming abundance (Quakenbush and Suydam 1999). Pomarine Jaegers (*Stercorarius pomarinus*) and Snowy Owls (*Nyctea scandiaca*) also nest at Barrow only during years of lemming abundance (Pitelka et al. 1955a, b). Evidence increasingly suggests that Steller's Eiders at Barrow nest within defended nesting territories of Pomarine Jaegers and Snowy Owls and benefit from their protection against predation by Arctic Foxes (Quakenbush and Suydam 1999). The Barrow area is well known for population cycles of Brown Lemmings that are more frequent and higher in amplitude than those farther south or east (Rausch 1950, Thompson 1955, Pitelka 1973, Batzli et al. 1980, Pitelka and Batzli 1993). Other areas within the Arctic coastal plain have been studied but have not shown lemming or other small-mammal cycles similar to those near Barrow (Feist 1975; Pitelka and Batzli 1993; D. Troy pers. comm.). If nesting Steller's Eiders are dependent on species of birds that defend their nests aggressively, such as the Pomarine Jaeger and Snowy Owl, for protection against Arctic Foxes, Barrow may be the most reliable place in northern Alaska for eiders to nest successfully, although not annually.

When Steller's Eider nests were found on the Yukon-Kuskokwim Delta in 1924 by Conover (1926), Snowy Owls and all three species of jaegers also were nesting. More than 40 Snowy Owl nests were found, and extremely high populations were reported for lemmings and voles (*Lemmus*, *Dicrostonyx*, *Microtus*; Brandt 1943). The Steller's Eider nest on St. Lawrence Island in 1954 was found near three Snowy Owl nests; two additional Snowy Owl nests were found approximately 13 km away, and a high in the Tundra Vole (*Microtus oeconomus*) population was reported that year (Fay and Cade 1959). Hence, the relationship between Snowy Owls and Steller's Eiders observed at Barrow may be important for western Alaska as well. Snowy Owls were formerly uncommon breeders on the Yukon-Kuskokwim Delta (Conover 1926), but they are essentially absent now (C. Dau, USFWS, Anchorage, pers. comm.). If Steller's Eiders nest with Snowy Owls and/or jaegers whenever possible, their breeding distribution and breeding frequency would be more similar to those of predatory birds (spatially unpredictable and temporally sporadic) than other waterfowl (spatially predictable and temporally regular).

Population growth in eiders and other waterfowl with similar life-history strategies appears to be sensitive to survival rates of adults (USFWS 1996, Schmutz et al. 1997). Steller's, like other eiders, tends toward late sexual maturity, high annual adult survival (90%; Flint et al. 2000), longevity (20+

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years; Dunning 1997), and low productivity in most years (Quakenbush and Suydam 1999, Quakenbush unpubl. data).

With our current state of knowledge, efforts to aid the conservation of the Alaska breeding population of Steller's Eiders should focus on factors that maintain high adult survival and increase productivity and survival to maturity. Further investigation of the relationship among Steller's Eiders, Snowy Owls, and jaegers may better our understanding of the eider's breeding distribution, breeding frequency, and productivity and may provide insights for its recovery.

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