DISAPPEARANCE OF THE STELLER'S EIDER FROM THE YUKON-KUSKOKWIM DELTA, ALASKA

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ABSTRACT: The Steller's eider (*Polysticta stelleri*) is apparently extinct as a breeding bird on the Yukon-Kuskokwim (Y-K) delta, one of two areas in Alaska where it was a regular breeder. Once considered a common breeding bird on the Y-K delta, it has not been found nesting since 1975, despite recent extensive geographic coverage of waterfowl habitats and ground searches of historically important nesting areas. The Y-K delta was the only subarctic breeding area in the species' range. Size of the former population and reasons for its disappearance are unclear, but possible factors responsible for the decline include changes in patterns of movement and increased mortality resulting from overharvest, predation, habitat change, and weather. The Steller's eider is now considered a rare species in the Yakutsk Republic, U.S.S.R., the center of the world breeding range. The North American population is now restricted to a small geographical area near Barrow and it has not yet received special consideration or protection comparable to that in the U.S.S.R. Because most of the world population breeds in the U.S.S.R. and winters in Alaska, effective conservation of the species will require cooperation at the international level.

Key Words: Steller's eider, *Polysticta stelleri*, Yukon-Kuskokwim delta, declining species, eiders, subsistence harvest, Alaska

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INTRODUCTION

A common public perception is that ". . . Alaska remains a pristine wilderness and that wildlife populations are still at prehistoric levels" (King and Derksen, 1986). Recent dramatic declines in goose populations in western Alaska (Raveling, 1984) on the Yukon-Kuskokwim (Y-K) delta serve to remind us that this is not the case, and that vast areas of habitat do not necessarily guarantee wildlife abundance. Hunted populations of wildlife, because of the public interest and financial support they receive, are monitored closely for indications of decline. But even major changes in populations of species not important for hunting may pass unnoticed.

The Steller's eider (*Polysticta stelleri*) is one such species. It winters at northern latitudes in areas remote from hunters and wildlife observers. Because of its inaccessibility it has not received the same financial support for research and management activities as have other waterfowl species, such as geese. Consequently, its life history and habitat requirements are poorly understood and its current status is unclear. In this respect it is like the over 90% of North American migratory nongame birds which, by virtue of not being hunted or endangered, receive almost no attention (Senner, 1986).

Steller's eiders breed above the Arctic Circle along the coasts of the Arctic Ocean in Alaska and the USSR. (Fig. 1), with the majority (at least 100,000 adults; Uspenski, 1972) breeding in eastern Siberia (Jones, 1965). Uspenski (1972) estimated the world population at 500,000 birds, but Palmer (1976) thought the total was closer to 400,000, possibly fewer.

In the USSR, the Stellers eider was considered a common breeding bird in the Yakutsk Republic (Fig. 1) at the beginning of the century, and was still considered locally common in the 1950's (Solomonov, 1987). Its status is now of concern in the USSR. where it is presently a rare species (red book, category 3) in the Yakutsk Republic (Solomonov, 1987). This region encompasses most of the current Soviet breeding range (Fig. 1), an area that extends from the New Siberian Islands and Lena Delta east to the Chukotski Peninsula (American Ornithologists' Union, 1983; Bellrose, 1976; Godfrey, 1986), and includes Wrangel Island (I.V. Dorogoi, pers. comm. 1985). Recoveries of banded eiders west of the Lena Delta suggest that they nest westward to at least the Kheta River (Fig. 2).

In Alaska, the Steller's eider has been described as a regular breeder at only two locations (Fig. 1); near Barrow and on the Y-K delta (Myres, 1958; Gabrielson and Lincoln, 1959; Pitelka, 1974; Palmer, 1976). It has not been found nesting on the Y-K delta since 1975. Because its disappearance from the Y-K delta would represent the loss of the only subarctic portion of the North American breeding population, special consideration in North America, comparable to that given to the Steller's eider in the U.S.S.R., may be warranted.

The purpose of this paper is to: (1) summarize historical literature and current records of Steller's eiders breeding on the Y-K delta; (2) comment on possible reasons for the disappearance of the Steller's eider from the Y-K delta; and (3) discuss legal mandates and information needed to manage the species.

HISTORY OF BREEDING ON THE Y-K DELTA

Prior to 1950

During a 1924 biological survey of the central Y-K delta (Fig. 3), the Steller's eider was described as a common breeder (Murie, 1924; Conover, 1926; Brandt, 1943). On 27 May "many pairs" were observed on coastal tide pools and in late June eiders were found to be "numerous" in the vicinity of Kokechik Bay (Brandt, 1943) where groups of 40 or more were observed on the mudflats (Dufresne, 1924). Nesting birds were later observed commonly at Kokechik Bay (Dufresne, 1924; Conover, 1926), along the Kokechik River (Murie, 1924; Conover, 1926), and sparingly near Hooper Bay (Dufresne, 1924). Murie (1959) stated that there were large nesting populations at Hooper Bay and Nelson Island.

The distributional abundance of nests in 1924 is unclear. According to Brandt (1943), "The nest of the Steller Eider in the Hooper Bay region must be sought only in the vast morass about Igiak [now Kokechik] Bay", where it was thought to be the most common nesting eider. In his narrative, Brandt reports finding five nests at Hooper Bay from 21 to 26 June. Steller's eiders nested "nearer Kokechik Bay" than either common (*Somateria mollissima*) or spectacled eiders (*S. fischeri*) (Brandt, 1943). Murie (1924) stated that they nested near the tide flats along Kokechik Bay, where he described two nests each with 2 eggs (possibly two of the same nests described by Brandt), and on the flat tundra adjacent to the Kokechik River.

During this 1924 survey, downy young were first found on 2 July (Conover, 1926). Large young (large enough to band) were "frequently"

located after 16 July in the vicinity of Kokechik Bay and adjacent to the Kokechik River (Murie, 1924). Of 13 eiders collected at Kokechik Bay and 24 collected at Hooper Bay (Brandt, 1943), eight were downy young, all collected at Kokechik Bay.

Observations in the 1940's document the continued presence of the Steller's eider as a breeding bird on the Y-K delta. Eiders were seen in "considerable number" in 1941 near the coast on the lower Kashunuk River by Gillham (1941), who felt that they were the most common duck in that area. However, most of the birds were subadult females from the previous year, and, although young were seen, the majority of females (presumably adults in this case) did not have young. Gillham also observed a single male 150 miles inland. According to Gabrielson and Lincoln (1959), Gillham collected a female and downy young at Chevak (lower Kashunuk River) on 2 July 1941. Ten juveniles were reportedly banded in the Old Chevak area in 1949 (Nelson, 1949).

1950-Present

Surveys of important waterfowl nesting areas on the Y-K delta were much more intensive after 1950 than before, particularly beginning in the mid-1980's when actions were taken by managing agencies to reverse declines in goose populations. The development and implementation of the Hooper Bay Agreement in 1983-84 and the Yukon-Kuskokwim Delta Goose Management Plan in 1985 resulted in increased research and expanded surveys (Pamplin, 1986), primarily for geese, but also for eiders and other waterfowl. Much of this research was conducted in coastal areas historically important to Steller's eiders, such as the lower Kashunuk River and

Kokechik Bay. During most years, biologists conducted surveys from permanent camps during the entire breeding season (May-August). In addition to these studies, beginning in 1986 a sampling program was implemented to provide broader coverage of waterfowl nesting areas throughout the Y-K delta (R. Stehn, USFWS unpubl. data).

Kashunuk River: Information on densities of Steller's eiders was collected on the lower Kashunuk River in 1951, incidental to a study of brant abundance (Olson, 1951). Olson established three study areas (Fig. 4) with the intention of sampling three distinct vegetation zones located between the seacoast and an area about 13 km inland. Steller's eiders were found nesting in only one of the study areas (#2, about 2 km inland), where they were the second most common of three nesting eider species (Table 1). They also were observed nesting between study areas #2 and #3, but the number of nests was not mentioned.

The lower Kashunuk River (area #2) was resurveyed for eiders in 1961, 1962, and 1963 (Shepherd, 1963). Compared with 1951, Steller's eiders were more common in 1962 but less common in 1961 and 1963 (Table 1). Too few nests were located, however, to inspire confidence that the data represented trends in abundance. During 1961-63, the mean number of spectacled eider nests increased over threefold compared with 1951 and the number of common eider nests remained consistently low (Table 1).

From 1964 to 1966, Steller's eiders were not found nesting on the lower Kashunuk River in study area #2 (C. Lensink, USFWS pers. comm. 1985). Common eiders also failed to nest in area #2 during that period, and spectacled eiders were much less common than in the period 1961-63 (Table

1). Area #2 was not censused in its entirety after 1966, however portions of area #2, and several surrounding areas, were censused for black brant through 1980 (C. Dau, USFWS pers. comm. 1989). No further sightings of Steller's eiders were made in this area. For the the seven years that area #2 was studied, annual mean nest density for Steller's eiders was $1.53 \cdot km^{-2}$, compared to $19.10 \cdot km^{-2}$ for spectacled eiders and $0.92 \cdot km^{-2}$ for common eiders.

From 1969-1972, biologists censused waterfowl in a 10.4 km^2 study area located about 6 km inland from area #2 (Mickelson, 1975). Although pairs of Steller's eiders were observed during the study (Appendix A), no nests were found. In 1973, a plot 1.9 km^2 in size was established within Mickelson's old study area. On 27 and 28 May, 1973, a female was seen copulating and constructing a nest scrape within this plot (Appendix A), but no completed nest were found (C. Dau, USFWS unpubl. data). Although this area was surveyed almost yearly from 1973 to 1990 (most recently during 1985-1990 by C. Ely, USFWS pers. comm. 1990), there has been no further evidence of nesting.

Kokechik Bay: Biologists studying waterfowl in the Kokechik Bay area in the 1960's, noted a decline in the number of Steller's eiders from what had been observed in 1924. Biologists conducting general avian surveys in the vicinity of the Kolomak River (east end of Kokechik Bay) in 1963 (Kessel *et al.*, 1964) and between 1966-69 (Holmes and Black, 1973), and in the vicinity of Kokechik and Hooper Bays in 1964 (Johnsgard, 1964) failed to locate any nests. Two nests along the south side of Kokechik Bay in 1969 (Appendix A) are the last reported from that area.

During the 1970's and 1980's, intensive waterfowl surveys were conducted in the lowlands adjacent to Kokechik Bay. From 1971-73, Eisenhauer failed to find Steller's eider nests on a 4.5 km^2 study area on the south side of Kokechik Bay (Eisenhauer and Kirkpatrick, 1977). In 1985, I also was unsuccessful at finding Steller's eiders in the southern Kokechik Bay area despite intensive searches throughout the breeding season. Similarly, no Steller's eiders were observed during waterfowl nest searches on a 1.9 km^2 study area at the southeast end of Kokechik Bay during 1982-86 (Petersen, 1990) or during studies in 1988-1990 by Yukon Delta National Wildlife Refuge staff (R. Stehn, USFWS pers. comm. 1990).

Opagyarak River: The last breeding records for the Steller's eider in the Y-K delta are from the Opagyarak River (Fig. 5). From 1970-1980, between 2-4 small plots (4 ha each) located along the Opagyarak River were surveyed annually for nesting brant. In 1975, a single nest was discovered on one of the plots (Fig. 6). A nest and a female with a brood were also found along the Opagyarak River in 1969 (Appendix A). There have been no further records. During 1974-1980, Brant plots located along the Anerkockik River and Naskonat Peninsula were also surveyed, but no Steller's eider nests were found.

Waterfowl monitoring program: During 1986 to 1990, ground searches for nests of geese and spectacled eiders were conducted on randomly located plots (0.32 km^2 in size) distributed in over 3900 km^2 of coastal tundra on the central Y-K delta from Kokechik Bay to Nelson Island (R. Stehn, unpubl. data). Each year, between 70-100 plots (covering 22.4-32.0 km^2 of coastal tundra) were randomly selected from a total of 447 total plots distributed in a

variety of physiographic areas, and searched for active and inactive nests during a single visit in early June. Some of the plots were within the geographic area covered by historic ground plots (e.g. Kokechik Bay and Kashunuk River). Despite coverage of formerly important Steller's eider breeding locations and a variety of physiographic areas, and emphasis on locating eider nests, no nests of Steller's eiders were found.

HISTORIC POPULATION SIZE

Prior to the 1950's, surveys of eider abundance were too qualitative to be useful in estimating past population size. Olson's study area #2 was the only area of known size on the Y-K delta that was censused during several years at a time when nests of Steller's eiders were still found regularly. Consequently, it provides the only data useful in estimating population size.

Study area #2 was located in vegetated intertidal habitat (see King and Dau, 1981), the only habitat in which Steller's eiders have been found nesting on the Y-K delta. There are about 2300 km^2 of vegetated intertidal habitat on the central Y-K delta from Kokechik Bay to Nelson Island (C. Dau, USFWS unpubl. data). There are no reports of nests north of Kokechik Bay or south of Nelson Island. Using an average annual nest density of $1.53 \cdot km^{-2}$, I would estimate an upper limit of about 3500 pairs for the population in the 1950's and early 1960's. Considering that Steller's eiders preferred to nest near the coastline at the periphery of vegetated intertidal habitat, the population may have been much smaller than predicted by this estimate.

POSSIBLE REASONS FOR DISAPPEARANCE FROM THE Y-K DELTA

The disappearance of the Steller's eider from the Y-K delta may have resulted from a change in patterns of movement, an increase in mortality, or a combination of the two. Possible reasons for these changes are discussed below.

Change in movement patterns

Movement from the Y-K delta: Eiders from the Y-K delta may have been displaced to breeding areas in northeast Siberia or northern Alaska. The ranges of populations from Siberia and Alaska overlap in lagoons along the north side of the Alaska Peninsula during fall when molting occurs and during winter and early spring (Jones, 1965) when mate-selection and pair-bonding occurs (McKinney, 1965). It is possible that male eiders switched breeding areas during pair formation, resulting in a decrease in productivity among females. When populations are small, changes in the sex ratio can accelerate population decline (Brown and Gibson, 1983).

Although the possibility exists for displacement of birds to other breeding areas, there have been no reports indicating population buildups at Barrow, or elsewhere in Alaska, although coverage has not been as extensive at Barrow or in coastal locations other than the Y-K delta. Despite reports of a considerable decline in Steller's eiders in east Siberia during this century, a population decline does not discount the possibility of Y-K delta eiders moving there. Indeed, if the Y-K delta population was small it would be very difficult to detect the gradual addition of a few thousand birds into the much larger nesting population in the USSR.

Movement to the Y-K delta: The Steller's eider population on the Y-K delta may have been sustained in the past by immigration from breeding areas along the arctic coast of Siberia, the center of the breeding range (Jones, 1965; Uspenski, 1972). Eiders nesting on the Y-K delta formed a peripheral population at the southernmost extreme of this range. For bird populations, abundance is usually greatest in central regions and declines toward the periphery of the species range, suggesting that central areas offer the most favorable habitats (Brown and Gibson, 1983). Because habitats in peripheral areas are often marginal, many peripheral populations (of mobile species such as birds) have death rates that exceed birth rates and are sustained by a continual influx of immigrants from central populations that produce a net excess of individuals (Brown and Gibson, 1983). This may have been the case with the Steller's eider. As numbers of eiders (and other waterfowl) in east Siberia declined during this century (Kistchinski, 1973; Solomonov, 1987) and a surplus of individuals was no longer produced, immigration to the Y-K delta may have ceased.

Increased mortality

Subsistence harvest: Geese on the Y-K delta declined from nearly one million birds in the 1950's to less than half that in the 1980's (Raveling, 1984). Populations of cackling Canada geese (*Branta canadensis minima*) declined by over 93% between the mid-1960's and the early 1980's. Overharvest, including spring subsistence hunting by natives of coastal villages, has been identified as a major reason for waterfowl declines (Raveling, 1984). Recent excessive harvest of geese has accompanied a 42% increase between 1960 and 1980 in the Yupik Eskimo population of coastal delta villages (Copp and

Smith, 1981; in Raveling, 1984) and improved mobility of hunters (Raveling, 1984).

Steller's eiders also may have been affected by this combination of more hunters and greater hunter mobility. Excessive hunting prior to 1981 has recently been suggested as the major reason for decline of the Steller's eider in the USSR, where until recently there was no limit on the number harvested (Solomonov, 1987). (Beginning in 1981, it was declared illegal to hunt Steller's eiders in the Yakutsk Republic.)

In Alaska, Klein (1966) believed that eiders were an important food source to the coastal native population during spring, although king and common eiders predominated in the harvest. Steller's eiders made up a small proportion of the spring harvest, apparently because of their small size and low numbers onshore. (They continue to be common in offshore leads during spring migration; C. Dau, USFWS pers. comm. 1989.) In 1989, only king eiders were taken in any numbers (about 3107 birds) by natives on the Y-K Delta (J. Copp, unpubl. data). Steller's eiders were not included in the reported take, presumably because too few were taken. Late summer and fall harvest of eiders on the Y-K delta is considered negligible (e.g. about 83 spectacled eiders were harvested in 1989; J. Copp, unpubl. data).

Egging of eider nests has been considered of little importance to natives on the Y-K delta (Dau, 1974; Klein, 1966; J. Copp, unpubl. data). Considering that Steller's eider nests were well hidden (like the nests of other eiders) and probably uncommon (there is no evidence that Steller's eider nests were clumped; Palmer, 1976), and assuming that discovery of waterfowl nests by eggers is dependent on nest frequency (common nests are more frequently

located), it is unlikely that egging would have had a serious impact on the Steller's eider unless nests were predictably placed in certain habitats. Because Steller's eiders reportedly nested closer to tidewater than either common or spectacled eiders (Brandt, 1943), they may have been, because of their greater accessibility by coastal villages, more vulnerable to egging than the other eider species. Although numerically insignificant as a human food item, the loss of even one nest may have been significant to a small, declining population.

Predation: Steller's eider may have succeeded on the Y-K delta by nesting in close association with the formerly extensive coastal goose colonies (J. King, pers. comm. 1990). Although there are no complete censuses available for goose colonies on the Y-K delta before 1980 (Sedinger, 1987), historically brant were described as nesting on the delta in a near-continuous band extending 160 km from the northern side of Nelson Island to Kokechik Bay and in a smaller colony on the southern side of Nelson Island (Spencer *et al.*, 1951). Such large colonies are thought to have evolved because high densities minimize losses to predators by "swamping" them with overabundant food (Wittenberger and Hunt, 1985). By breeding in association with these colonies, eiders may have been afforded similar protection from predators. (Spectacled and common eiders sometimes breed in association with more aggressive colonial species like gulls and terns [Kistchinski and Flint, 1974; Gotmark, 1989].).

Brant nesting on the Y-K delta have declined significantly during the past few decades (Raveling, 1984; King and Derksen, 1986). As nesting brant disappeared from much of the Y-K delta and colonies were broken up (remaining brant are largely confined to four remnant colonies: King and Derksen, 1986; Sedinger, 1987), Steller's eiders, because they were much less

common than brant, may have declined disproportionately as protection from predators was eliminated. High predation rates in the major brant colonies on the Y-K delta in the mid 1980's demonstrated how predators, especially arctic fox, can decimate numerically small goose colonies (Raveling, 1989).

The recently documented decline of the spectacled eider on the Y-K delta may have resulted from foxes having switched to alternate prey species in response to a decline in the availability of preferred food sources (e.g. eggs of brant and cackling Canada goose). Diet switching by foxes, resulting from declines in goose populations during the last three decades, could have had a similar impact on the Steller's eider. Even though fox populations were at a low from the mid-1960's until the mid-1970's (R. Gill, USFWS pers. comm. 1990) when the Steller's eider apparently disappeared from the delta, any increase in predation on an already rare species like the Steller's eider potentially could have had a significant impact on the breeding population.

Storm-tides and nesting habitat: Vegetated intertidal habitat on the Y-K delta consists of wet sedge and grass meadows that lie adjacent to extensive unvegetated intertidal flats (King and Dau, 1981). Because of their proximity to the coast and their low relief, these wet meadows are susceptible to flooding from storm-tides far beyond the normal range of tidal influence (King and Dau, 1981). Storm-tides are most common during fall and winter, but occur occasionally in spring (King and Dau, 1981; Thorsteinson et al. 1989).

Flooding of coastal habitats on the Y-K delta during the waterfowl nesting season (June and early July) periodically has had a serious impact on productivity of some species (Hansen, 1961; King, 1964). However, severe

storm-tides (those capable of destroying a large percentage of brant nests on the outer Y-K delta) are relatively rare (estimated recurrence interval of 14.3 years; King, 1964). During the past 30 years, storm-tides of this magnitude have had a serious impact on nest success of waterfowl only twice, in 1963 (King, 1964) and 1978 (C. Dau, pers. comm. 1985). Although records of storm-tides prior to 1950 are unavailable, natives living on the Y-K delta, when questioned by Olson (1951), could not remember having seen the nesting grounds flooded during May, June, or early July.

Ice scour, sediment deposition, and coastal erosion resulting from storm-tides continually affect the distribution of plants, land forms, and the amount of intertidal habitat on the Y-K delta (King and Dau, 1981; Thorsteinson *et al.*, 1989). Storm-tides in fall can accelerate normal rates of coastal erosion on west- and southwest-facing shorelines (Reimnitz and Maurer, 1979; Thorsteinson et al., 1989). The degree to which these processes have affected important waterfowl habitats, however, is unknown. There has been no detailed appraisal of the effects of storm-tides on (1) the distribution and characteristics of the permafrost layer, (2) coastal and riverine erosion, (3) lake formation (including thermokarst), and (4) the dynamics of intertidal habitats (King and Dau, 1981).

The distributions of birds on the Y-K delta presumably has always been influenced, to varying degrees, by habitat changes resulting from periodic storm-tides (King and Dau, 1981). There is no evidence that such events have occurred with greater frequency in recent years. The fact that eiders probably disappeared at a time when brant were still relatively common (though declining) at coastal locations suggests that habitat changes alone probably cannot explain their disappearance. However, a more thorough evaluation

of changes, if any, to coastal nesting habitats on the Y-K delta would be of interest.

Winter mortality: The majority of the world population of the Steller's eider winters along the north side of the Alaska Peninsula (Fig. 1) (Petersen, 1981). (Smaller populations winter along the Asiatic coastline, primarily from the Commander Islands south to the Kuril Islands [Fig.1] and Japan, and along the Kola Peninsula in the USSR and the adjacent Varanger Peninsula in Norway [Dement'ev and Gladkov, 1952; Frantzen, 1985; Palmer, 1976].). Because of the inaccesibility of wintering locations, it is unlikely that current levels of winter harvest by people are an important source of mortality in Steller's eider, though annual harvest data are unavailable. (The Steller's eider is legally taken on the Alaska Peninsula from 1 September to 16 December; Alaska Department of Fish and Game, 1989.) Mortality resulting from birds becoming entrapped in gill nets, especially those nets that drift unattended into shallow waters along the Alaska Peninsula, is unknown.

Winter weather conditions on the Alaska Peninsula may be an important source of mortality in some species of waterfowl. For example, large numbers of emperor geese are periodically killed after the birds, already weakened by a prolonged blizzard, congregate on spits and shorelines to roost during high tide and are covered by wind-driven spray and freezing rain (R. Gill, USFWS pers. comm. 1989). Because Steller's eiders winter in similar nearshore habitats and roost on shores, they may also be subject to such weather-related mortality. Indeed, villagers along the north side of the Alaska Peninsula have observed king eiders frozen into the ice or weakened by these conditions. However, there have been no reports of Steller's eiders being affected by the ice, presumably because they move to open nearshore

waters of the Bering Sea or fly to areas with more moderate conditions along the south side of the Alaska Peninsula just prior to storms.

A decline in the Alaskan breeding component of Steller's eiders would be difficult to document in their Alaska Peninsula wintering area due to their mixing with Soviet birds. From 1961-1984, 6980 Steller's eiders were banded during September at Izembek Lagoon (Fig. 1). Of 143 recoveries through 1986, 82 (57%) were from breeding areas in the USSR versus only three (2%) from breeding areas in Alaska (Fig. 2). The remainder were recovered in fall near Izembek (Jones, 1965; Dau, 1985). These data suggest that a large proportion of Alaskan wintering birds breed in Siberia.

Late break-up of sea ice and quick freezes along the Arctic coast in spring periodically result in extensive mortality to waterfowl by limiting access to offshore feeding areas. For example, an estimated 100,000 king eiders, about 10 percent of the average annual estimated population, died from starvation caused by unusually bad ice conditions in the Beaufort Sea in the spring of 1964 (Barry, 1968). These conditions can also cause heavy mortality in birds that have not yet reached flight stage in the fall. Although Steller's eiders nest along the Arctic coast, no large die-offs have been reported. This is not surprising considering their low numbers in Alaska and a lack of reports from the Soviet Union.

DISCUSSION

The Steller's eider possibly was never a common nesting bird on the Y-K delta during historic times, despite claims of its abundance by early observers. Estimating the early population size is difficult because most early reports of abundance were not quantitative and surveys were geographically

restricted. Localized surveys may have given erroneous impressions of great overall abundance. Although the magnitude of the historic population is largely speculative, concurrent reductions in populations of Y-K delta geese serve to demonstrate the dramatic speed by which even formerly large Y-K delta waterfowl populations have been reduced.

The Steller's eider apparently is not now a regular breeder in Alaska except near Barrow. It is believed to be uncommon east of Pt. Barrow (see Johnson and Herter, 1989) and has not been recorded breeding in the Arctic National Wildlife Refuge coastal plain (McWhorter *et al.*, 1986), or along the Canadian Beaufort Sea coast (see Johnson and Herter, 1989). Recently, it was described as possibly a very rare breeder on the Seward Peninsula (Kessel, 1989). Steller's eiders were reportedly found breeding in small numbers on St. Lawrence Island in the late 1800's (Nelson, 1887), but by the 1950's were rarely found nesting there (Fay and Cade, 1959).

The Steller's eiders near Barrow are largely restricted to a small geographic area of the arctic coastal plain (Myres, 1958; Pitelka, 1974), on lands with no special protection. Although there are no available estimates for this population, several nests and/or territorial males were found at two study areas during the period 1975 to 1980 (Table 2). Annual mean nest densities during this period ranged from $3.0 \bullet km^{-2}$ (study area #1) to $6.8 \bullet km^{-2}$ (study area #2), considerably higher than those recorded for the Steller's eider on the Y-K delta. Nevertheless, the Barrow population is believed to be small and localized.

Restriction of the North American breeding population of the Steller's eider to one region is significant because the population is now much more

susceptible to complete eradication resulting from either natural or human-induced disturbance. Equally troublesome is the absence of information concerning its disappearance from the Y-K delta.

Effective surveys or monitoring methods do not exist for many northern breeding populations of waterfowl and shorebirds. Disappearance of a geographically significant portion of the North American breeding population of Steller's eider, before it was ever counted, is a recent excellent example of why such surveys are needed.

LEGAL MANDATES AND INFORMATION NEEDS

Effective monitoring of Steller's eider will require international cooperation between the United States, the USSR, and Japan, in addition to a national effort. A coordinated international effort using standard population monitoring techniques at wintering areas in Alaska and northeast Asia (the Soviet Union and Japan) could be instituted to detect further declines before populations reach dangerously low levels. Studies on the breeding biology and nesting chronology of the northern Siberian population are needed to better understand timing of arrival at wintering locations (Petersen, 1981) and to monitor changes in reproductive success. The Siberian population should be counted and closely monitored (Solomonov, 1987).

Recent amendments to the Fish and Wildlife Conservation Act (P.L. 100-653) require that the U.S. Department of the Interior monitor all species, subspecies, and populations of migratory nongame birds. Although this provision does not explicitly cover Steller's eider (because it is a hunted species), it is significant that Congress recognizes the need for broad-scale monitoring.

There exist treaties between the United States and the USSR (T.I.A.S. 9073) and between the United States and Japan (25 U.S.T. 3329; T.I.A.S. 7990) concerning the conservation of migratory birds and their environment (Senner and Howe, 1984). The Steller's eider is included in the list of shared species of migratory birds qualifying for consideration in both treaties. These treaties could in spirit, if not in law, establish a basis and framework for a cooperative monitoring program for Steller's eider, and, if warranted, habitat protection for the benefit of eiders and other shared species.

The US-Soviet treaty in particular contains language important in establishing a framework for cooperation. Among other things, the treaty addresses the following:

1) " . . . cooperate to the maximum possible degree in preventing, reducing or eliminating . . . damage to migratory birds and their environment and in providing for the rehabilitation of their habitat."

2) "Identify areas of breeding, wintering, feeding, and moulting which are of special importance to the conservation of migratory birds within the areas of jurisdiction. Such identification may include areas which require special protection because of their ecological diversity or scientific value."

3) " . . . promote research related to the conservation of migratory birds and their environment, and agree to coordinate . . . national bird banding programs. In cases where it is desirable, such research may be conducted under agreed upon programs coordinated by the competent authorities of the Contracting Parties."

In Alaska, studies should be immediately initiated to identify the size and the geographic extent of the Arctic population. Additional protection or management may be needed in areas where the species currently nests. Causes of mortality should be monitored at these breeding locations and at migratory staging and winter locations.

Studies of the spectacled eider on the Y-K delta could provide clues useful in understanding the disappearance of the Steller's eider from the same area. This species shares the same breeding range as the Steller's eider and also has suffered recent declines on the Y-K delta (R. Stehn, unpubl. data), where most of the world population breeds (Bellrose, 1976; Dau and Kistchinski, 1977). Current waterfowl nest studies on the Y-K delta should emphasize important spectacled eider (and formerly important Steller's eider) use areas.

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APPENDIX A. Observations of Steller's eider on the Yukon-Kuskokwim delta, Alaska, from 1967 to 1976. Only observations of nesting birds or pairs are included.

Year	Date(s)	Locations/Comments	Source
1967	6 June	lower Kashunuk River (Hock Slough) 1 pair seen by C. Martell.	YDNWR
1969	21 June	Opagyarak River. Female w/brood of unknown size seen by J. Hout.	YDNWR
	21 June	Opagyarak River. 1 pair and nest w/5 eggs on peninsula in small lake seen by C. Lensink. Onset laying est. 28 May.	YDNWR
	26 June	Kokechik Bay. 2 nests each w/8 eggs seen by C. Lensink. Onset laying est. 13 June.	YDNWR
1970	28 May	lower Kashunuk River (Onumtuk Slough). 2 pair seen by P. Mickelson.	C. Dau, pers. comm.
	21 June	Opagyarak River. 1 pair seen by C. Lensink.	
1971	29-31 May	lower Kashunuk River (Onumtuk Slough). 2 pair seen each day by P. Mickelson.	C. Dau, pers. comm.
	1 June	lower Kashunuk River (Onumtuk Slough). 1 pair seen by P. Mickelson.	C. Dau, pers. comm.
1972	9 June	lower Kashunuk River. 2 males and 1 female seen by C. Dau.	C. Dau, pers. comm.
1973	27 May	lower Kashunuk River (Onumtuk Slough). 2 pair; 1 female plucking grass and placing nearby; comfort movements; pair bathings; 'rearing' neck compress movements by males; 1 attacked and chased by territorial cackling goose.	C. Dau, pers. comm.
	28 May	lower Kashunuk River (Onumtuk Slough). Above female made nest scrape, throwing vegetation out behind w/feet; side-to-side body movements to form scrape; male feeding away from nest site; copulation observed lasting 10 sec.	C. Dau, pers. comm.
	2-3 June	lower Kashunuk River (Onumtuk	C. Dau,

		Slough). 1 pair seen each day by C. Dau.	pers comm.
	6 June	lower Kashunuk River (Onumtuk Slough). 1 pair seen by C. Dau.	Dau, pers. comm.
1975	20 June	Opagyarak River. Nest w/5 eggs found by C. Dau (same nest w/7 eggs on 3 July). Onset laying est. 22 June. 2 pair in area.	C. Dau, pers. comm.
1976	24 June	Opagyarak River. 1 pair seen by C. Dau.	C. Dau, pers. comm.

[1]Yukon Delta National Wildlife Refuge observation files

Table 1. Number of nesting eiders at study area #2 (93.5 ha[1]) on the lower Kashunuk River in 1951 and 1961-1966

Year	Steller's Eider Nests	Spectacled Eider Nests	Common Eider Nests
1951[2]	3	8	2
1961[3]	1	36	2
1962	5	26	1
1963	1	22	1
1964[4]	0	21	0
1965	0	1	0
1966	0	11	0
Total	10	125	6

[1] Study area #2 was described by Olson (1951) as being 0.5x1.0 miles (129.5 ha) in size but later was surveyed and found to be approximately 93.5 ha (C. Lensink, pers. comm. 1990).
[2] Information for 1951 is from Olson (1951).
[3] Information for 1961-1963 is from Shepherd (1963).
[4] Information for 1964-1966 is from C. Lensink (pers. comm. 1985).

Table 2. Number of Steller's eider nests found at two study areas near Barrow from 1975 to 1980.

Year	Study Area #1[1] (33 ha)	Study Area #2[2] (27 ha)	Source
1975	2	2	Myers and Pitelka (1975a,b)
1976	3	7	Myers et al. (1977a,b)
1977	0	0	Myers et al. (1978a,b)
1978[3]	0	1	Myers et al. (1979a)
			Myers et al. (1979b)
1979[3]	0	0	Myers et al. (1980a)
			Myers et al. (1980b)
1980	1	1	Myers et al. (1981a,b)
Total	6	11	

[1]Referred to as wet coastal plain tundra (I) by Myers and Pitelka (1975).

[2]Referred to as wet coastal plain tundra (II) by Myers and Pitelka (1975).

[3]Territorial males were present on study area #1 in 1978 and on study areas #1 and #2 in 1979, however no nests were found.

Figure 1. Current breeding and wintering distributions of the Steller's eider.

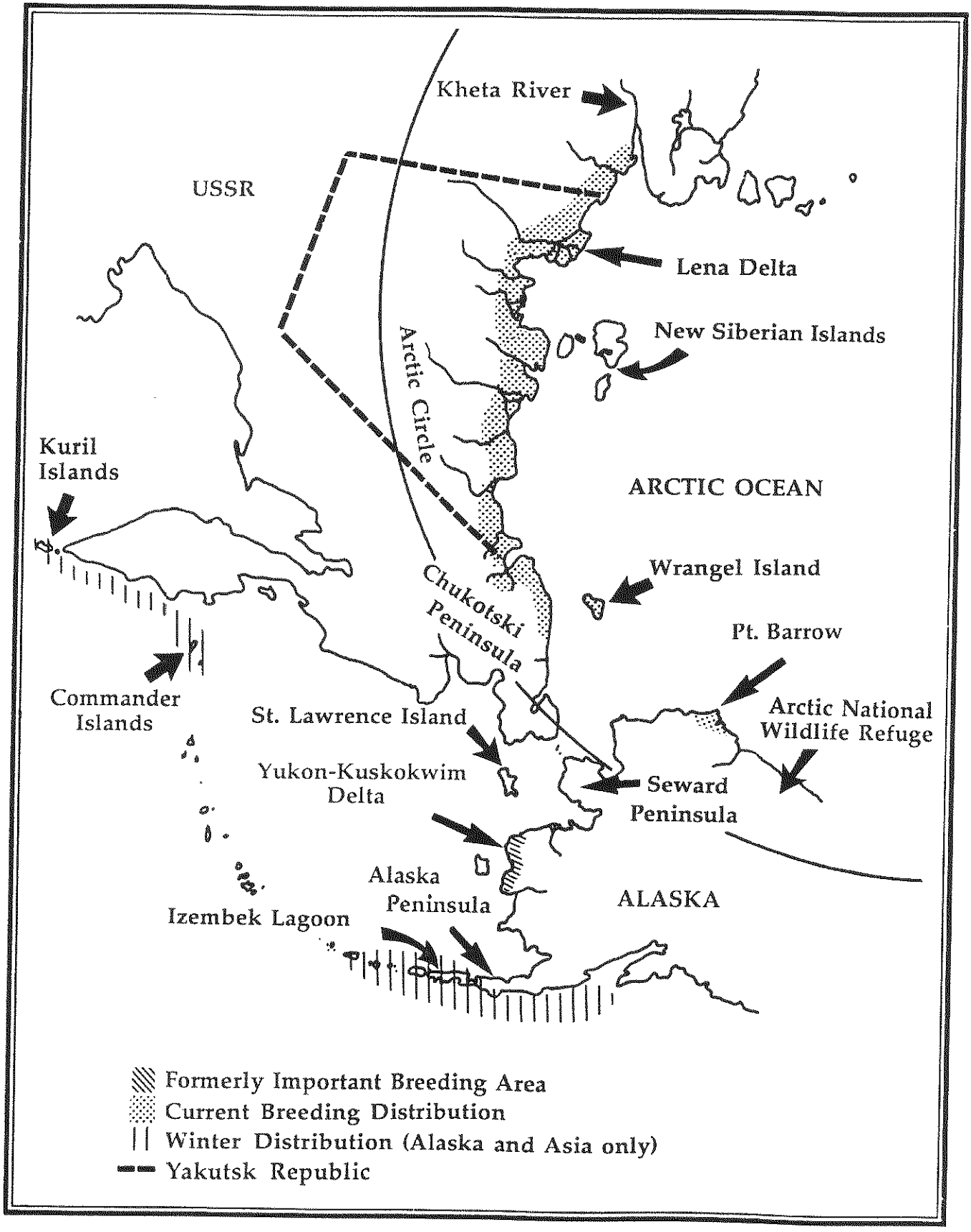
Kheta River
USSR
Lena Delta
New Siberian Islands
Arctic Circle
Kuril Islands
ARCTIC OCEAN
Wrangel Island
Chukotski Peninsula
Pt. Barrow
Commander Islands
St. Lawrence Island
Arctic National Wildlife Refuge
Yukon-Kuskokwim Delta
Seward Peninsula
Alaska Peninsula
ALASKA
Izembek Lagoon
Formerly Important Breeding Area
Current Breeding Distribution
Winter Distribution (Alaska and Asia only)
Yakutsk Republic

Figure 2. Recoveries in the U.S.S.R. and Alaska of 143 Steller's eiders banded at Izembek Lagoon, Alaska (through 1986). Courtesy of C. Dau.

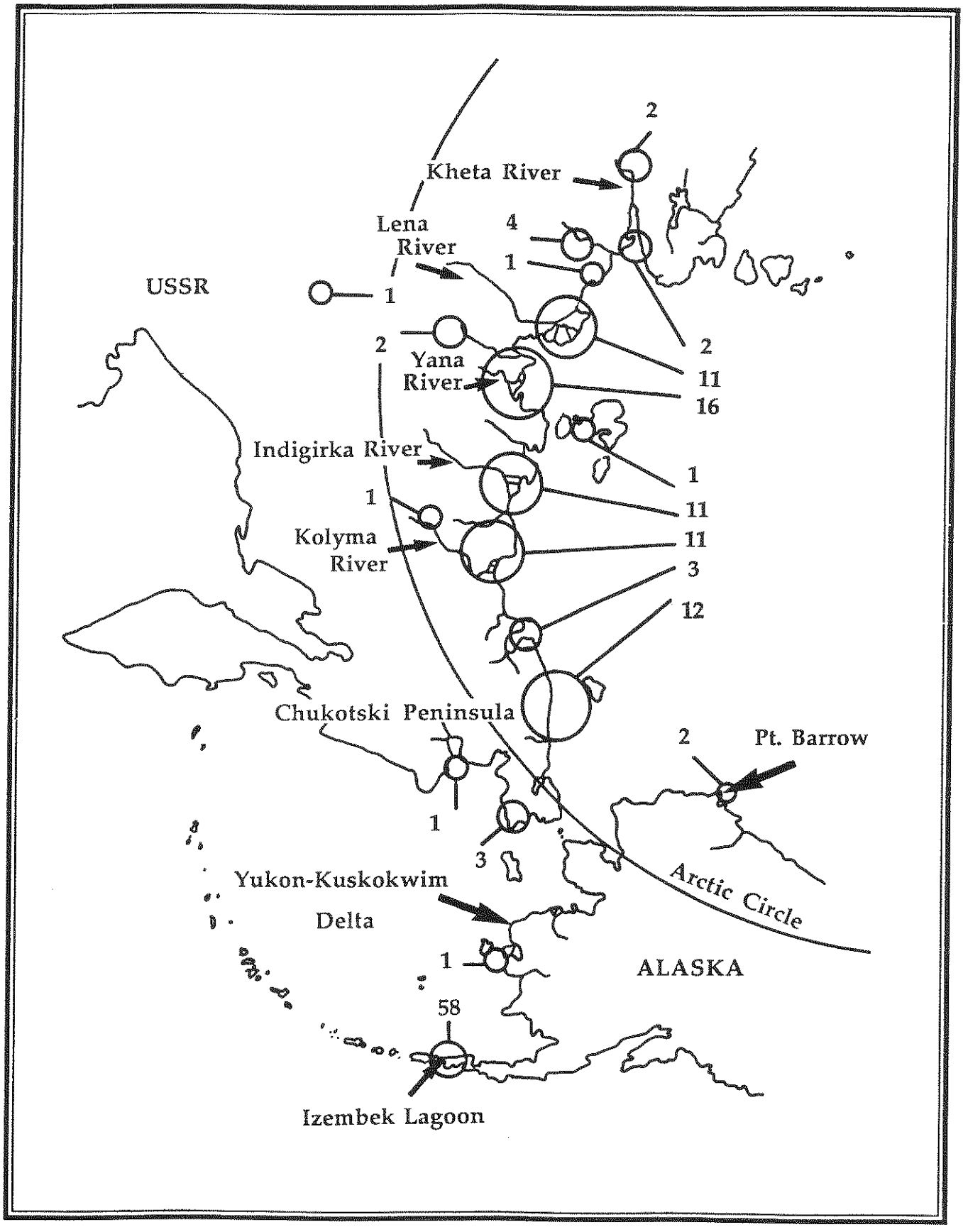
2
Kheta River
Lena
River
4
1
USSR
1
2
2
Yana
River
11
16
Indigirka River
1
1
11
Kolyma
River
11
3
12
Chukotski Peninsula
2
Pt. Barrow
1
3
Arctic Circle
Yukon-Kuskokwim
Delta
1
ALASKA
58
Izembek Lagoon

Figure 3. The Yukon-Kuskokwim delta, Alaska, showing place names and major geographic features.

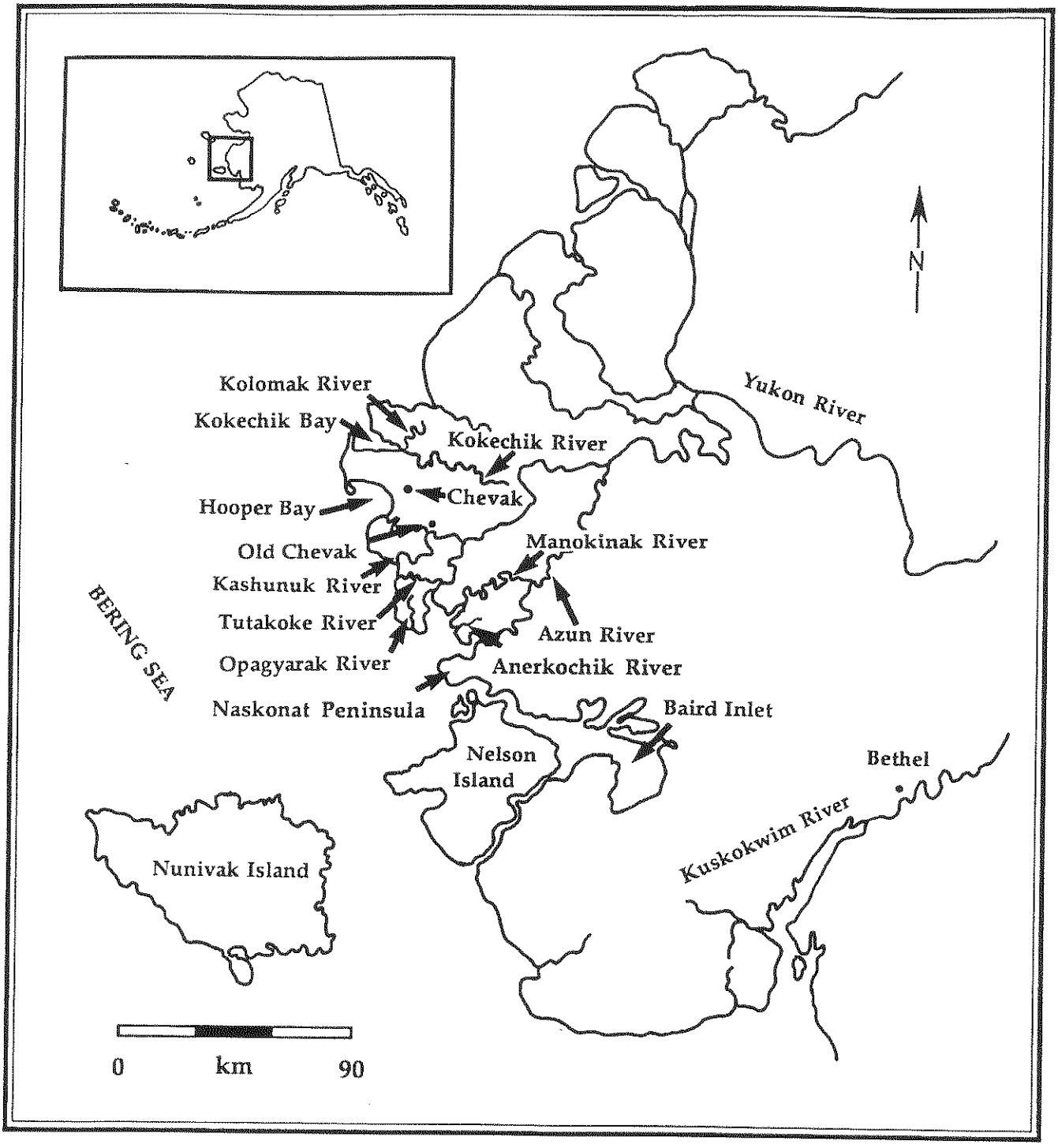
Kolomak River
Kokechik Bay
Kokechik River
Yukon River
Hooper Bay
Chevak
Old Chevak
Manokinak River
Kashunuk River
Tutakoke River
Azun River
BERING SEA
Opagyarak River
Anerkochik River
Naskonat Peninsula
Baird Inlet
Nelson
Island
Bethel
Kuskokwim River
Nunivak Island
N
0
km
90

Figure 4. Study areas established by Olson (1951) along the Kuparuk River, Yukon-Kuskokwim delta.

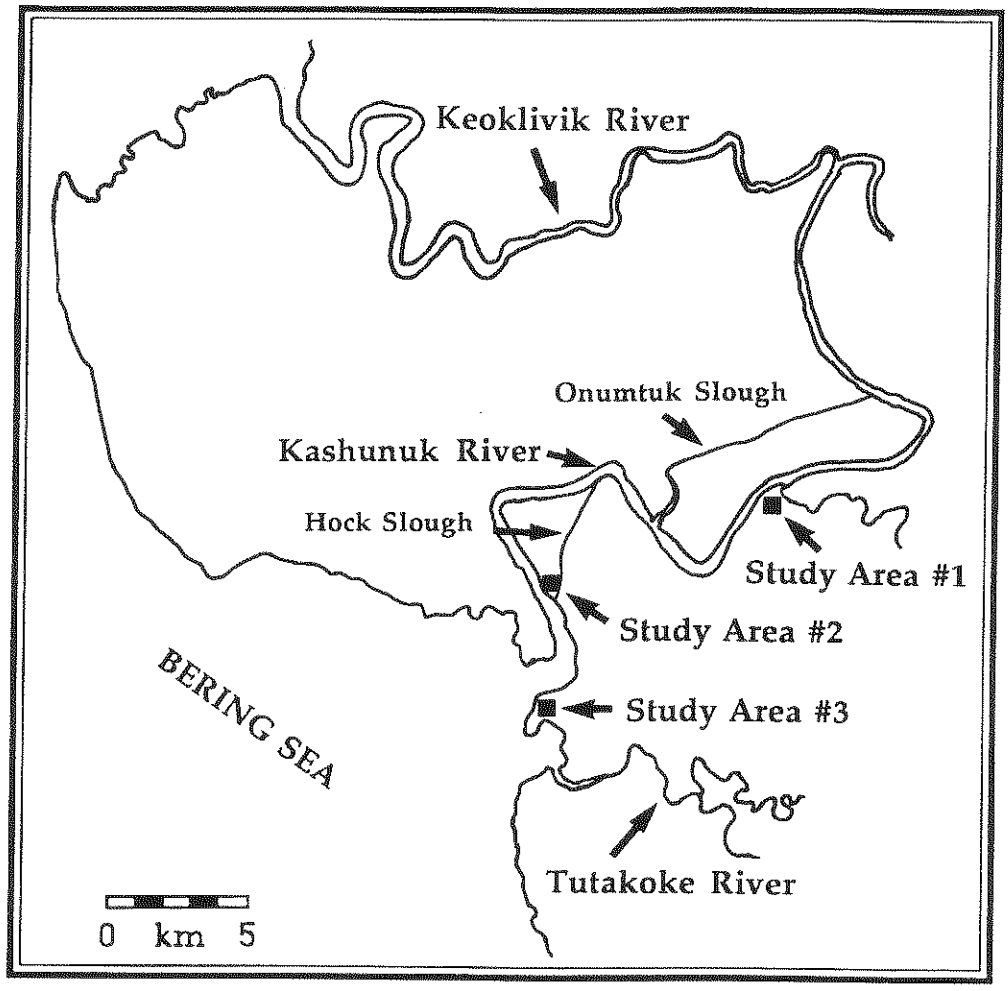
Keoklivik River
Onumtuk Slough
Kashunuk River
Hock Slough
Study Area #1
Study Area #2
Study Area #3
BERING SEA
Tutakoke River
0 km 5

Figure 5. Vegetated intertidal habitat along the Opagyarak River, Yukon-Kuskokwim delta. Photo by C. Dau.

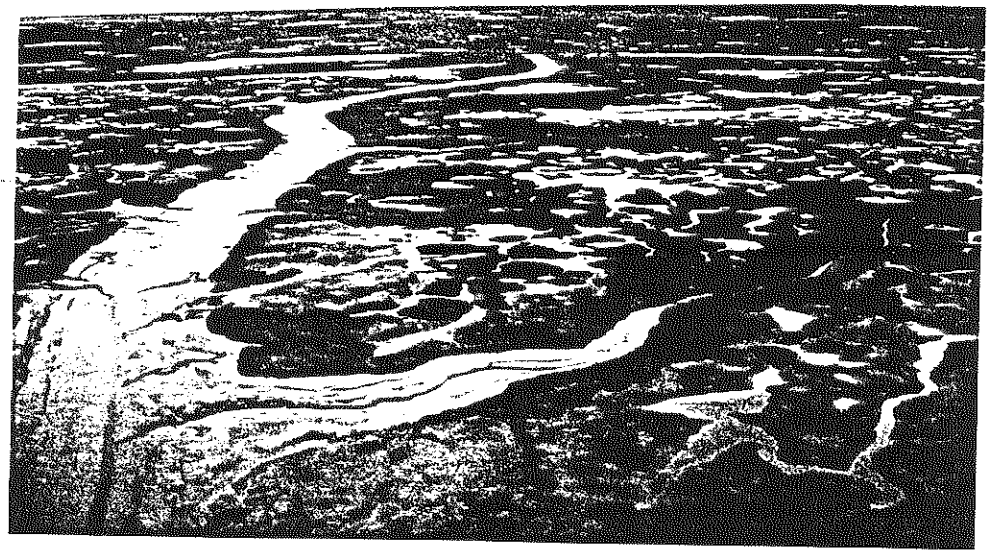

Figure 6. Female Steller's eider on nest along the Opagyarak River in 1975, the last confirmed breeding record on the Yukon-Kuskokwim delta. Photo by C. Dau.